# Table of Contents


| S. No. | Technology | Page |
|---|---|---|
| **CSIR–Advanced Materials and Processes Research Institute (CSIR-AMPRI), Bhopal** | | |
| 1 | Eco-friendly Jarosite Based X-Ray Shielding Panels and Doors | 1 |
| 2 | High Performance Hybrid Composite Materials (HP Composites) | 2 |
| 3 | Lead Free Eco-friendly Red Mud Based X-ray Radiation Shielding Doors and Panels | 3 |
| 4 | Sisal Fibre-Based Hybrid Composite Wood Materials | 4 |
| 5 | Ceramic Waste-Based Geopolymer Infrastructure Components | 5 |
| 6 | Evergreen Hybrid Composites of Parali (Agro Wastes) | 6 |
| 7 | Fly Ash Based (Cement Free) Geopolymeric Concrete for Rigid Pavement | 7 |
| 8 | Red Mud Based Advanced Heavy Density Aggregates and Gamma Ray Shielding Concrete | 8 |
| 9 | Lead Free X-Ray Shielding Tiles | 9 |
| 10 | Make in India Raman Spectrometer: IndiRam CSIR-TechnoS Raman (CTR) | 10 |
| **CSIR–Central Building Research Institute (CSIR-CBRI), Roorkee** | | |
| 11 | Fire Retardant Intumescent Coating for Steel and GI Duct Applications | 11 |
| 12 | Climate Resilient Building (CRB) for Cold Regions – Leh, Ladakh, India | 12 |
| 13 | COVID – 19 Makeshift Hospitals | 13 |
| 14 | CSIR SMART Village | 14 |
| 15 | Model Resilient Village | 15 |
| 16 | Portable Solar-Assisted Heat Pump Water Heating System Know-How | 16 |
| 17 | Agro-Industrial Waste Based 3D Printed Concrete Blocks (3DPCB) and Their Production Method | 17 |
| 18 | Design of High Draught Brick Kilns with Zig-Zag Setting | 18 |

## CSIR–Centre for Cellular and Molecular Biology (CSIR-CCMB), Hyderabad


| | | |
|---|---|---|
| 19 | mRNA-Based Vaccines for SARS-CoV2 and Other Viruses, including Chikungunya | 19 |
| 20 | Non-Invasive Early Pregnancy Detection in Cattle and Buffaloes | 20 |
| 21 | Climate-Resilient, High-Yielding and Diabetic-friendly Rice Varieties (Improved Samba Mahsuri (ISM), Improved Versions, DRR Dhan-58, 60, 62) | 21 |
| 22 | DNA-Based methods to Differentiate between Pashmina and other Animal Fibres including Shahtoosh | 22 |
| 23 | Dried Blood Spot-Based Molecular Kit for Detection of Sickle Cell Anaemia | 23 |
| 24 | Dry Swab Technology for SARS-CoV-2 Diagnostics | 24 |
| 25 | Genomics-Guided Wastewater-based surveillance (WWS) for Pathogens like SARS-CoV-2 and Antimicrobial Resistance | 25 |
| 26 | Wildlife Crime Detection & Bird Hit cases using Universal Primer Technology | 26 |


## CSIR–Central Drug Research Institute (CSIR-CDRI), Lucknow


| | | |
|---|---|---|
| 27 | CDRI S007-1500: Novel, Orally Active Bone Fracture Healing Drug Candidate | 27 |
| 28 | Levormeloxifene for Contraception | 28 |
| 29 | A Novel Phytopharmaceutical: A Standardized fraction of Picrorhiza Kurroa for Treatment of Non-Alcoholic Fatty Liver Disease (NAFLD) | 29 |
| 30 | Indigenous DNA Gel Stain "GreenR" | 30 |


## CSIR–Central Electronics Engineering Research Institute (CSIR-CEERI), Pilani


| | | |
|---|---|---|
| 31 | 2.6 MW S-Band Tunable Pulse Magnetron | 31 |
| 32 | Affordable PCR | 32 |
| 33 | MBRT Analyser | 33 |
| 34 | Space Qualified Thermionic Emitter (Hollow Thermionic Emitter for Thruster Application) | 34 |
| 35 | IoT-Enabled Colposcope for Pre-Stage Cervical Cancer Examination | 35 |
| 36 | IoT-Enabled Field-Testing Kit for Rapid Water Quality Analysis | 36 |
| 37 | Ksheer Scanner | 37 |

## CSIR–Central Food Technological Research Institute (CSIR-CFTRI), Mysuru


| | | |
|---|---|---|
| 38 | A Process for Flavor Essence from Decalepis | 38 |
| 39 | Process know how for Bifido Curd | 39 |
| 40 | Mobile Processing Unit for Demonstration of Fruits and Vegetables Processing Technologies for North Eastern Region | 40 |
| 41 | Process for Development of Gluten Free Bread Premixes[Three Versions] 1.Proso Millet 2. Foxtail Millet 3. Barnyard Millet | 41 |
| 42 | A Process Know-how for 'Freshness Keeper Paper for Extension of Shelf Life of Cut Roses' | 42 |
| 43 | Carbonated Fruit Beverages from Select Fruits (Mango, Grapes, Lime Orange) | 43 |
| 44 | Low Glycemic Index Atta | 44 |
| 45 | Malted Ragi Based Ready to Eat Weaning Food | 45 |
| 46 | Marigold Oleoresin | 46 |
| 47 | McDonald's Multi-Millet Bun | 47 |
| 48 | Nutra Chikki with Added Spirulina | 48 |
| 49 | Paan Flavoured Water | 49 |
| 50 | Preparation of Shelf Stable Biryani Paste | 50 |
| 51 | Process for Preparation of Raw Banana Powder (Unripe) | 51 |
| 52 | Process for the Production of Soluble and Insoluble Arabinoxylan from Wheat Bran | 52 |
| 53 | Process for the Production of Transglycosylating α- Glucosidase using Novel Fungal Strain | 53 |
| 54 | Process know-how for Probiotic Carrot Nectar | 54 |
| 55 | Roasted and Flavoured Cashew Kernel | 55 |
| 56 | The Protein Plus Slice | 56 |


## CSIR–Central Institute of Medicinal and Aromatic Plants (CSIR-CIMAP), Lucknow


| | | |
|---|---|---|
| 57 | Eco-Friendly Incense Sticks (Agarbatti) from Offered Flowers | 57 |
| 58 | Psoria-CIM – Essential Oil Based Non-Steroidal Herbal Cream for Psoriasis Management | 58 |

## CSIR–Central Leather Research Institute (CSIR-CLRI), Chennai


59 Extreme Cold Weather Protection Gloves 59

60 Regenerated Leather from Tannery Solid Waste 60

61 Light Weight and Cold Resistant Leathers 61

62 Waterless Chrome Tanning 62


## CSIR–Central Glass and Ceramic Research Institute (CSIR-CGCRI), Kolkata


63 Bioactive, Radiolucent & Antibacterial PEKK Composite Implants for Advanced Spinal Reconstructions (NeoPEKK™) 63

64 Ceramic on Ceramic Articulating Components for Total Hip Replacement (THR) 64

65 Indigenous Specialty Fiber for High Power Amplifier and Laser 65

66 Manufacturing Technology on High Density (D=5.2 g/cc) Radiation Shielding Window (RSW) Glass for Nuclear Hot Cell Application towards self-reliance in Nuclear Safety. 66

67 Calcium Phosphate (CaP) and Non-CaP Scaffolds/ Granules for Dental and Orthopaedic Applications 67

68 Indigenous Fiber Laser Technologies 68


## CSIR–Central Institute of Mining and Fuel Research (CSIR-CIMFR), Dhanbad


69 1.5 TPD Pressurized Fluidized Bed Gasification (PFBG) Technology 69

70 Shale Gas Potentiality Evaluation of Damodar Basin of India 70

71 Biometric-Based Exploder 71

72 Paste Backfill Technology for Stabilization of Critical Infrastructure Over Mined/ Underground Voids 72

73 Controlled Blasting Technology Developed for Safe Extraction of Minerals from Mines and Construction of Various Civil Infrastructure Projects 73

74 Development of Dust Suppression Chemical Useful for Mining and Allied Industries 74

75 Dynamic Balancing of Pressure Technique for Control of Concealed Fire in Underground Coal Mines 75

76 Improved Soft Coke Making Technology 76

77 Mine Transport Surveillance System (MTSS) 77

78 Technology for Non-Recovery Type Coke Oven, Drag Type coke oven with Stamp Charging and Coke Quenching 78

79 Virtual Fencing System (VFS) 79

80 Vision Enhancement System (VES) for Foggy Weather 80

**CSIR–Central Mechanical Engineering Research Institute (CSIR-CMERI), Durgapur**

81 Compact Electric Tractor-CSIR PRIMA ET-11 81

82 Integrated Municipal Solid Waste Disposal System (i-MSWDS) for Bulk Waste Generators 82

83 Vehicle Mounted Mechanized Drain Cleaning System 83

**CSIR–Central Road Research Institute (CSIR-CRRI), New Delhi**

84 A Process of Producing Bio-Bitumen from Pyrolysis of Lignocellulosic Biomass 84

85 AVCC: Automated Vehicle Counting & Classification System (Software) 85

86 End-of-Life Plastic Technical Textile Geocell Roads 86

87 LUMETRA: Portable Light and Glare Measurement System 87

88 LUXSPECS: Wearable Light and Glare Measurement Device 88

89 SMACEL: Indigenized Pelletized Fiber for Stone Matrix Asphalt 89

90 BSS-101: Cementitious Material for Stabilization of Sub-Base & Base Course in Flexible Pavement 90

91 Cementitious Grout for use in Cement Grouted Bituminous Mix (CGBM) for Flexible Pavements 91

92 ECOFIX: Ready to Use Pothole Mix using Iron and Steel Slag Aggregates 92

93 Mobile Bridge Inspection Unit 93

94 Mobile Cold Mixer Cum Paver 94

95 MSS+: Modified Mix Seal Surfacing 95

96 Noise Barrier Based on Different Frequencies 96

97 PatchFILL: The Pothole Repair Machine 97

98 REJUBIT 98

99 REJUPAVE: Rejuvenator for Recycling of Aged Bituminous Mixes 99

100 Steel Slag Road Technology 100

101 Stepwise Repeated Destabilization and Stabilization of Highly Collapsible Soil Mass by Soil Nailing Technique Used for Construction of Railway/Road Underpass 101

102 TERASURFACING: Microsurfacing Technology with Industrial Waste Materials, i.e. Steel Slag, Fly Ash and Marble Dust 102

103 Two-Pack PatchFILL: On-site Pothole Filling Mix 103

**CSIR–Central Scientific Instruments Organisation (CSIR-CSIO), Chandigarh**

104 Additive Manufactured Lattice Orthopedic Implants 104

105 Aspheric Lens Based Spectacles for Persons with Functional Low-Vision 105

106 Precision Iodine Value Analyser 106

107 Retractable and Fixed Anti-collision Light for LCA MK-II and AMCA 107

108 Head Up Display (HUD) for LCA 108

109 LED Based NVG Compatible Wing and Fin Navigation Lights, Taxi & Landing Lights (TLL) and Drogue Lights Along with Associated Test Rigs for LCA Tejas 109

110 UV-C Disinfection Systems 110

**CSIR–Central Salt & Marine Chemicals Research Institute (CSIR-CSMCRI), Bhavnagar**

111 Kappaphycus Seaweed Farming Expansion 111

112 CI-STARS Salt Technology Facility "Centre for Integrated Salt Technologies and Advanced Research Station" 112

113 Preparation of Low Sodium Salt of Botanic Origin – Saloni – with Backward Integration of Cultivation of Salicornia Brachiate. 113

114 Recovery of 100% Water Soluble Sulphate of Potash (WS SOP) from K-rich Distillery Incinerator Ash 114

**CSIR–Institute of Genomics and Integrative Biology (CSIR-IGIB), New Delhi**

115 GOMED: Genomic Diagnostics for Rare Genetic Diseases – 27 Tests Commercialized via Dr Lal PathLabs 115

**CSIR–Institute of Himalayan Bioresource Technology (CSIR-IHBT), Palampur**

116 Development of Aromatic and Non- Aromatic Floral Wax and Floral Wax Candles 116

117 Natural Naphthoquinone Pigment Production using Arnebia Euchroma Adventitious Roots on Sustainable Basis 117

118 Natural Pocket/Travel Perfume 118

119 Agro and Processing Technology of Stevia 119

120 Green Stevia Processing Technology 120

121 Picrorhiza Kurroa for the Management of Non-Alcoholic Fatty Liver Disease (NAFLD) 121

122 Vitamin D Enriched Mushroom Technology 122

123 Herbal Formulation for Immunity Modulation 123

124 Agrotechnology for Tulip Cultivation 124

125 Agrotechnology of Lilium 125

126 Fortified Foods for TB recovery 126

127 Nutritional Products (Poshan Abhiyan) 127

128 Technology for Artifact Making using Dry Flowers 128

**CSIR–Indian Institute of Chemical Biology (CSIR-IICB), Kolkata**

129 Medha Plus: A Herbal Cognitive Health Formulation for Alzheimer's Disease 129

**CSIR–Indian Institute of Chemical Technology (CSIR-IICT), Hyderabad**

130 Cost-Effective Technology for Producing Delignified Rice Straw (DRS) with Enhanced Digestibility for Cattle Feed Applications 130

131 Process to Manufacture High-Energy Rocket Propellant (CL-20) - Catalytic Process for Preparation of TAIW (Key Material for CL-20) 131

132 Accelerated Anaerobic Composting (AAC) for the Conversion of Organic Wastes to Nutrient Rich Soil Conditioner 132

133 Anaerobic Gas lift Reactor (AGR) - A high rate Biomethanation Technology for the Concomitant Treatment and Generation of Biogas and Fermented Organic Manure from Organic Wastes. 133

134 Cost-effective and Scalable Process for the Synthesis of TLR 7/8 Agonist Molecule (IMDG), used as an Adjuvant in COVAXIN® (COVID-19 vaccine) 134

135 Scaled-Up Plant for Production of Hydrazine Hydrate 135

**CSIR–Indian Institute of Integrative Medicine (CSIR-IIIM), Jammu**

136 Approval of Hydroxyurea for Treatment of Sickle Cell Anemia (SCA) in India. 136

**CSIR–Indian Institute of Petroleum (CSIR-IIP), Dehradun**

137 Briquetting of Pine Needles to Produce Biogenic Fuel for Industry, Rural Livelihood Generation and Forest Fire Mitigation 137

138 Dual-Fuel Engine System 138

139 Single-Step Catalytic HEFA Process for Sustainable Aviation Fuel (SAF) from Waste Oils and Fats (DILSAAFTM) 139

140 A Novel Energy Efficient Domestic Burner for Piped Natural Gas (PNG) and its Implementation for Clean Cooking Transition 140

141 A Novel LPG Sweetening Catalyst 141

142 Advanced Vacuum Swing Adsorption for the Upgradation of Raw Biogas to Renewable Bio-methane (AVSAR Bio- Methane) 142

143 CSIR IIP-EIL-NRL Wax De-oiling Technology For Production of Paraffin and Micro-Crystalline Waxes 143

144 Eco-friendly and Energy Efficient Jaggery Making Plant (Gur Bhatti) for Sugarcane Farmers of India and its Wide Implementation 144

145 Pressure Vacuum Swing Adsorption (PVSA) Technology for the Generation of Medical Grade Oxygen (MO2) Meeting I.P. 2018-PSA-Oxygen Specifications for Onsite Hospital Use 145

146 Simultaneous Production of US-Grade Gasoline and High-Purity Benzene 146

147 Soaker Internal Visbreaking Technology 147

**CSIR–Institute of Minerals and Materials Technology (CSIR-IMMT), Bhubaneswar**

148 TERAFIL Water Purification Technology 148

**CSIR–National Aerospace Laboratories (CSIR-NAL), Bengaluru**

149 NJ-100 Indigenous Small Gas Turbine Engine 149

150 Q Plane 150

151 JALDOST Airboat 151

152 HANSA New Generation (NG) Aircraft Production 152

153 Octa-Copter Drone 153

154 Composites for Airframe-Indigenous Production 154

155 Drishti Transmissometer 155

156 Engine Bay Door Parts for Tejas Mk1A 156

157 Indigenous Autoclave Technology 157

158 NALSUN-NG™ Solar Absorber Coating 158

159 TEJAS- Composite Parts Indigenized 159

**CSIR–National Botanical Research Institute (CSIR-NBRI), Lucknow**

160 Natural Fragrances 160

161 Agro-Technologies for the Cultivation of Lotus (Namoh 108) 161

162 Microbial Biofertilizer 162

163 Herbal Formulation for Diabetes Management (NBRMAP–DB) 163

164 Herbal Gulal 164

**CSIR–National Chemical Laboratory (CSIR-NCL), Pune**

165 Hydrogen Fuel Cell Powered Bus 165

166 Hydrogen Fuel Cell Powered Vessel in Varanasi 166

167 Indigenous Catalytic Dehydration of Methanol to Dimethyl Ether (DME) Process Technology 167

168 Indigenous Continuous Paracetamol Manufacturing Technology 168

169 Indigenous Zeolite for On Board Oxygen Generation System (OBOGS) for Fighter Aircraft MiG-29/Tejas 169

**CSIR–National Environmental Engineering Research Institute (CSIR-NEERI), Nagpur**

170 Affordable, Water-Efficient Sanitation Technologies for Swachh Bharat. 170

171 Renewable Hydropower from Drain/ Rivulet Outlet (ReHyDRO) 171

172 Artificial Intelligence Integrated GIS-Based Line Source Emission Inventory (AI-LSEI) Dashboard 172

173 DFAST: Accelerated Faecal Sludge Decomposition Technology 173

174 Compact Faecal Sludge Septage Separation and Treatment (CFSST) Plant 174

175 Dry Toilet System with Faeces - Urine Separation and Treatment (DToi-FUrST) 175

176 Eco-Rejuvenation Technology (ERT) 176

177 Himalayan Sewage Treatment Plant (Him-STP) 177

178 Low-Temperature Wastewater Treatment Technology 178

179 Mechanical Dewatering and Drying System (MDDS) for Faecal Sludge and Septage Management (FSSM). 179

180 Up-flow Compact Constructed Wetland (UCCW) Based Sewage Treatment Plant (STP) 180

181 Development of Green Firecrackers having reduced Chemicals and Environmental Footprint 181

182 Hand Pump Attachable Iron Removal Plant 182

183 High Rate Transpiration System (HRTS) 183

184 Innovative Patient Friendly Saline Gargle RT-PCR Testing Method 184

185 NEERDHUR – Multi-Fuel Improved Cookstove 185

186 "NEERI-ZAR" – Portable Instant Water Filter 186

187 Solar Assisted Electrolytic Defluoridation (EDF) Technology 187

**CSIR–North-East Institute of Science and Technology (CSIR-NEIST), Jorhat**

188 Carbon Quantum Dots 188

189 Process for Extraction of Caffeine from Tea Waste 189

190 Hybridized Coal-Based Supercapacitor and Li-ion Battery for e-Rickshaw Application 190

191 Process for the Synthesis of Graphene from Sub-bituminous North East Indian Coal 191

192 Herbal Anti-Arthritis Formulation 192

193 High Yielding Variety of Citronella, Jor Lab C-5 193

194 High Yielding Variety of Lemongrass, Jor Lab L-9 194

195 High Yielding Varieties of Patchouli Jor Lab P-1 195

196 OP-12 Biofertilizer 196

197 Process for Production of Decaffeinated Black Tea 197

## CSIR–National Institute for Interdisciplinary Science and Technology (CSIR-NIIST), Thiruvananthapuram


198 CSIR Designer Rice 198

199 Lightweight and High-strength Al-Mg-Sc Alloy Rolled Sheets for Aerospace Structures 199

200 Self-Powered Indoor Air Quality Monitors 200

201 Automated Biomedical Waste Conversion Rig 201

202 Aluminium–Silicon Carbide Thermal Management Component 202

203 Biodegradable Tableware from Agri Biomass 203

204 Bioremediation Technology for Perchlorate 204

205 NOWA-NIIST Onsite Wastewater Treatment Technology 205

206 Plant-Based Leather Alternatives from Agricultural Residues and Biomass 206

207 Solid-State Biogas Technology 207


## CSIR–National Metallurgical Laboratory (CSIR-NML), Jamshedpur


208 Vacuum-Distilled Magnesium Extraction 208

209 Advanced PCBs Recycling Technology 209

210 E-waste Recycling Plant 210


## CSIR–National Physical Laboratory (CSIR-NPL), New Delhi


211 GPS-Independent IST System 211

212 Laser Cooled Cesium Atomic Fountain Primary Frequency Standard 212

213 National Atomic Timescale 213

214 Bharatiya Nirdeshak Dravyas (BNDs) 214


## CSIR–Structural Engineering Research Centre (CSIR-SERC), Chennai


215 Emergency Retrieval System for Power Lines 215

216 Portable Lightweight Foldable Module for Make-Shift Hospitals and Other Needs (PoliTal-M) 216

# Eco-friendly Jarosite Based X-Ray Shielding Panels and Doors

**· TRL-6 ·**

## Overview

An innovative technology for manufacturing large-scale, eco-friendly X-ray shielding polymeric doors, panels, and tiles using inorganic jarosite waste generated from zinc industries. The developed advanced thermal insulating X-Ray shielding products provide a sustainable and effective alternative to toxic lead (Pb)-based radiation shielding products. This advanced technology enables large-scale utilization of jarosite waste, reducing environmental pollution caused by open dumping of jarosite waste, and promotes green and sustainable shielding solutions for hospitals and nuclear infrastructure with circular economy approach, which is aligned with visions of Make in India, Clean India and Viksit Bharat-2047.

## Functionalities

- High-strength, water-resistant X-ray shielding panels, doors, and tiles with ultra-low water absorption.
- Lead-free alternative to toxic Pb-based shielding for 60–100keV X-ray applications.
- Available in full-size, customizable thicknesses and finishesfor walls, ceilings, doors, and medical x-ray protection screen installation.
- Provides glossy finish, thermal insulation, and excellent mechanical durability.

## USP/Key Features

- Transforming Jarosite waste into wealth for medical sectors
- Resistance to weather, termite, corrosion, Fire retardant, Maintenance Free
- Green composite, Cost-effective than lead panels, BARC/AERB Validated

## Implementation Status

Demonstrated for X-ray shielding applications, with potential for wider deployment.

## Contact Details

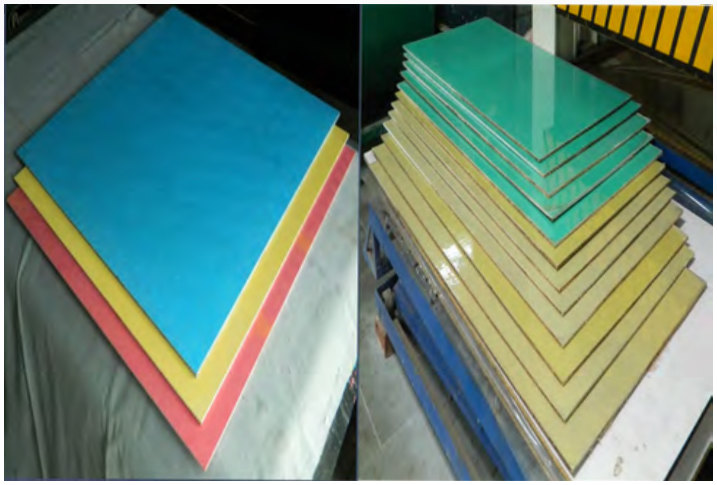
Dr. Thallada Bhaskar
Director, CSIR-AMPRI Bhopal
director.ampri@csir.res.in
Phone: 0755-2457105

# High Performance Hybrid Composite Materials (HP Composites)

**· TRL-6 ·**

## Overview

An eco-friendly process that converts inorganic wastes such as fly ash, marble, granite, stone, and mining waste into advanced hybrid composite panels, sheets, and sandwich composites as sustainable alternatives to plywood and wood products. These composites are durable, moisture-resistant, anti-fungal, termite-free, high-strength, low-maintenance, and cost-effective for applications in furniture, interiors, construction, railways, aerospace, and transport. The technology promotes waste-to-wealth utilization, circular economy practices, and reduced dependence on timber, creating opportunities for startups, green manufacturing, and sustainable infrastructure under the vision of Make in India and Viksit Bharat 2047.



## Functionalities

- Sustainable alternative to plywood, timber, MDF, Particle Board, wood panels, and decorative interior materials
- Advanced furniture, modular interiors, doors, interior and partition applications
- Available with variable density, thickness, colours and textures
- Durable hybrid sandwich composites for industry, railways, and transport sectors
- High-performance panels for aerospace, civil infrastructure, and prefabricated composite sheets

## USP/Key Features

- Stronger than teak wood, timber & synthetic wood and plywood
- Anti-fungal, termite-free, corrosion resistant for long-life construction applications
- Fire self-extinguishing nature and cost effective & maintenance free products
- Thermal insulating and high strength hybrid composites panels ensuring enhanced safety and reliability for advanced applications

## Implementation Status

Licensed and deployed

## Contact Details

Dr. Thallada Bhaskar
Director, CSIR-AMPRI Bhopal
director.ampri@csir.res.in
Phone: 0755-2457105

# Lead Free Eco-friendly Red Mud Based X-ray Radiation Shielding Doors and Panels

**· TRL-6 ·**

## Overview

An innovative, green and "Waste-to-Wealth" technology for manufacturing eco-friendly X-ray shielding red mud polymeric doors, panels and tiles using inorganic red mud waste generated from alumina industries. The developed high strength, and moisture resistant panels (6 × 3 feet size with 18 mm, 24 mm, and 35 mm thickness) serve as sustainable and effective alternatives to toxic lead (Pb)-based radiation shielding materials. This advanced technology enables large-scale utilization of red mud waste, reduces environmental pollution caused by open dumping, and promotes green, lead-free shielding solutions for hospitals, laboratories, airports, nuclear facilities, and healthcare infrastructure, which is aligned with vision of Make in India, Clean India and Viksit Bharat-2047 for a safer and cleaner future.

## Functionalities

- Lead-free alternative to Pb-based X-ray shielding panels and doors compliant with AERB/BARC guidelines.
- Moisture- and termite-resistant polymeric shielding with high mechanical strength and water resistance.
- Available in multiple sizes and thicknesses with 0.25–2 mm Pb equivalency for 60–100 keV X-ray applications.

## USP/Key Features

- Eco-friendly, cost-effective and lead-free alternative to toxic Pb-based X-ray shielding doors, panels, and tiles
- Manufactured using industrial red mud waste, promoting "Waste-to-Wealth" and circular economy practices
- Effective X-ray shielding performance with Pb equivalency as per AERB/BARC guidelines for 60 keV and 100 keV applications

## Implementation Status

Technology transfer done, Commercial Readiness being explored in association with Licensee.

## Contact Details

Dr. Thallada Bhaskar
Director, CSIR-AMPRI Bhopal
director.ampri@csir.res.in
Phone: 0755-2457105

# Sisal Fibre-Based Hybrid Composite Wood Materials

**· TRL-6 ·**

## Overview

A sustainable technology for the continuous supply and efficient extraction of high-quality sisal fibres for manufacturing green hybrid composite materials and eco-friendly handicraft products. The developed sisal fibre-based composites are lightweight, durable, and suitable for architectural, interior, furniture, and decorative applications. The technology promotes the utilization of renewable natural fibres as sustainable alternatives to synthetic materials while supporting rural employment, handicraft industries, and environmentally responsible manufacturing. It contributes to green construction, circular-economy practices, and sustainable industrial development, enabling eco-friendly infrastructure and value-added products.

## Functionalities

- Efficient sisal fibre extraction and processing for ropes, yarns, automotive, furniture, and industrial applications.
- Reinforcement for wood substitutes, natural fibre composites, and decorative interior materials.
- Sustainable alternative to synthetic fibres for packaging, buffing wheels, and composite products.
- Supports durable composite panels, skill development, employment, and rural income generation.

## USP/Key Features

- Strong natural fibres
- Natural fibres based high strength hybrid composite sheets
- Cost effective & maintenance free products

## Implementation Status

Deployed and Licensed, Panchayats & Rural Development Department, Principal Secretary, Govt of West Bengal, Kolkata

## Contact Details

Dr. Thallada Bhaskar
Director, CSIR-AMPRI Bhopal
director.ampri@csir.res.in
Phone: 0755-2457105

# Ceramic Waste-Based Geopolymer Infrastructure Components

**TRL-7**

## Overview

CSIR-AMPRI has undertaken R&D on the utilization of ceramic industrial waste such as broken tiles, sanitary ware and polishing slurry/dust for developing geopolymer-based sustainable construction materials. The work focuses on incorporating ceramic waste and fly ash into geopolymer matrices to develop low-carbon, durable and value-added infrastructure components, including paver blocks, kerb stones and other precast elements. The technology promotes large-scale utilization of ceramic waste, reduces dependence on conventional cement and supports waste-to-wealth and circular-economy approaches

## Functionalities

Waste Utilization: Under a CPCB-supported project for environmental restoration in the Morbi ceramic cluster, CSIR-AMPRI developed technology for converting inert ceramic waste, including broken tiles, sanitary ware, and polishing slurry, into advanced geopolymeric prefabricated precast pathway components for infrastructure applications, promoting circular economy and resource efficiency

## USP/Key Features

- Bulk Utilization of Industrial Waste i.e Fly Ash (Class-F) & Broken Ceramic Waste for making Precast Geopolymeric concrete Pathway components having compressive strength 35-45 MPa
- Obviates the need of water curing
- Eco-friendly and low-maintenance precast pathway components for infrastructural applications

## Contact Details

Dr. Thallada Bhaskar
Director, CSIR-AMPRI Bhopal
director.ampri@csir.res.in
Phone: 0755-2457105

## Implementation Status

Demonstrated for infrastructure applications, with potential for wider adoption in suitable projects.

# Evergreen Hybrid Composites of Parali (Agro Wastes)

**TRL-7**

## Overview

This green technology converts agricultural waste, particularly paddy straw (parali), into high-performance polymer-based composite materials that serve as sustainable alternatives to MDF, particle boards, and fibre boards. The process offers an eco-friendly solutionfor crop residue management, helping reduce stubble burning and air pollution. The resulting composites are lightweight, durable, and cost-effective, with applications in furniture, interiors, construction, infrastructure, and acoustic panels. By transforming waste into value-added products, the technology supports rural livelihoods, generates employment, reduces pressure on forest resources, and promotes circular economy and sustainable development initiatives.

## Functionalities

- Converts paddy straw into laminated and unlaminated fibre composite boards as sustainable alternatives to MDF, particle boards, and fibre boards.
- Suitable for furniture, interior, infrastructure, and acoustic applications.
- Reduces stubble burning and air pollution while promoting efficient agricultural waste utilization.
- Generates rural livelihoods and farmer income through value-added biomass utilization.

## USP/Key Features

- Stronger than MDF and particle boards, available with different thickness, colours and surface finishing including glossy and matt finish.
- Durable and weather resistant, resistant to moisture, thermally insulating
- Suitable as acoustic panel sand cost effective &maintenance free products

## Implementation Status

Licensed and Deployed

## Contact Details

Dr. Thallada Bhaskar
Director, CSIR-AMPRI Bhopal
director.ampri@csir.res.in
Phone: 0755-2457105

# Fly Ash Based (Cement Free) Geopolymeric Concrete for Rigid Pavement

**TRL-7**

## Overview

Geopolymer process utilizes alumino silicate-rich materials such as fly ash, slag, red mud, rice husk ash, and clays, activated by alkaline solutions to form high-strength inorganic binders. Unlike conventional Portland cement, geopolymers derive strength from an amorphous aluminosilicate gel, offering excellent mechanical performance and durability. The technology enables the productive utilization of industrial by-products and waste materials, reducing dependence on cement and lowering carbon missions. Owing to its sustainability, strength, and environmental benefits, geopolymer concrete is emerging as a promising alternative for construction and infrastructure applications

## Functionalities

- Utilizes industrial waste (fly ash) to produce eco-friendly geopolymer concrete with ~80% lower $CO_2$ emissions.
- Energy-efficient, water-free curing process compatible with conventional manufacturing equipment.
- Rapid strength development, achieving target strength in 14 days, reducing project time and cost

## USP/Key Features

- Bulk Fly Ash Waste Utilization
- Eco-friendly Rigid Pavement, 100% Replacement of Cement by Fly Ash-based Geopolymeric binder
- Water Curing Free Process
- Precast Pathway Components, such as paver blocks, kerb stone, can also be made
- Engineering properties
- Compressive Strength: 30-40 MPa
- Flexural Strength: 4.0-4.5 MPa
- Slump: 30-130 mm

## Contact Details

Dr. Thallada Bhaskar
Director, CSIR-AMPRI Bhopal
director.ampri@csir.res.in
Phone: 0755-2457105

## Implementation Status

Demonstrated in pavement applications, with potential for wider adoption in suitable projects.

# Red Mud Based Advanced Heavy Density Aggregates and Gamma Ray Shielding Concrete

**TRL-7**

## Overview

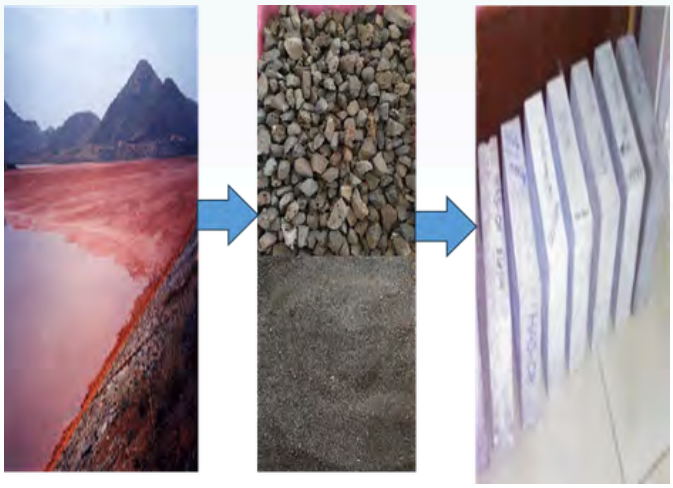
CSIR-AMPRI has developed and scaled up a technology to produce non-toxic, heavy-density radiation-shielding aggregates from red mud as a sustainable alternative to hematite ore aggregate. The developed red mud-based aggregates exhibit superior engineering properties used to produce high-density radiation shielding concrete with comparable density to conventional hematite ore aggregate-based radiation shielding concrete. Radiation attenuation studies carried out at DAE-BARC, Mumbai, demonstrated an 8–12% higher gamma-ray shielding attenuation efficiency. Suitable for construction of nuclear power plants, medical radiation facilities, food irradiation units, and strategic infrastructure. The technology promotes industrial waste utilization while conserving non-renewable hematite ore resources.

## Functionalities

- Provides high-density radiation shielding concrete for construction of nuclear power plants, strategic bunkers, and medical diagnostic facilities.
- Enhances gamma-rayprotection with
- superior shielding efficiency and higher mechanical strength than conventional radiation shielding concrete.
- Utilizes industrial red mud waste to produce heavy density radiation shielding aggregate as a sustainable alternative to natural hematite ore aggregates.
- Useful for construction of strategic critical infrastructure including Nuclear Power Plants, healthcare, food irradiation and defense installations.

## Contact Details

Dr. Thallada Bhaskar
Director, CSIR-AMPRI Bhopal
director.ampri@csir.res.in
Phone: 0755-2457105



## USP/Key Features

- Non-Toxic – Lead free & Hematite Ore Free Radiation Shielding Concrete
- Specific Gravity of developed Red Mud based Synthetic Aggregates: 4.1-4.2
- Density of Advanced Radiation Shielding Concrete: 3500-3700 Kg / m3
- Compressive Strength of Concrete: 30-35 MPa
- Flexural Strength of Concrete: 3 - 4 MPa
- Shielding–High Energy Radiation: Gamma Rays
- Capable of Shielding Gamma-Rays i.e. $^{137}$Cs & $^{60}$Co having 8–12% higher gamma-ray shielding efficiency as compared to conventional hematite ore based heavy density concrete (Tested at BARC Mumbai)

## Implementation Status

Case-to-case basis, funds and an industrial partner required.

# Lead Free X-Ray Shielding Tiles

**· TRL-8 ·**

## Overview

Red mud (alumina industry waste) is getting piled up in the disposal pond due to inadequate technologies for the largescale utilization of it. CSIR-AMPRI is working on the conversion of red mud into X-ray shielding tiles, gamma and neutron shielding bricks as it is rich in iron that is suitable for radiation shielding applications. In particular, CSIR-AMPRI has commercialized X-ray shielding tiles in collaboration with M/s Prism Johnson Ltd. These tiles are now started to place an important milestone in the market and used in more than 20 X-ray rooms across India. CSIR-AMPRI is further working on the upscaling of gamma and neutron shielding bricks, which is suitable to build X-ray diagnostic rooms till nuclear power plants

## Functionalities

- 13.5 mm thick tile (with groove)possesses 2mm Pb equivalent attenuation at 100 kV.
- Flexural strength >30 N/mm$^2$ and breaking strength of > 3000 N
- Suitable for CT Scan, Cath lab, X-ray fluoroscopy, Bone Mineral Densitometer, etc.

## USP/Key Features

- Lead-free and nontoxic.
- Thermally stable and easily repairable.
- Cheaper than lead and easily layable by masons.
- Recommended by AERB.

## Contact Details

Dr. Thallada Bhaskar
Director, CSIR-AMPRI Bhopal
director.ampri@csir.res.in
Phone: 0755-2457105

## Implementation Status

The radiation shielding tiles are used in more than 20 X-ray installations.

# Make in India Raman Spectrometer: IndiRam CSIR-TechnoS Raman (CTR)

**TRL-9**

## Overview

IndiRam CTR Series is India's first commercial-grade, high-end confocal micro-Raman spectrometer, developed by CSIR-AMPRI, Bhopal with M/s TechnoS Instruments, Jaipur under the CSIR-NMITLI programme. It delivers research-grade Raman, photoluminescence and optical emission spectroscopy with performance, resolution and reproducibility at par with imported international brands, but at significantly lower cost. By substituting costly imports for research laboratories, academia and industry, it strengthens national self-reliance in analytical instrumentation, supports the'Make in India' mission, and provides locally available installation, calibration and after-sales support to users across the country.

## Functionalities

- Non-destructive confocal micro-Raman spectroscopy for chemical, molecular, and structural characterization of solids, liquids, and powders.
- Supports Raman, Photoluminescence (PL), and Optical Emission Spectroscopy (OES) with configurable multi-laser excitation and automated X-Y-Z mapping.
- Fully automated spectral acquisition with integrated analysis, material identification, and reporting using IndiRamID software.

## Contact Details

Dr. Thallada Bhaskar
Director, CSIR-AMPRI Bhopal
director.ampri@csir.res.in
Phone: 0755-2457105

## USP/Key Features

- CSIR developed India's first commercial-grade, high-end confocal micro-Raman spectrometer under a CSIR-NMITLI public-private partnership with 20–25% indigenous value.
- The 'Make in India' instrument delivers global-standard performance, validated to NIST and ASTM E1840 standards with <1 $cm^{-1}$ spectral resolution.
- It features indigenous software, 10–23%
- lower cost than comparable imports, and local installation and after-sales support.
- The technology boosts India's self-reliance in advanced scientific instrumentation and reduces dependence on imported systems.

## Implementation Status

17 systems ordered by institutes and industry across India (~15 installed and operational; 2 under installation).

# Fire Retardant Intumescent Coating for Steel and GI Duct Applications

**TRL-6**

## Overview

Steel and GI structural materials when exposed to fire starts losing its structural strength (at temperature above 500°C) leading to risk of collapsing structures. A fire-retardant intumescent paint is a coating that reacts to heat by swelling several times its original thickness, producing a carbonaceous char that acts as an insulating layer to protect the substrate.

## Functionalities

- Fire protection for steel and GI duct structures by forming an insulating char layer during high-temperature exposure.
- Intumescent heat-responsive coating technology that expands several times its original thickness to delay temperature rise in substrates.
- Maintains structural integrity during fire events by reducing heat transfer and preventing premature loss of mechanical strength.
- Provides passive fire resistance solution for enhanced safety and protection of industrial and building infrastructure.

## USP/Key Features

- Heat-activated intumescent coating that expands upon fire exposure to form a protective insulating char layer.
- Enhanced fire resistance by reducing heat transfer and protecting steel and GI duct substrates from high temperatures.
- Passive fire protection solution designed to maintain structural stability and prevent premature collapse during fire incidents.
- Suitable for diverse infrastructure applications requiring improved safety, durability, and thermal protection of metallic structures.

## Contact Details


Prof. Pradeep Kumar Ramancharla
Director, CSIR–CBRI Roorkee
director.cbri [at] csir.res.in
+91-1332-272243, 283393


## Implementation Status

Licensed and Deployed

# Climate Resilient Building (CRB) for Cold Regions – Leh, Ladakh, India

**TRL-7**

## Overview

CSIR-Central Building Research Institute (CSIR-CBRI) has successfully demonstrated a Climate Resilient Building (CRB) for Cold Regions at Leh, Ladakh to address the challenges of extreme cold-desert climatic conditions. The building integrates passive solar design, high-performance insulated envelopes, and earthquake-resistant construction techniques to improve indoor thermal comfort and reduce heating energy demand. The project demonstrates a sustainable, low-carbon, and energy-efficient habitat solution scientifically validated through simulation studies and real-time performance monitoring under actual high-altitude cold-climate conditions.

## Functionalities

- Provides enhanced indoor thermal comfort through passive solar heating and high-performance insulated building envelopes.
- Reduces heating energy demand and improves energy efficiency under extreme cold-desert climatic conditions.
- Ensures structural safety through earthquake- and weather-resistant construction suitable for high-altitude Himalayan regions.

## USP/Key Features

- Climate-responsive planning and orientation
- Use of locally available stone and materials
- High-thermal-performance hybrid envelope
- Passive solar-based design
- Earthquake- and weather-resistant construction
- Reduced energy consumption and improved winter comfort

## Implementation Status

Demonstrated at ITBP, Leh, Ladakh, India.

## Contact Details

Prof. Pradeep Kumar Ramancharla
Director, CSIR – CBRI Roorkee
director.cbri@csir.res.in
+91-1332-272243, 283393

# COVID – 19 Makeshift Hospitals

**TRL-7**

## Overview

This technology employs lightweight, prefabricated foldable steel portal frames with modular units of 30.23 m², enabling easy transportation, rapid assembly, and deployment in remote locations. The structure uses steel-built columns, foldable trusses, sandwich panel cladding, and prefabricated foundations, and is designed for Seismic Zone V and wind speeds up to 160 km/h. Key features include scalability, reusability, thermal and acoustic comfort, foldable partitions, and a 25-year service life. The technology was successfully deployed for makeshift COVID-19 hospitals at 10 locations across Himachal Pradesh and Delhi, providing over 1,000 beds.

## Functionalities

- Integrated MEP services and utilities including electrical, water supply, heating/cooling systems, and medical gas lines such as oxygen supply.
- Advanced access control system ensuring secure and efficient facility management.
- Modular healthcare facility design comprising patient triage, assessment, holding areas, medical care units, staff zones, and support services.
- Flexible room configuration adaptable for varied healthcare applications, including conversion of isolation rooms to specialized treatment facilities.
- Code-compliant and scalable infrastructure designed as per relevant standards for safe and efficient healthcare operations.

## USP/Key Features

- Lightweight, foldable prefabricated steel structure enabling quick erection, easy transportation, dismantling, and reuse.
- Customizable and scalable design with adjustable sizes, internal partitions, optimum space utilization, and multifunctional applications.
- Enhanced occupant comfort through thermal, acoustic, waterproofing features, safety, and appealing aesthetics.
- Durable and cost-effective solution with 25-year service life, reusable components, prefabricated foundation, and economical construction.
- Rapid manufacturing and compliant design suitable for diverse temporary and permanent infrastructure needs.

## Implementation Status

Make shift hospitals were deployed during COVID pandemic

## Contact Details

Prof. Pradeep Kumar Ramancharla
Director, CSIR–CBRI Roorkee
director.cbri@csir.res.in
+91-1332-272243, 283393

# CSIR SMART Village

**TRL-7**

## Overview

The SMART Village Initiative of the Council of Scientific and Industrial Research (CSIR) is a multidisciplinary mission aimed at transforming rural communities through science and technology-driven interventions. The project focuses on sustainable housing, clean energy, water management, sanitation, digital connectivity, skill development, and livelihood enhancement tailored to diverse climatic zones of India. The initiative integrates affordable, resilient, and eco-friendly technologies developed by CSIR laboratories to improve quality of life, strengthen rural infrastructure, and promote self-reliant and sustainable village ecosystems.

## Functionalities

- Deployment of CSIR sustainable rural technologies including housing, sanitation, water treatment, renewable energy, and waste management systems.
- Integration of smart infrastructure solutions for improving healthcare, education, digital connectivity, and community services in villages.
- Capacity building and technology transfer for local communities to support livelihood generation and long-term rural sustainability.

## USP/Key Features

- Multi-disciplinary integration of technologies from multiple CSIR laboratories under a single rural development platform.
- Climate-responsive and region-specific solutions designed for different agro-climatic zones of India.
- Focus on affordable, scalable, eco-friendly, and community-centric technologies for sustainable rural transformation.

## Implementation Status

CSIR technologies deployment in Smart Villages are under progress.

## Contact Details

Prof. Pradeep Kumar Ramancharla
Director, CSIR–CBRI Roorkee
director.cbri@csir.res.in
+91-1332-272243, 283393

# Model Resilient Village

**TRL-7**

## Overview

The Model Resilient Village project at Sil Village, Bwasani Gram, Solan, Himachal Pradesh, was implemented by CSIR-Central Building Research Institute (CSIR-CBRI) to support rehabilitation and disaster resilience following the devastating flash floods, landslides, and cloudbursts of August 2023. The project focused on restoring safe living conditions through semi-permanent shelters, retrofitting of schools and Anganwadi, sanitation and water infrastructure, solar lighting, and community facilities. The intervention enhanced safety, resilience, and quality of life for vulnerable rural communities while promoting sustainable and disaster-resilient village development.

## Functionalities

- Construction of semi-permanent disaster-resilient shelters and retrofitting of schools and Anganwadi centres for improved structural safety.
- Development of community infrastructure including toilets, water storage units, solar street lighting, and public recreational spaces.
- Preparation of a Detailed Project Report (DPR) for drainage systems and retaining walls to reduce future disaster risks and improve village resilience.

## Contact Details

Prof. Pradeep Kumar Ramancharla
Director, CSIR–CBRI Roorkee
director.cbri [at] csir.res.in
+91-1332-272243, 283393

## USP/Key Features

- Integrated rehabilitation approach combining housing, infrastructure, sanitation, energy, and community resilience measures.
- Climate-responsive and disaster-resilient construction tailored for landslide- and flood-prone Himalayan regions.
- Community-centric implementation based on technical assessment, stakeholder consultations, and sustainable infrastructure planning.

## Implementation Status

Implemented in Sil Village, Bwasani Gram, Solan District, Himachal Pradesh.

# Portable Solar-Assisted Heat Pump Water Heating System Know-How

**· TRL-7 ·**

## Overview

The system heats water up to 50 °C by utilizing less energy than conventional water geysers. Cost and energy efficient system with high solar energy and ambient energy harvesting capacity. Suitable for the intermittent sunshine climate of ≥ 3-4 kWh/sqm/day.

## Functionalities

- Energy-efficient water heating using solar and ambient energy harvesting with reduced power consumption compared to conventional geysers.
- Portable heat pump-based operation providing hot water up to 50°C for diverse domestic and commercial applications.
- High solar utilization capability suitable for intermittent sunshine conditions with solar energy availability of ≥3–4 kWh/m²/day.
- Cost-effective and sustainable heating solution reducing electricity usage and operational costs while promoting renewable energy adoption.

## USP/Key Features

- Life- cycle: 18-20 years
- Payback period: 2-3 years
- Easy to install
- Less energy consumption
- Portable

## Contact Details

Prof. Pradeep Kumar Ramancharla
Director, CSIR–CBRI Roorkee
director.cbri@csir.res.in
+91-1332-272243, 283393

## Implementation Status

Licensed and deployed

# Agro-Industrial Waste Based 3D Printed Concrete Blocks (3DPCB) and Their Production Method

**TRL-8**

## Overview

This technology offers a sustainable, cost-effective, and high-performance alternative to conventional concrete blocks by combining agro-industrial waste materials with 3D printing. It significantly reduces carbon footprint, material cost, and production time while delivering superior mechanical strength, durability, and thermal comfort. By eliminating formwork, minimizing labor dependency, and using locally available waste resources such as bagasse ash and fly ash, the technology enables faster, cleaner, and more economical masonry construction with up to 27% cost reduction compared to conventional OPC-based blocks.

## Functionalities

- Masonry construction in residential and institutional buildings
- Load-bearing and non-load-bearing walls
- Infill walls in RCC frame structures
- Low-rise and medium-rise buildings (up to 2 storeys, and higher with core filling if required)

## Contact Details

Prof. Pradeep Kumar Ramancharla
Director, CSIR–CBRI Roorkee
director.cbri@csir.res.in
+91-1332-272243, 283393

## USP/Key Features

- Cost-effective and sustainable production with up to 27% cost reduction and lower carbon footprint through the use of agro-industrial wastes like bagasse ash and fly ash.
- Faster automated manufacturing using 3D printing technology, eliminating formwork, molds, and reducing labor dependency.
- Enhanced mechanical performance with higher compressive strength compared to conventional concrete blocks.
- Improved durability and longevity through better resistance to acid, sulphate attack, moisture ingress, and reduced water absorption.

## Implementation Status

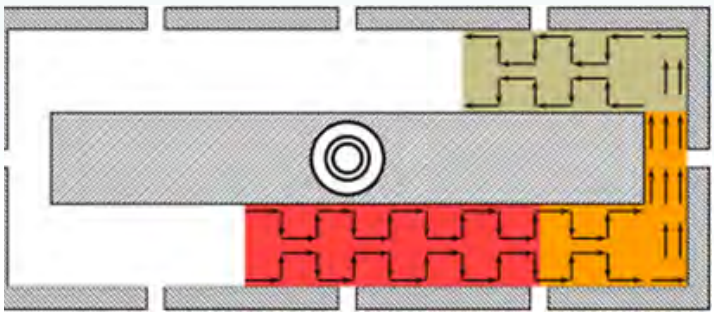
India's first 3D Printed Rural House under PMAY-G has been developed by CSIR-CBRI, Roorkee, marking a new era of sustainable, disaster-resilient, and rapidly deployable housing solutions.

# Design of High Draught Brick Kilns with Zig-Zag Setting

**TRL-9**

## Overview

As per MoEF Gazette notification dated 22.2.2022, it is necessary for all brick kilns to adopt high-draught zigzag brick kilns technology by Dec. 2023 for complying with emission standards of 250 mg/Nm$^3$ and save of environment.



## Functionalities

- High-draught zig-zag firing technology enabling improved combustion efficiency and uniform heat distribution in brick kilns.
- Reduced emissions and environmental impact by achieving compliance with prescribed particulate matter emission standards.
- Fuel-efficient brick production through optimized airflow, improved thermal efficiency, and reduced coal consumption.
- Enhanced brick quality and productivity with uniform firing, reduced wastage, and sustainable kiln operation.

## USP/Key Features

In zigzag kilns, green bricks are arranged in a way that forces hot air to travel in a zigzag path. The length of the zigzag air path is about three times that of a straight-line air path, and this improves the heat transfer from the flue gases to the bricks, making the entire operation more efficient.

## Implementation Status

Licensed and deployed

## Contact Details

Prof. Pradeep Kumar Ramancharla
Director, CSIR–CBRI Roorkee
director.cbri@csir.res.in
+91-1332-272243, 283393

# mRNA-Based Vaccines for SARS-CoV2 and Other Viruses, including Chikungunya

**· TRL-6 ·**

## Overview

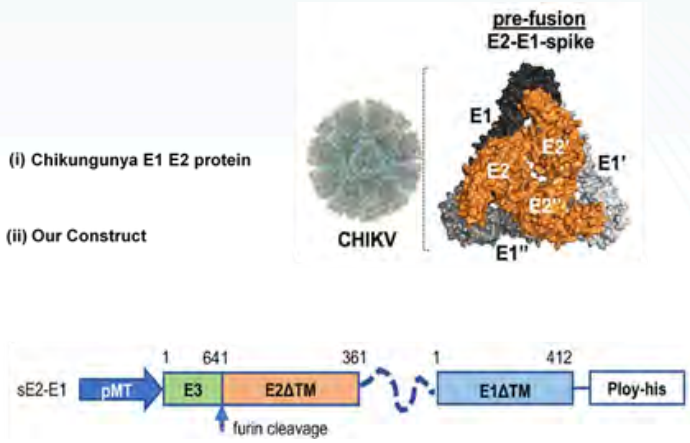
mRNA based platforms were discovered to be effective and scalable platforms to fight infections and cancer. CSIR-CCMB has demonstrated competency on these platforms by conducting complete validation on one product. Vaccine against Chikungunya is in progress. Technology of mRNA platform requires a judicious design of the gene construct with 5' and 3' UTR and selection of appropriate length of Poly A. Gene construct is translated in vitro and capped and formulated into ionic lipid based Lipid Nanoparticles. In the process, purification of the mRNA from aborted products, DNA, endotoxin etc,. is critical. Efficacy of these formulations is tested in cell lines, followed for immune response in small animals and later on viral challenged animals.

## Functionalities

- No vaccine for Chikungunya is available in India.
- CSIR-CCMB has established the entire process of gene construct, optimization of control elements, in-house synthesis of LNPs, characterization, high quality QC on formulations and efficacy in immune response and therapeutic studies in small animals.
- Initially the platform was established for SARS-CoV2 and then for Chikungunya.
- Based on this prototype, currently additional diseases are being explored.

## Contact Details

Dr. Vinay K. Nandicoori
Director, CSIR-CCMB Hyderabad
director.ccmb@csir.res.in
+91-040-27192534 / 040-27160789




## USP/Key Features

- The Chikungunya mRNA construct is unique in its design with optimized control elements;
- 100% Indigenous mRNA vaccines;
- Offers major advantages such as easier expression of proteins than DNA based expression and is highly immunogenic;
- Due to RNA's labile nature, the modification induced by RNA vaccine is temporary and it causes no permanent modification in host's genome, transcriptome or proteome;
- Enhancing the stability of mRNA, which has been its handicap, was overcome by modified nucleotides and the other major innovation is in using ionizable lipids that generate well protected mRNA and are safe to humans.

## Implementation Status

- The technology is validated and pre-clinical studies are ongoing.
- CCMB can collaborate with interested companies for co-development of mRNA-based therapeutics.

# Non-Invasive Early Pregnancy Detection in Cattle and Buffaloes

**TRL-7**

## Overview

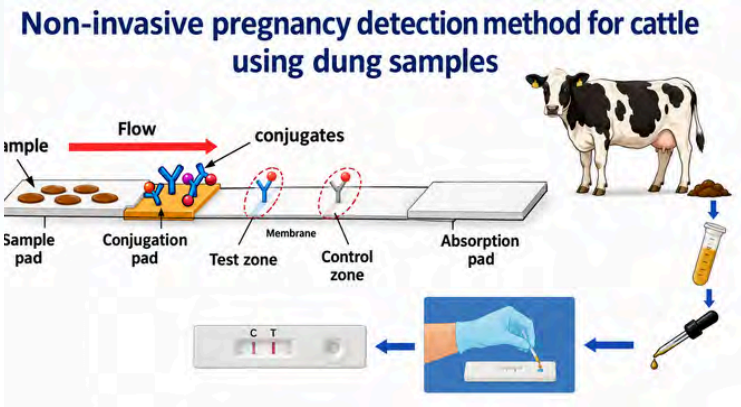
CCMB has identified a progesterone metabolite from dung sample for early detection of pregnancy in cattle and buffaloes. This technology comprises of a novel method of extraction of a progesterone metabolite from faeces/dung sample for early determination of pregnancy in cattle and buffaloes. It is very important to detect pregnancy for planning for the next calving period and increase milk productivity and planning. This is a game changer technology in the Dairy industry as this is the first non-invasive way to detect pregnancy early (at 4-6 weeks contrary to the usual 10-12 weeks) in cattle and buffaloes.

## Functionalities

- Early Pregnancy Detection: Enables timely identification of pregnancy in livestock, helping reduce calving intervals, improve breeding efficiency, and enhance dairy productivity.
- Farmer-Friendly Technology: A non-invasive, affordable, and field-deployable solution accessible to both smallholder and commercial dairy farmers.
- Economic Impact: Supports higher milk yield, increased calf production, and improved farmer incomes, benefiting the dairy industry, livestock farmers, and animal husbandry departments.

## Contact Details

Dr. Vinay K. Nandicoori
Director, CSIR-CCMB Hyderabad
director.ccmb@csir.res.in
+91-040-27192534 / 040-27160789




## USP/Key Features

- Non-invasive detection of pregnancy as opposed to usual invasive techniques;
- Traditionally, pregnancy in livestock is detected 3 to 4 months after conception; this technology offers it in 3 - 4 weeks;
- It is a user-friendly, rapid and inexpensive system;
- Does not require cold chain for transportation or storage, making its availability in far off remote areas easy;

## Implementation Status

Lab-based Service are being provided (ELISA based). Discussions are ongoing with other potential Licensees for creation of point-of-care device.

# Climate-Resilient, High-Yielding and Diabetic-friendly Rice Varieties (Improved Samba Mahsuri (ISM), Improved Versions, DRR Dhan-58, 60, 62)

**· TRL-9 ·**

## Overview

CSIR-CCMB and ICAR-IIRR have jointly developed climate-resilient, high-yielding, and low glycaemic index (GI) rice varieties with tolerance to major biotic and abiotic stresses, including bacterial blight, blast, salinity, flooding, low soil phosphorus, and lodging. These fine-grain varieties offer excellent grain and cooking quality with yields exceeding 6 t/ha. Improved Samba Mahsuri (RP BIO 226) combines bacterial blight resistance with a clinically validated low GI (~51), making it diabetic-friendly while delivering higher productivity and farmer income. Advanced derivatives, DRR Dhan-58, 60, and 62, incorporate additional beneficial traits.

## Functionalities

- Disease Resistance & Yield: Improved Samba Mahsuri offers bacterial blight resistance while retaining the high yield and premium grain quality of Samba Mahsuri.
- Diabetic-Friendly: With a low glycaemic index (~51), it is suitable for health-conscious and diabetic consumers.
- Economic Impact: The variety has generated substantial value, with an estimated production value of ~Rs 12,000 crore and farmer benefits of ~Rs 2,000 crore.

## Contact Details


Dr. Vinay K. Nandicoori
Director, CSIR-CCMB Hyderabad
director.ccmb@csir.res.in
+91-040-27192534 / 040-27160789

## USP/Key Features

- High Yield & Quality: Bacterial blight-resistant variety with ~5 t/ha yield, premium grain quality, and excellent cooking characteristics.
- Enhanced Performance: Delivers ~40% higher yield under disease pressure, matures 7–10 days earlier, and is suitable for direct seeding and mechanized harvesting.
- Health & Economic Benefits: Non-transgenic, marker-assisted variety with a clinically validated low GI (~51), premium market value, and suitability for major fine-grain rice-growing regions.

## Implementation Status

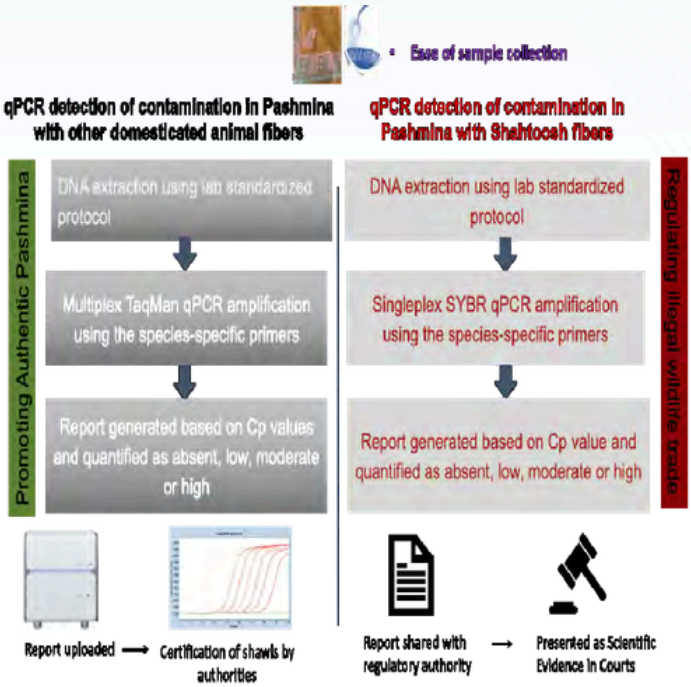
- ISM so far it has been cultivated in about ~11,00,000 hectares of farmers' fields in Telangana, Andhra Pradesh, Tamil Nadu, Bihar, Karnataka, Chhattisgarh, Uttar Pradesh, etc.;
- Stakeholders for this technology would include companies and start-ups into Rice business, private seed companies and FPOs

# DNA-Based methods to Differentiate between Pashmina and other Animal Fibres including Shahtoosh

**TRL-9**

## Overview

This technology comprises advanced qPCR-based diagnostic kits for authentication of animal-origin textile fibres. The first kit enables highly sensitive detection of Shahtoosh (Pantholops hodgsonii) fibres in raw wool, yarn, and woven shawls, even from a few hair fibres, supporting wildlife conservation and prevention of illegal trade. The second multiplex-qPCR kit simultaneously differentiates and authenticates Pashmina, Merino, and Angora fibres with high accuracy. Together, these technologies provide reliable fibre authentication, promote fair trade practices, ensure product quality, and strengthen regulatory enforcement in the specialty textile sector while supporting Mission LiFE objectives.




## Functionalities

- Fibre Authentication: Enables molecular-level verification of Pashmina, Merino, Angora, and Shahtoosh fibres, ensuring product authenticity and supporting export quality assurance.
- Economic & Trade Benefits: Protects artisans and genuine producers from counterfeit products, strengthens buyer confidence, and enhances market competitiveness.
- Stakeholder Impact: Supports regulatory agencies, customs authorities, textile industries, traders, and artisan communities through reliable fibre authentication.

## USP/Key Features

- Multiplex qPCR-based kit simultaneously detects Pashmina, Merino, and Angora fibres in woven fabrics with high accuracy.
- Efficient DNA extraction technology yields high-quality DNA from hair tissues compared to conventional kits.
- Identifies trace fibre adulteration using species-specific primers and probes, even from limited samples.
- Affordable molecular testing solution enabling accurate detection of Pashmina adulteration with other animal fibres.

## Contact Details


Dr. Vinay K. Nandicoori
Director, CSIR-CCMB Hyderabad
director.ccmb@csir.res.in
+91-040-27192534 / 040-27160789


## Implementation Status

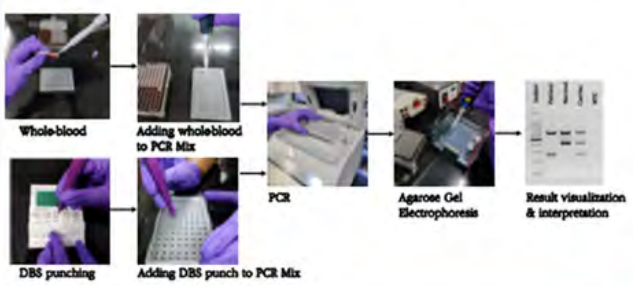
Licensed to Endemik Solutions, J&K; deployed as a laboratory service for Pashmina fabric authentication.

# Dried Blood Spot-Based Molecular Kit for Detection of Sickle Cell Anaemia

**TRL-9**

## Overview

This technology is a one-step molecular test for detection of the mutation causing Sickle Cell Anaemia (SCA) with direct use of whole-blood (WB)/dried blood spot (DBS) as template and mutation-specific primers (using Allele-Specific Primers) in a single tube polymerase chain reaction (PCR), followed by detection of individual status using conventional methods. It combines the established knowledge of SCA genetics, basic molecular biology techniques, limitations of the current methods, along with innovative steps to convert a simple concept to a test following ASSURED criteria (Affordable, Sensitive, Specific, User-friendly, Rapid and robust, Equipment-free or simple, and Deliverable to end-users).



## Functionalities

- Enables population-scale genetic screening for Sickle Cell Anaemia (SCA), supporting the National SCA Elimination Mission (2023–2030).
- Provides reliable screening and counselling support to empower families, promote timely care, and reduce social stigma.
- Builds diagnostic capacity through training of ASHA/ANM workers and field healthcare personnel.
- Integrates with district health systems through scalable frameworks covering training, logistics, quality assurance, and data monitoring.
- Strengthens India's genomic healthcare ecosystem with last-mile screening and community-based implementation.

## USP/Key Features

- Accessible & Affordable Diagnosis: Enables confirmatory screening of sickle cell anemia directly from dried blood spots collected through a painless finger-prick, making it ideal for remote and underserved regions.
- High Accuracy: Uses novel primers and optimized reagents for highly sensitive and specific detection of normal, carrier, and affected individuals.
- Public Health Impact: Supports nationwide screening at ~Rs 100/test, reducing healthcare costs and strengthening India's diagnostic and bioeconomy capabilities.

## Contact Details

Dr. Vinay K. Nandicoori
Director, CSIR-CCMB Hyderabad
director.ccmb@csir.res.in
+91-040-27192534 / 040-27160789

## Implementation Status

- The technology/kit is validated by ICMR and adopted in the national Sickle Cell Anaemia Elimination Mission, deployed for screening in many states.
- Technology is transferred to 2 Start-ups.

# Dry Swab Technology for SARS-CoV-2 Diagnostics

**TRL-9**

## Overview

A diagnostic method was developed at CSIR-CCMB that uses dry swab samples instead of conventional viral transport media for SARS-CoV-2 diagnostics. The approach simplifies sample collection, transport, and processing, enabling large-scale, affordable & SAFER transportation & testing, during public health emergencies.

## Functionalities

- Offered faster, affordable and SAFER testing method;
- Offered larger testing access for populations at edge and reduced testing backlogs and wait times, lower cost per test by eliminating the requirement of VTM;
- Enables faster identification and isolation of cases helped reduce transmission;
- Enables resource-efficient management of COVID-19 testing pan India under resource constraints.

## USP/Key Features

It simplifies sample collection, transport, and processing, reducing dependence on specialized supplies; compared to conventional Rt-PCR based kits/methods.

## Implementation Status

- Technology licenced to 5 companies in 2020-21;
- Domestic manufacturing of testing kits by partner industry was commercialized in 2021;
- Trainings conducted for deployment by various diagnostic centres/ hospitals across the country.

## Contact Details


Dr. Vinay K. Nandicoori
Director, CSIR-CCMB Hyderabad
director.ccmb@csir.res.in
+91-040-27192534 / 040-27160789

# Genomics-Guided Wastewater-based surveillance (WWS) for Pathogens like SARS-CoV-2 and Antimicrobial Resistance

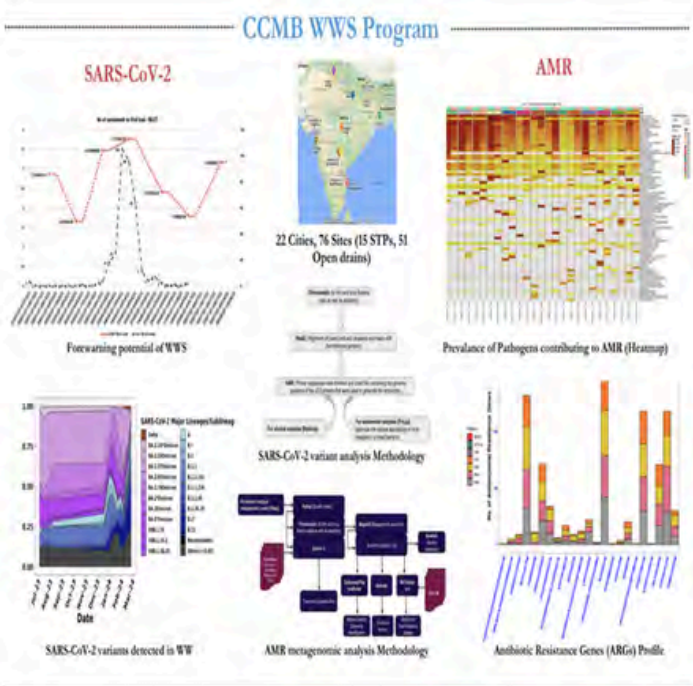
**TRL-9**

## Overview

Wastewater-based surveillance can fetch invaluable insights into studying the emergence or recurrence of diseases like Malaria, tuberculosis, dengue and viral diseases like SARS-CoV2, Poliovirus etc. and drug resistance patterns of pathogens like these, and emergence of newer pathogenic strains resistant to the existing drugs prescribed by health practitioners to treat and contain the spread of these pathogenic diseases.

## Functionalities

- Monitoring wastewater provides insights into the presence and concentration of disease-causing pathogens in communities;
- Conducting genomics driven research for a targeted population via wastewater-based surveillance with the precious support from local health and administrative authorities, generates plethora of invaluable information, which would subsequently serve as a beacon in the field of AMR studies and devising data-driven public health policies locally and eventually globally.




## USP/Key Features

- Affordable monitoring of community health monitoring
- Offers fore-warning advantage giving the authorities enough time for preparedness

## Contact Details

Dr. Vinay K. Nandicoori
Director, CSIR-CCMB Hyderabad
director.ccmb@csir.res.in
+91-040-27192534 / 040-27160789

## Implementation Status

CSIR-led wastewater surveillance deployed nationwide as an early-warning tool for pathogen detection, disease monitoring, and antimicrobial resistance tracking, supporting public health decision-making.

# Wildlife Crime Detection & Bird Hit cases using Universal Primer Technology

**TRL-9**

## Overview

Universal Primer technology that was invented by CSIR- CCMB and is a patented technology, which is a DNA-based approach for species identification. It is used to provide species identification service to the nation even after 25 years. The technique is accepted world-wide and also by legal justice system in India. It is now being used extensively for addressing wildlife crimes and bird hit cases at the airports.

## Functionalities

- Species identification and authentication using DNA-based Universal Primer technology for wildlife samples and biological materials.
- Forensic support for wildlife crime investigations by providing scientifically reliable evidence for species verification.
- Bird hit case analysis at airports through accurate identification of bird species involved in collisions.
- Nationwide identification service capability with long-term applicability for conservation, enforcement, and legal proceedings.

## Contact Details

Dr. Vinay K. Nandicoori
Director, CSIR-CCMB Hyderabad
director.ccmb@csir.res.in
+91-040-27192534 / 040-27160789

## USP/Key Features

- DNA-based species identification technology enabling accurate identification of wildlife species for crime investigation and bird hit analysis.
- Patented Universal Primer technology providing reliable species identification capability with long-term applicability and global acceptance.
- Supports wildlife crime detection and airport bird strike investigations through rapid and scientifically validated identification methods.
- Legally accepted forensic solution recognized by judicial systems and used for evidence-based species authentication.

## Implementation Status

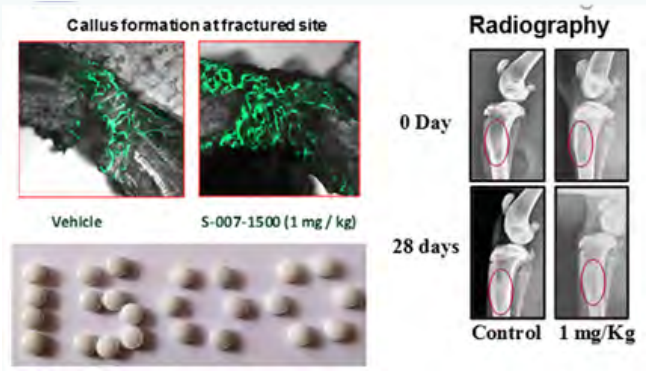
- Lab-level Wildlife Forensics services are offered to the nation in the cases pertaining to wildlife crime.
- Services on bird hit cases are being offered to IAF and various airports are also being handle at the lab-level.

# CDRI S007-1500: Novel, Orally Active Bone Fracture Healing Drug Candidate

**TRL-6**

## Overview

Globally, bone fractures constitute a major and escalating public health burden, with nearly 178 million new fracture cases and 455 million individuals living with acute or chronic fracture-related complications. No approved, oral drug is available for enabling the healing of bone fractures. The CDRI team has developed a novel, orally active molecule S-007-1500 for rapid healing of bone fractures (Goel et al.: US Patent Granted US-8686028 dated 01-04-2014). The technology has been licensed and transferred to Troikaa Pharmaceuticals Ltd. Ahmedabad for clinical development and commercialization. The Troikaa team has received CDSCO permission for a Phase-I Clinical Trial to establish the safety and pharmacokinetics of S-007-1500 in healthy volunteers. The study is expected to start shortly.



## Functionalities

- Orally active fracture healing drug candidate.
- It enhances bone regeneration at fracture site at only 1.0 mg.kg-1.day-1 dose and restores bone micro-architecture in adult osteopenic rats.
- New bone formation at the fracture site is increased by ~40-50% in in vivo animal models treated with CDRI-1500.

## USP/Key Features

- CDRI S007-1500 is a first-in-class, orally active small molecule.
- Efficacy and safety have been established in preclinical models.
- A cost-effective, industrially viable five-step process was developed using easily accessible starting materials.
- If found efficacious and safe in human clinical trials, S007-1500 will be a breakthrough therapy for Bone Fracture treatment.

## Contact Details

Dr. Radha Rangarajan
Director, CSIR-CDRI, Lucknow
director@cdri.res.in
+91-522-2772450, +91-522-2771940

## Implementation Status

First-in-human clinical trial stage.

# Levormeloxifene for Contraception

**· TRL-6 ·**

## Overview

Ormeloxifene (Centchroman) is a non-steroidal oral contraceptive and selective estrogen receptor modulator (SERM) that provides effective contraception with minimal side effects. Its convenient once-weekly dosing regimen has made it a valuable option, particularly in low-resource settings. CSIR-CDRI, in collaboration with CIPLA Ltd., has developed a scalable process for isolating Levormeloxifene (l-enantiomer), identified as the primary contributor to the contraceptive efficacy of racemic Ormeloxifene. A Phase I clinical trial to evaluate the pharmacokinetics of Levormeloxifene has received CDSCO approval and is expected to commence shortly.

## Functionalities

- Ormeloxifene (Saheli/Chhaya), developed by CSIR-CDRI, is a non-steroidal oral contraceptive marketed since 1992 and included in India's National Family Planning Programme since 2016.
- Preclinical studies identified Levormeloxifene (l-isomer) as the primary active component, leading to its development in partnership with Cipla Ltd.
- The pure enantiomer is expected to reduce chemical exposure while maintaining efficacy. CDSCO has approved a Phase I clinical trial to evaluate its pharmacokinetics.

## USP/Key Features

- Reduced Drug Burden: Levormeloxifene has the potential to halve the required dose compared to racemic Ormeloxifene, lowering overall drug exposure and possibly reducing long-term side effects.
- Improved Safety Profile: Elimination of the inactive d-enantiomer may decrease adverse effects and non-specific receptor interactions.
- Global Potential: As a next-generation contraceptive, Levormeloxifene offers improved marketability and international translational prospects beyond India.

## Contact Details

Dr. Radha Rangarajan
Director, CSIR-CDRI, Lucknow
director@cdri.res.in
+91-522-2772450, +91-522-2771940

## Implementation Status

Clinical Trials are to be commenced.

# A Novel Phytopharmaceutical: A Standardized fraction of Picrorhiza Kurroa for Treatment of Non-Alcoholic Fatty Liver Disease (NAFLD)

**· TRL-8 ·**

## Overview

CSIR-CDRI and CSIR-IHBT have jointly developed a first-in-class phytopharmaceutical for the treatment of Non-Alcoholic Fatty Liver Disease (NAFLD/MASLD), a condition affecting an estimated 25–30% of the Indian population with limited approved treatment options. The formulation employs a multi-target mechanism, including anti-inflammatory, antioxidant, and lipid-lowering actions, and has demonstrated significant reduction in hepatic steatosis and lipid aaccumulation in preclinical studies. The candidate is currently undergoing regulator-approved Phase III clinical trials at leading Indian medical institutions and has been licensed to Themis Medicare Ltd., Mumbai.

## Functionalities

- Standardized *Picrorhiza kurroa* (Kutki) extract enriched with bioactive Picroside I & II, developed by CSIR-CDRI and CSIR-IHBT.
- Reverse pharmacology-based phytopharmaceutical technology integrating traditional knowledge with modern drug development.
- Demonstrated hepatoprotective efficacy by reducing hepatic fat accumulation, oxidative stress, and inflammation associated with NAFLD.
- Validated across multiple preclinical liver injury models, including toxin-induced and metabolic liver disorders.

## USP/Key Features

- Multi-modal action targeting lipid metabolism, oxidative stress, and inflammation.
- Standardized phytopharmaceutical formulation with defined phytomarkers ensuring consistent quality.
- Favorable safety profile supported by traditional use and preclinical/clinical evidence.
- Potential disease-modifying therapy with strong global phytopharmaceutical market potential.

## Contact Details

Dr. Radha Rangarajan
Director, CSIR-CDRI, Lucknow
director@cdri.res.in
+91-522-2772450, +91-522-2771940

## Implementation Status

Phase 3 clinical trial ongoing.

# Indigenous DNA Gel Stain "GreenR"

**TRL-9**

## Overview

CSIR-CDRI has developed an indigenous DNA Gel Stain "GreenR™", which binds to nucleic acids of all kinds: Genomic DNA, PCR products, and plasmids. The technology was licensed and transferred to M/s Gene to Protein Pvt. Ltd., Lucknow. The product was launched in the Indian Market under brand name GreenR™. The product is patented (Goel et al, Indian Pat. No. 202211040311 dated 12July 2022) and is available..

## Functionalities

- GreenR dye is non-fluorescent but upon binding with DNA/RNA, it exhibits green fluorescence.
- The stain was benchmarked with a commercial dye and equivalent staining outcomes were observed.
- The dye binds to nucleic acids of all kinds (genomic DNA, plasmid DNA and RNA, PCR amplified products of different sizes).
- The dye can be used with PCR master mix for highly sensitive qPCR experiments.
- GreenR dye applications span molecular diagnostics, biotechnology research and life sciences laboratories.

## Contact Details

Dr. Radha Rangarajan
Director, CSIR-CDRI, Lucknow
director@cdri.res.in
+91-522-2772450, +91-522-2771940

## USP/Key Features

- Cost-effective indigenous alternative to imported DNA gel stains, reducing dependency on expensive foreign " life sciences reagents".
- GreenR DNA Gel Stain technology enables safe and efficient visualization of nucleic acids during electrophoresis.
- Master Mix kit solutions provide reliable and convenient molecular biology workflows for research and diagnostic applications.
- Commercially available in India for 3+ years, supporting widespread adoption in "academic institutions and biotechnology industries.

## Implementation Status

Several private industries and government institutions/universities are using the GreenR DNA Gel stain for their research work.

# 2.6 MW S-Band Tunable Pulse Magnetron

**· TRL-6 ·**

## Overview

CSIR-CEERI has successfully developed and delivered S-band 2.6 MW tunable pulsed magnetron with the support of Ministry of Electronics and Information Technology, Govt. of India.

The scope of the project was to develop High power pulsed magnetrons (in particular) which act as RF source in medical LINAC. This indigenously developed magnetron is intended to retrofit in existing medical LINAC systems, thus replacing the imported magnetron. This development facilitates the advancement of LINAC program for medical (Radiation Therapy) and non-destructive testing (NDT) applications at an affordable cost.

## Functionalities

Tunable frequency (±5 MHz min) with remote motorized tuner Medical LINAC/NDT applications Low cost and compact structure with variable power

## USP/Key Features

Roughed ceramic cathode support Performance as per imported magnetron Indigenously developed

## Contact Details

Prof. Shantanu Bhattacharya
Director (Additional Charge), CSIR-CEERI
director.ceeri@csir.res.in
+91-1596-242111

## Implementation Status

- Technology has been transferred to the industry namely M/s Panacea Medical Technologies Private Limited, Bengaluru, India, which is also user of the developed magnetron in their medical LINAC systems.
- Till now industry has developed four magnetrons for their own uses and fitted in their LINAC cavities.

# Affordable PCR

**· TRL-6 ·**

## Overview

Affordable-PCR developed by CSIR-Central Electronics Engineering Research Institute is an indigenous, portable, and cost-effective PCR platform designed for on-field and laboratory-based molecular diagnostics, research, and training applications. The system offers precise thermal cycling, integrated data analysis, and user-friendly operation for reliable nucleic acid amplification. Its compact and deployable design supports academic institutions, diagnostic laboratories, and skill development centres by enabling affordable access to molecular testing technologies. The innovation reduces dependence on expensive imported PCR systems while promoting decentralized diagnostics, research capability, and biotechnology skill development in India.

## Functionalities

- Performs precise Polymerase Chain Reaction (PCR) thermal cycling for nucleic acid amplification in molecular diagnostics and research applications.
- Enables portable on-field and laboratory-based testing with integrated software for real-time monitoring, analysis, and user-friendly operation.
- Supports applications in diagnostic laboratories, academic biotechnology training, skill development programs through an affordable and indigenous platform.

## USP/Key Features

- Indigenous, portable, and cost-effective PCR platform providing a reliable alternative to expensive imported PCR systems for diagnostics, research, and training applications.
- Compact and field-deployable design with precise temperature control, high thermal accuracy, and integrated data analysis research, and software for efficient and user-friendly operation.
- Versatile technology suitable for academic institutions, diagnostic laboratories, and skill development centres, enabling wider accessibility to molecular diagnostic and biotechnology capabilities in India.

## Contact Details

Prof. Shantanu Bhattacharya
Director (Additional Charge), CSIR-CEERI
director.ceeri@csir.res.in
+91-1596-242111

## Implementation Status

- Transferred to 3 industry partners for manufacturing and commercialization.
- Enables affordable PCR system production and further product development.
- Supports wider adoption in molecular diagnostics, research, and smart agriculture.

# MBRT Analyser

**TRL-7**

## Overview

The developed portable automated Methylene Blue Reduction Test (MBRT) analyser enables automated, reliable, and field-deployable assessment of microbial quality in raw milk, addressing limitations of conventional laboratory-based MBRT methods. The system integrates automated mixing, incubation, and advanced colorimetric sensing with an enhanced user-friendly GUI for real-time monitoring and accurate analysis. Multiple prototypes have been successfully designed, fabricated, and tested, demonstrating improved repeatability and operational efficiency. The technology benefits dairy farmers, milk collection centres, cooperatives, and processing industries by enabling early quality assessment, reducing contamination risks, improving procurement decisions, and supporting safer dairy supply chains.

## Functionalities

- Portable automated MBRT analyser for rapid and real-time microbial quality assessment of raw milk at field level.
- Integrated system comprising automated mixing, incubation, colorimetric accurate, sensing repeatable, independent testing.
- User-friendly embedded GUI with real time visualization, data monitoring, and deployable operation suitable for dairy farmers, milk collection centres, and processing industries.

## USP/Key Features

- Portable and field-deployable embedded system enabling on-site microbial quality assessment of raw milk without dependence on centralized laboratory infrastructure.
- Fully automated operation integrating mixing, incubation, and advanced colorimetric sensing modules, ensuring improved accuracy, repeatability, and reduced human intervention compared to conventional MBRT methods.
- User-friendly real-time monitoring and visualization interface with enhanced reliability and rapid decision-making capability for dairy collection centres, cooperatives, and milk processing industries.

## Contact Details

Prof. Shantanu Bhattacharya
Director (Additional Charge), CSIR-CEERI
director.ceeri@csir.res.in
+91-1596-242111

## Implementation Status

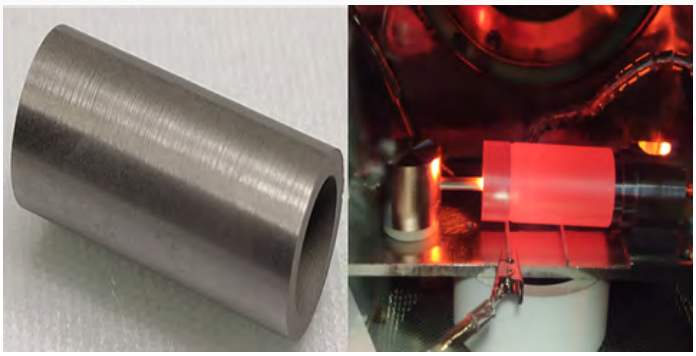
- Transferred to 2 industry partners in Jaipur for manufacturing and commercialization.
- Enables commercial production and further product development of the MBRT Analyser.
- Supports wider adoption for milk quality testing and dairy-sector applications.

# Space Qualified Thermionic Emitter (Hollow Thermionic Emitter for Thruster Application)

**TRL-7**

## Overview

A hollow thermionic emitter for thruster application is a hot electron-emitting component used inside electric propulsion systems, especially ion thrusters and Hall thrusters. Its job is to supply electrons that help ionize propellant and/or neutralize the ion beam leaving the thruster. World-wide only two USA-based companies are available who can commercially supply the emitter. They may decline to supply for strategic application. Indigenous development of emitter will lead to self-reliance and strategic independence.



## Functionalities

- E-thrusters offer precise control and higher payloads.
- Thermionic cathodes are required for ionization of propellant and neutralization.
- Device Dimensions OD x ID x L: 7.0 mm x 5.0 mm x 15 mm

## Contact Details

Prof. Shantanu Bhattacharya
Director (Additional Charge), CSIR-CEERI, Pilani
director.ceeri@csir.res.in
+91-1596-242111

## USP/Key Features

- Space-qualified hollow thermionic emitter designed for electron emission in ion and Hall thruster propulsion systems.
- Supports propellant ionization and ion beam neutralization, ensuring efficient and stable electric propulsion performance.
- Indigenous technology reducing dependence on limited foreign suppliers and strengthening strategic self-reliance.
- Enables secure availability for space and strategic applications, supporting India's advanced space missions and propulsion capabilities.

## Implementation Status

Demonstrated for thruster propulsion applications, with potential for wider deployment

# IoT-Enabled Colposcope for Pre-Stage Cervical Cancer Examination

**TRL-9**

## Overview

The technology is a visible imaging-based digital colposcopy system designed for cervical lesion visualization and screening. It offers 30X optical and 25X digital zoom, filter-based image enhancement, quick keypad operation, and connectivity to PC, smartphone, and cloud dashboards through UART and Wi-Fi. It supports efficient image capture, documentation, and review of cervical abnormalities. The system can improve early screening, aid clinical decision making, and strengthen cervical cancer detection services, especially in resource limited healthcare settings. Its portability, digital workflow, and multi-platform data access make it valuable for gynaecology clinics, screening programs, and telemedicine-based women's health services.

## Functionalities

- High-Resolution Imaging: Enables imaging-based colposcopy for cervical lesion visualization and screening with 30× optical and 25× digital zoom.
- Enhanced Examination: Supports image enhancement using green/blue and variable-intensity visible filters, with freeze, timer, and quick-access controls.
- Smart Connectivity: Connects to PC and smartphones via UART and Wi-Fi for image transfer, visualization, documentation, and cloud-based monitoring through software, mobile app, and dashboard.

## Contact Details

Prof. Shantanu Bhattacharya
Director (Additional Charge) CSIR-CEERI
director.ceeri@csir.res.in
+91-1596-242111

## USP/Key Features

- High-Resolution Imaging: 30× optical and 25× digital zoom for detailed visualization of cervical lesions.
- IoT-Enabled Connectivity: Connects with PCs, smartphones, and cloud platforms for image storage, documentation, and remote review.
- Enhanced Examination: Filter-based imaging with quick keypad controls for efficient clinical assessment.
- Portable & Telemedicine-Ready: Supports early cervical cancer screening and improved diagnostic services in resource-limited settings.

## Implementation Status

- Technology Transfer: Technology was successfully transferred to M/s Divine Meditech Pvt. Ltd., Uttar Pradesh.
- Product Commercialization: Technology transferred for further product development, manufacturing, and commercialization.
- Market Deployment: Supports translation of the indigenously developed colposcopy technology into clinical and healthcare applications.

# IoT-Enabled Field-Testing Kit for Rapid Water Quality Analysis

**TRL-9**

## Overview

The IoT-Enabled Portable Water Quality Testing Kit is designed for rapid, on-site water quality assessment in rural, remote, and field environments. The compact and user-friendly system enables real-time testing and data transmission, helping detect potential contamination at an early stage and supporting timely water management decisions.

The kit is specifically designed to minimize dependence on laboratory infrastructure and provide accessible water quality monitoring at the point of use.

## Functionalities

- Multi-Parameter Testing: Measures 14+ water quality parameters as per JJM guidelines.
- Rapid On-Site Testing: Quick contamination detection without laboratory infrastructure.
- IoT Connectivity: Real-time data transmission for remote monitoring and analysis.
- Ultra-Low Power: Energy-efficient operation for extended field use.
- Dual Charging: Supports USB and solar charging.
- Portable & Compact: Easy to carry and deploy in rural and remote areas.
- Rechargeable Battery: Li-ion battery-based operation for convenient field use.
- Digital Monitoring: Enables data logging, tracking, and faster decision-making.

## USP/Key Features

- Rapid Testing: On-site water quality testing with real-time IoT data transmission.
- Portable Design: Compact, user-friendly, and suitable for field deployment without lab infrastructure.
- Early Detection: Identifies contamination quickly for timely intervention and better water management.
- Digital Connectivity: Enables remote monitoring, data logging, and faster decision-making.

## Contact Details

Prof. Shantanu Bhattacharya
Director (Additional Charge), CSIR-CEERI
director.ceeri@csir.res.in
+91-1596-242111

## Implementation Status

- Technology transferred to 3 industry partners for commercial production.
- Product launched in India with initial market sales.
- Deployed in villages under the CSIR Smart Village Programme for field validation.

# Ksheer Scanner

**TRL-9**

## Overview

The Ksheer Scanner is an electrochemical, embedded system-based innovation for rapid detection of milk adulteration at collection points and dairy facilities. It identifies hazardous adulterants such as urea, salt, detergent, soda, ammonium sulphate, hydrogen peroxide, and others. Using only a small sample and no chemicals, it delivers quick PASS/FAIL results in a safe, green format. The technology strengthens milk quality enforcement, helps dairy societies and milk producers detect adulteration early, improves consumer safety, and supports reliable testing across the dairy value chain.

## Functionalities

- Detects hazardous milk adulterants such as urea, salt, detergent, soda, caustic soda, ammonium sulphate, hydrogen peroxide, boric acid, and other unknowns in raw and pasteurized milk.
- Measures key milk quality parameters including fat, SNF, protein, lactose, density, and added water, with rapid PASS/FAIL output for quick screening.
- Operates as a green, embedded, menu driven system with small sample intake, fast detection time, continuous scanning capability, and serial interface for field and dairy-use deployment.

## USP/Key Features

- Rapid, chemical-free "green technology" platform that enables safe milk adulteration screening without buffers or hazardous reagents.
- Detects a wide range of common and harmful adulterants in very small sample volumes, with fast, field-deployable operation and clear PASS/FAIL output.
- Combines embedded hardware, dedicated software, and integrated sampling/cleaning for automated, user-friendly, source-level milk quality monitoring.

## Implementation Status

1100+ units are operational

## Contact Details

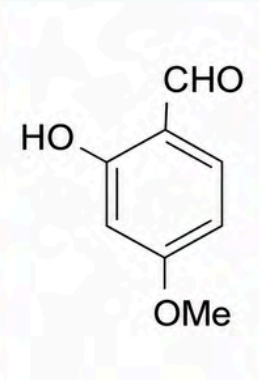
Prof. Shantanu Bhattacharya
Director (Additional Charge), CSIR-CEERI
director.ceeri@csir.res.in
+91-1596-242111

# A Process for Flavor Essence from Decalepis

**TRL-7**

## Overview

This technology relates to the extraction and preparation of flavor essence from Decalepis (Decalepis hamiltonii), an aromatic medicinal plant known for its characteristic sweet flavour and aroma. The extracted essence is used as a natural flavouring ingredient in food, beverage and confectionery applications. The process focuses on efficient extraction, preservation of volatile compounds and development of a stable flavour ingredient with commercial potential.



## Functionalities

- Produces natural flavour essence with characteristic aroma and taste
- Used as flavouring ingredient in beverages, confectionery and food products
- Enables value addition to medicinal and aromatic plant resources

## USP/Key Features

- Natural plant-derived flavouring alternative to synthetic essences
- Retains unique aromatic compounds and sensory characteristics
- Suitable for food, beverage and nutraceutical applications

## Contact Details

Dr. Giridhar Parvatam
Director, CSIR-CFTRI Mysuru
director.cftri@csir.res.in
+91-821-2517760

## Implementation Status

The technology has been licensed.

# Process know how for Bifido Curd

**TRL-7**

## Overview

Bifido Curd is a probiotic fermented dairy product prepared using beneficial Bifidobacterium cultures along with conventional starter cultures. The product offers improved gut health benefits, enhanced digestibility and nutritional value. The process focuses on controlled fermentation, maintenance of probiotic viability and production of a safe, high quality functional dairy product suitable for regular consumption and wellness applications.

## Functionalities

- Provides probiotic benefits that support gut health and digestion
- Enhances nutritional and functional value of traditional curd
- Delivers viable beneficial bacterial cultures through fermented dairy matrix

## USP/Key Features

- Contains health-promoting Bifidobacterium probiotic cultures
- Functional dairy product with improved digestive benefits
- Suitable for health-conscious and wellness-focused consumers

## Contact Details

Dr. Giridhar Parvatam
Director, CSIR-CFTRI Mysuru
director.cftri@csir.res.in
+91-821-2517760

## Implementation Status

The technology has been licensed.

# Mobile Processing Unit for Demonstration of Fruits and Vegetables Processing Technologies for North Eastern Region

**TRL-8**

## Overview

The Mobile Processing Unit (MPU) aims to reduce post-harvest losses, promote value addition, and create rural entrepreneurship opportunities. The unit enables decentralized processing of locally grown produce into products such as pulps, juices, beverages, pickles, jams, canned and dehydrated products, thereby improving income generation and supporting sustainable food processing ecosystems in remote regions.

## Functionalities

- Enables on-site processing and value addition of fruits and vegetables in remote and rural areas.
- Reduces post-harvest losses and transportation-related wastage of perishable produce.
- Supports production of multiple value-added products such as juices, pulps, jams, pickles, beverages, canned and dehydrated products.

## USP/Key Features

- Mobile and flexible processing unit designed specifically for Northeast regional requirements.
- Provides site-specific equipment customization based on local produce and thematic processing needs.
- Promotes decentralized food processing, rural entrepreneurship, and farmer income enhancement.

## Implementation Status

Developed by CSIR-CFTRI with NECTAR, the portable Mobile Processing Unit enables doorstep fruit and vegetable processing, farmer support, skill development, and value addition across Northeast India.

## Contact Details

Dr. Giridhar Parvatam
Director, CSIR-CFTRI Mysuru
director.cftri@csir.res.in
+91-821-2517760

# Process for Development of Gluten Free Bread Premixes[Three Versions] 1.Proso Millet 2. Foxtail Millet 3. Barnyard Millet

**TRL-8**

## Overview

The development of gluten-free bread premixes using millet varieties such as proso millet, foxtail millet and barnyard millet. The premixes are formulated to provide improved nutritional quality, dietary fibre and functional benefits while addressing the needs of gluten intolerant and health conscious consumers. The technology enables preparation of soft and acceptable gluten-free bread with enhanced shelf stability and convenience for bakery and household applications.

## Functionalities

- Enables preparation of gluten-free bread using millet-based premixes
- Provides nutritious bakery alternative rich in fibre and essential nutrients
- Supports convenient and standardized bread preparation for consumers and bakeries

## Contact Details

Dr. Giridhar Parvatam
Director, CSIR-CFTRI Mysuru
director.cftri@csir.res.in
+91-821-2517760

## USP/Key Features

- Developed using nutrient-rich millet varieties with gluten-free properties
- Suitable for celiac, gluten-sensitive and health-conscious consumers
- Offers improved nutritional profile compared to conventional refined bread premixes

## Implementation Status

The technology has been licensed.

# A Process Know-how for 'Freshness Keeper Paper for Extension of Shelf Life of Cut Roses'

**TRL-9**

## Overview

Freshness keeper paper designed to extend the shelf life and maintain the quality of cut roses during storage and transportation. The paper incorporates suitable moisture-retention and preservative mechanisms that help reduce wilting, microbial spoilage and physiological deterioration. The technology is beneficial for floriculture industries, exporters and retail flower supply chains by improving freshness retention and marketability of cut flowers.

## Functionalities

- Extends shelf life and freshness of cut roses during storage and transport
- Reduces moisture loss, wilting and post-harvest deterioration
- Helps maintain visual quality and market value of flower

## Contact Details

Dr. Giridhar Parvatam
Director, CSIR-CFTRI Mysuru
director.cftri@csir.res.in
+91-821-2517760

## USP/Key Features

- Specialized preservation paper for floriculture applications
- Improves post-harvest handling efficiency and flower longevity
- Suitable for domestic marketing and export supply chains

## Implementation Status

The technology has been licensed.

# Carbonated Fruit Beverages from Select Fruits (Mango, Grapes, Lime Orange)

**TRL-9**

## Overview

Carbonated Fruit Beverages are refreshing ready-to-drink products developed using fruit juices or pulp from select fruits such as mango, grapes, lime and orange combined with carbonation technology. The beverages provide desirable flavour, aroma and sensory appeal while retaining fruit characteristics. The technology focuses on product stability, carbonation retention and shelf-life enhancement for commercial beverage applications.

## Functionalities

- Provides refreshing fruit-based ready-to-drink carbonated beverage
- Enhances flavour and sensory appeal through controlled carbonation
- Utilizes fruit pulp/juice for value-added beverage development

## Contact Details

Dr. Giridhar Parvatam
Director, CSIR-CFTRI Mysuru
director.cftri@csir.res.in
+91-821-2517760

## USP/Key Features

- Combines natural fruit flavour with refreshing carbonation
- Available in multiple fruit variants with attractive sensory quality
- Suitable for commercial beverage production and consumer convenience markets

## Implementation Status

The technology has been licensed.

# Low Glycemic Index Atta

**TRL-9**

## Overview

CSIR-CFTRI, Mysuru, in collaboration with BigBasket (BB), has developed a low Glycemic Index flour launched as "bb Royal Slow Sugar Release Atta." to provide a lower glycemic response compared to conventional wheat flour. The product is made from a blend of multiple grains and functional ingredients and has a clinically tested Glycemic Index of less than 45, helping manage blood sugar levels and improve metabolic health. The technology incorporates selected cereals, millets, pulses, and dietary fibre sources to support controlled glucose release and improved nutritional quality. It is designed for health conscious consumers, diabetic individuals, and people seeking healthier dietary alternatives.

## Functionalities

- Helps in slower glucose release and supports better glycemic management.
- Provides improved nutritional profile with dietary fibre and balanced ingredients.
- Suitable for preparation of chapati, roti, and other traditional food products.

## Contact Details

Dr. Giridhar Parvatam
Director, CSIR-CFTRI Mysuru
director.cftri@csir.res.in
+91-821-2517760

## USP/Key Features

- The innovation supports healthier dietary habits while retaining the familiarity of traditional Indian staples such as roti and chapati, making it suitable for everyday consumption.
- Combines nutritional benefits with consumer-acceptable taste and texture.
- Supports growing demand for diabetic-friendly and lifestyle-oriented food products.

## Implementation Status

- Developed using optimized blending of cereals, millets, pulses, and fibre-rich ingredients.
- Can be integrated into existing flour milling and food processing systems.
- Suitable for commercial production, retail distribution, and institutional nutrition programs.
- The product was commercialized and introduced into the market in association with BigBasket.

# Malted Ragi Based Ready to Eat Weaning Food

**TRL-9**

## Overview

Weaning Food is a nutrient-rich supplementary food developed using malted finger millet (ragi) and other suitable ingredients for infant and young child nutrition. Malting improves digestibility, nutrient bioavailability and sensory quality while reducing anti nutritional factors. The product is designed to provide balanced nutrition, easy preparation and convenient consumption for weaning age children.

## Functionalities

- Provides nutrient-rich supplementary food for infants and young children
- Enhances digestibility and nutrient availability through malting process
- Offers convenient ready-to-eat formulation for weaning applications

## Contact Details

Dr. Giridhar Parvatam
Director, CSIR-CFTRI Mysuru
director.cftri@csir.res.in
+91-821-2517760

## USP/Key Features

- Rich source of calcium, dietary fibre and essential nutrients
- Malted formulation improves digestibility and sensory acceptability
- Suitable for health-oriented infant nutrition and supplementary feeding programs

## Implementation Status

The technology has been licensed and commercialized.

# Marigold Oleoresin

**TRL-9**

## Overview

Marigold Oleoresin is a natural extract obtained from the petals of marigold flowers (Tagetes erecta), rich in lutein and xanthophyll carotenoids. The oleoresin is widely used as a natural colouring and antioxidant ingredient in food, feed, nutraceutical, cosmetic and pharmaceutical industries. It is primarily valued for its eye-health benefits and pigmentation properties in poultry and aquaculture feed applications. The product serves as a natural alternative to synthetic colourants and is gaining demand due to increasing consumer preference for clean-label and plant-derived ingredients.

## Functionalities

- Natural source of lutein and xanthophylls used as food and feed colourant
- Provides antioxidant and eye-health supporting properties in nutraceutical formulations
- Used for pigmentation enhancement in poultry, aquaculture and cosmetic applications.

## USP/Key Features

- Rich natural carotenoid extract with high lutein content
- Clean-label and plant-based alternative to synthetic colourants
- Wide industrial applicability in food, feed, nutraceutical and cosmetic sectors.

## Contact Details

Dr. Giridhar Parvatam
Director, CSIR-CFTRI Mysuru
director.cftri@csir.res.in
+91-821-2517760

## Implementation Status

The technology has been licensed.

# McDonald's Multi-Millet Bun

**TRL-9**

## Overview

McDonald's Multi-Millet Bun is a nutritionally enhanced bakery innovation developed by CSIR-CFTRI, using multiple millets to improve the dietary fibre, mineral, and nutrient content of conventional burger buns. The technology supports the incorporation of indigenous millets into popular fast-food products without compromising taste, texture, or consumer acceptability. It promotes healthier food choices among consumers while creating value addition opportunities for millet producers and the food processing sector. The innovation aligns with national initiatives promoting millet consumption and contributes to the development of sustainable, health-oriented convenience foods for large-scale commercial food service applications.

## Functionalities

- Enhances the nutritional profile of burger buns through incorporation of multiple millets rich in dietary fibre and minerals.
- Provides a healthier alternative to conventional refined flour-based fast-food bakery products.
- Suitable for large scale commercial production and food service applications while maintaining desirable taste and texture.

## USP/Key Features

- Incorporates multiple indigenous millets to develop a nutritionally enriched and consumer acceptable bakery product.
- Combines health benefits with the sensory qualities of conventional burger buns, ensuring wider consumer acceptance.
- Supports millet promotion initiatives and offers value addition opportunities for the food processing and bakery industry.

## Contact Details

Dr. Giridhar Parvatam
Director, CSIR-CFTRI Mysuru
director.cftri@csir.res.in
+91-821-2517760

## Implementation Status

Developed for commercial bakery production, the millet-based product integrates seamlessly into existing processing systems, supports large-scale manufacturing, and has been commercialized with McDonald's.

# Nutra Chikki with Added Spirulina

**TRL-9**

## Overview

Nutra Chikki with Added Spirulina is a nutrient-enriched traditional snack developed by incorporating spirulina into conventional chikki formulation. The product combines the nutritional benefits of nuts/jaggery with the protein, vitamins, minerals and antioxidant properties of spirulina. It serves as a convenient, energy-rich and health-oriented snack suitable for all age groups, especially for nutrition supplementation and wellness-focused consumers.

## Functionalities

- Provides protein-rich and energy-dense nutritious snack
- Enhances nutritional profile with spirulina-derived vitamins and minerals
- Offers convenient ready-to-eat functional food for health-conscious consumers

## USP/Key Features

- Combines traditional chikki with nutrient-rich spirulina supplementation
- Rich source of protein, antioxidants and micronutrients
- Healthy snack alternative with improved functional and nutritional benefits

## Contact Details

Dr. Giridhar Parvatam
Director, CSIR-CFTRI Mysuru
director.cftri@csir.res.in
+91-821-2517760

## Implementation Status

The technology has been licensed and commercialized.

# Paan Flavoured Water

**TRL-9**

## Overview

Paan Flavoured Water is a refreshing beverage developed using flavour compounds inspired by traditional Indian paan ingredients such as betel leaf, fennel, cardamom and other aromatic herbs/spices. The product delivers a unique sensory experience with refreshing taste and aroma while catering to consumer demand for innovative ethnic beverages. The technology focuses on flavour stability, product safety and shelf-life enhancement for commercial beverage applications.

## Functionalities

- Provides refreshing ready-to-drink beverage with traditional paan flavour profile
- Delivers unique aroma and sensory appeal using herbal and spice extracts
- Suitable for convenient consumption and specialty beverage markets

## Contact Details

Dr. Giridhar Parvatam
Director, CSIR-CFTRI Mysuru
director.cftri@csir.res.in
+91-821-2517760

## USP/Key Features

- Innovative beverage inspired by traditional Indian paan flavours
- Distinctive sensory profile with refreshing taste and aroma
- Suitable for ethnic, premium and novelty beverage segments

## Implementation Status

The technology has been licensed.

# Preparation of Shelf Stable Biryani Paste

**TRL-9**

## Overview

Shelf Stable Biryani Paste is a ready-to-cook culinary formulation developed using spices, herbs, condiments and suitable preservation techniques to retain flavour, aroma and quality during storage. The technology enables extended shelf life without significant deterioration in sensory characteristics, making it suitable for household, food service and institutional applications. The product offers convenience, consistency and reduced preparation time for preparing biryani and related rice dishes.

## Functionalities

- Provides ready-to-use standardized biryani base for quick preparation
- Retains flavour, aroma and quality during extended storage
- Reduces cooking time and improves convenience for consumers and food service sectors

## USP/Key Features

- Shelf stable formulation with preserved authentic taste and aroma
- Convenient ready to cook product with consistent quality
- Suitable for commercial, institutional and household applications

## Contact Details

Dr. Giridhar Parvatam
Director, CSIR-CFTRI Mysuru
director.cftri@csir.res.in
+91-821-2517760

## Implementation Status

The technology has been licensed and commercialized.

# Process for Preparation of Raw Banana Powder (Unripe)

**TRL-9**

## Overview

This technology relates to the preparation of powder from unripe/raw bananas through controlled processing techniques including peeling, slicing, drying and pulverizing. Raw banana powder is rich in resistant starch, dietary fibre and essential nutrients, making it suitable for functional food, bakery, weaning food and nutraceutical applications. The process ensures improved shelf life, product stability and retention of nutritional quality.

## Functionalities

- Produces nutrient-rich banana powder with high resistant starch content
- Serves as functional ingredient in bakery, health food and nutraceutical products
- Extends shelf life and enables value addition to raw bananas

## USP/Key Features

- Rich source of dietary fibre and resistant starch with health benefits
- Suitable for gluten-free and functional food applications
- Provides effective utilization and value addition to unripe bananas

## Contact Details

Dr. Giridhar Parvatam
Director, CSIR-CFTRI Mysuru
director.cftri@csir.res.in
+91-821-2517760

## Implementation Status

The technology has been licensed and commercialized.

# Process for the Production of Soluble and Insoluble Arabinoxylan from Wheat Bran

**TRL-9**

## Overview

It relates to the extraction and production of soluble and insoluble arabinoxylan fractions from wheat bran. Arabinoxylans are important non-starch polysaccharides known for their dietary fibre and prebiotic properties. The process enables value addition to wheat bran by converting it into functional ingredients suitable for food, nutraceutical and health-oriented applications. The extracted arabinoxylans can be incorporated into bakery, beverage and functional food formulations to improve nutritional and physiological benefits.

## Functionalities

- Produces soluble and insoluble dietary fibre fractions from wheat bran
- Provides prebiotic and functional health benefits in food applications
- Enables utilization of wheat bran for value-added nutraceutical ingredients

## USP/Key Features

- Rich source of functional dietary fibre with health-promoting properties
- Converts cereal by-products into high-value functional ingredients
- Suitable for incorporation into diverse functional food formulations

## Contact Details

Dr. Giridhar Parvatam
Director, CSIR-CFTRI Mysuru
director.cftri@csir.res.in
+91-821-2517760

## Implementation Status

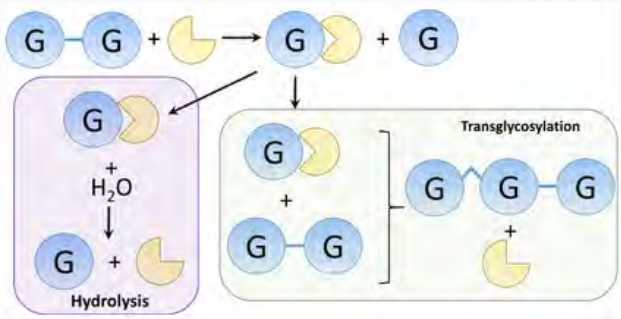
The technology has been licensed and commercialized.

# Process for the Production of Transglycosylating α- Glucosidase using Novel Fungal Strain

**TRL-9**

## Overview

Process for the production of transglycosylating α-glucosidase using novel fungal strain is an industrial biotechnology innovation developed for efficient enzyme production using a specialized fungal source. The enzyme has applications in the synthesis of functional oligosaccharides and value-added food ingredients with health benefits. The process is optimized for enhanced enzyme yield, stability, and industrial applicability. The technology supports food, nutraceutical, and bioprocess industries by enabling cost effective production of functional ingredients and promoting sustainable microbial fermentation-based manufacturing systems.



## Functionalities

- Produces transglycosylating α-glucosidase through optimized microbial fermentation.
- Enables synthesis of functional oligosaccharides and value-added food ingredients.
- Supports scalable industrial enzyme production with improved process efficiency.

## USP/Key Features

- Utilizes a novel fungal strain for enhanced enzyme productivity and functionality.
- Suitable for industrial applications in food, nutraceutical, and biotechnology sectors.
- Offers potential for cost-effective and sustainable enzyme manufacturing processes.

## Implementation Status

Developed using controlled microbial fermentation, the technology integrates with existing bioprocessing facilities and enables scalable commercial enzyme and functional ingredient production.

## Contact Details

Dr. Giridhar Parvatam
Director, CSIR-CFTRI Mysuru
director.cftri@csir.res.in
+91-821-2517760

# Process know-how for Probiotic Carrot Nectar

**TRL-9**

## Overview

Probiotic carrot nectar fortified with beneficial probiotic cultures to provide enhanced nutritional and functional health benefits. The product combines the natural nutrients, beta-carotene and antioxidant properties of carrot with probiotic microorganisms that support digestive wellness. The process focuses on maintaining probiotic viability, sensory quality and shelf stability for commercial beverage applications.

## Functionalities

- Provides probiotic beverage supporting digestive and gut health
- Delivers beta-carotene, antioxidants and nutrients from carrot
- Offers ready-to-drink functional health beverage with enhanced nutritional value

## Contact Details

Dr. Giridhar Parvatam
Director, CSIR-CFTRI Mysuru
director.cftri@csir.res.in
+91-821-2517760

## USP/Key Features

- Combines carrot nutrition with beneficial probiotic cultures
- Functional beverage with antioxidant and digestive wellness benefits
- Suitable for health-conscious and wellness-oriented consumers

## Implementation Status

The technology has been licensed and commercialized.

# Roasted and Flavoured Cashew Kernel

**TRL-9**

## Overview

Roasted and Flavoured Cashew Kernel is a value added ready-to-eat snack product developed through controlled roasting and seasoning of cashew kernels with selected flavouring agents and spices. The technology enhances sensory quality, shelf life and consumer acceptability while retaining the nutritional benefits of cashew nuts. The product caters to the growing demand for healthy, premium and convenient snack foods in domestic and international markets.

## Functionalities

- Provides ready-to-eat nutritious snack with enhanced flavour and texture
- Improves shelf life and sensory appeal through controlled roasting
- Enables development of multiple flavour variants for diverse consumer preferences

## USP/Key Features

- Premium quality snack with attractive taste and crisp texture
- Retains nutritional value of cashew kernels with value addition
- Suitable for retail, export and institutional snack markets

## Contact Details

Dr. Giridhar Parvatam
Director, CSIR-CFTRI Mysuru
director.cftri@csir.res.in
+91-821-2517760

## Implementation Status

The technology has been licensed and commercialized.

# The Protein Plus Slice

**TRL-9**

## Overview

Protein Plus Slice is a nutritionally enhanced bakery product developed by CSIR - CFTRI to provide higher protein content along with improved nutritional benefits compared to conventional bread products. The technology focuses on incorporating quality protein sources while maintaining desirable taste, texture, and shelf stability. It is suitable for health conscious consumers, children, fitness enthusiasts, and individuals requiring protein enriched diets. The innovation supports the growing demand for functional and convenient foods and offers commercial opportunities for the bakery and food processing industry.

## Functionalities

- Provides enhanced protein content for improved nutritional intake.
- Serves as a convenient and RTE functional bakery product.
- Maintains consumer acceptable taste, texture, and shelf stability.

## USP/Key Features

- Protein enriched formulation with improved nutritional value over regular bread slices.
- Suitable for health conscious consumers and special dietary requirements.
- Can be produced using existing bakery processing infrastructure with minimal modification.

## Contact Details

Dr. Giridhar Parvatam
Director, CSIR-CFTRI Mysuru
director.cftri@csir.res.in
+91-821-2517760

## Implementation Status

Developed using optimized protein-fortification technology, the product is compatible with commercial bakery production, scalable for mass manufacturing, and commercialized in association with McDonald's.

# Eco-Friendly Incense Sticks (Agarbatti) from Offered Flowers

**TRL-9**

## Overview

A sustainable circular economy-based technology developed by CSIR-Central Institute of Medicinal and Aromatic Plants for converting offered floral waste into eco-friendly incense sticks (agarbatti). The technology utilizes offered flowers such as marigold, rose, and jasmine blended with natural binders to produce low-smoke, non-toxic incense sticks and fragrant cones. The process supports Swachh Bharat and Skill India Mission, waste valorization, women-led enterprises, and rural livelihood generation while reducing the environmental pollution caused by improper disposal of floral waste especially in rivers and water bodies.

## Functionalities

- Converts offered and waste flowers into natural incense sticks through drying, pulverizing, blending, and rolling process.
- Produces low-smoke, chemical-free incense sticks suitable for religious and household applications
- Enables decentralized micro-enterprises and SHG-based production units with low investment requirements

## USP/Key Features

- Circular economy-based "Waste to Wealth" technology utilizing offered floral waste
- Low-cost, scalable technology suitable for SHGs, women entrepreneurs, and rural startups.
- Eco-friendly, natural, and non-toxic incense products with premium eco-spiritual market potential

## Implementation Status

Transferred to shrine boards, SHGs, and NGOs; deployed at 30+ major worship sites, creating livelihoods and promoting sustainable floral waste management.

## Contact Details

Dr. Prabodh Kumar Trivedi
Director, CSIR-CIMAP Lucknow
director.cimap@csir.res.in
+91-522-2718505

# Psoria-CIM – Essential Oil Based Non-Steroidal Herbal Cream for Psoriasis Management

**TRL-9**

## Overview

Psoria-CIM is a scientifically validated non-steroidal herbal cream developed by CSIR-Central Institute of Medicinal and Aromatic Plants for the management of psoriasis-like skin inflammation. The formulation contains a novel combination of phyto-molecules derived from aromatic plants and provides efficacy comparable to corticosteroid therapy without associated side effects. The technology offers a safe, plant-based therapeutic alternative for long-term psoriasis management and supports indigenous herbal healthcare innovation.

## Functionalities

- Provides topical management of psoriasis-like inflammatory skin conditions
- Reduces PASI scores and inflammatory cytokines including IL-17, IL-23, and TNF-α
- Offers non-steroidal long-term therapeutic support with improved safety profile

## USP/Key Features

- Essential oil-derived phytomolecule formulation with clinically validated anti-psoriatic efficacy
- Non-steroidal herbal cream avoiding corticosteroid-associated adverse effects
- Commercially validated indigenous herbal therapeutic technology from CSIR-CIMAP

## Contact Details

Dr. Prabodh Kumar Trivedi
Director, CSIR-CIMAP Lucknow
director.cimap@csir.res.in
+91-522-2718505

## Implementation Status

Commercialized as PSOROHEAL by a Lucknow-based startup; CSIR-CIMAP patented the formulation for herbal dermatological and phytopharmaceutical applications.

# Extreme Cold Weather Protection Gloves

**TRL-6**

## Overview

Extreme Cold Weather Protection Gloves have been developed for use under extreme low-temperature environments up to –50°C. The technology focuses on lightweight leather processing and specialized glove design interventions to provide superior thermal insulation, enhanced grip, and protection under extreme climatic conditions. The gloves are intended for use by defense personnel and civilians operating in high-altitude and cold-weather regions.

## Functionalities

- Provides hand protection under extreme cold weather conditions up to –50°C.
- Utilizes lightweight leather and technical textile materials for improved insulation and comfort.
- Suitable for defense personnel and users operating in high-altitude or severe cold environments.

## USP/Key Features

- Developed processing technology using lightweight leathers meeting all required performance specifications.
- Designed with higher leather content for enhanced cold insulation and improved grip performance.
- Performance comparable to global benchmark gloves at nearly one-third the cost of imported gloves

## Contact Details

Dr. Palanisamy Thanikaivelan
Director, CSIR-CLRI, Adyar, Chennai
director.clri@csir.res.in
+91 44 2491 0846 / +91 44 2443 7131

## Implementation Status

Technology has been licensed

# Regenerated Leather from Tannery Solid Waste

**TRL-6**

## Overview

Regenerated Leather (Geno-corium) technology utilizes tannery solid wastes such as chrome shavings, shaving dust, crust trimmings, and leather finishing wastes through thermo-chemical and enzymatic processing. The processed hydrolyzed waste is transformed into leather-like sheets using specialized formulations and calendaring techniques, creating a sustainable alternative material while addressing waste management challenges in the leather industry.

## Functionalities

- Converts tannery solid wastes such as chrome shavings, buffing dust, crust trimmings, and finished leather waste into regenerated leather through thermo-chemical and enzymatic processing.
- Hydrolyzed solid waste is blended with cross-linkers, acrylic syntan, dye, and synthetic fatliquor, followed by calendaring to produce leather-like sheets.
- Suitable for manufacturing leather products including shoes, lifestyle products, garments, and other value-added applications.

## USP/Key Features

- Provides a sustainable solution for utilization of tannery solid waste and discarded leather products.
- Enables waste valorization while generating economic returns and reducing environmental burden.
- Produces Geno-corium regenerated leather suitable for multiple applications and meets required physical property standards.

## Contact Details

Dr. Palanisamy Thanikaivelan
Director, CSIR-CLRI Chennai
director.clri@csir.res.in
+91 44 2491 0846 / +91 44 2443 7131

## Implementation Status

Commercialized and validated at commercial scale.

# Light Weight and Cold Resistant Leathers

**TRL-7**

## Overview

Light Weight and Cold Resistant Leather process technology has been developed to manufacture specialized leathers suitable for gloves and clothing to be used in extreme cold environments. Through optimized leather processing involving controlled selection of fatliquors, retanning agents, and tanning conditions, the technology produces lightweight leather with enhanced cold resistance properties. The developed leather is particularly suited for high-altitude and cold-weather applications for defense personnel and civilians.

## Functionalities

- Produces lightweight leather materials with enhanced resistance to low-temperature conditions.
- Suitable for manufacturing gloves and garments intended for defense personnel and cold-weather civilian applications.
- Can be implemented in existing glove and garment leather production facilities with minimal process modification.

## USP/Key Features

- Provides cold resistance up to -30C while maintaining lightweight characteristics (450±100 GSM).
- Process validated at CSIR-CLRI pilot tannery with demonstrated reproducibility and scalability.
- Developed leathers conform to physical and chemical standards prescribed for glove and garment leathers

## Implementation Status

Technology is ready for commercialization and has already been transferred to an industrial client manufacturing glove leather.

## Contact Details

Dr. Palanisamy Thanikaivelan
Director, CSIR-CLRI Chennai
director.clri@csir.res.in
+91 44 2491 0846 / +91 44 2443 7131

# Waterless Chrome Tanning Technology

**TRL-9**

## Overview

Waterless Chrome Tanning Technology (WCTT) is a patented CSIR-CLRI innovation that eliminates the water-intensive pickling and basification steps in chrome tanning. It reduces chromium, salt, and wastewater discharge while delivering leather quality equivalent to conventional processing. Already commercialized and licensed to more than 190 tanneries, the technology saves large volumes of water, lowers pollution, and supports sustainable, zero-capital adoption by the leather sector.

## Functionalities

- Eliminates water, pickling, and basification in chrome tanning, thereby reducing wastewater and chemical load.
- Produces leather with comparable shrinkage temperature and acceptable physical properties for industrial use.
- Enables tanneries to improve environmental compliance without new equipment or major process overhaul.

## USP/Key Features

- Zero-water chrome tanning with no new infrastructure or capital investment required for adoption.
- Significant environmental benefit through reduction of chromium, salt, and TDS in effluent.

## Contact Details

Dr. Palanisamy Thanikaivelan
Director, CSIR-CLRI Chennai
director.clri@csir.res.in
+91 44 2491 0846 / +91 44 2443 7131

## Implementation Status

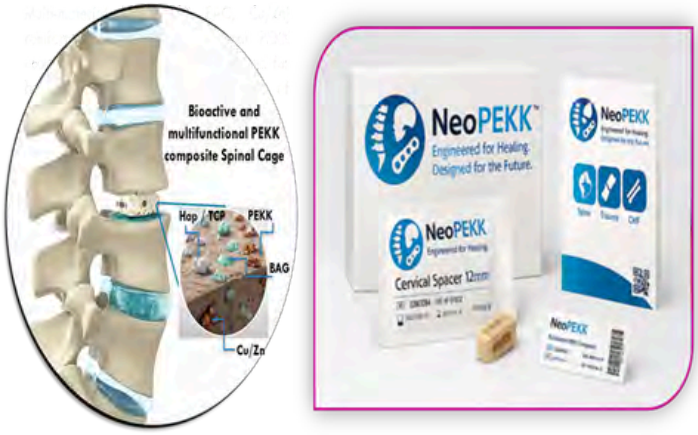
Commercially validated and already licensed/adopted by more than 190 tanneries, proving industry readiness.

# Bioactive, Radiolucent & Antibacterial PEKK Composite Implants for Advanced Spinal Reconstructions (NeoPEKK™)

**· TRL-6 ·**

## Overview

NeoPEKK™ is an indigenous next-generation bioactive, radiolucent, and antibacterial PEKK-based composite implant platform designed for spinal reconstruction, orthopedic, and dental applications. The technology integrates osteogenic bioactive fillers (HAp/TCP/bioactive glass) with antibacterial agents (ZnO/CuO) to accelerate bone regeneration, improve osteointegration, and reduce post-surgical infections. Unlike conventional PEEK implants, NeoPEKK™ offers multifunctionality, enhanced mechanical stability, and compatibility with machining and 3D printing. The innovation addresses the growing burden of spinal disorders by providing an affordable, high-performance alternative to imported implants, benefiting patients, surgeons, and the indigenous medical device sector.




## Functionalities

- Multifunctional PEKK-based implant platform with bioactive and antibacterial reinforcements for faster bone regeneration and infection control.
- Radiolucent, mechanically stable, and osteoconductive for spinal, orthopedic, and dental implant applications.
- Compatible with machining, molding, and 3D printing, enabling scalable indigenous manufacturing and customized implant production.

## USP/Key Features

- Combines bioactive and antibacterial functionality to promote bone regeneration, infection resistance, and mechanical stability in a single PEKK implant.
- Radiolucent and bone-compatible for improved imaging, reduced stress shielding, and enhanced osteointegration.
- Indigenous, cost-effective technology compatible with machining and 3D printing for scalable, customized implant manufacturing.

## Contact Details

Prof. Bikramjit Basu
Director, CSIR-CGCRI Kolkata
director.cgcri@csir.res.in
+91 33 2473 5829

## Implementation Status

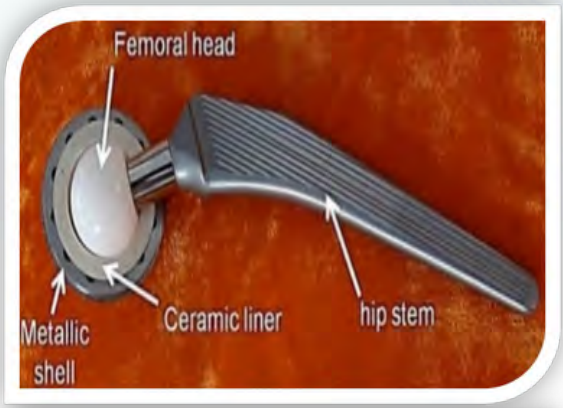
Developed for spinal reconstruction applications, with potential for wider adoption in advanced medical implants.

# Ceramic on Ceramic Articulating Components for Total Hip Replacement (THR)

**· TRL-6 ·**

## Overview

The technology involves the development of indigenous Zirconia Toughened Alumina (ZTA)-based ceramic-on-ceramic articulating components for Total Hip Replacement (THR), offering a high-performance and cost-effective alternative to imported implants. Building on CSIR-CGCRI's earlier commercially successful pure $Al_2O_3$ ceramic technology introduced around 2011, the present innovation delivers enhanced fracture toughness, wear resistance, and reliability comparable to global benchmarks. The technology supports affordable advanced joint replacement, strengthens India's self-reliance in medical devices, and is expected to benefit orthopedic patients through improved implant longevity and accessibility across healthcare centers.



## Functionalities

- Indigenous Zirconia Toughened Alumina (ZTA) ceramic components for total hip replacement with high hardness, wear resistance, and fracture toughness.
- Biocompatible and cost-effective alternative to imported ceramic hip implants, enabling affordable joint replacement.
- Enhanced mechanical reliability with reduced implant failure risk and improved long-term clinical performance.
- Supports large-scale indigenous manufacturing and strengthens self-reliance in advanced orthopedic implants.

## USP/Key Features

- Comparable performance with internationally benchmarked ceramic implant materials while being fully indigenous and cost-effective.
- Enhanced fracture toughness (up to 9.5 MPa.Öm) and wear resistance over earlier international benchmark technology, ensuring improved implant durability, reliability, and longer service life.
- Supports Atmanirbhar healthcare through indigenous manufacturing, reduced import dependence, and wider accessibility of advanced ceramic hip implants for Indian patients.

## Contact Details

Prof. Bikramjit Basu
Director, CSIR-CGCRI Kolkata, West Bengal
director.cgcri@csir.res.in
+91 33 2473 5829

## Implementation Status

Transferred to M/s G Surgiwear Ltd., Shahjahanpur, UP.

# Indigenous Specialty Fiber for High Power Amplifier and Laser

**TRL-7**

## Overview

CSIR-CGCRI has developed indigenous Erbium-Ytterbium co-doped double clad octagonal shaped fiber for high power optical amplifier and double clad Ytterbium doped fiber for high power laser application tailored to the end user's specification for strategic, industrial, telecommunication applications under the Make in India and National Mission initiative.

Octagonal shaped Yb fiber

## Functionalities

- Optimized rare-earth doped optical fibers delivering high-efficiency amplification with suppressed parasitic emissions.
- High-quality beam performance through uniform dopant distribution, ideal for industrial pulsed laser applications.
- Advanced wave guide design enabling higher laser efficiency, improved beam quality, and strategic high-power laser applications.

## USP/Key Features

- Excellent process repeatability with optimized host glass composition and waveguide
- High Output Power for Advanced Applications Reliability in Harsh Operating Conditions

## Implementation Status

Demonstrated for high-power laser and amplifier applications, with potential for wider deployment in strategic and industrial applications.

## Contact Details

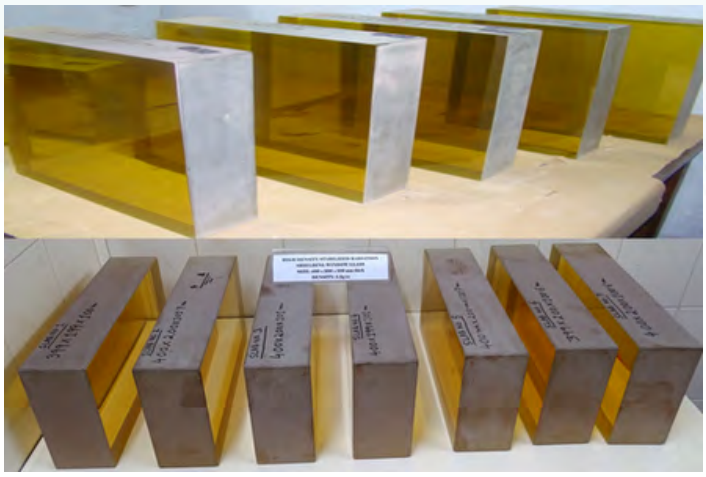
Prof. Bikramjit Basu
Director, CSIR-CGCRI Kolkata
director.cgcri@csir.res.in
+91 33 2473 5829

# Manufacturing Technology on High Density (D=5.2 g/cc) Radiation Shielding Window (RSW) Glass for Nuclear Hot Cell Application towards self-reliance in Nuclear Safety.

**TRL-7**

## Overview

The technology of high density Radiation Shielding Window (RSW) glass derived from $PbO-SiO_2-K_2O$ system with a high concentration of PbO around 71 wt% with 5.2 g/cc density have been successfully developed and indigenously established a pilot scale facility in CGCRI for producing homogeneous glass blocks (ceria stabilized and un-stabilized) up to 400 × 400 × 100 $mm^3$ of different sizes and supplied 26 MT to DAE. The technology on Specialty Glass development involves cullet making in 310 L refractory pot, final melting in 40 L Platinum pot, casting through bottom pouring technique (Cast block size is 425x425x130 $mm^3$).



## Functionalities

- High density RSW glass acts as a visual window which allow direct viewing access to the workers for a watch inside Hot cell (Nuclear power plant). This glass provides protection to the living beings against exposure of high energy ionizing harmful radiations, thus, ensuring safety from radiation to operating personnel.
- Stringent quality assurance measures are required to make this strategic material. CSIR-CGCRI has developed both unstabilized and stabilized RSW glasses (by adding $CeO_2$) of different sizes ( 400x400x100 in mm).

## USP/Key Features

- Indigenous high-density (5.2 g/cc) radiation shielding glass developed for nuclear hot cell and radiation protection applications.
- Pilot-scale manufacturing capability for producing large, homogeneous ceria-stabilized and unstabilized shielding glass blocks.
- Optimized specialty glass processing technology using platinum-pot melting and bottom-pouring casting for high-quality production.
- Strengthens self-reliance in nuclear safety, with successful supply of radiation shielding glass to the Department of Atomic Energy (DAE).

## Contact Details

Prof. Bikramjit Basu
Director, CSIR-CGCRI Kolkata
director.cgcri@csir.res.in
+91 33 2473 5829

## Implementation Status

The technology has been demonstrated and have the potential for wider deployment.

# Calcium Phosphate (CaP) and Non-CaP Scaffolds/ Granules for Dental and Orthopaedic Applications

**TRL-9**

## Overview

This technology on calcium phosphate (CaP) and non-calcium phosphate (non-CaP) porous scaffolds and granules, include pure hydroxyapatite (HAp), biphasic (BCP, Hap+bTCP) and stronitum titanate/strontium niobate (with our without Hap) variants. These high-purity, porous granules offer excellent biocompatibility, osteoconductivity, and tissue bonding, enabling effective filling and regeneration of bone and dental defects. The technology uses simple wet-chemical or dry route to produce customizable sizes and shapes with high crystallinity, comparable mechanical properties supporting commercial biomedical products for bone regeneration.

## Functionalities

- Indigenous high-purity bone graft granules for dental and orthopaedic applications with controlled porosity for enhanced bone regeneration.
- Highly biocompatible and osteoconductive substitute promoting effective tissue bonding and accelerated healing.
- Cost-effective, customizable technology supporting affordable advanced bone repair treatments.
- Scalable indigenous manufacturing process ensuring consistent quality and widespread clinical adoption.

## USP/Key Features

- Biocompatible Excellence for Swasth Bharat: Superior osteoconductive granules mimicking human bone with controlled degradation and rapid vascularization for optimal healing.
- Indigenous Alternative via Make in India: Affordable, premium-quality domestic solution reducing dependency on expensive imported bone grafts for dental and orthopedic applications.
- Scalable & Market-Ready for Atmanirbhar Bharat: Standardized, easily transferable technology empowering local manufacturers to mass-produce world-class biomaterials independently.

## Contact Details

Prof. Bikramjit Basu
Director, CSIR-CGCRI Kolkata
director.cgcri@csir.res.in
+91 33 2473 5829

## Implementation Status

CaP scaffold technology transferred to IFGL Bioceramics (commercialized) and GESCO; strong demand from orthopedic and dental sectors.

# Indigenous Fiber Laser Technologies

**TRL-9**

## Overview

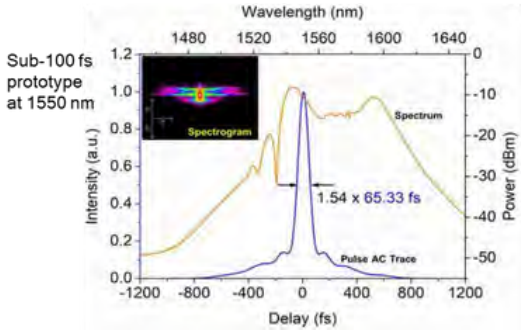
CSIR-CGCRI has developed indigenous high-power fiber laser systems in CW and Pulsed mode tailored to the end user's specification, and ultrafast photonic platforms for strategic, industrial, biomedical, and sensing applications under the Make in India and National Mission initiative.

## Functionalities

- Indigenous kW class Yb fiber laser for strategic and industrial manufacturing
- Ultrafast laser for THz generation, spectroscopy and precision manufacturing
- Broad band Super continuum source for imaging
- Stable narrow line width fiber amplifier for interferometric based precision measurement

## Contact Details

Prof. Bikramjit Basu
Director, CSIR-CGCRI Kolkata
director.cgcri@csir.res.in
+91 33 2473 5829




## USP/Key Features

- High wall plug efficiency with excellent heat dissipation leading to high average power scaling capability specifically for the strategic sector.
- Optical fiber waveguide based laser architecture delivering inherently good beam quality.
- Low SWaP (Size, weight and power) and robust module design for application specific customization and field deployment.
- Inherent fiber based delivery enabling applications tight spaces such as minimally invasive surgeries.

## Implementation Status

Indigenous laser subsystems - demonstrated and deployed.

# 1.5 TPD Pressurized Fluidized Bed Gasification (PFBG) Technology

**· TRL-6 ·**

## Overview

This indigenously developed technology is suitable for gasifying low-grade, high-ash Indian coals, biomass, and washery middling into high-quality syngas. Operating under non-slagging conditions, it directly bypasses the severe clinkering, oxygen consumption, and operational penalties typical of imported entrained-flow systems. As a part of the National Coal Gasification Mission, 1.5 TPD pilot-scale facility provides valuable inputs to select suitable gasification technology to convert Indian coal/lignite/biomass into high-value chemical feed stocks, methanol, DRI, and hydrogen, etc.

## Functionalities

- Multi-Fuel Pressurized Gasification: Operates in pressurized oxy-steam fluidization modes at up to 10 kg/cm² pressure to generate steady chemical-grade syngas.
- High-Ash Continuous Extraction: This technology can be used for gasification for high ash indigenous coal (high ash low grade feed stocks)
- Variable Feeding Control: Executes dynamic, high-pressure volumetric dosing of sub-bituminous coal, lignite, and biomass individually or in blends.

## USP/Key Features

- Accepts a wide range of Feed stocks: Can be utilized for gasification of feed stocks with varying physico-chemical characteristics.
- High-Ash Tolerance: Safely processes low-grade high ash feed-stocks, eliminating the high costs and capital required for extensive coal washing.
- Sub-Melting Thermal Efficiency: Operates efficiently below the ash fusion temperature (900 to 1050 °C), which cuts oxygen demand and eliminates molten slag.
- Rich Syngas Generation: Generates rich syngas ideal for downstream methanol and ammonia synthesis with carbon conversion efficiency up to 94% without tar, liquid bi-products.

## Contact Details

Prof. (Dr.) Arvind Kumar Mishra
Director, CSIR-CIMFR Dhanbad
director.cimfr@csir.res.in
+91-326-2296023

## Implementation Status

PFBG (TRL-6) is being utilized for (a) Evaluation of the gasification performance of high-ash coals, lignite, and North-Eastern coal resources. (b) Generation of crucial engineering and design data required for scaling up and modeling and simulation purposes

# Shale Gas Potentiality Evaluation of Damodar Basin of India

**· TRL-6 ·**

## Overview

CSIR-CIMFR, Dhanbad, in collaboration with CSIR-NGRI, Hyderabad, and CMPDI, Ranchi, discovered shale gas in the Rangamati Block of the Raniganj Coalfield and the Radhanagar Block of the Jharia Coalfield under a Ministry of Coal-funded project. Extensive 2D/3D seismic surveys, reservoir modelling, and drilling of 10 boreholes confirmed shale gas reserves of approximately 1.26 BCM and 0.42 BCM, respectively. Recovery modelling projects about 40% gas extraction over 20 years using hydraulic fracturing and secondary gas injection. The findings have strengthened commercial shale gas exploration, with Essar Oil and Gas already initiating drilling activities in the Raniganj Coalfield.

## Functionalities

- Integrates geophysical, geological, geochemical, and reservoir engineering for comprehensive shale gas evaluation.
- Uses seismic surveys, reservoir modelling, and borehole validation to identify and assess gas resources.
- Applies reservoir simulation to optimize production and recovery strategies.
- Supports commercial shale gas development and strengthens India's indigenous energy security.

## USP/Key Features

- The outcomes of the project are highly beneficial for CBM and shale gas operators working in the Damodar Valley region.
- The successful drilling activities undertaken by Essar Oil and Gas Exploration and Production Limited (EOGEPL) in the eastern part of the Raniganj Coalfield further demonstrate the practical applicability and industrial relevance of the developed exploration and reservoir evaluation methodology.

## Implementation Status

Demonstrated applicability in shale gas exploration and resource evaluation.

## Contact Details

Prof. (Dr.) Arvind Kumar Mishra
Director, CSIR-CIMFR Dhanbad
director.cimfr@csir.res.in
+91-326-2296023

# Biometric-Based Exploder

**· TRL-8 ·**

## Overview

A biometric-based exploder has been developed to avoid its misuse and safe blasting. It can only be operated by those peoples who are biometrically registered with the specific device. The device comprises of an embedded microcontroller, converter circuit, rectification circuit, safe discharge circuit, and authentication circuit and display unit. The fingerprint scanner with the help of embedded microcontroller registers authorized personnel using their finger print up to 100 numbers. Once registered, no other person can use these devices. Two types of exploders have been developed, one for underground mines and another for opencast mines.

## Functionalities

- The device provides constant current source across its output probes, and the device output is ≤1.2 A for ≤ 4 ms across any load varying between 4 and 150 Ω, and internally locks itself if the load increases or decreases.
- The device is able to fire 25 shots in series and it is ingress protected.
- The biometric exploder is equipped with dual push button switch for firing, and the device is intrinsically safe for underground mine use.

## USP/Key Features

- The developed device is technically superior then the existing key-based exploder with more safety features.
- Implementation of biometric-based exploder helps in controlling misuse of exploder by the unauthorized person and saving of human life.
- Application of biometric-based exploder eliminates chance of misfire, and blasting operation in mines is safe and chance of stealing of exploder is less.

## Contact Details

Prof. (Dr.) Arvind Kumar Mishra
Director, CSIR-CIMFR Dhanbad
director.cimfr@csir.res.in
+91-326-2296023

## Implementation Status

The developed technology has been transferred to a firm for commercialisation. Field trial of the device has been carried out in an underground mine.

# Paste Backfill Technology for Stabilization of Critical Infrastructure Over Mined/ Underground Voids

**TRL-8**

## Overview

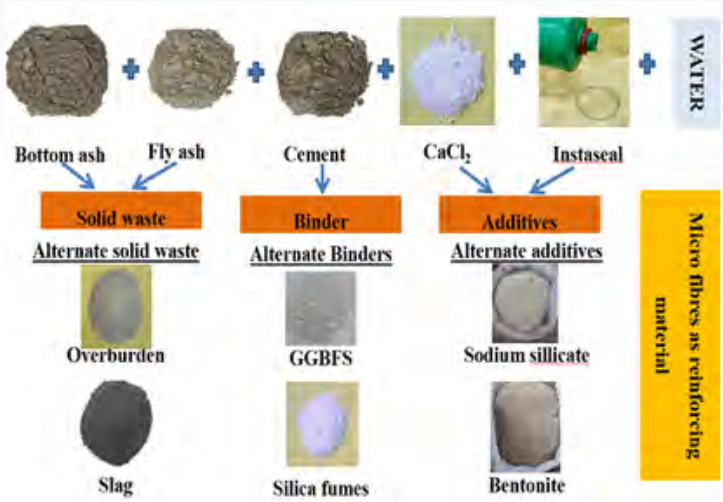
CSIR-CIMFR has developed India's first indigenous pilot-scale paste backfilling technology (10 m³/hr) to address critical challenges in underground coal mining, including ground subsidence, mine fires, and coal losses due to inadequate backfilling. Commissioned at Digwadih Colliery of Tata Steel, the technology enables scientific filling of inaccessible underground mine voids beneath critical infrastructure such as railway tracks. By stabilizing abandoned mine galleries and reducing geotechnical risks, it enhances public safety, prevents damage to life and property, facilitates extraction of coal locked in pillars, and promotes safer, sustainable underground mining practices.

## Functionalities

- Developed a low-cost, dismantlable, and mobile paste backfill plant for filling underground voids beneath railways, roads, and critical infrastructure.
- Utilizes industrial wastes such as fly ash, bottom ash, and mine waste with suitable binders to produce paste backfill.
- Improves underground coal recovery, minimizes ground subsidence and mine fires, stabilizes abandoned mine workings, and provides a sustainable solution for challenging geo-mining conditions.

## Contact Details

Prof. (Dr.) Arvind Kumar Mishra
Director, CSIR-CIMFR Dhanbad
director.cimfr@csir.res.in
+91-326-2296023




## USP/Key Features

- Paste recipe optimization using industrial waste, binder and additives
- Indigeneous fabricated, installed and commissioned low operation and capital cost plant to serve area requiring immediate stabilization
- Reusability of the plant at different site

## Implementation Status

Deployed at various sites.

# Controlled Blasting Technology Developed for Safe Extraction of Minerals from Mines and Construction of Various Civil Infrastructure Projects

**TRL-9**

## Overview

Controlled blasting technologies developed by the institute have significantly advanced mining and infrastructure excavation across India. Pre-split blasting has enhanced mineral recovery while ensuring stable pit walls at major mines operated by Hindustan Zinc, Tata Steel, Uranium Corporation of India, Sasan Power, and Cupram Bagrodia. In infrastructure, these technologies have enabled hill flattening for the Navi Mumbai International Airport, stabilization of slopes for the Konkan Railway, strategic border road construction by BRO, metro and tunnel projects, eco-sensitive road development in the Northeast, railway bridge foundation blasting, and rock excavation for railway line expansion.

## Functionalities

- Developed controlled blasting technologies for safe, efficient mining and infrastructure excavation.
- Implemented pre-split blasting at major mines of Hindustan Zinc, Tata Steel, UCIL, Sasan Power, and others.
- Enabled Navi Mumbai International Airport hill flattening and Konkan Railway slope stabilization.
- Supported BRO border roads, metro and tunnel construction, Northeast hill roads, railway bridge foundations, and railway line expansion through safe rock excavation.

## USP/Key Features

- The controlled blasting techniques have significantly enhanced the safety, production and long-term stability of mines.
- The technique is capable for conducting safe rock excavation in densely populated areas/cities.
- Huge market potential in generating the external cash flow of the institute.

## Implementation Status

Implemented at various sites

## Contact Details

Prof. (Dr.) Arvind Kumar Mishra
Director, CSIR-CIMFR Dhanbad
director.cimfr@csir.res.in
+91-326-2296023

# Development of Dust Suppression Chemical Useful for Mining and Allied Industries

**TRL-9**

## Overview

CSIR-CIMFR has developed a safe, cost-effective, and environmentally friendly dust suppression chemical to control airborne dust generated from unpaved haul roads in open-pit mines. With nearly 96% of India's coal production coming from opencast mines, vehicle movement on haul roads is a major source of dust, affecting worker health, mine productivity, and the surrounding environment. The developed technology effectively suppresses dust emissions, improves air quality and visibility, enhances operational efficiency and safety, and supports sustainable mining practices while minimizing environmental impacts.

## Functionalities

- This dust suppression chemical is a biodegradable and eco-friendly formulation used primarily for unpaved haul roads, mining zones, stockpiles, blasting areas, and other dust-prone industrial environments.
- Application of this chemical with water significantly reduce visibility, respiratory diseases such as pneumoconiosis and silicosis, accelerated equipment wear, and ecological degradation.

## USP/Key Features

- Overcomes limitations of water/chemical dust suppression, including rapid evaporation, high water use, mud formation and poor fine-dust control.
- Biodegradable formulation enables deeper roadbed penetration and effective dust binding without brittle surface formation.
- Improves moisture retention and dust stabilization, reducing fugitive emissions while supporting eco-friendly, sustainable mining.

## Implementation Status

Licensed and deployed

## Contact Details

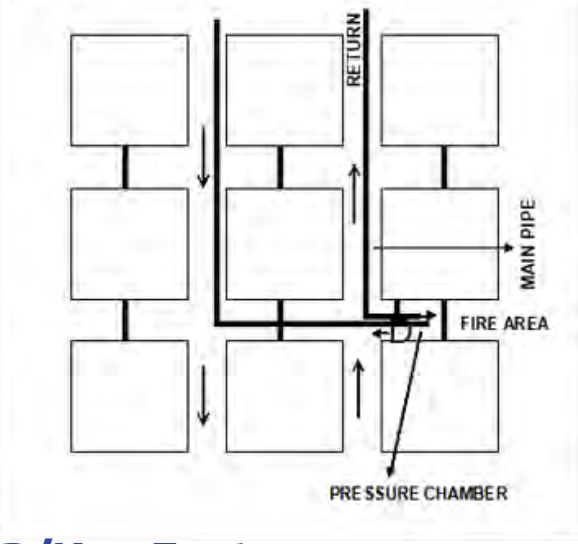
Prof. (Dr.) Arvind Kumar Mishra
Director, CSIR-CIMFR Dhanbad
director.cimfr@csir.res.in
+91-326-2296023

# Dynamic Balancing of Pressure Technique for Control of Concealed Fire in Underground Coal Mines

**TRL-9**

## Overview

Fires that occur in old workings or goaf, called concealed fires, are generally isolated by erection of fire stoppings or repair of old stoppings. To deal with these fires one of the important approaches is to maintain pressure difference across the stoppings as small as possible which ultimately led to cutting off supply of oxygen to the fire area. This can be achieved through dynamic balancing of pressure technique.




## Functionalities

- Developed a dynamic pressure balancing technique to control underground mine fires by balancing air pressure across fire isolation stoppings.
- Uses ventilation airflow, specially designed pressure chambers, connecting pipes, and air sampling systems to regulate pressure differentials without external energy.
- Enhances fire isolation, minimizes oxygen ingress, improves mine safety, and supports effective fire control in underground coal mines.

## USP/Key Features

- Monitors pressure differential across fire stoppings continuously to assess variations.
- Optimizes mine ventilation by adjusting airflow in relevant circuits to minimize pressure differences without affecting working districts.
- Neutralizes residual and atmospheric pressure fluctuations using specially designed pressure chambers and connecting pipes, ensuring effective fire isolation, preventing oxygen ingress, and improving underground mine safety.

## Contact Details

Prof. (Dr.) Arvind Kumar Mishra
Director, CSIR-CIMFR Dhanbad
director.cimfr@csir.res.in
+91-326-2296023

## Implementation Status

This technique has been successful to control fire in more than 35 Indian mines including Madhujore Colliery, ECL, Jhanjra 1 and 2 incline, ECL, Ningha Colliery, ECL, NCPH Colliery, SECL, Sijua Colliery, Tata Steel etc.

# Improved Soft Coke Making Technology

**TRL-9**

## Overview

The ovens, made of standard refractory bricks, are arch shaped having single door which can be removed during discharge. Coal is charged in the previously heated oven, and the door is placed and sealed with mud. The volatiles coming out of the coal are burnt and the heat generated during combustion of the volatiles help to maintain the temperature of the oven. The flue gas generated is typically channelized into the sole of the oven with the hindrance created special design sole resulting in higher sole temperature which helps to burn out the unburnt components of the gas before exit through the chimney. Circulation of gases generated during low/medium temperature carbonization of coal gives the following benefits- Higher temperature of sole which reduce the coking time and thus increase the productivity With the help of secondary air, the un-burnt hydrocarbons burn out in the oven sole which produce additional head as well as reduce pollution.

## Functionalities

- Production of soft coke for domestic/industrial application.
- One battery of oven can produce about 42000 tons of soft coke per annuam.
- The achieves benefits of Higher temperature of sole which reduces the coking time and thus increase productivity.

## USP/Key Features

- Technology for use of wide variety of non-coking bituminous coal.
- Optimized use of indigenously available carbon resources as blend for soft coke making.
- The technology allows the tarry matters coming out during carbonization, to be completely burnt and thus reduces pollution.

## Contact Details

Prof. (Dr.) Arvind Kumar Mishra
Director, CSIR-CIMFR Dhanbad
director.cimfr@csir.res.in
+91-326-2296023

## Implementation Status

Deployed at 23 industrial sites

# Mine Transport Surveillance System (MTSS)

**TRL-9**

## Overview

Mine transport surveillance system (MTSS) has been developed for controlling unauthorized transportation of mineral from mines, accurate and fool-proof weighing by proper positioning of trucks and controlling overloading, on-line monitoring and surveillance of mining activities as well as improving safety, production and productivity of opencast mines. The system has 8 integrated modules for different purposes: weighbridge automation system, in-motion weighbridge, GPS-RFID based tracking, mine surveillance, wireless networking, CCTV surveillance, proximity warning device for heavy earth moving machinery, and centralized monitoring and surveillance. The system is useful for fast, accurate and automated weighing with the help of integrated weighbridge automation system.

## Functionalities

- Automated control of mineral weighing, overloading, vehicle entry and exit, and mineral dispatch.
- Dumper tracking, real-time transport visualization, and optimized shovel-dumper deployment.
- Integrated weighbridge automation, in-motion weighing, vehicle tracking, CCTV surveillance for controlling unauthorized transportation of mineral from mines, on-line monitoring of production and dispatch of mineral from mines, accurate and fast weighment, etc.

## USP/Key Features

- It enables real-time surveillance and monitoring of mine transportation, and enhances operational efficiency and fleet utilization.
- It reduces transportation-related accidents and improved traffic management.
- It controls illegal mineral transportation and enhances royalty to the government.

## Implementation Status

The technology has been successfully deployed since 2018 at NMDC's Kumaraswamy Iron Ore Mine, Donimalai Iron Ore Mine, and Pellet Plant, with field trials conducted at Tirap Opencast Coal Mine of Coal India. Commercialized through technology transfer, it has also been implemented across 108 weighbridges of Eastern Coalfields and mining areas of Bharat Coking Coal and Central Coalfields.

## Contact Details

Prof. (Dr.) Arvind Kumar Mishra
Director, CSIR-CIMFR Dhanbad
director.cimfr@csir.res.in
+91-326-2296023

# Technology for Non-Recovery Type Coke Oven, Drag Type coke oven with Stamp Charging and Coke Quenching

**TRL-9**

## Overview

CSIR-CIMFR has developed non-recovery (heat-recovery) coke oven technology for efficient production of high-quality metallurgical coke used in blast furnace steelmaking. Unlike conventional by-product coke ovens, the technology burns volatile gases generated during carbonization within the oven itself, eliminating the need for chemical by-product recovery while supplying the heat required for coking. When integrated with Waste Heat Recovery Boilers (WHRB), the system captures surplus thermal energy for power generation, improving overall energy efficiency. The technology offers a cleaner, energy-efficient, and economically viable solution for sustainable coke production in the steel industry.

## Functionalities

- Production of metallurgical coke from coking coal.
- Production of power through WHRB from waste flue gas.
- One battery of ovens for may produce about 75000 Tons of coke per annum

## USP/Key Features

- Technology for use of wide variety of non-metallurgical coals like non-coking bituminous coal, LVMC and heat affected coal in association with low ash, high fluid coking coals.
- Optimized use of indigenously available carbon resources as blend for coke making.
- Reduces dependence on imported prime coking coal for metallurgical coke making.

## Contact Details

Prof. (Dr.) Arvind Kumar Mishra
Director, CSIR-CIMFR Dhanbad
director.cimfr@csir.res.in
+91-326-2296023

## Implementation Status

Deployed at 8 sites.

# Virtual Fencing System (VFS)

**TRL-9**

## Overview

A virtual fencing system (VFS) using a license-free radar, CCTV and wireless network for detecting any intruder along the boundary line or unauthorized routes. The radar sensor transmits the measurement data using a wireless network to the control room. Any intruder is detected if found crossing the 300 m detection zone of radar which is along the straight path of a boundary line. The video image is integrated with the system and displayed on a single screen along with the graphical location of intrusion. The audio-visual warning is integrated with the system at radar point and in the control room.

## Functionalities

- The system integrates RADAR, CCTV and wireless network, which are installed along the boundary or unauthorized path.
- The system detects location of intruders using radar and simultaneously displays objects in the control room through CCTV footage, and the system gives audio visual warning at the respective field radar point and in the control room.
- CCTV output is integrated with vision enhancement software for improving visibility range and quality of video footage in real-time.

## USP/Key Features

- Detects moving objects in the periphery for intruder detection at remote locations by monitoring distance, direction, angle, velocity, and image of object.
- Gives audio visual warning at the respective field radar point and in the control room, and it stores the object detection information in the form of logs for future uses.
- Proper detection in advance allows the security personnel to take immediate action and stop intrusion by sending a patrolling team from a central command-control centre.

## Implementation Status

Deployed at NMDC, Coal India, and BCCL mines; demonstrated for Tata Steel and Indo-Bangladesh border surveillance applications.

## Contact Details

Prof. (Dr.) Arvind Kumar Mishra
Director, CSIR-CIMFR Dhanbad
director.cimfr@csir.res.in
+91-326-2296023

# Vision Enhancement System (VES) for Foggy Weather

**TRL-9**

## Overview

The vision enhancement system (VES) for foggy weather has been developed to continue opencast mining operation during foggy weather, collision avoidance, fleet management, production monitoring, etc.The vision enhancement system comprises of front, right, and back infrared (IR) cameras, proximity warning device, vehicle-to-everything (V2X) devices, high precision global navigation satellite system (GNSS), rugged high-performance computer, wireless access point, and a rugged touch screen. The system not only helps the operators to see through fog but also alerts the operators if any vehicle is nearby and mitigates the accidental risks caused by vehicle collision during adverse weather conditions.

## Functionalities

- Enables safe opencast mining during fog through 3D navigation, GNSS, and augmented reality.
- Provides collision avoidance and route deviation alerts using multi-stage sensor-based safety systems.
- Supports fleet management, equipment diagnostics, transport surveillance, and production monitoring.
- Enhances operator safety and mining efficiency with real-time visualization and automated reporting.

## Contact Details

Prof. (Dr.) Arvind Kumar Mishra
Director, CSIR-CIMFR Dhanbad
director.cimfr@csir.res.in
+91-326-2296023

## USP/Key Features

- Integrates IR cameras, radar, GNSS, V2X communication, artificial intelligence, image processing, and augmented reality.
- Enables operators to see through fog, avoid collisions, and maintain optimal fleet movement and management.
- Multi-stage intelligent safety alerts for route deviation, obstacles, and approaching hazards.

## Implementation Status

Field trial of the system has been carried out at Bacheli Complex of Bailadila Iron Ore Mines of NMDC Limited in Dantewada district of Chhattisgarh state and other foggy locations in India. Under evaluation by Boarder Security Force for border management. Interest shown by Tata Steel, National Aluminum Company (NALCO), etc.

# Compact Electric Tractor-CSIR PRIMA ET-11

**· TRL-6 ·**

## Overview

CSIR-CMERI Durgapur has developed a compact electric tractor tailored specifically for small and marginal farmers in India. Designed for precision and efficiency, this e-tractor stands out for its compact size, making it ideal for navigating the tight and uneven terrains typical of small farmland holdings. Its electric power train ensures lower operational costs and significant fuel savings, offering an economically viable solution for farmers with limited resources.

The adoption of this e-tractor marks a major stride towards sustainable agriculture. With zero tailpipe emissions and minimal noise pollution, it contributes to improved air quality and reduced environmental impact. The tractor also promotes soil health by eliminating the heavy vibrations and emissions of traditional diesel tractors.

## Functionalities

- Industrial logistics and material handling for campuses, agro-processing units, industrial estates, and power plants.
- Smart agriculture and rural mobility supporting precision farming, small farmers, and women-friendly operations.
- Eco-friendly transportation for green industrial zones, municipal services, and educational demonstrations.

## Contact Details

Dr. Naresh Chandra Murmu
Director, CSIR-CMERI Durgapur
ps2dir.cmeri@csir.res.in
+91-343-2546749, +91-343-9434022951

## USP/Key Features

- Compact design enables smooth, easy operation with minimal mechanical losses
- Modular Main Frame Design First-of-its-kind modular frame structure in a compact electric tractor.
- Optimized Weight Distribution (54:46 Front: Rear) scientifically balanced component placement for ideal front-to-rear weight ratio.
- Energy-Efficient and Eco-Friendly Operation Battery-powered drive train with zero tailpipe emissions and low noise.
- Highly user-friendly, especially women-friendly

## Implementation Status

The electric tractor market is projected to grow from USD 0.7 billion in 2024 to USD 3.4 billion by 2030, reflecting a CAGR of 28.3%.

# Integrated Municipal Solid Waste Disposal System (i-MSWDS) for Bulk Waste Generators

**· TRL-6 ·**

## Overview

The Integrated Municipal Solid Waste Disposal System (i-MSWDS) developed by CSIR-CMERI is a decentralized, modular, and customizable solution for on-site management of municipal solid waste generated by residential complexes, institutions, markets, and urban local bodies. The plug-and-play system integrates mechanized waste segregation with downstream processing to separate biodegradable, recyclable, inert, and sanitary waste, enabling efficient composting, recycling, and safe disposal. It minimizes waste transportation, reduces environmental impact, supports resource recovery, and complies with the Solid Waste Management Rules, 2016, offering a scalable and sustainable solution for decentralized waste management.

## Functionalities

- Mechanized waste segregation for efficient sorting of municipal solid waste.
- Resource recovery technologies including biogas, composting/vermicomposting, and briquetting of biodegradable waste.
- Plastic waste valorization through pyrolysis, agglomeration, reprocessing, and plasma gasification.
- Construction and demolition waste utilization for sustainable waste management and circular economy.

## Contact Details

Dr. Naresh Chandra Murmu
Director, CSIR-CMERI Durgapur
ps2dir.cmeri@csir.res.in
+91-343-2546749, +91-343-9434022951

## USP/Key Features

- Decentralized, on-site municipal solid waste management promoting circular economy through resource recovery.
- Mechanized waste segregation into biodegradable, recyclable, inert, and metallic fractions for efficient processing.
- Integrated waste-to-value technologies including biogas, pyrolysis, plasma gasification, briquetting, and construction waste recycling.
- Reduces landfill dependence and waste transportation, minimizing pollution and supporting sustainable urban waste management.

## Implementation Status

Units have been deployed in five states

# Vehicle Mounted Mechanized Drain Cleaning System

**TRL-6**

## Overview

Vehicle-mounted mechanized drain cleaning machine an indigenous, integral, and self-powered, developed with a noble intention to eradicate the manual scavenging process and also to provide one-point solution for sewer-related problems like, sewer chocking, overflowing manholes, damaged sewer pipelines etc. The machine is equipped with many cutting-edge technologies and innovative ideas that makes this machine to stand apart from the other similar equipment's available in the market that includes: innovative mechanical slurry water filtration system, re-using of filtered slurry water for jetting process, three way split type gearbox unit to utilize the engine power for the system's operation. An automated hose reel guiding and disinfectant facility, inbuilt feedback system and underwater camera based post drain cleaning inspection system etc. makes the machine most effective and user friendly in negotiating many drain cleaning related challenges with ease and comfort. All the above sub systems are mounted in the BS-VI chassis very compactly and its gets operated pneumatically to make the operations easy and safe.

## Functionalities

- Machine is equipped with five modules to clean the sewer system effectively.
- Key Modules: Suction, Jetting, Grabbing and Filtration.
- Post-Cleaning Inspection System.

## USP/Key Features

- Utilization of Recycled Slurry Water for Jetting Operation.
- Continuous Process leveraging the recycled water for sustainable operation.
- Automated Hose Reel Guiding Mechanism integrated with a Disinfectant Unit for hygienic functioning.
- In-house Developed and Fully Indigenous Machine, tailored to Indian municipal needs.
- Operator Feedback System built-in to ensure:
- Ease of operation.
- Safe working environment.

## Contact Details

Dr. Naresh Chandra Murmu
Director, CSIR-CMERI Durgapur
ps2dir.cmeri@csir.res.in
+91-343-2546749, +91-343-9434022951

## Implementation Status

Four numbers of units have been deployed at Vapi Municipality

# A Process of Producing Bio-Bitumen from Pyrolysis of Lignocellulosic Biomass

**TRL-8**

## Overview

Bio-bitumen developed jointly by CSIR-CRRI and CSIR-IIP through pyrolysis of agricultural biomass such as rice straw provides a sustainable alternative to conventional petroleum-based bitumen. The technology helps reduce stubble burning, lowers dependence on imported bitumen, and supports environmentally friendly road construction. It promotes circular economy practices by converting agricultural waste into value-added road construction materials suitable for flexible pavements.

## Functionalities

- Converts agricultural residue into bio-binder for flexible pavement applications.
- Can be used as a partial replacement/modifier for conventional bitumen.
- Supports sustainable and low-emission road construction practices.

## USP/Key Features

- Utilizes agricultural waste and reduces stubble burning.
- Reduces dependency on imported petroleum bitumen.
- Compatible with existing hot mix asphalt practices and equipment.

## Contact Details

Dr. Chalumuri Ravi Sekhar
Director, CSIR-CRRI Delhi
director.crri@nic.in
+91-11-26848917

## Implementation Status

- Developed and validated through laboratory studies and field trials, including trial construction on NH-6 (Jorabat–Shillong Expressway). Technology transferred to industries for commercialization and scale-up.
- Field trial sections constructed; technology transferred to 25 industries

# AVCC: Automated Vehicle Counting & Classification System (Software)

**TRL-8**

## Overview

AVCC is a software based automated traffic monitoring system developed for vehicle counting and classification applications. The system enables efficient traffic data collection, analysis, and classification for transportation planning, traffic management, pavement design, and infrastructure assessment. It supports accurate and real time traffic monitoring with reduced manual intervention.

## Functionalities

- Automated vehicle counting and classification.
- Traffic data acquisition and analysis.
- Real time traffic monitoring support.

## Contact Details

Dr. Chalumuri Ravi Sekhar
Director, CSIR-CRRI, Mathura Road, Delhi
director.crri@nic.in
+91-11-26848917

## USP/Key Features

- Reduces manual traffic survey requirements.
- Improves accuracy and efficiency of traffic data collection.
- Supports transportation planning and pavement design studies.

## Implementation Status

- The software system has been developed and utilized for automated traffic monitoring and traffic engineering applications.
- The technology has been transferred to an industry.

# End-of-Life Plastic Technical Textile Geocell Roads

TRL-8

## Overview

This technology utilize send-of-life plastic technical textiles for manufacturing geocells used in road construction applications. The technology improves load distribution, enhances pavement stability, and promotes environmentally sustainable reuse of plastic waste materials.

## Functionalities

- Converts plastic waste into geocell reinforcement systems.
- Improves load distribution and pavement stability.
- Supports road construction in weak subgrade conditions.

## Contact Details

Dr. Chalumuri Ravi Sekhar
Director, CSIR-CRRI Delhi
director.crri@nic.in
+91-11-26848917

## USP/Key Features

- Utilizes end-of-life plastic waste for infrastructure development.
- Improves pavement performance and longevity
- Reduces environmental burden associated with plastic disposal.

## Implementation Status

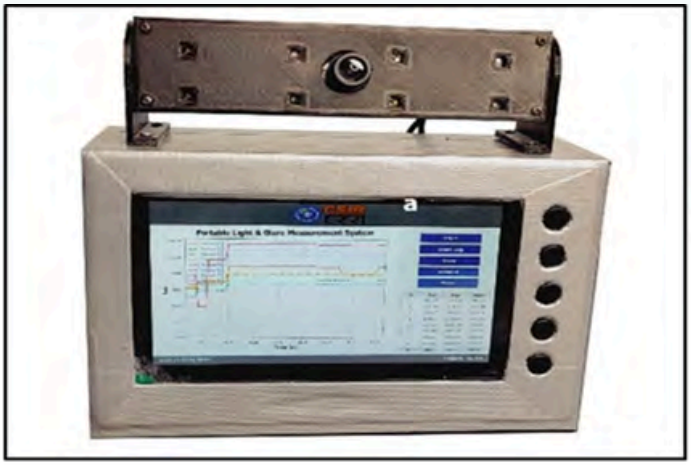
- The technology has been demonstrated and evaluated in pilot road construction projects for sustainable pavement applications.
- Test section constructed at Loop No. 1 of the DND–Faridabad–KMP Expressway and at Indian Army Camp, Leh.

# LUMETRA: Portable Light and Glare Measurement System

**TRL-8**

## Overview

A rugged, handheld system for field measurement, logging and real-time display of illumination and glare using multiple sensors. The unit supports wireless data transfer and on-board data logging with basic/advanced analysis capabilities for post-processing.



## Functionalities

- Portable measurement system for convenient on-site assessment of lighting conditions
- Light intensity measurement for evaluating illumination levels across different environments
- Field assessment of lighting to identify inadequate or excessive illumination
- Glare measurement and assessment for evaluating visual discomfort and safety
- Real-time data recording for systematic capture of lighting and glare parameters
- Easy field deployment for measurements across roads, buildings and public spaces
- Supports lighting performance evaluation and data-driven improvement of illumination systems

## USP/Key Features

- High portability
- Quick field diagnostics
- Easy usability

## Implementation Status

- The system has been developed for portable field measurement and evaluation of roadway lighting and glare levels.
- The technology is in certification process by the Licensee. A few units to be commercialized soon.

## Contact Details

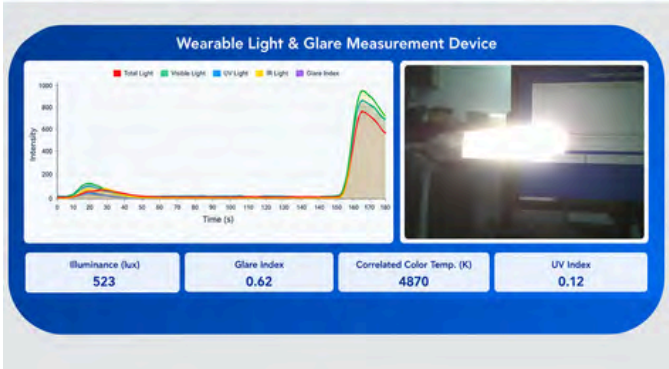
Dr. Chalumuri Ravi Sekhar
Director, CSIR-CRRI Delhi
director.crri@nic.in
+91-11-26848917

# LUXSPECS: Wearable Light and Glare Measurement Device

**TRL-8**

## Overview

A head-wearable / head-mounted device that continuously measures and displays local light and glare exposure in real time. It offers wireless connectivity to phones/computers, data logging and statistical analysis of glare exposure for individuals or routes. Designed for hands-free operation in field surveys.




## Functionalities

- Light intensity measurement for accurate assessment of illumination levels.
- Glare detection to identify and quantify uncomfortable or hazardous glare conditions.
- Wearable and portable design enabling convenient measurements during field activities.
- Real-time field monitoring of lighting and glare conditions at different locations.
- On-site data collection for evaluating lighting performance and visual comfort.
- Improved assessment of lighting conditions across roads, infrastructure and built environments.
- Supports data-driven lighting design and safety evaluation for field applications.

## USP/Key Features

- Wearable real-time monitoring
- Ergonomic design
- Portable safety tool

## Implementation Status

- The device has been developed and evaluated for real time assessment of roadway lighting and glare conditions.
- The technology is in certification process by the Licensee. A few units to be commercialized soon.

## Contact Details

Dr. Chalumuri Ravi Sekhar
Director, CSIR-CRRI Delhi
director.crri@nic.in
+91-11-26848917

# SMACEL: Indigenized Pelletized Fiber for Stone Matrix Asphalt

**TRL-8**

## Overview

Indigenized Pelletized Fiber for Stone Matrix Asphalt (SMA) is a specially developed stabilizing additive used in SMA mixes to prevent binder drain down and improve pavement performance. The technology supports durable, rut resistant, and high performance bituminous pavements suitable for heavy traffic conditions. The indigenous development of pelletized fiber reduces dependence on imported additives and promotes cost effective road construction practices.

## Functionalities

- Prevents binder drain down in SMA mixes.
- Enhances stability and durability of bituminous pavements.
- Improves rutting resistance under heavy traffic loading.

## Contact Details

Dr. Chalumuri Ravi Sekhar
Director, CSIR-CRRI Delhi
director.crri@nic.in
+91-11-26848917

## USP/Key Features

- Indigenous alternative to imported stabilizing fibers.
- Improves performance and life of SMA pavements.
- Cost effective and suitable for Indian road conditions.

## Implementation Status

- The technology has been evaluated and demonstrated for use in Stone Matrix Asphalt pavement applications under field conditions.
- The technology has been transferred to the industry partner for commercialization.

# BSS-101: Cementitious Material for Stabilization of Sub-Base & Base Course in Flexible Pavement

**TRL-9**

## Overview

This technology involves the development of a cementitious stabilization material for improving the engineering properties of sub base and base layers in flexible pavements. The technology enhances load bearing capacity, durability, and pavement performance while enabling efficient utilization of locally available materials for sustainable road construction.

## Functionalities

- Stabilizes sub base and base layers in flexible pavements.
- Improves strength and load carrying capacity.
- Enhances durability and pavement performance.

## Contact Details

Dr. Chalumuri Ravi Sekhar
Director, CSIR-CRRI Delhi
director.crri@nic.in
+91-11-26848917

## USP/Key Features

- Reduces dependence on conventional aggregates.
- Improves pavement life and structural stability.
- Suitable for sustainable and cost effective road construction.

## Implementation Status

Deployed in national and state highway projects across India, including Kanpur–Kannauj, Gorakhpur–Sonauli, Vadodara–Waghodia, Mohali, and Shimla–Shoghi.

# Cementitious Grout for use in Cement Grouted Bituminous Mix (CGBM) for Flexible Pavements

**TRL-9**

## Overview

A specially designed flowable cementitious grout used to fill the voids of an open-graded bituminous layer, forming a semi-rigid, durable composite surfacing that combines the flexibility of asphalt with the strength and impermeability of concrete.

## Functionalities

- Pavement strengthening.
- Load distribution improvement.
- Crack resistance enhancement.

## Contact Details

Dr. Chalumuri Ravi Sekhar
Director, CSIR-CRRI Delhi
director.crri@nic.in
+91-11-26848917

## USP/Key Features

- High structural stability
- Improved pavement life
- Better load-bearing capacity

## Implementation Status

- The technology has been successfully evaluated and demonstrated for high strength and durable pavement applications.
- The technology has been implemented on Variety of Roads like city Roads, MDR Roads, State Highways, National Highways and PMGSY Roads; Variety of Climate Zones Ranging from Very Low Temperatures like Leh, Shimla (HP); High Monsoon Area like Mumbai and Mahabaleshwar Maharashtra ; Hill Roads – Udhampur. Total KM covered- 200 KM Plus.

# ECOFIX: Ready to Use Pothole Mix using Iron and Steel Slag Aggregates

**TRL-9**

## Overview

ECOFIX is a rapid pothole repair technology developed by CSIR-CRRI and M/s RamukaGlobal Services LLP, Gujaratusing processed steel slag and polymeric binders. The technology enables pothole repair within approximately 20 minutes under both dry and waterlogged conditions without requiring heavy machinery or heating, there by ensuring quick restoration of road usability.

## Functionalities

- Repairs potholes rapidly in dry and waterlogged conditions.
- Allows immediate reopening of roads after repair.
- Uses ready-to-use cold mix technology without heating requirements.

## Contact Details

Dr. Chalumuri Ravi Sekhar
Director, CSIR-CRRI, Delhi
director.crri@nic.in
+91-11-26848917

## USP/Key Features

- Repairs potholes within about 20 minutes.
- Can be applied without dewatering or heavy machinery.
- Utilizes processed industrial waste for sustainable road maintenance.

## Implementation Status

- Successfully demonstrated and implemented in the state of Karnataka, Assam, Delhi, Uttar Pradesh, Tamil Nadu, Maharashtra, Gujarat, Madhya Pradesh, Orissa, Chhattisgarh, Andhra Pradesh in India. Commercially supplied to Chicago, USA for rapid pothole repair applications.
- Implemented in multiple cities and states in India.

# Mobile Bridge Inspection Unit

**TRL-9**

## Overview

Vehicle-mounted system enabling safe and efficient inspection of bridge undersides and elevated structures.

## Functionalities

- Under-bridge inspection access enabling safe and convenient access to difficult-to-reach bridge components.
- Structural condition assessment for systematic evaluation of bridge health and performance.
- On-site inspection capability enabling detailed examination of structural elements in the field.
- Field data collection for recording defects, structural conditions and inspection observations.
- Improved inspection efficiency by reducing the need for conventional access arrangements.
- Enhanced safety and accessibility during inspection and maintenance activities.
- Suitable for routine and detailed bridge inspections across diverse road and infrastructure conditions.

## USP/Key Features

- Enhanced inspection safety
- Mobile and flexible system
- Reduced inspection time

## Implementation Status

- The technology has been developed and deployed for efficient inspection and condition assessment of bridges and elevated structures.
- The technology has been used in various cities across India.

## Contact Details

Dr. Chalumuri Ravi Sekhar
Director, CSIR-CRRI, Mathura Road, Delhi
director.crri@nic.in
+91-11-26848917

# Mobile Cold Mixer Cum Paver

**TRL-9**

## Overview

A mobile cold mixing and paving system designed for in-situ road construction and maintenance without dependency on hot mix plants.It enables rapid execution of pavement works, particularly in remote and difficult terrain, ensuring reduced logistics, faster deployment, and sustainable road construction practices.

## Functionalities

- On-site cold mixing of road materials.
- Mechanized paving and laying of layers.
- Suitable for remote and emergency works.

## Contact Details

Dr. Chalumuri Ravi Sekhar
Director, CSIR-CRRI Delhi
director.crri@nic.in
+91-11-26848917

## USP/Key Features

- Eliminates need for hot mix plants.
- Fully mobile and self-contained system.
- Faster and flexible road construction.

## Implementation Status

- The technology has been successfully demonstrated for in situ cold mix road construction and maintenance applications under field conditions.
- A prototype transferred to BRO for filed implementation in Himalayan Regions.

# MSS+: Modified Mix Seal Surfacing

**TRL-9**

## Overview

Modified Mix Seal Surfacing (MSS+) is a dense graded thin bituminous surfacing based on customized bitumen emulsion for low volume bituminous roads. It provides a dense durable riding surface for road users. It is an ambient temperature road surfacing which does not require pre-heating of aggregate and bitumen as required in conventional hot mix asphalt. In order to ensure early curing and strength achievement bitumen emulsion has been customized along with suitable admixtures for different set of aggregates. It overcomes the various limitations of conventional Mix Seal Surfacing commonly used for bituminous roads.

## Functionalities

- Improves pavement sustainability and structural performance.
- Optimizes utilization of construction materials.
- Enhances long-term pavement durability.

## Contact Details

Dr. Chalumuri Ravi Sekhar
Director, CSIR-CRRI Delhi
director.crri@nic.in
+91-11-26848917

## USP/Key Features

- Promotes sustainable and resource-efficient road construction.
- Reduces lifecycle maintenance requirements.
- Supports environmentally responsible infrastructure development.

## Implementation Status

- The technology has undergone field validation and demonstration for sustainable road applications under varying traffic and climatic conditions.
- Implemented in five districts of Uttar Pradesh for construction of PMGSY road in district of Gonda, Raibareli, Lucknow, Prayagraj and Sultanpur

# Noise Barrier Based on Different Frequencies

**TRL-9**

## Overview

Acoustic barrier system designed using frequency-specific noise attenuation principles to reduce traffic noise pollution in urban and highway corridors.

## Functionalities

- Traffic noise reduction through effective roadside noise barrier systems.
- Frequency-specific sound absorption targeting different traffic noise frequencies.
- Enhanced acoustic performance for reducing noise propagation to surrounding areas.
- Customised barrier design based on the dominant frequency characteristics of traffic noise.
- Roadside installation for effective noise control along highways and urban roads.
- Improved acoustic comfort for nearby residential and public areas.
- Potential for integration with existing road infrastructure and noise-control measures.

## Contact Details

Dr. Chalumuri Ravi Sekhar
Director, CSIR-CRRI Delhi
director.crri@nic.in
+91-11-26848917

## USP/Key Features

- Frequency tuned noise control.
- Improved urban livability.
- Modular design.

## Implementation Status

- The technology has been developed and evaluated at prototype level for mitigation of traffic noise across varying frequency ranges.
- The Licensees in various projects are implementing the technology across India.

# PatchFILL: The Pothole Repair Machine

**· TRL-9 ·**

## Overview

Mechanized pothole repair system enabling fast, uniform, and durable patching of road defects with minimal manpower and traffic disruption.

## Functionalities

- Automated pothole filling with minimal manual intervention.
- Efficient material dispensing for accurate and uniform filling.
- Integrated compaction to achieve proper material density.
- Automated finishing for a smooth and level road surface.
- Rapid repair cycle enables quick restoration of damaged road sections.
- Reduced traffic disruption through faster on-site repairs.
- Improved repair consistency compared with conventional manual methods.
- Suitable for routine and emergency pothole maintenance.

## Contact Details

Dr. Chalumuri Ravi Sekhar
Director, CSIR-CRRI Delhi
director.crri@nic.in
+91-11-26848917

## USP/Key Features

- High-speed repair capability.
- Consistent quality output.
- Reduced manual intervention.

## Implementation Status

- The technology has been field validated for rapid, mechanized, and durable pothole repair operations on road pavements.
- Two Machines Sold By the Licensee for Field Implementation. Projects implemented in Kerala, Uttarakhand & Delhi.

# REJUBIT

**TRL-9**

## Overview

REJUBIT is a sustainable solution for rejuvenating old and damaged bituminous roads. It uses specially developed additives to restore the original properties of aged bitumen, extending the life of roads without complete reconstruction. This reduces the use of fresh materials, lowers repair costs, and minimizes environmental impact. By promoting reuse and improving road performance, Rejubit supports cost-effective maintenance and contributes to greener, more durable road infrastructure..

## Functionalities

- Restores performance characteristics of aged bituminous pavements.
- Improves pavement flexibility and crack resistance.
- Extends pavement service life with reduced maintenance needs.

## Contact Details

Dr. Chalumuri Ravi Sekhar
Director, CSIR-CRRI, Mathura Road, Delhi
director.crri@nic.in
+91-11-26848917

## USP/Key Features

- Cost-effective pavement rejuvenation solution.
- Enhances durability and riding quality of roads.
- Reduces requirement for extensive rehabilitation works.

## Implementation Status

- The technology has been evaluated through field applications and demonstration projects for pavement maintenance and rehabilitation.
- Technology implemented at TPP Chennai Tirupati; Samakhiyali Santalpur; Behrampore; Farak. Implemented on 140 km. roads.

# REJUPAVE: Rejuvenator for Recycling of Aged Bituminous Mixes

**TRL-9**

## Overview

REJUPAVE technology developed by CSIR-CRRI and M/s Verma Industries, New Delhi is a liquid bio based asphalt modifier cum rejuvenating agent designed for recycling of hot mix asphalt used in bituminous pavements. The technology facilitates higher utilization of Reclaimed Asphalt Pavement (RAP) material in bituminous recycling by restoring the flexibility and performance characteristics of aged asphalt binders. REJUPAVE is particularly suitable for sustainable road construction and maintenance in high altitude and cold regions, where pavement performance and durability under extreme climatic conditions are critical.

## Functionalities

- Rejuvenates aged asphalt binders in bituminous pavements
- Facilitates higherutilization of Reclaimed Asphalt Pavement (RAP) materials
- Improves performance and durability of pavements in high altitude and cold regions

## USP/Key Features

- Suitable for harsh climatic and high-altitude conditions
- Reduces maintenance frequency and rehabilitation costs
- Promotes sustainable pavement preservation practices

## Implementation Status

- The technology has been demonstrated and adopted in selected road stretches under field conditions, including mountainous and border regions.
- Utilized for the recycling of NH and SH in state of Uttar Pradesh, Rajasthan, Gujarat, Madhya Pradesh, West Bengal, Haryana and Jharkhand; Utilized for low temperature asphalt road construction in high altitude regions by BRO in J&K, Ladakh, Arunachal Pradesh, Nagaland; Also utilized by BRO in Royal Kingdom of Bhutan.

## Contact Details

Dr. Chalumuri Ravi Sekhar
Director, CSIR-CRRI, Mathura Road, Delhi
director.crri@nic.in
+91-11-26848917

# Steel Slag Road Technology

**· TRL-9 ·**

## Overview

Steel Slag Road Technology utilizes processed steel slag aggregates in road construction as a sustainable alternative to natural aggregates. The technology improves pavement strength, durability, and resistance to rutting while promoting large-scale utilization of industrial by-products.

## Functionalities

- Uses processed steel slag in pavement layers.
- Enhances pavement strength and load-bearing capacity.
- Supports sustainable utilization of industrial waste materials.

## Contact Details

Dr. Chalumuri Ravi Sekhar
Director, CSIR-CRRI Delhi
director.crri@nic.in
+91-11-26848917

## USP/Key Features

- Improves pavement durability and performance
- Reduces dependence on natural aggregates
- Promotes circular economy and sustainable construction

## Implementation Status

- The technology has been implemented in multiple road projects and demonstration stretches across India in collaboration with industry and government agencies.
- Implemented in Field in Hazira, Surat, Gujarat; NH-66, Mumbai Goa at Maharashtra; NH 53, at Surat Gujarat; Nagpur Maharashtra, NH-33; Jamshedpur-Ranchi in Jharkhand; Adani Hazira port at Surat, Gujarat; On Border Road at Ziro, Arunachal Pradesh; Steel Slag Road at Raigarh, Chhattisgarh is under construction.

# Stepwise Repeated Destabilization and Stabilization of Highly Collapsible Soil Mass by Soil Nailing Technique Used for Construction of Railway/Road Underpass

**TRL-9**

## Overview

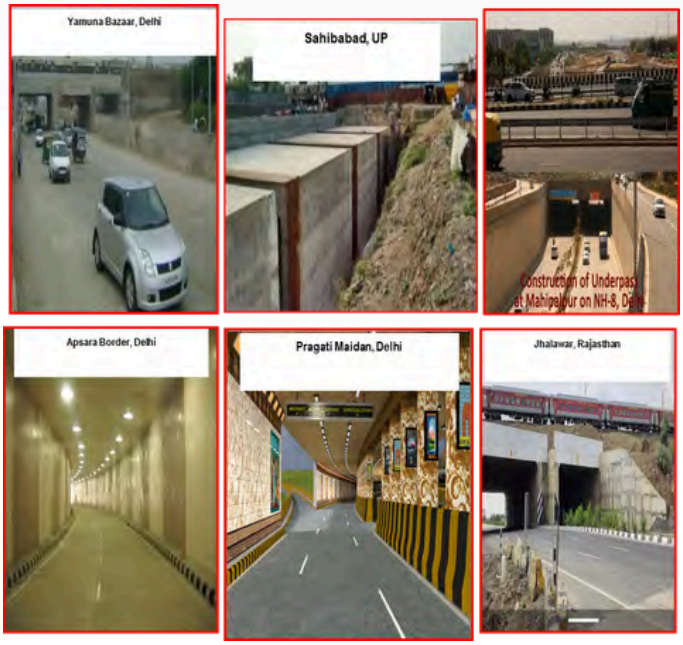
Technique for stabilizing weak and collapsible soil masses for construction of underpasses and infrastructure in difficult terrain.

## Functionalities

- Soil stabilization in weak strata.
- Structural reinforcement.
- Safe underpass construction.

## Contact Details

Dr. Chalumuri Ravi Sekhar
Director, CSIR-CRRI Delhi
director.crri@nic.in
+91-11-26848917




## USP/Key Features

- Suitable for highly collapsible soils.
- Enhances construction safety.
- Cost-effective stabilization method.

## Implementation Status

- The technology has been successfully implemented for stabilization of collapsible soil masses during railway and road underpass construction.
- Implemented in various consultancy assignments.

# TERASURFACING: Microsurfacing Technology with Industrial Waste Materials, i.e. Steel Slag, Fly Ash and Marble Dust

**· TRL-9 ·**

## Overview

Terasurfacing is waste material i.e. steel slag, marble dust and fly ash based thin surfacing for pavement preservation and rehabilitation of distressed pavement. It facilitates the utilization of industrial waste materials as partial substitute of natural aggregates in road re-surfacing. It is a bitumen emulsion based technology which impart minimal thickness in road surfacing.

## Functionalities

- Surface treatment and strengthening.
- Waste material utilization.
- Pavement rehabilitation.

Terasurfacing

## Contact Details

Dr. Chalumuri Ravi Sekhar
Director, CSIR-CRRI Delhi
director.crri@nic.in
+91-11-26848917

## USP/Key Features

- Eco-friendly waste-based technology.
- Improves pavement performance.
- Cost-effective sustainable solution.

## Implementation Status

- The technology has been successfully demonstrated for sustainable micro surfacing applications utilizing industrial waste materials in pavement construction and maintenance.
- The industry partner at various sites has implemented the technology.

# Two-Pack PatchFILL: On-site Pothole Filling Mix

**TRL-9**

## Overview

Two-component cold mix technology enabling instant on-site pothole repair without heating or plant requirement, ensuring quick traffic restoration.

## Functionalities

- Two-pack mixing system enabling convenient preparation at the repair site.
- On-site application without the need for elaborate mixing infrastructure.
- Fast curing material allowing quicker reopening of repaired road sections.
- Easy-to-use formulation suitable for rapid pothole maintenance.
- Reduced repair time compared with conventional pothole-filling methods.
- Suitable for emergency and routine road repairs with minimal traffic disruption.
- Effective pothole restoration for durable and efficient surface repair.

## Contact Details

Dr. Chalumuri Ravi Sekhar
Director, CSIR-CRRI Delhi
director.crri@nic.in
+91-11-26848917

## USP/Key Features

- No hot mix plant required.
- Traffic-ready within minutes.
- Easy field deployment.

## Implementation Status

The technology has been successfully demonstrated under field conditions for rapid pothole repair and quick restoration of traffic movement.

# Additive Manufactured Lattice Orthopedic Implants

**· TRL-6 ·**

## Overview

Conventional orthopaedic implants are typically manufactured from solid Ti6Al4V ELI biomedical-grade titanium alloy. However, the significant mismatch between the mechanical properties of titanium and natural bone often results in stress shielding, implant loosening, and eventual failure, necessitating revision surgery. Additive Manufacturing addresses this challenge by enabling the fabrication of implants with bone-inspired lattice structures that closely mimic the architecture of human bone. These optimised lattice designs promote bone ingrowth and osseointegration, ensuring superior biological fixation while reducing the elastic modulus of the implant. This minimises stress shielding, enhances implant longevity, and significantly lowers the risk of implant migration and failure. Target Beneficiaries: Patients requiring hip and spine implantation

## Functionalities

- Avascular Necrosis Implant (AVN) used for the treatment of necrosis of femur head.
- Lattice shell, buttress and shim augment used for defect filling in hip revision surgeries.
- Lattice Acetabular Cup, Coen Acetabular Cup and Cage Construct used in Hip surgeries according to use case.
- Lattice PLIF and TLIF spinal Implants used for the treatment of spine disc degeneration.

## Contact Details

Prof. Shantanu Bhattacharya
Director, CSIR-CSIO, Chandigarh
director.csio@csir.res.in
+91-172-2657190

## USP/Key Features

- Additively manufactured lattice titanium implants designed to mimic natural bone structure for hip and spine applications.
- Enhanced osseointegration and bone ingrowth providing superior biological fixation and long-term implant stability.
- Reduced stress shielding through optimized lattice architecture, lowering the risk of implant loosening and failure.
- Patient-specific, high-performance implants supporting improved clinical outcomes in complex hip revision and spinal surgeries.

## Implementation Status

- Technology transferred to Multiple Industries i.e. JK Digital, UPS Lakshmi, CIPLA Medtech
- Under Regulatory Evaluation by CDSCO, commercial launch expected within 6 months

# Aspheric Lens Based Spectacles for Persons with Functional Low-Vision

**· TRL-6 ·**

## Overview

Functional low vision is defined as visual acuity below 6/18 and/or a visual field of less than 10 degrees that cannot be corrected through surgery, medication, or conventional spectacles. Rehabilitation primarily relies on affordable, high-magnification, plastic aspheric lens-based Low Vision Aids (LVAs) tailored to individual needs, along with user training. CSIR-CSIO has developed advanced LVAs that significantly improve the quality of life of people with low vision. The use of aspheric lenses ensures superior optical performance across the entire lens surface, enhancing peripheral vision, environmental awareness, and overall visual functionality for daily activities.

## Functionalities

- These spectacles are fitted with high-power aspheric lenses designed to enhance vision for those requiring strong dioptric corrections, specifically lenses of +8D to +26D.
- The aspheric lenses minimize spherical aberrations and edge distortions, offering a wider and clearer field of view compared to conventional spherical lenses. This improves visual comfort and image quality.
- These lenses are lighter by 60-65% as compared to conventional spherical lenses and offer

## USP/Key Features

- Lightweight, compact, and user-friendly low-vision spectacles for comfortable long-duration use.
- High-performance aspheric lens design delivering sharper vision, wider field of view, and reduced optical distortions.
- Cost-effective, customizable indigenous technology enabling accessible low-vision rehabilitation and large-scale deployment.

## Implementation Status

User Trials of the developed LVAs (15 Nos.) have been carried out at NIEPVD Dehradun and at Institute of Blind Chandigarh.

## Contact Details

Prof. Shantanu Bhattacharya
Director, CSIR-CSIO, Chandigarh
director.csio@csir.res.in
+91-172-2657190

# Precision Iodine Value Analyser

**TRL-7**

## Overview

CSIR-CSIO has developed the Precision Iodine Value Analyser (PIVA) for rapid quality assessment of six commonly used edible oils—sunflower, soybean, mustard, rice bran, palm, and coconut. The analysis process and software are protected through intellectual property rights. The device accurately measures iodine value, a key indicator of oil unsaturation, quality, shelf life, and adulteration. Unlike conventional titration methods that require hazardous chemicals, fragile equipment, and skilled personnel, PIVA offers a safe, portable, and cost-effective solution. It is ideally suited for edible oil industries, quality control laboratories, food regulators, bakeries, cosmetics, soap, meat, and paint industries.

## Functionalities

- Rapid iodine value analysis in 3 minutes.
- Portable, low-cost and easy-to-use technology.
- Detects oil quality and adulteration efficiently.

## USP/Key Features

- Eliminates titration and reduces toxic chemical usage
- Low analysis cost with high accuracy and precision
- Portable system suitable for field and industrial testing

## Contact Details

Prof. Shantanu Bhattacharya
Director, CSIR-CSIO, Chandigarh
director.csio@csir.res.in
+91-172-2657190

## Implementation Status

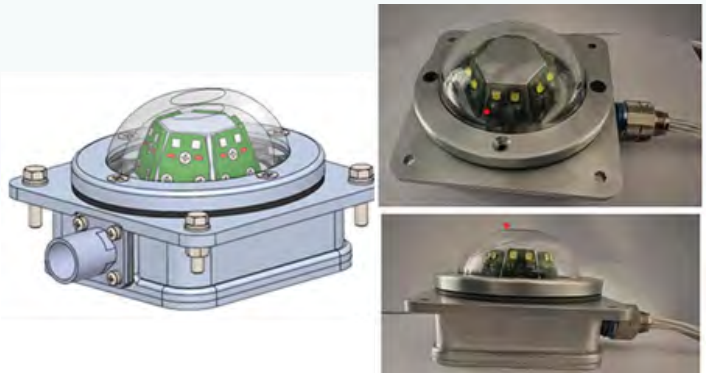
Licensed and deployed

# Retractable and Fixed Anti-collision Light for LCA MK-II and AMCA

**TRL-8**

## Overview

Retractable and Fixed Anti-collision Light (ACL) for LCA MK-II and AMCA is an indigenously developed aircraft lighting system designed to enhance aircraft visibility and prevent mid-air collisions during flight operations. The LED-based ACL operates in visible and IR modes and complies with stringent military airworthiness standards. Its lightweight, aerodynamic and NVIS-friendly design improves operational safety, reliability and mission effectiveness for modern fighter aircraft platforms.



## Functionalities

- Provides flashing anti-collision illumination in visible and IR spectrum for enhanced aircraft visibility during flight operations.
- Supports software-controlled flashing and dimming modes with pilot-operated switching for operational flexibility.
- Enables reliable operation under harsh aerospace environments through aerodynamic design, seal-proof construction and natural convection cooling.

## USP/Key Features

- LED-based dual-mode operation with NVIS compatibility and communication between top and bottom ACL units.
- High reliability with MTBF greater than 30,000 hours, lightweight construction and shock/vibration resistance.
- Fully indigenized system designed to meet form-fit requirements and qualified to MIL STD-810-G and MIL STD-704-C/E standards.

## Implementation Status

Licensed and deployed

## Contact Details

Prof. Shantanu Bhattacharya
Director, CSIR-CSIO, Chandigarh
director.csio@csir.res.in
+91-172-2657190

# Head Up Display (HUD) for LCA

**TRL-9**

## Overview

Head-Up Display (HUD) is a critical avionics system used in aircraft, particularly fighter aircraft, to project essential flight and mission information directly into the pilot's line of sight. It enables pilots to access real-time data without diverting attention from the external environment, thereby enhancing situational awareness, flight safety, mission effectiveness and operational efficiency. HUD technology supports navigation, targeting and landing operations even under adverse weather conditions. With increasing demand in defence aviation and modernization programs, the technology offers significant commercial potential in both domestic and global aerospace markets.

Head Up Display for LCA AF

Head Up Display for LCA Navy

## Functionalities

- Displays critical flight information such as altitude, airspeed, navigation cues, weapon aiming and flight parameters in collimated form within the pilot's forward field of view.
- Interfaces electronically with the aircraft's Open Architecture Computer (OAC) to generate and project symbology, characters and operational data onto the beam combiner.
- Enables overlay of flight and runway imagery aligned with the real environment, improving pilot situational awareness and operational capability under poor visibility conditions.

## USP/Key Features

- Enhances pilot safety and mission efficiency by allowing "head-up" operation without looking down at cockpit instruments.
- Advanced optical projection and beam combiner technology provide clear, real-time and accurately aligned visual information.
- Suitable for integration with modern fighter aircraft platforms and adaptable for future upgraded avionics systems.

## Implementation Status

Licensed and deployed

## Contact Details

Prof. Shantanu Bhattacharya
Director, CSIR-CSIO, Chandigarh
director.csio@csir.res.in
+91-172-2657190

# LED Based NVG Compatible Wing and Fin Navigation Lights, Taxi & Landing Lights (TLL) and Drogue Lights Along with Associated Test Rigs for LCA Tejas

**· TRL-9 ·**

## Overview

These are advanced aircraft lighting systems designed to replace conventional filament-based lights used in fighter and passenger aircrafts as well as helicopters. Installed on the nose landing gear, these lights improve visibility and operational safety during taxiing, take-off and landing operations. The system operates on 28V DC aircraft power supply and offers enhanced reliability, long operational life and optimized illumination performance compliant with aviation and military standards.

## Functionalities

- Provides Taxi Mode operation with wide beam, lower intensity aviation white light for safe ground movement and taxiing operations.
- Provides Landing Mode operation with narrow beam, high intensity aviation white light for improved runway visibility during landing and take-off.
- Operates on standard 28V DC aircraft power supply with dedicated indoor and outdoor test rigs for performance validation.

## USP/Key Features

- LED-based replacement for conventional filament lights with high reliability and MTBF greater than 10,000 hours.
- Dual operational modes with optimized beam spread and illumination intensity for taxiing and landing requirements.
- Compliant with MIL-STD 704D and aviation lighting standards, suitable for fighter aircrafts, passenger aircrafts and helicopters.

## Implementation Status

Licensed and deployed

## Contact Details

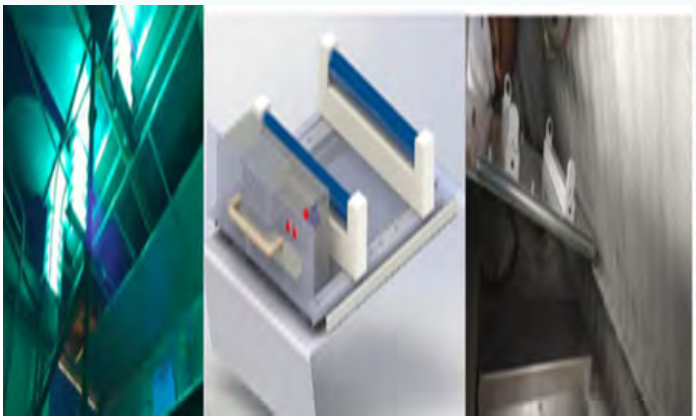
Prof. Shantanu Bhattacharya
Director, CSIR-CSIO, Chandigarh
director.csio@csir.res.in
+91-172-2657190

# UV-C Disinfection Systems

**· TRL-9 ·**

## Overview

CSIR-CSIO has developed an Induct UV-C Disinfectant System for HVAC ducts to effectively disinfect mechanically ventilated indoor spaces and reduce the spread of viruses, bacteria, fungi and mold. The retrofit UV-C system can be integrated into existing air ducts and AHUs with minimal modifications. Optimized through optical modelling and airflow analysis, the system delivers calibrated UV-C dosage for effective microbial deactivation, thereby improving indoor air quality and public health safety in buildings, transport systems and large public spaces.



## Functionalities

- Disinfects circulating air in HVAC ducts and AHU systems by deactivating airborne viruses, bacteria, fungi and mold using calibrated UV-C radiation.
- Integrates into existing HVAC air ducts, lifts, washrooms and circulating airflow systems with minimal retrofit modifications.
- Optimizes virucidal performance through airflow analysis, optical modelling and CFD-based duct design implementation.

## USP/Key Features

- Retrofit and maintenance-friendly ergonomic design with UV-sealing, leak-proof construction and IP-55 protection.
- Scientifically validated UV-C intensity, virucidal dosage and performance certifications from CSIR-CSIO and CSIR-IMTECH Chandigarh.
- Suitable for large HVAC systems in auditoriums, malls, educational institutions, buses, railways and other public infrastructure applications.

## Contact Details

Prof. Shantanu Bhattacharya
Director, CSIR-CSIO, Chandigarh
director.csio@csir.res.in
+91-172-2657190

## Implementation Status

Licensed and deployed

# Kappaphycus Seaweed Farming Expansion

**TRL-7**

## Overview

CSIR-CSMCRI has developed standardized cultivation technology for Kappaphycus alvarezii, enabling large-scale, sustainable seaweed farming through optimized monoline, tube net, bamboo raft, and HDPE-based systems. Successfully demonstrated across India's coastal states, the technology is adapted to local environmental conditions for enhanced biomass productivity and crop stability. It provides sustainable livelihood opportunities for fisherfolk and women's self-help groups while ensuring a reliable domestic supply of raw material for the nutraceutical, pharmaceutical, cosmetic, and food industries. The technology also promotes environmentally sustainable mariculture and contributes significantly to India's blue economy.

## Functionalities

- Validated Technology: Standardized and optimized Kappaphycus alvarezii cultivation through extensive field trials across India's coastal states using monoline, tube net, bamboo raft, and HDPE systems.
- Capacity Building: Trained 100+ fishermen in each coastal state, promoting technology adoption, coastal entrepreneurship, and large-scale commercialization.
- Blue Economy: Strengthened domestic seaweed supply chains, supporting sustainable livelihoods and India's growing blue economy.

## Contact Details

Dr. Arup Ghosh
Director, CSIR-CSCMRI Bhavnagar
director.csmcri@csir.res.in
+91-278-2569496

## USP/Key Features

- Successfully commercialized Kappaphycus alvarezii cultivation technology in Gujarat, Maharashtra, and Andhra Pradesh through intensive training and capacity-building programs for local fisher communities, coupled with industry linkages and buyback arrangements to ensure market integration and economic sustainability.
- Environmentally sustainable and low-cost mariculture technology supporting carbon sequestration, nutrient bioextraction, livelihood generation, and strengthening of domestic carrageenan-based industrial supply chains in India.

## Implementation Status

Deployed at 75+ coastal sites across India, with commercial adoption supported through farmer training, SHGs, and industry partnerships.

# CI-STARS Salt Technology Facility "Centre for Integrated Salt Technologies and Advanced Research Station"

**TRL-8**

## Overview

CI-STARS is a flagship CSIR initiative demonstrating India's leadership in salt and marine chemical technologies. Developed by CSIR-CSMCRI, it is India's first world-class experimental salt farm, spanning 180 acres and integrating scientific design, mechanization, and sustainable practices. The facility bridges laboratory research with industrial applications, enabling climate-resilient salt production and recovery of high-value marine chemicals and critical elements from seawater, subsoil brine, RO reject brine, and lake brine. CI-STARS improves productivity, reduces occupational hazards for salt workers, supports rural livelihoods, strengthens import substitution, and serves as a full-scale field laboratory for the salt, soda ash, and chlor-alkali industries.

## Functionalities

- Increases solar salt productivity from 50 to 80 tons per acre through climate-resilient scientific technologies.
- Validates and scales salt production technologies while enabling value addition through marine chemical recovery.
- Strengthens livelihoods by promoting mechanization, skill development, and safer, high-quality salt production for Salt Agarias and MSMEs.

## Contact Details

Dr. Arup Ghosh
Director, CSIR-CSCMRI Bhavnagar
director.csmcri@csir.res.in
+91-278-2569496

## USP/Key Features

- Enhanced Productivity: Increases solar salt yield from 50 to 80 tons per acre through scientific design, mechanization, and advanced brine management.
- Sustainable Production: Enables climate-resilient salt production with rainwater management, geopolymer saltpan technology, and integrated marine chemical recovery.
- Import Substitution & Value Addition: Supports indigenous recovery of potash, lithium, strontium, and magnesia, while promoting seaweed and microalgae cultivation for nutraceuticals and sustainable biofuels.

## Implementation Status

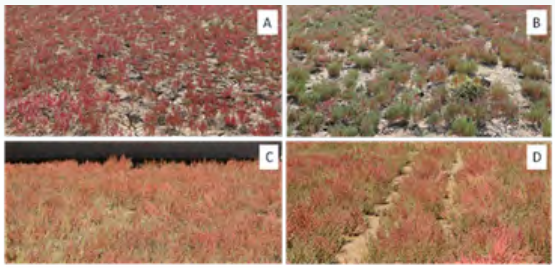
CI-STARS inaugurated on 11 April 2025; first salt harvest achieved in May–June, 2026

# Preparation of Low Sodium Salt of Botanic Origin – Saloni – with Backward Integration of Cultivation of Salicornia Brachiate.

**TRL-9**

## Overview

These technologies enables the development of low sodium salt formulations derived from botanical source to support healthier dietary practices. The innovation has been designed to reduce sodium intake without significantly compromising taste, making it suitable for consumers suffering from hypertension, cardiovascular disorders, and lifestyle-related diseases. The technology offers a healthier alternative to conventional table salt for use in household cooking, processed foods, and nutraceutical applications, thereby contributing to preventive healthcare and improved public nutrition. Cultivation technology helps in generating large amount of biomass of Salicornia helps in coastal farmers/fishermen community as livelihood option besides contributing to an extent on GHGs emission.




*Salicornia brachiata* cultivation at Sartanpur (Gujarat Coast) under different fertilizer application and agronomic condition at maturity stage.

Salt in Market

## Functionalities

- Reduces sodium content in edible salt formulations while maintaining acceptable taste and flavour profile.
- Produced from the plant biomass and acts as healthier salt alternatives.
- Suitable for domestic, institutional, and food processing applications including ready-to-eat and packaged foods.

## USP/Key Features

- Health-oriented low sodium formulation aimed at supporting management of hypertension and cardiovascular risks.
- Botanical origin ingredients provide improved nutritional and functional value compared to conventional salts.
- Compatible with existing food processing systems and adaptable for large-scale commercial production.

## Contact Details

Dr. Arup Ghosh
Director, CSIR-CSCMRI Bhavnagar
director.csmcri@csir.res.in
+91-278-2569496

## Implementation Status

Licensed and deployed

# Recovery of 100% Water Soluble Sulphate of Potash (WS SOP) from K-rich Distillery Incinerator Ash

**TRL-9**

## Overview

Many of the distilleries manage their effluent (spent wash) through concentration-incineration route, in accordance with prevailing MoEF&CC/CPCB guidelines & generate high volume of potash-rich ash.
This 'W2W' process, enables recovery of 100% water soluble FCO grade Sulphate of Potash fertilizers and other by products from such ash, by employing appropriate impurity management protocol(s) & fractional crystallization technique.
Deployment of the technology across Indian distillery sector, can potentially generate more than 1.5 lakh ton indigenous potash fertilizer per annum.

## Functionalities

- Sustainable indigenous potash fertilizer – Import Substitution
- Product acceptance across domestic & global players – Consistent Quality
- Robust Plant performance – Operating since Jan 2024 without major issue

## USP/Key Features

- Premium product from industrial waste – Additional profit for distilleries
- Process simplicity – Ease of deployment & operation
- Can create new export opportunities for India – SE Asia major market for SOP

## Contact Details

Dr. Arup Ghosh
Director, CSIR-CSCMRI Bhavnagar
director.csmcri@csir.res.in
+91-278-2569496

## Implementation Status

- Technology licensed in Oct 2022 (DCM Sriram Bio Enchem Ltd.)
- Commercial production started in Jan 2024
- Current Status: 16-17 t SOP / day (nom.)
- Produced >10000 t SOP (Jan '24 – Mar, '26)
- Revenue generated > ₹49 crore
- Direct employment ~ 65

# GOMED: Genomic Diagnostics for Rare Genetic Diseases – 27 Tests Commercialized via Dr Lal PathLabs

**TRL-9**

## Overview

CSIR-IGIB's GOMED (Genomics and Other Omics technologies for Enabling Medical Decisions) programme has developed single gene tests for 300+genetic disorders ranging from beta-thalessemia, Ataxias, achondroplasia and muscular dystrophy etc. Of these, 27 indigenous developed tests were licensed to Dr Lal Pathlabs for nationwide deployment. GOMED served 10000+ patients, referred by 200+ clinicians across 25 major medical centres, making it India's most impactful rare disease genomics programme, reducing genetic diagnostics cost by upto 50% and cutting average diagnosis time from 7 years to weeks, directly benefiting India's estimated 70 million rare disease patients.

## Functionalities

Comprehensive diagnostics for over 300 rare genetic disorders, developed validated genetic test for rare neurological, metabolic, hematological and chromosomal disorders using advanced sequencing technologies.

## Contact Details

Dr. Souvik Maiti
Director, CSIR-IGIB, New Delhi
director.igib@csir.res.in
+91 11 27662407

## USP/Key Features

- Indigenous Genomics Suite: India's only commercially deployed rare disease genomics platform with 300 in-house tests, optimized using Indian genomic data and offered at nearly 50% lower cost than imported assays. Clinical Impact: Enabled 10,000+ diagnoses, 50,000+ tests, and 200+ clinicians, significantly reducing diagnostic delays.
- Scalable Translation Model: A successful CSIR-IGIB– Dr Lal PathLabs partnership delivering affordable nationwide genomic diagnostics for 27 disease-associated genes.

## Implementation Status

Commercial Deployment: 27 genomic diagnostic tests are commercially deployed through Dr Lal PathLabs across 200+ laboratories and 5,000+ collection centres. The TRL-9 platform has enabled 50,000+ tests, 10,000+ patient diagnoses, and supports 200+ clinicians across 25+ hospitals nationwide.

# Development of Aromatic and Non-Aromatic Floral Wax and Floral Wax Candles

**· TRL-6 ·**

## Overview

This technology focuses on the extraction, purification and utilization of aromatic and non-aromatic floral waxes obtained from natural floral biomass for the development of eco-friendly candles and wellness products. The technology enables value addition of floral resources into premium sustainable wax products with applications in aromatherapy, home decor, wellness and fragrance industries. Floral wax candles offer biodegradable, low-soot and naturally scented alternatives to conventional paraffin candles.

## Functionalities

- Production of aromatic and non-aromatic floral waxes from natural floral biomass and floral processing residues.
- Development of eco-friendly floral wax candleswith enhanced fragrance retention and clean burning properties.
- Suitable for aromatherapy, wellness, decorative and premium gifting applications.

## USP/Key Features

- Natural and biodegradable alternative to petroleum-based paraffin wax products.
- Can incorporate Himalayan floral extracts and essential oils for premium fragrance profiles.
- Potential for commercialization through MSMEs, women entrepreneurs and rural livelihood generation.

## Implementation Status

- The technology is ready to transfer. The process has potential for scale-up and commercialization in fragrance, wellness and sustainable consumer product sectors.
- Deployed:TOT signed with M/S Mountleaf Pvt. Ltd. On 8th October 2025

## Contact Details

Dr. Sudesh Kumar Yadav
Director, CSIR-IHBT Palampur
director.ihbt@csir.res.in
01894-230411

# Natural Naphthoquinone Pigment Production using Arnebia Euchroma Adventitious Roots on Sustainable Basis

**TRL-6**

## Overview

The technology leverages in-vitro adventitious root culture to produce naphthoquinone red pigments (primarily shikonin and its derivatives) from Arnebia euchroma. By applying fundamental science to bioprocess engineering, the system cultivates plant tissue in controlled bioreactors.

## Functionalities

- Controlled in vitro biosynthesis
- Sustainable, eco-friendly, and year-round production
- Natural colour ingredient for food, cosmetics, textiles, pharmaceuticals etc.

## Contact Details

Dr. Sudesh Kumar Yadav
Director, CSIR-IHBT Palampur
director.ihbt@csir.res.in
01894-230411

## USP/Key Features

- High-yield bioreactor technology producing pure naphthoquinone pigments within 4–5 weeks.
- Sustainable, weather-independent production ensuring consistent quality while conserving endangered Himalayan Arnebia populations.
- Multi-functional natural product for food colorants, cosmeceuticals, and pharmaceutical applications.

## Implementation Status

- Technology licensed to M/s Phytopulse, Palampur (HP)
- Patent: Bhushan et al. (2021). A process for the production of naphthoquinone red pigments from adventitious roots of Arnebia euchroma (Patent No. IN202111045278)

# Natural Pocket/Travel Perfume

**TRL-6**

## Overview

This technology focuses on the development of compact, grain alcohol based natural pocket perfumes using absolutes, essential oils and plant-derived aromatic compounds.The formulation provides lasting fragrance, portability, skin-friendly characteristics and sustainable alternatives to synthetic perfumes. The technology supports rural entrepreneurship, value addition of Himalayan bioresources and development of premium natural wellness products for personal care applications.

## Functionalities

- Portable and travel-friendly natural fragrance formulation for daily personal use.
- Utilizes plant-based absolutes, essential oils and floral extracts with pleasant and long-lasting aroma.
- Can be customized for therapeutic, aromatherapy and wellness-oriented fragrance applications.

## USP/Key Features

- Made using natural floral extracts and essential oils with reduced synthetic additives.
- Compact pocket-sized design suitable for premium retail and gifting applications.
- Potential for commercialization through MSMEs, self-help groups and rural entrepreneurship initiatives.

## Contact Details

Dr. Sudesh Kumar Yadav
Director, CSIR-IHBT Palampur
director.ihbt@csir.res.in
01894-230411

## Implementation Status

- The technology is ready to transfer. The perfumes have potential for further optimization, branding and commercialization for fragrance and wellness sectors, as per industries need.
- TOT signed with M/S Pahadicraft on 26th February 2025

# Agro and Processing Technology of Stevia

**TRL-7**

## Overview

CSIR-IHBT has developed end-to-end technologies for Stevia (Stevia rebaudiana), a natural, zero-calorie sweetener rich in steviol glycosides such as stevioside and Rebaudioside-A (Reb-A), which are nearly 300 times sweeter than sucrose. To address the growing demand for healthier sugar alternatives, the institute has developed high Reb-A varieties, quality planting material, improved cultivation practices for diverse agro-climatic conditions, and efficient extraction technologies for steviol glycosides. These innovations support large-scale cultivation and processing, strengthening India's capability in the rapidly expanding global natural sweetener market.

## Functionalities

- Stevia cultivation technology for large-scale production of natural sweetener leaves.
- Applications in diabetic foods, beverages, bakery, dairy, confectionery, and oral care products.
- Adaptable to diverse soil and climatic conditions with scientific cultivation and irrigation management.

## USP/Key Features

- Improved variety having high Reb A ( 5.0 to7.4%) and total steviol glycosides content ranges from 12 to 14.5%.
- Developed Good Agricultural Practices (GAP) for different agro-climatic conditions.
- The average dry leaf yield is 3.5- 4.0 t ha-1 (-2.5 times higher than traditional crops)
- Reduces the cost of cultivation by 23-25%, and yield improvement up to 28% through advanced agro-technology

## Contact Details

Dr. Sudesh Kumar Yadav
Director, CSIR-IHBT Palampur
director.ihbt@csir.res.in
01894-230411

## Implementation Status

Technology transferred to multiple Industries and entrepreneurs, promoting large-scale stevia cultivation across the Country

# Green Stevia Processing Technology

**TRL-7**

## Overview

CSIR-IHBT has developed India's first indigenous green extraction technology for producing steviol glycosides from Stevia rebaudiana without using hazardous chemicals. The process employs eco-friendly solvents such as water or ethanol to produce high-quality, zero-calorie natural sweeteners that are 150–300 times sweeter than sugar. Designed for food, beverage, and pharmaceutical applications, the technology offers an energy-efficient, sustainable, and zero-waste alternative for commercial production of diabetic-friendly sweeteners

## Functionalities

- Alternate non-nutritive sweetener in food, bakery, beverages, table top formulations. Beneficiaries will be the sweetener industry, Diabetic consumers, Nutraceutical Food, Beverage & Dairy Industry
- Steviol glycoside-based solid and liquid product formulations are done as per the FSSAI guidelines
- FSSAI, US FDA, European Union-approved natural sweetener

## USP/Key Features

- Indigenous Green Process: No use of hazardous/toxic solvents (Made in India)
- Average yield of finished product: 8-10% (w/w basis)
- Developed steviol glycoside-based powder and liquid formulations

## Implementation Status

Licensed and deployed

## Contact Details

Dr. Sudesh Kumar Yadav
Director, CSIR-IHBT Palampur
director.ihbt@csir.res.in
01894-230411

# *Picrorhiza Kurroa* for the Management of Non-Alcoholic Fatty Liver Disease (NAFLD)

**TRL-7**

## Overview

CSIR-IHBT has developed an indigenous process for producing a phytopharmaceutical active pharmaceutical ingredient (pAPI) from *Picrorhiza kurroa*, a Himalayan medicinal plant traditionally used for liver disorders. Rich in bioactive compounds such as picrosides, the pAPI has shown promising efficacy against Non-Alcoholic Fatty Liver Disease (NAFLD). Following successful preclinical and clinical studies by CSIR-CDRI, an Investigational New Drug (IND) application was filed, and the candidate is currently undergoing Phase III multi-centre clinical trials. The technology addresses the growing global demand for effective therapies for NAFLD, a rapidly increasing metabolic liver disease.

## Functionalities

- Produces a standardized phytopharmaceutical API from *Picrorhiza kurroa* for the management of Non-Alcoholic Fatty Liver Disease (NAFLD).
- Utilizes picroside-rich bioactive compounds to improve liver health and support hepatoprotective therapy.
- Validated through preclinical and clinical studies, with the candidate currently in Phase III multi-centre clinical trials.
- Provides an indigenous plant-based therapeutic solution for the growing burden of metabolic liver diseases.

## USP/Key Features

- Green Process with Industrial scale
- Enriched with Iridoids and Phenolics
- CMC parameter found within permissible limits as per regulatory (Pharmacopoeias standards).
- Stable product.
- Chemically characterized as per Phytopharmaceuticals.
- Effective product for NAFLD (non-alcoholic fatty liver diseases).

## Implementation Status

- IND filed (DCGI): CSIR-CDRI & CSIR-IHBT; Clinical trial Phase-III is underway
- Technology Transfer to Themis Medicare Ltd. Mumbai, Maharashtra, India.

## Contact Details

Dr. Sudesh Kumar Yadav
Director, CSIR-IHBT Palampur
director.ihbt@csir.res.in
01894-230411

# Vitamin D Enriched Mushroom Technology

**TRL-7**

## Overview

Vitamin D deficiency is prevalent in more than 70% of the Indian population. Mushrooms are the only food source of Vitamin D for vegetarian population. The global market for Shiitake mushroom is estimated at USD 35 billion (4370 tons) as of 2025. Shiitake (*Lentinula edodes*) is an edible mushroom rich in Vitamin D precursor ergosterol. CSIR-IHBT has developed a technology for enhanced production of ergocalciferols (Vitamin D2) from shiitake mushroom using a cost-effective technology

## Functionalities

- Shorter crop cycle shiitakeen riched with Vitamin D2.
- Shorter cultivation time 2.5 to 3 months as opposed to 8-12 months in conventional processes.
- Utilizes low-cost substrates for production of mushroom and suitable for pan-India deployment.

## USP/Key Features

- Yield 0.5-0.6 kg/ 1 kg dry substrate.
- 250 mg of shiitake powder meets 100% RDA of Vitamin D.
- Improves vitamin D levels serum 25-hydroxyvitamin D (25-OHD) levels in human subjects.
- Cost-effective solution for improving and maintaining Vitamin D levels.

## Contact Details

Dr. Sudesh Kumar Yadav
Director, CSIR-IHBT Palampur
director.ihbt@csir.res.in
01894-230411

## Implementation Status

Licensed to SHGs, FPOs, and MSMEs; deployed through SFURTI in Sikkim, Nagaland, and Mizoram, benefiting nearly 700 farmers.

# Herbal Formulation for Immunity Modulation

**TRL-8**

## Overview

CSIR-IHBT has developed an indigenous herbal formulation for immunity modulation, designed for incorporation into a wide range of food, functional food, and nutraceutical products. Classified under the AYUSH category, the formulation contains bioactive herbal ingredients that support immune function and overall health, making it suitable for individuals with immunity-related concerns. The technology addresses the rapidly growing demand for natural immune-health products and offers significant commercial potential in the expanding global nutraceutical market, creating opportunities for value-added product development and technology commercialization.

## Functionalities

- Immunomodulator
- Enhance immune function, reduce the severity and duration of illnesses, and promote overall health and well-being.

## Contact Details

Dr. Sudesh Kumar Yadav
Director, CSIR-IHBT Palampur
director.ihbt@csir.res.in
01894-230411

## USP/Key Features

- Major ingredient orthodox Kangra tea (Black & Green), Moringa, Giloe, Tulsi, Ginger, Black pepper, Dalchini
- Green process
- Enriched in polyphenols such as catechins, rutin, hyperoside Isoquercetin, quercetin.
- The composition has antioxidant potential.
- Stimulates innate as well as adaptive immune response by regulating Th1 cytokine levels and modulates T cell subsets population in pre-clinical studies.

## Implementation Status

Technology Transfer to M/s Vigada Care Private Ltd., Delhi and M/s Rasvaidyashala, Jobner, Jaipur (RJ)

# Agrotechnology for Tulip Cultivation

**TRL-9**

## Overview

CSIR-IHBT has developed a comprehensive technology package for the commercial cultivation of tulips as a high-value cut flower under both open-field and protected conditions. The package includes optimized pre-planting practices, nutrient and irrigation management, integrated pest and disease control, and post-harvest handling to meet market standards. Tailored for temperate and mid-hill regions, the technology enhances flower quality, yield, vase life, and profitability while reducing production costs. It supports crop diversification, rural employment, and the sustainable growth of India's floriculture sector, catering to the rising domestic and export demand for premium tulips.

## Functionalities

- Scientific Cultivation: Standardized protocols for crop establishment, bulb treatment, planting, nutrition, irrigation, and integrated pest management ensure uniform flowering and higher productivity.
- Indigenous Bulb Production: Technologies for large-scale multiplication of disease-free tulip bulbs reduce dependence on imports.
- Post-Harvest & Market Linkages: Scientific harvesting, cold-chain management, packaging, and market integration enhance flower quality, shelf life, and farmer profitability.

## USP/Key Features

- Adapted for Temperate and Mid-Hill Agro-climatic Conditions.
- Dual Production System: Open Field and Protected Cultivation.
- Forcing Techniques for Market-Aligned Flower Production.
- Stage-wise Integrated Nutrient and Irrigation Management.
- Market-Oriented Post-harvest Protocols.
- Scalable and Adoptable by Small and Marginal Hill Farmers.
- Employment, Livelihood, and Crop Diversification Potential.

## Contact Details

Dr. Sudesh Kumar Yadav
Director, CSIR-IHBT Palampur
director.ihbt@csir.res.in
01894-230411

## Implementation Status

- Licensed and Deployed in association with two industries.
- Total area covered under these crops: 0.72 ha.
- Number of farmers associated: 110
- States covered: HP, Ladakh
- Revenue generation by the farmers:Rs 0.53 Cr.

# Agrotechnology of Lilium

**TRL-9**

## Overview

CSIR-IHBT has developed a comprehensive technology package for the commercial cultivation of Lilium under open-field and shade-net conditions. The package covers the entire production cycle, including quality bulb selection, pre-planting treatment, nutrient and irrigation management, microclimate regulation, integrated pest and disease management, and post-harvest handling. Tailored for temperate and mid-hill regions, the technology enhances flower quality, productivity, shelf life, and profitability while reducing production costs. It supports year-round production, strengthens India's floriculture sector, generates rural employment, and meets the growing domestic and export demand for premium Lilium cut flowers.

## Functionalities

- Standardized cultivation practices ensuring uniform growth, flowering, and high-quality bulb production.
- Integrated crop management optimizing nutrients, irrigation, pest control, and productivity.
- Indigenous disease-free bulb multiplication reducing import dependence and strengthening domestic supply.
- Scientific post-harvest management improving shelf life, marketability, and farmer returns.

## USP/Key Features

- Adapted for Temperate and Mid-Hill Agro-climatic Conditions.
- Dual Production System-Open Field and Shade Net.
- Bulb Production Through Scaling.
- Stage-wise Integrated Nutrient and Irrigation Management.
- Scalable and Adoptable by Small and Marginal Farmers.
- Employment and Livelihood Generation Potential.
- Promotes Crop Diversification from Traditional Field Crops.

## Contact Details

Dr. Sudesh Kumar Yadav
Director, CSIR-IHBT Palampur
director.ihbt@csir.res.in
01894-230411

## Implementation Status

- Licensed and Deployed in association with two industries.
- Total area covered under these crops: 4 ha
- Number of farmers associated: 540
- States covered: HP, Uttarakhand and Ladakh
- Revenue generation by growers: Rs 4.5 Cr

# Fortified Foods for TB recovery

**TRL-9**

## Overview

Tuberculosis patients suffer from malnutrition leading to anorexia, high inflammation and impaired immunity. An adult tuberculosis patient requires 58 to 73 grams proteins per adult, averaging 1 gram protein per kg body weight. Currently there are no specific nutrition programs for TB patients. Nikshay Mitra kits providing Take Home ration consisting pulses, cereals, vegetable oils and skimmed milk powder through respective district TB offices and NGOs. These interventions have poor compliances and quality assurance issues. In this regard, CSIR-IHBT developed protein and micronutrient fortified food products that can be provided as supplementary nutrition products to TB patients.

## Functionalities

- Promotes recovery from protein deficiency and associated morbidities such as oxidative stress and tissue damage (validated using pre-clinical models).
- Cost-effective products with prices less than Rs. 10.00 per single serving.
- Process validated at 500 kg per day scale and licensed to more than 30 MSMEs across India.

## Contact Details

Dr. Sudesh Kumar Yadav
Director, CSIR-IHBT Palampur
director.ihbt@csir.res.in
01894-230411

## USP/Key Features

- Energy and nutrient dense.
- Fortified with protein, iron, zinc, vitamin A, vitamin B12, Vitamin C, Folic acid.
- Rich in essential micronutrients iron and zinc (>25% RDA).
- 20% RDA protein per serving.
- Preservative free.

## Implementation Status

The products/technologies are commercialized to more than 30 MSMEs across India.The products are approved under State TB Mukht Bharat Abhiyaan. The nutrition supplementation programs have been conducted in collaboration with Directorate of Health, District TB office, Una, Himachal Pradesh benefitting 200 TB patients

# Nutritional Products (Poshan Abhiyan)

**TRL-9**

## Overview

CSIR-IHBT has developed a range of nutrient-rich functional foods to address protein-energy malnutrition (PEM) and iron deficiency anemia (IDA), two major public health challenges in India. The portfolio includes ready-to-eat energy bars, micronutrient-fortified premixes, multigrain protein mixes, and value-added millet products that provide balanced nutrition with long shelf life and high consumer acceptability. These products have been integrated into the POSHAN Abhiyaan (National Nutrition Mission) and are supporting the nutritional needs of nearly 7,000 malnourished children in Himachal Pradesh, offering a scalable solution for community nutrition programmes.

## Functionalities

- Promotes recovery from anemia & protein deficiency, validated both pre-clinically and through human intervention studies
- Cost-effective products with prices less than Rs. 10.00 per single serving
- Process validated at 500 kg per day scale and licensed to more than 30 MSMEs across India

## Contact Details

Dr. Sudesh Kumar Yadav
Director, CSIR-IHBT Palampur
director.ihbt@csir.res.in
01894-230411

## USP/Key Features

- Developed using nutrient dense, indigenous bioresources such as pulses, millets, pseudo-cereals and microbial proteins
- Meets 25% Recommended dietary allowances of proteins and iron
- Preservative free, shelf stable products
- Bioavailable proteins and micronutrients

## Implementation Status

- Mission Bharpoor at Kangra benefitting 1500 children aged 3 to 6 years
- Mission Jeevan Uphaar at Chamba benefitting 6000 children and 1000 lactating mothers
- WINGS scaleup program at Una benefitting 6 months to 3 years
- Janani Shishu Suraksha Karyakram, National Health Mission benefitting nearly 500 lactating mothers

# Technology for Artifact Making using Dry Flowers

**TRL-9**

## Overview

Dry flower technology involves the controlled dehydration and preservation of flowers and other botanicals to maintain their natural shape, colour, texture, and ornamental quality for prolonged time. The technology converts highly perishable floral biomass into durable, eco-friendly, value-added products such as, floral frames, greeting cards, floral arrangements and other floral artefacts. It promotes waste utilization, enhances income generation, supports women entrepreneurship, and creates sustainable livelihood opportunities.

## Functionalities

- Scientific drying and preservation of flowers and foliage for long-term use.
- Development of decorative and value-added floral products.
- Promotion of rural entrepreneurship and women empowerment through skill-based training.

## USP/Key Features

- Eco-friendly and sustainable utilization of floral waste and surplus flowers.
- High-value products with enhanced shelf life and market potential.
- Low-cost technology suitable for rural and small-scale enterprises.

## Contact Details

Dr. Sudesh Kumar Yadav
Director, CSIR-IHBT Palampur
director.ihbt@csir.res.in
01894-230411

## Implementation Status

Deployed through technology transfer to startups, SHGs, and enterprises across Himachal Pradesh, Punjab, and West Bengal for commercial dry flower production.

# Medha Plus: A Herbal Cognitive Health Formulation for Alzheimer's Disease

**TRL-9**

## Overview

CSIR-IICB scientifically validated the efficacy of Medha Plus, a herbal syrup developed by Parker Robinson Pvt. Ltd., containing aqueous extracts of six medicinal plants—Brahmi, Mandukaparni, Shankhapushpi, Yastimadhu, Kokilaksha, and Shunthi. Preclinical studies demonstrated that the formulation effectively reversed cognitive deficits and restored synaptic health in rodent models representing both sporadic and familial Alzheimer's disease. These findings establish its potential as a neuroprotective and cognition-enhancing therapeutic intervention, offering a promising herbal approach for managing dementia and age-related cognitive decline.

## Functionalities

- Protects neurons against β-amyloid-induced neurotoxicity.
- Improves learning, memory, and cognitive performance in sporadic and familial rodent models of Alzheimer's disease.
- Enhances synaptic integrity associated with cognitive function.

## Contact Details

Prof. Vibha Tandon
Director, CSIR-IICB, Kolkata
director.iicb@csir.res.in
+91-33-2473-5368

## USP/Key Features

- Herbal formulation with demonstrated safety and no observable toxic effects in preclinical studies.
- Cost-effective Ayurvedic product suitable for long-term use.
- Scientifically validated efficacy in preclinical models of Alzheimer's disease.

## Implementation Status

Licensed and deployed

# Cost-Effective Technology for Producing Delignified Rice Straw (DRS) with Enhanced Digestibility for Cattle Feed Applications

**TRL-6**

## Overview

Agricultural crop residues such as straws and stovers are abundant, low-cost feed resources for ruminants, but their utilization is limited by low crude protein, poor digestibility, and high lignin content. To address these challenges, CSIR-Indian Institute of Chemical Technology developed an advanced hydrodynamic cavitation-based pretreatment technology for efficient delignification and nutritive enhancement of crop residues. The technology offers a sustainable solution for reducing crop-residue burning and producing nutritionally enriched animal feed. It also promotes a circular bioeconomy by converting agricultural waste into high-value fodder through a zero-waste discharge process with additional value-added by-products.

## Functionalities

- Sustainable conversion of agricultural biomass into value-added animal fodder through integrated processing.
- High-efficiency, low-emission manufacturing using hydrodynamic cavitation technology.
- Commercially scalable circular economy solution reducing crop residue burning and agricultural waste.

## Contact Details

Dr. D. Srinivasa Reddy
Director, CSIR-IICT Hyderabad
director.iict@csir.res.in
+91-40-27193030

## USP/Key Features

- Converts agricultural crop residues into nutritionally enriched animal fodder, promoting circular bioeconomy and eliminating the food–feed conflict.
- Employs scalable hydrodynamic cavitation, thermo-mechanical and biotechnological processing with Zero Liquid Discharge, water recycling, and energy-efficient operations.
- Reduces crop burning, methane emissions, pollution, and landfill burden while enabling climate-resilient, cost-effective, and sustainable livestock production.

## Implementation Status

The technology is validated at 250 kg/day pilot scale: licensed to one industry, for 5 TPD commercialization by Hiras Agritech, Hyderabad

# Process to Manufacture High-Energy Rocket Propellant (CL-20) - Catalytic Process for Preparation of TAIW (Key Material for CL-20)

**TRL-6**

## Overview

Catalytic synthesis of TAIW, a precursor for CL20 high-energy propellant, using a low amount of catalysts starting from easily available raw materials. The process has been optimized with all steps, resulting in a yield of over 75%.

## Functionalities

- Use of a very low percentage of noble metal catalyst and recyclable.
- Operates under moderate conditions with minimal catalyst loading.
- The synthesis of catalysts is simple and does not require a reduction step, unlike conventional methods.

## USP/Key Features

- Enables indigenous production of CL-20, enhancing strategic autonomy.
- High strategic value in the defence and aerospace sectors.
- Missile and space propulsion systems.

## Contact Details

Dr. D. Srinivasa Reddy
Director, CSIR-IICT Hyderabad
director.iict@csir.res.in
+91-40-27193030

## Implementation Status

Technology transferred to premier explosives and it's producing the TAIW in commercial scale.

# Accelerated Anaerobic Composting (AAC) for the Conversion of Organic Wastes to Nutrient Rich Soil Conditioner

**· TRL-9 ·**

## Overview

Accelerated Anaerobic Composting (AAC) is a low-cost and efficient process for converting organic wastes such as market vegetable waste, water hyacinth, dry leaves, the organic fraction of municipal solid waste (MSW), and agricultural crop residues into nutrient-rich soil conditioner within a short duration, without any external energy or oxygen requirement.

## Functionalities

- Developed as a user-friendly and low-maintenance technology suitable for adoption by urban local bodies, institutions, and rural communities for decentralized organic waste processing.
- Facilitates faster stabilization of organic waste compared to conventional composting methods, thereby reducing land requirement and waste handling time.
- Demonstrates potential for large-scale implementation as a sustainable waste management solution aligned with resource recovery and environmental protection objectives.

## Contact Details

Dr. D. Srinivasa Reddy
Director, CSIR-IICT Hyderabad
director.iict@csir.res.in
+91-40-27193030

Water hyacinth was pulled inside the mesh area to allow phytoremediation and clean water

## USP/Key Features

- Accelerated Anaerobic Composting (AAC) enables efficient anaerobic composting of organic wastes without the requirement of external energy or oxygen, making the process simple, sustainable, and cost-effective.
- The technology facilitates complete compost formation within a shorter residence time of about 28 days under ambient temperature conditions, ensuring rapid waste stabilization.
- AAC minimizes carbon and nitrogen losses while preventing direct $CO_2$ and methane emissions into the atmosphere, thereby supporting environmentally sustainable waste management practices.

## Implementation Status

- CSIR-IICT demonstrated AAC technology through Kapra and Kudikuntla lake restoration, decentralized organic waste management across 47 Telangana market yards, and a 500 kg/day community unit for sustainable compost production.
- Technology licensed to 04 companies; No. of installations: 51

# Anaerobic Gas lift Reactor (AGR) - A high rate Biomethanation Technology for the Concomitant Treatment and Generation of Biogas and Fermented Organic Manure from Organic Wastes.

**· TRL-9 ·**

## Overview

The Anaerobic Gas Lift Reactor (AGR) technology developed by CSIR-IICT is an innovative "high-rate", technology for sustainable management and valorization of biodegradable organic wastes. The technology enables efficient conversion of market vegetable waste, food waste, OFMSW, and other biodegradable fractions into renewable biogas and value-added organic fertilizer. AGR technology addresses challenges related to waste disposal, greenhouse gas emissions, and fossil fuel dependency through an environmentally sustainable waste-to-energy approach. Suitable for decentralized and commercial-scale applications, the technology can be deployed in markets, institutions, municipalities, residential communities, and agro-industrial sectors, contributing towards renewable energy generation, resource recovery, circular economy, and net-zero sustainability goals.

## Functionalities

- Facilitates stable and continuous anaerobic digestion for efficient processing of high-moisture biodegradable organic wastes under controlled reactor conditions.
- Generates biogas suitable for combined heat and power (CHP) applications, contributing towards decentralized renewable energy generation and energy recovery.
- Produces nutrient-rich digestate that can be utilized as fermented organic manure, supporting sustainable agriculture and resource recovery practices.

## USP/Key Features

- Advanced two-stage anaerobic digestion with ammonia and sulfide inhibition control for stable, high methane production.
- Efficient reactor design featuring non-mechanical mixing, integrated three-phase separation, and compact footprint.
- Scalable technology (150 kg/day–10 TPD) producing renewable biogas and nutrient-rich NPK fertilizer.

## Implementation Status

Technology licensed to 13 companies; No. of installations - 35

## Contact Details

Dr. D. Srinivasa Reddy
Director, CSIR-IICT Hyderabad
director.iict@csir.res.in
+91-40-27193030

# Cost-effective and Scalable Process for the Synthesis of TLR 7/8 Agonist Molecule (IMDG), used as an Adjuvant in COVAXIN® (COVID-19 vaccine)

**· TRL-9 ·**

## Overview

CSIR-IICT developed a cost-effective, scalable, and chromatographic-free synthetic process for the TLR 7/8 agonist molecule IMDG, a key adjuvant used in COVAXIN®. The technology enabled kilogram-scale production using indigenous raw materials and was transferred to Bharat Biotech for commercial manufacture. It strengthened India's self-reliance in vaccine production, improved affordability, and supported large-scale immunization during the COVID-19 pandemic in India and abroad.

## Functionalities

- Enables synthesis of IMDG, the TLR 7/8 agonist used as a vaccine adjuvant in COVAXIN®.
- Enhances vaccine immunogenicity and supports a stronger protective immune response when used in the adjuvant system.
- Supports cost-effective kilogram-scale production for industrial vaccine manufacturing and deployment.

## USP/Key Features

- Cost-effective and scalable 10-step process suitable for bulk manufacturing.
- Chromatography free and environmentally benign process, reducing purification complexity and process burden.
- Developed using indigenously available raw materials, enabling rapid commercialization and self-reliant production.

## Implementation Status

Transferred to Bharat Biotech for commercial COVAXIN® production, enabling large-scale indigenous manufacturing and vaccine supply to India and ~50 countries.

## Contact Details

Dr. D. Srinivasa Reddy
Director, CSIR-IICT Hyderabad
director.iict@csir.res.in
+91-40-27193030

# Scaled-Up Plant for Production of Hydrazine Hydrate

**TRL-9**

## Overview

The innovation involves the indigenous development and commercialization of an advanced hydrazine hydrate production technology by CSIR-Indian Institute of Chemical Technology (IICT) and Gujarat Alkalies and Chemicals Limited (GACL). Using a novel peroxide-ketazine route, the process is energy-efficient, environmentally friendly, and enables solvent recovery with near-zero effluent generation. The technology supports India's "Atmanirbhar Bharat" initiative by reducing dependence on imports of a strategically important chemical used in agrochemicals, polymers, water treatment, pharmaceuticals, and aerospace applications. The 10,000 TPA commercial plant creates strong import substitution potential, export opportunities, and skilled employment generation in the chemical manufacturing sector. The first consignment has been flagged off in 2023.

## Functionalities

- Indigenous peroxide-ketazine process for high-purity, energy-efficient hydrazine hydrate production.
- Integrated solvent recovery system enabling near-zero effluent and sustainable manufacturing.
- Commercial-scale technology (10,000 TPA) supporting agrochemical, pharmaceutical, aerospace, and industrial applications.

## USP/Key Features

- First indigenous hydrazine hydrate technology in India, reducing import dependence and supporting the "Make in India" and "Atmanirbhar Bharat" initiatives.
- Novel peroxide-ketazine route offers higher yield, lower energy consumption, safer processing, and minimal environmental impact compared to conventional urea-based processes.
- Commercially validated and scalable technology with integrated solvent recovery, raw material recycles, and export-quality product specifications meeting international standards.

## Contact Details

Dr. D. Srinivasa Reddy
Director, CSIR-IICT Hyderabad
director.iict@csir.res.in
+91-40-27193030

## Implementation Status

Developed by CSIR-IICT with GACL, the indigenous hydrazine hydrate technology powers India's first 10,000 TPA commercial plant, operational since 2023.

# Approval of Hydroxyurea for Treatment of Sickle Cell Anemia (SCA) in India.

**TRL-9**

## Overview

Sickle cell anemia (SCA) is India's most common monogenic inherited blood disorder, highly prevalent among disadvantaged tribal populations. India accounts for nearly half of the 500,000 annual SCA births worldwide. This genetic disease affects the β-globin gene, causing red blood cells to sickle under low oxygen conditions. While hydroxyurea (HU) is a critical, disease-modifying therapy, it lacked approval for SCA treatment in India. To address this, CSIR-IIIM, through the SCA Mission project, collaborated with Cipla Ltd. to secure CDSCO approval. This milestone provides immense relief and accessible management to millions of Indian SCA patients.

## Functionalities

- Hydroxyurea elevates fetal hemoglobin (HbF): to dilute sickle hemoglobin (HbS), reducing its polymerization and preventing red blood cell sickling.
- Reduces clinical complications. It decreases the frequency and severity of painful vaso-occlusive crises, acute chest syndrome,and the need for blood transfusions.
- Improves survival and accessibility: It provides an affordable, orally administered therapy that lowers mortality rates in resource-limited settings.

## Contact Details

Dr. Zabeer Ahmed
Director, CSIR-IIIM Jammu
director@iiim.res.in
0191-2584999, 0191-2585222

## USP/Key Features

- Targets the root cause: It boosts fetal hemoglobin (HbF) to directly prevent cell sickling, whereas newer drugs like Crizanlizumab only manage secondary symptoms like cell stickiness.
- Decades of proven safety: It has over 30 years of data demonstrating that it prevents organ damage and lowers mortality.
- Curative options like bone marrow transplants or gene therapies carry high risks of severe immune complications.
- Low cost and highly scalable: It is an affordable daily oral pill that can be easily distributed to remote tribal areas.

## Implementation Status

The drug (Trade Name Cytodrox by Cipla Ltd.) is already available in the market. CSIR-IIIM, with the help of Cipla Ltd., facilitated its approval from CDSCO for the treatment of SCA patients in India.

# Briquetting of Pine Needles to Produce Biogenic Fuel for Industry, Rural Livelihood Generation and Forest Fire Mitigation

**TRL-7**

## Overview

CSIR-Indian Institute of Petroleum, in collaboration with Uttarakhand State Council for Science and Technology, is implementing a science and technology-based research project under the "Adarsh Champawat" mission. The project focuses on the scientific utilization of pine needles, which are otherwise a major cause of recurring forest fires in the Himalayan region. By converting pine needles into briquettes, the project aims to provide a renewable biogenic fuel for industrial applications while simultaneously addressing the issue of forest fire hazards. The project is contributing towards environmental protection, rural employment generation, women empowerment, and promotion of clean and sustainable energy resources in the region.

## Functionalities

Production capacity: 50-150 kg/h; Briquettes diameter: 30-40 mm; Briquettes length: 25 mm to 125 mm; Bulk density: more than 500kg/m³; GCV: 4500 –5000 kcal/kg.

## USP/Key Features

- Forest fire in pine forests is a major environmental issue.
- Pine needle briquettes are excellent biogenic fuel for domestic stoves, commercial furnaces, and boilers having calorific value comparable to coal or wood.
- The CO2 generated during the heating applications of pine needle briquettes is carbon neutral.

## Contact Details

Dr. Harender Singh Bisht
Director, CSIR-IIP Dehradun
director.iip@csir.res.in
0135-2660205, 2525709

## Implementation Status

The technology has been demonstrated at one location (village Bhingrara, Champawat District, Uttarakhand) with the financial support of Uttarakhand Council for Science & Technology (UCOST). Two more units are being installed in Champawat district

# Dual-Fuel Engine System

**TRL-7**

## Overview

In CSIR-IIP's dual-fuel engine technology, gaseous fuel is fumigated at the engine intake manifold to partially substitute diesel fuel in gensets. This technology helps achieve a reduction in particulate matter (PM) emissions from in-use diesel gensets. The technology has been transferred to an industrial partner, Upcharge Energy Solutions LLP, New Delhi.

## Functionalities

- Simultaneous use of PNG and diesel: Replaces up to 70% of diesel with PNG during mid- to high-load operations.
- Switches smoothly back to 100% diesel mode if PNG becomes unavailable.

## Contact Details

Dr. Harender Singh Bisht
Director, CSIR-IIP Dehradun
director.iip@csir.res.in
0135-2660205, 2525709

## USP/Key Features

- Achieves over a 70% reduction in particulate matter (PM) emissions.
- Ensures seamless performance in dual-fuel mode during frequent or sudden load changes
- High ROI potential: Lowers operational costs and ensures quick return on investment since PNG is cheaper than diesel.

## Implementation Status

One commercial unit supplied by UES is currently being installed for deployment in 320 KVA genset at CSIR-IIP, and efforts are underway to deploy three additional units in New Delhi.

# Single-Step Catalytic HEFA Process for Sustainable Aviation Fuel (SAF) from Waste Oils and Fats (DILSAAF™)

**· TRL-7 ·**

## Overview

CSIR-IIP's single step catalytic HEFA process converts used cooking oil, non-edible tree borne oils,
animal fats, and other waste lipids into drop-in Sustainable Aviation Fuel (SAF) and automotive
fuels. Using a non-noble metal catalyst in one reactor, it performs deoxygenation, cracking, and
isomerization simultaneously. A 9,000 TPA SAF demo plantis expected to be operational by mid
2027. The CSIR-IIP SAF is in the final stage of ASTM approval.

First test flight by Spice-jet (Dehradun to Delhi) with CSIR-IIP Bio-jet (25%) on 27th August 2018

## Functionalities

- Converts used cooking oil (UCO), plant oils, animal fats, and their mixtures into SAF and green diesel in a single reactor.
- Performs simultaneous deoxygenation, cracking, and isomerization to produce drop-in fuels matching petroleum-based jet fuel properties.
- Demonstrated SAF yield of 55-60% with fuel composition suitable for aviation use.

## USP/Key Features

- Patented non-noble metal catalyst enabling cost-competitive, single-step HEFA process.
- High feedstock flexibility – processes UCO, non-edible oils, palm fatty acid distillates, algae oil, fats, and blends.
- Commissioned 1TPD green diesel demo plant and a 9,000 TPA SAF demo plant is under construction with clear scale-up pathway
- Produces aromatics, which makes it potential for >50% blending with Jet-A1

## Contact Details

Dr. Harender Singh Bisht
Director, CSIR-IIP Dehradun
director.iip@csir.res.in
0135-2660205, 2525709

## Implementation Status

One ton per day (TPD) green diesel demonstration plant is operational and a 9,000 tonnes per annum (TPA) SAF demonstration plant is being set up.

# A Novel Energy Efficient Domestic Burner for Piped Natural Gas (PNG) and its Implementation for Clean Cooking Transition

**· TRL-9 ·**

## Overview

Piped Natural Gas, mainly methane, is widely used in India but often burned in retrofitted LPG stoves, compromising efficiency and safety. To address this, CSIR-Indian Institute of Petroleum (CSIR-IIP) has developed a dedicated PNG domestic burner. This self-aerated, partially premixed burner achieves over 68% thermal efficiency as per IS 17153 and offers up to 25% fuel savings. Designed using CFD and validated experimentally, it delivers 1.5 - 2.25 kW output at competitive cost for large-scale deployment.

## Functionalities

- Up to 25% Improved thermal efficiency over retrofitted LPG burners.
- Designed for safety against flame lift and flashback.
- Conforms to BIS 17153 specifications.

## Contact Details

Dr. Harender Singh Bisht
Director, CSIR-IIP Dehradun
director.iip@csir.res.in
0135-2660205, 2525709

## USP/Key Features

- The burner can replace approximately 1.5 crore inefficient retrofitted burners currently in use across India.
- The technology offers an annual fuel saving potential of about ₹5,000 million, along with a reduction of nearly 1 million tones of $CO_2$ emissions.
- The technology has strong potential to boost the MSME sector, with an estimated market size of ₹1000 Crores.

## Implementation Status

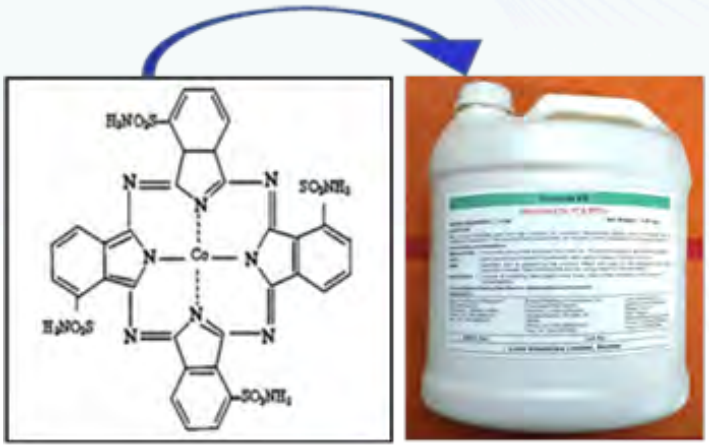
The technology has been transferred to forty two (42) stove manufacturing MSME companies of India. The technology has been commercialized and the product is already available in the market.

# A Novel LPG Sweetening Catalyst

**· TRL-9 ·**

## Overview

The process for converting mercaptans into less deleterious disulfides is termed as sweetening. CSIR-IIP and BPCL have developed a homogeneous sweetening catalyst, Thoxcat ES™, which helps conversion of mercaptans present in LPG into disulfides in a very cost effective manner. Mercaptans are undesirable due to their foul smell, corrosive nature and adverse effects on downstream catalysts. The mercaptans present in LPG are first extracted with alkali and subsequently oxidized in presence of Sweetening Catalyst in to disulfides. Lona Industries is our licensed manufacturing partner



## Functionalities

- Extractive sweetening of LPG
- Liquid-liquid sweetening of lighter petroleum fractions like naphtha or light cracked gasoline
- Higher activity, comparable stability compared to other commercial sweetening catalysts

## USP/Key Features

- Drop in Catalyst - No changes in existing LPG Sweetening plant required
- Lower catalyst consumption due to higher activity
- Competitively priced, cost effective with shelf life of 3 years

## Implementation Status

It has been deployed in 12 Indian Refineries and two foreign refineries

## Contact Details

Dr. Harender Singh Bisht
Director, CSIR-IIP Dehradun
director.iip@csir.res.in
0135-2660205, 2525709

# Advanced Vacuum Swing Adsorption for the Upgradation of Raw Biogas to Renewable Bio-methane (AVSAR Bio-Methane)

**· TRL-9 ·**

## Overview

Biogas is a complex gas mixture formed by anaerobic decomposition of organic matter. It primarily consists of methane (CH ): 55-65%, carbon dioxide (CO ): 30-40%, hydrogen sulphide (H S): 0.05-3%, and is saturated with moisture. The presence of CO , H S, and moisture in raw biogas are critical barriers for its effective utilization as fuel as they lower calorific value and brings pipeline corrosion and toxicity problems. CSIR-Indian Institute of Petroleum (CSIR-IIP) has developed an advanced adsorptive process which can upgrade raw biogas to pipeline quality biomethane at high recovery (>97%), meeting BIS 16087 (2025) specifications, suitable for vehicular and industrial fuel applications.

## Functionalities

- The vacuum swing adsorption technology is designed to operate at moderate pressure considering low pressure availability of biogas
- H2S and moisture removal is integrated upstream of the CO removal along with CH4 enrichment process scheme
- Ensures high recovery and purity of bio-methane (≥ 98%) meeting BIS 16087 (2025) specs.

## USP/Key Features

- CSIR-IIP's patented and trademarked
- (AVSAR-Biomethane) Technology
- Improved Vacuum Swing Adsorption (VSA)
- cycle with better thermal management.
- Very high adsorbent life >6 years.
- CAPEX of Membrane technology is ~30%
- higher than CSIR-IIP's AVSAR technology
- and ~25% higher in terms of Energy
- Consumption
- High Pressure Water Scrubbing CAPEX is
- comparable to AVSAR but energy
- requirement is ~20% higher

## Contact Details

Dr. Harender Singh Bisht
Director, CSIR-IIP Dehradun
director.iip@csir.res.in
0135-2660205, 2525709

## Implementation Status

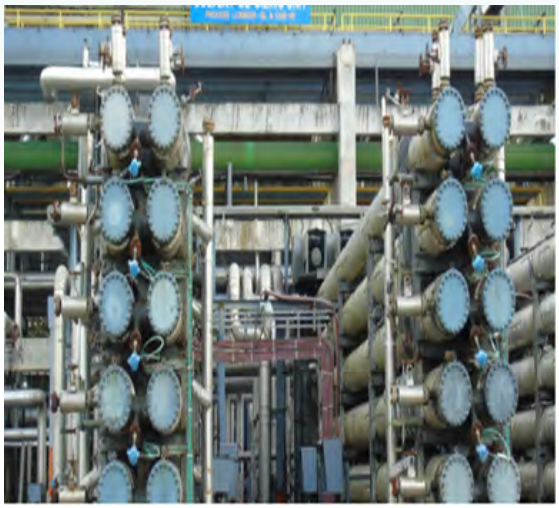
A plant is running based on CSIR-IIP technology at 2TPD biomethane production The technology has been licensed to two companies.

# CSIR IIP-EIL-NRL Wax De-oiling Technology For Production of Paraffin and Micro-Crystalline Waxes

**· TRL-9 ·**

## Overview

CSIR-IIP along with Engineers India Limited has developed a Wax De-oiling Technology for Production of Paraffin Waxes from Wax-rich Vacuum Gas Oil (VGO) and NRL has set up a Wax plant with capacity of 50,000 TPA of Paraffin Wax with an investment of ~₹ 676 Crores. This investment has increased refinery profitability by ₹127 crores/annum, corresponding to enhanced gross refining margins by US $ 0.90 per barrel. Wax production at NRL cut down India's wax import by ~50% and saved foreign exchange of ~US $50 million (Rs. 450 Crore/annum) and NRL has started export of Paraffin Wax to more than 35 countries.



## Functionalities

- CSIR-IIP 'Wax De-oiling Technology' involves processing of Waxy Distillates in series of steps comprising 'Extractive Fractional Crystallization', 'Filtration' and 'Solvent Recovery' and uses Methyl-Iso-Butyl Ketone (MIBK) solvent to produce 'Paraffin Wax'
- Paraffin Wax is used for making Candles, Polishes, Food Packaging, Cosmetic Industry and Medicinal applications etc.

## USP/Key Features

- Energy-efficient solvent de-oiling technology with optimized solvent utilization and controlled crystallization for improved wax recovery.
- Advanced two-stage filtration process ensuring high product quality and operational efficiency.
- Pinch analysis-based process optimum fuel-fired furnace requirements, reducing costs and carbon footprint.

## Contact Details

Dr. Harender Singh Bisht
Director, CSIR-IIP Dehradun
director.iip@csir.res.in
0135-2660205, 2525709

## Implementation Status

Licensed and deployed

# Eco-friendly and Energy Efficient Jaggery Making Plant (Gur Bhatti) for Sugarcane Farmers of India and its Wide Implementation

**· TRL-9 ·**

## Overview

CSIR-Indian Institute of Petroleum took an initiative to develop an eco-friendly & energy efficient Jaggery plant (aka Gur Bhatti) to revive this rural industry and support sugarcane farmers through low cost improved combustion techniques. An improved three pan & four pans Jaggery plant of conventional capacity was designed. The overwhelming performance of (25% fuel saving & 15% increased production capacity) the installed plant gathered the attention of many farmers in the states of Uttar Pradesh & Uttarakhand. This resulted in the quick adoption by farmers. As a result, total 69 such units have already been installed in the rural areas of Uttar Pradesh, Uttarakhand and Odisha that are running successfully providing employment to hundreds of locals and additional income in lakhs of rupees annually.

## Functionalities

1 ton/day production capacity; 25% Fuel Saving compared to conventional; 15% Increased daily production capacity; 85% Smoke Reduction; Payback of one season.

## USP/Key Features

- Jaggery making is among the major agro processing industries found in rural India.
- CSIR-IIP successfully developed a 100% indigenous jaggery-making plant with 25% fuel saving and 15% increased production using locally available raw materials and fuels.
- This technology lowers the emissions and increases the production capacity.

## Contact Details

Dr. Harender Singh Bisht
Director, CSIR-IIP Dehradun
director.iip@csir.res.in
0135-2660205, 2525709

## Implementation Status

Total 69 such units have already been installed in the rural areas of Uttar Pradesh, Uttarakhand and Odisha.

# Pressure Vacuum Swing Adsorption (PVSA) Technology for the Generation of Medical Grade Oxygen ($MO_2$) Meeting I.P. 2018-PSA-Oxygen Specifications for Onsite Hospital Use

**· TRL-9 ·**

## Overview

Oxygen makes up 21% of the air. However medical applications require a higher concentration of oxygen. As per Indian Pharmacopeia Standards I.P. 2018 (PSA Oxygen), the allowable composition of the Medical Grade Oxygen (MO ) is 93±3% O , CO : ≤300 ppm, CO: ≤5ppm. During the COVID pandemic there was a steep upsurge of MO2 requirement. CSIR-Indian Institute of Petroleum developed an efficient Pressure Vacuum Swing Adsorption Technology with improved recovery of medical grade oxygen for patients. The technology was implemented in 108 Govt. health care facilities across India during the COVID pandemic at 30m³/h/plant MO throughput under PMCARES funding through DRDO.

## Functionalities

- PVSA-based oxygen generation system removes moisture, nitrogen, and impurities using advanced composite adsorbents.
- Twin-tower cyclic operation enables continuous oxygen production through automated adsorption and regeneration.
- Delivers 93±3% pure medical oxygen with stable pressure supply for uninterrupted patient care.

## Contact Details

Dr. Harender Singh Bisht
Director, CSIR-IIP, Dehradun
director.iip@csir.res.in
0135-2660205, 2525709

TRL-3
Bench Scale Study

TRL-5
Pilot Scale (100 LPM)

TRL-7
Field Demonstration at ACH, Pune

TRL-9
Commercial Deployment (500 & 1000 LPM)

## USP/Key Features

- Two times higher N working capacity achieved due to a vacuum regeneration
- step applied during in-situ regeneration of N2 loaded bed
- The layered bed adsorber design resulted in 50% lower adsorbent requirement compared to conventional PSA
- IoT enabled features helps remote monitoring of the process performance

## Implementation Status

- Transferred to 7 companies including MSMEs, PSUs, and MNCs for large-scale deployment.
- Commissioned 148+ medical oxygen plants across 14 states and 2 UTs, supporting over 10,000 hospital beds.
- Enabled reliable oxygen supply during COVID-19, generating employment and strengthening healthcare infrastructure.
- Demonstrated Atmanirbhar Bharat success through indigenous oxygen generation technology and robust field performance.

# Simultaneous Production of US-Grade Gasoline and High-Purity Benzene

**TRL-9**

## Overview

The technology is an advanced solvent-based process for selective benzene recovery and reduction of benzene content in FCC gasoline streams without requiring prior hydrogenation. The process utilizes a highly stable and adaptable solvent system, resulting in lower energy consumption, minimized solvent losses, improved product quality, and enhanced operational efficiency. Developed jointly by CSIR-Indian Institute of Petroleum and Reliance Industries Limited, the technology was successfully commercialized through the world's first industrial scale unit at Jamnagar. The innovation has significantly benefited the refining sector by enabling production of cleaner gasoline with reduced benzene content while preserving octane value, thereby supporting environmental compliance, improved fuel quality, and refinery profitability.

## Functionalities

- Energy-efficient extractive distillation technology producing US-grade gasoline and high-purity benzene simultaneously.
- Compatible with multiple refinery and bioderived feedstocks for efficient aromatic recovery.
- Supports stricter gasoline benzene standards while improving refinery sustainability and product quality.

## USP/Key Features

- First of its kind technology in India for recovery of high value benzene from FCC Naphtha
- Process does not require any feed pretreatment like selective hydrogenation for removal of reactive di-olefins or sulfur
- Solvent system is thermally and chemically stable at the operating conditions even in the presence of reactive impurities like oxygenates, sulfur and di-olefins in feedstock. The entire process is designed for effective heat integration between process units and to minimize solvent loss through product streams.

## Contact Details

Dr. Harender Singh Bisht
Director, CSIR-IIP Dehradun
director.iip@csir.res.in
0135-2660205, 2525709

## Implementation Status

One 0.6 MMTPA plant based on this technology was successfully commercialized at RIL Jamnagar in May 2016 and has been in successful operation since then.

# Soaker Internal Visbreaking Technology

**· TRL-9 ·**

## Overview

CSIR-IIP has developed Soaker Internal Visbreaking Technology for production of ultra stable fuel oil and lighter hydrocarbons from heavy vacuum residues. Earlier, IIP developed soaker visbreaking technology and it was commercialized in seven different Indian refineries meeting more than 80% of fuel oil demand in India. Subsequently, this soaker visbreaking technology has been upgraded to Soaker Internal Technology. In this upgraded technology, internals have been designed to reduce back-mixing and hence to minimize weeping and pressure drop. It also provides uniform gas-liquid hold-up profiles, improves residence time distribution and less coking.

## Functionalities

- Production of high quality fuel oil from waste material
- Lighter transportation fuels are produced in higher quantity. Refinery will save substantial amount of cutter stock (diesel) to dilute the viscous residual oil.

## USP/Key Features

- Internals and its arrangement inside the reactor.
- Energy is saved as the same conversion is achievable at lower temperature.
- Low cost and very easy to implement without any major change in the hardware of the existing unit.

## Contact Details

Dr. Harender Singh Bisht
Director, CSIR-IIP Dehradun
director.iip@csir.res.in
0135-2660205, 2525709

## Implementation Status

Commercial plants are running at HPCL Vizag, IOCL-Mathura and Haldia

# TERAFIL Water Purification Technology

**TRL-9**

## Overview

TERAFIL is a low cost and sustainable water purification media produced from materials like clay, sand and saw dust. It provides an efficient treatment and filtration method for turbid and high iron containing water into clean drinking water for domestic and community applications. Quality of product water is within BIS limits, particularly for turbidity & iron. Average life of TERAFIL filter media is more than 03 years. Employments can be generated through production and marketing of TERAFIL water filters in various capacity. TERAFIL water purification systems are developed in different capacities ranging from 50 to 100,000 lit/day through gravity filtration.

## Functionalities

- Turbidity removal : > 99 %
- Iron removal :90-95 %
- Life cycle : > 03 Years or 20,000 liters per cartridge.
- Cost of filtration : 02-03 paisa/liter (including Filtration unit, Operation & maintenance cost)
- Filtration capacity : 50-100000 LPD (Scalable to any capacity as per the requirement)
- Electricity not required for its operation.

## Contact Details

Dr. Ramanuj Narayan
Director, CSIR-IMMT Bhubaneswar
director.immt@csir.res.in
+91-674-256-7126, +91-674-237-9400

Community size TERAFIL Water Purification Unit (60,000 liters/day)

Domestic TERAFIL Water Filter Units

## USP/Key Features

- Sustainable low-cost water purification using clay, sand, and sawdust-based TERAFIL media.
- High removal efficiency for turbidity (>99%) and iron (90–95%) with BIS-compliant water quality.
- Electricity-free gravity filtration with scalable capacity (50–100,000 LPD).
- Long-life, economical solution with over 3 years filter life.

## Implementation Status

Commercialized through technology transfer to 128 MSMEs/Government agencies, with 50,000+ TERAFIL filtration units deployed nationwide.

# NJ-100 Indigenous Small Gas Turbine Engine

**TRL-6**

## Overview

NJ-100 is a Small Gas Turbine (SGTE) is a 1 KN Thrust turbojet engine developed indigenously by CSIR-NAL. This engine is a suitable for power plant for UAVs, Drones & Cruise Missiles. Every component of the core engine has designed in house & manufactured within the country. The engine has successfully undergone 2 Builds of Prototype 1 (PT-01)

NJ-100

## Functionalities

- Centrifugal Compressor
- Vaporizer Combustor
- Axial Turbine
- Convergent Nozzle
- Integrated Bearing Housing
- Two Bearing System
- Lubrication: Fuel
- Starting: Pneumatic/Electric Motor assist

## Contact Details

Dr. Abhay Anant Pashilkar
Director, CSIR-NAL Bengaluru
director.nal@csir.res.in
+91-80-25086000

## USP/Key Features

- Design Sea-level Static Thrust: 1000 N
- Engine Speed: Approx.: 50,000 rpm
- Self-sustaining Speed: 10,000 rpm
- Engine Pressure Ratio: 4:1
- Specification Fuel Consumption: 0.119 kg/ N.h
- Max. Diameter: 292 mm
- Engine Weight: 21 kg
- 100 kg-f thrust small gas turbine engine aimed at tactical UAVs and cruise missiles. It was successfully tested to 100% of engine design speed.

## Implementation Status

CSIR-NAL is exploring for transfer of technology licensing to the potential industry for manufacturing and commercialization in India.

# Q Plane

**· TRL-6 ·**

## Overview

NAL Q plane is all electric, lightweight UAV with vertical take-off and landing capabilities operating completely autonomously. Qplane has modular design that allows for swift assembly and effortless transportation, thereby simplifying field operations. Offering competitive performance and reliability , the NAL Qplane stands as the ultimate indigenous choice for surveillance, reconnaissance or exploration missions.

## Functionalities

- Composite Airframe
- All electric UAV
- Vertical take-off and landing
- 4kg payload (30kg AUW)
- Range of 30KM
- Endurance of 70min
- Gimballed camera (EO/IR/EO+IR)
- Last mile Delivery Payload

## Contact Details

Dr. Abhay Anant Pashilkar
Director, CSIR-NAL Bengaluru
director.nal@.res.in
+91-80-25086000

## USP/Key Features

- Dimensions: Wing Span: 4.0m, Length: 2.3m, Height: 1.0m
- Empty weight 16 kg; payload 4 kg; MTOW 30 kg.
- Endurance: Fixed Wing Mode: 70min, Quad Mode: 10min
- Flying Speed:Cruise Speed: 23ms-1, Max crooswind: 10ms-1, Stall Speed: 15ms-1
- Altitude: Operational Altitude: upto 1000m AGL, Max. Launch Altitude: 5000m AMSL
- Range 20 km, 80 min fixed-wing endurance, 10 min quad mode and TRL 5

## Implementation Status

The technology has been transferred to M/s. KRR Aerospace Private Limited for manufacturing and commercialization in India and Abroad.

# JALDOST Airboat

**TRL-7**

## Overview

First Indigenous advanced cleaning airboat system at relatively low cost for clearing weeds and garbage and maintenance of lakes furthering to clean water mission. The JALDOST has closed airtight pontoon type hull to make it inherently unsinkable. It has hybrid propulsion system comprising air propulsion and paddle wheel propulsion. Paddle wheel propulsion is useful for turning maneuvers and for reversing operations. Air propulsion provides additional thrust to travel faster to shore and return.

## Functionalities

- 12-ft JALDOST evolved into a 40-ft floating earthmover, achieved TRL 9, and was used by BBMP for cleaning lakes across Bengaluru.
- Collection width 7 feet, cutting depth upto 3 feet below water
- Cleaning area approximately 1 acre in 8 hrs (5400 sqft per hour) depending on type of vegetation.
- Fuel Consumption 5 litres of diesel per hour.

## USP/Key Features

- An aerospace technology based spin off societal product for cleaning waterbodies
- Mechanised system to pick up the floating trash as well as rooted aquatic weeds and excess vegetation.
- Capable to move on lower depth even in shallow waters.
- Enabled to transfer the collected wastes directly to ground vehicles
- Closed pontoon type stainless steel hull makes it inherently unsinkable.

## Contact Details

Dr. Abhay Anant Pashilkar
Director, CSIR-NAL Bengaluru
director@nal.res.in
+91-80-25086000

## Implementation Status

- JALDOST technology has been transferred to M/s Srivari Engineering Systems Pvt. Ltd. for manufacturing and commercialization in India and Abroad.
- M/s. Srivari Engineering Private Limited is in process for exploring the product for commercialization.

# HANSA New Generation (NG) Aircraft Production

**TRL-8**

## Overview

HANSA-3(NG) is a two-seat, all-composite, low-wing, single-engine light aircraft developed for ab-initio pilot training IFR certification work is being pursued using CS-23 Amendment 6, with a maximum all-up weight of 750 kg. It features dual controls, a full bubble canopy, an all-glass cockpit, ergonomic seating, and ample baggage space for enhanced comfort and visibility. Offering excellent flying characteristics, it delivers a climb rate of 570 fpm, cruise speed exceeding 100 KCAS, a stall speed of 42 KCAS, and a take-off distance of about 1,600 feet over a 50-foot obstacle. The aircraft received DGCA Type Certification and TCDS in 2023.

## Functionalities

- India's first all-composite light two-seat aircraft for pilot training, sport, and recreational flying.
- Advanced avionics and engine systems including glass cockpit, digital monitoring, and fuel-efficient Rotax engine.
- Enhanced safety and comfort features with lightning protection, day/night VFR capability, and panoramic bubble canopy.
- Improved operational efficiency through lightweight design, faster manufacturing, Li-ion battery system, and baggage provision.

## Contact Details

Dr. Abhay Anant Pashilkar
Director, CSIR-NAL Bengaluru
director.nal@csir.res.in
+91-80-25086000

## USP/Key Features

- Wingspan: 10.47m; Length: 7.658m; Height: 2.614m
- Max All Up Weight : 750 Kg
- Max Service Ceiling : 10,000 ft
- Stall speed : 48 KCAS (Flaps Up); 43 KCAS (Flap 20 deg)
- Max. Cruise Speed @SL & ISA: 98 KCAS
- Max Range @ 8,000 ft & ISA
- Single Pilot: 620 nm + 30 min. reserve
- Pilot+ Occupant: 440 Nm+ 30 min. reserve
- Max Endurance @ 8,000 ft & ISA
- Single Pilot: 7hrs+30 min. reserve
- Pilot+ Occupant: 5hrs+30 min. reserve
- Max Usable Fuel: 95L

## Implementation Status

- CSIR-NAL licensed HANSA-3(NG) technology to M/s. Pioneer Clean Amps Pvt. Ltd., Mumbai; One Production-standard aircraft has also been manufactured.
- Commercial deployment: Under progress.

# Octa-Copter Drone

**TRL-8**

## Overview

Multi-copter Drone Technology Quadcopter, Hexacopter and Octcopter for Emergency Medicine Deliveries, Agricultural Pesticide Spraying/Hyper Spectral Imaging and Geo-Physical Exploration. The drones having Pay-load ranges from 5 kg to 20 kg, Maximum range upto 25 km and Max. operational altitude < 500m AGL.

## Functionalities

- Lightweight Composite airframe
- Fully autonomous BVLOS operations from take-off to landing
- Folds to 1/3 of its size for easy transportation
- Safe flight operations up to two motors failure
- Robust & Reliable design with in-built system redundancies
- Digital sky compliant
- User friendly Ground Control Station for easy mission planning
- Interchangeable payload capability for wide variety of applications.

## Contact Details

Dr. Abhay Anant Pashilkar
Director, CSIR-NAL Bengaluru
director.nal@csir.res.in
+91-80-25086000

## USP/Key Features

- Max. Payload: 10 kg
- Max. Flying Speed: 36Kmph
- Max. Range: 20Km
- Max. Operational Altitude: <500m AGL
- Max. Launch Altitude: 3 km MSL
- Wind Resistance: up to 10m / sec
- Landing / Take off: Non Line of sight landing / takeoff at payload delivery point
- Regulatory Compliance: DGCA-NPNT, Digital Sky, Geo Fencing, 360 Degree Collision Avoidance
- Certification: Flight permit based on the Drone Rules, 2021

## Implementation Status

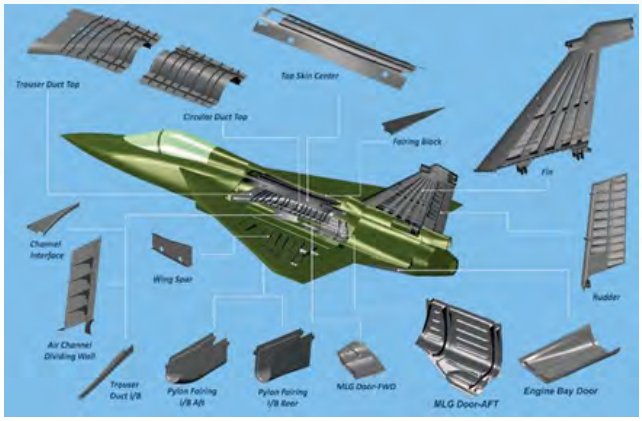
The multicopter drone technology has been transferred to 11 industries across India for manufacturing and commercialization, including companies in Indore, Ahmedabad, Bengaluru, Hyderabad, Chennai, and Delhi, supporting its large-scale production and deployment across diverse applications.
Deployed: No

# Composites for Airframe-Indigenous Production

**TRL-9**

## Overview

The Advanced Composites Division (ACD) has pioneered the design & development of composite structures using innovative and cost-effective manufacturing technologies including co-curing/co-bonding constructions. ACD-NAL has played a pivotal role in the development of the Fin & Rudder, Wing Spars, Wing Fuselage Fairings, Fairings blocks, Centre Fuselage parts & Undercarriage doors. The innovative technologies developed by CSIR-NAL not only reduce the cost but also improve structural efficiency by minimising the number of mechanical joints. The innovations have resulted in more than 20% savings in cost and 25% reduction in weight.




## Functionalities

- Provides aerodynamic stability and directional control for the LCA-Tejas fighter aircraft.
- Enables precise yaw control during tactical maneuvers and crosswind operations.
- Carbon-fiber composite design offers radar signature reduction and lightweight high-strength structure.
- Reduces aircraft weight by eliminating heavy rivets and fasteners through co-cured manufacturing.

## USP/Key Features

- Weight Reduction: Achieves an impressive 25% reduction in overall weight compared to traditional metallic or mechanically jointed components.
- Cost Efficiency: Cuts fabrication and production costs by more than 20%.
- Structural Integrity: Minimizes the number of mechanical joints, reducing stress concentration and fatigue points while improving aerodynamic efficiency.
- Strategic Self-Reliance: Developed indigenously during international sanctions, using homegrown autoclaves to establish sovereign aerospace manufacturing capabilities

## Contact Details

Dr. Abhay Anant Pashilkar
Director, CSIR-NAL Bengaluru
director.nal@csir.res.in
+91-80-25086000

## Implementation Status

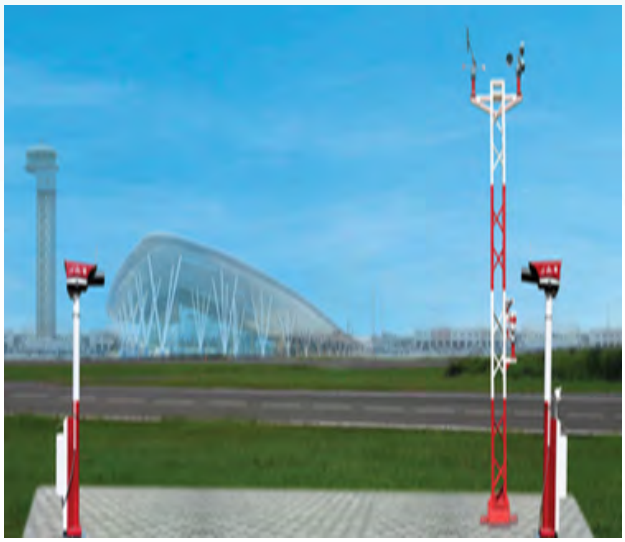
Licensed Agreement signed with M/s. Hindustan Aeronautics Limited for transfer of Design Know-how of Fin & Rudder parts/assemblies for Series Production of LCA-Tejas

# Drishti Transmissometer

**TRL-9**

## Overview

DRISHTI gives runway visibility information to pilots and AWAS gives information on weather parameters like wind speed, wind Direction, Pressure, Humidity, Temperature and Dev Point on the runway. The weather sensors are mounted an a Frangible - Flexible 10 meter ecofriendly free standing mast with provision for ease of maintenance of sensors. The above parameters are very essential for airports aiding safe landing and takeoff operations of the aircrafts.



## Functionalities

- DRISHTI and AWMS provide essential visibility and meteorological information required for safe airport operations.
- Drishti Measures visibility on the runway and is reported to pilots through Air Traffic Control Room.
- AWMS measures all the weather parameters required for airport operations wherein the weather sensors are mounted on a 10 meter Mast as per the requirement of International Civil Aviation Organization.

## Contact Details

Dr. Abhay Anant Pashilkar
Director, CSIR-NAL Bengaluru
director.nal@csir.res.in
+91-80-25086000

## USP/Key Features

- Baseline: 30m
- Measurement Range of visibility: 10-10000m
- Reporting Range: MOR: 10-3000m RVR: 50-2000m
- Pressure: 600 to 1100 hpa
- Temperature: -40 to +60 Degree Celsius
- Relative Humidity: 0 to 100%
- Wind Speed: 0 to 100 knots
- Wind Direction: 0-360 Degree
- Visibility: 10 - 10000m
- Meets ICAO & WMO Requirements

## Implementation Status

- CSIR-NAL had signed technology license agreement with 2 Industries namely M/s. Central Electronics Limited, Ghaziabad and The Tata Power Company Limited for manufacturing and commercialization of the technology in India and Abroad.
- 177 units have been deployed

# Engine Bay Door Parts for Tejas Mk1A

**· TRL-9 ·**

## Overview

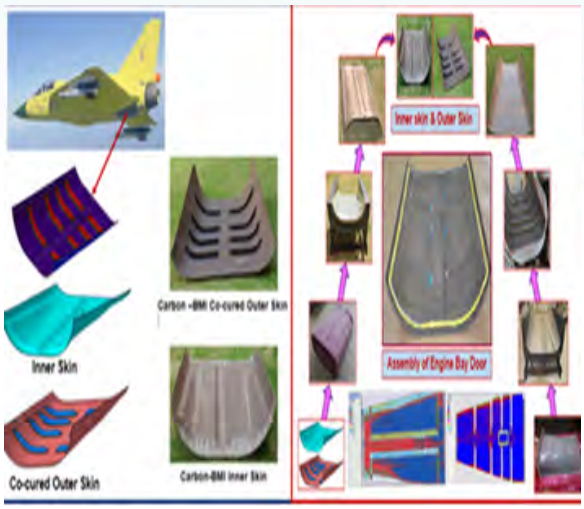
Most of the composite structures for the aircraft have been developed using carbon-epoxy prepreg material system, which can withstand maximum service temperature of 120° C temperature. Hence this material system cannot be used in the hot zones like Engine vicinity areas. Carbon-BMI materials are used on some of the most important and complex high performance application ranging from military programs such as US Air force F 22 to Formula-1 race cars. This technology is useful for emerging aircraft engine programs for the development of Composite fan blades, fan cases etc. This development opens a new segment in the composite processing technology, where composite can be used up to service temperature of 230 degree C in any engineering sector.

## Functionalities

The processing of Carbon-BMI is very tricky, because the resin become very thin as viscosity reaches 8-10 centipoises at higher temperatures. Hence retaining the resin within laminate is a major challenge. They emit volatiles and moisture during curing. Therefore, proper venting is necessary during the curing of these resins; otherwise, it may cause process-related defects such as voids and delaminations.

## Contact Details

Dr. Abhay Anant Pashilkar
Director, CSIR-NAL Bengaluru
director.nal@csir.res.in
+91-80-25086000




## USP/Key Features

Engine Bay Door parts are savings in weight and performance can be maximized using cocuring technology. This results in large reduction of fabrication cycle time, cost and weight. Cocured structures have fewer fasteners which results in shorter assembly cycle time and also reduce sealing issues. Hence, composite materials are the materials of choice for the designer today. It is not only sufficient to reduce the weight, but to make it cost effective.

## Implementation Status

Engine Bay Door Technology has been transferred to M/s. Hindustan Aeronautics Limited for manufacturing and commercialization in India.
Deployed: Yes.

# Indigenous Autoclave Technology

**TRL-9**

## Overview

CSIR-NAL has successfully developed state-of-the-art Indigenous Autoclave Technology for processing advanced light weight composites that are integral to modern's day civil and military airframe. The size of autoclaves developed range from smaller lab scale to very large scale size up to 5m working Dia and 12m working length. The operating temperature can be as high as 425 Deg C and Pressure up to 15 barg. This will meet the requirement of Aerospace Industry, Research and Educational Institute.

Industrial grade Autoclave

Lab scale Autoclave

Power panel for Industrial grade Autoclave

Desktop Autoclave

## Functionalities

- Fail safe and easy to operate
- Auto, semi-auto and manual modes of operation
- Davit arm/ Hinged door with lock ring less design
- Pressurized motor with health Monitoring
- PC, PLC, Front-end controllers and Recorder based C&I architecture
- Multiple level safeties
- Heater power steering logic
- Advanced insulation system for minimal energy losses
- Identification and management of single point failures
- Advanced process control software with remote monitoring
- Master and stand by computer control

## USP/Key Features

- Autoclaves for manufacture of airworthy composite components
- CSIR-NAL with its expertise has developed autoclaves over the years for aerospace applications from Desktop size to Labscale to Large industrial grade autoclaves
- Desktop: 450mm dia, 500mm Length, 200°C, 7 bar
- Lab scale: 0.9m Dia, 1.0m Length, 200°C, 7 bar
- Industry Grade: Up to 5m Dia, Up to 13m Length, Upto 425°C, 15 bar

## Implementation Status

Transferred to 6 industries for lab, industrial, and desktop autoclave manufacturing, with 9 autoclave systems deployed.

## Contact Details

Dr. Abhay Anant Pashilkar
Director, CSIR-NAL Bengaluru
director.nal@csir.res.in
+91-80-25086000

# NALSUN-NG™ Solar Absorber Coating

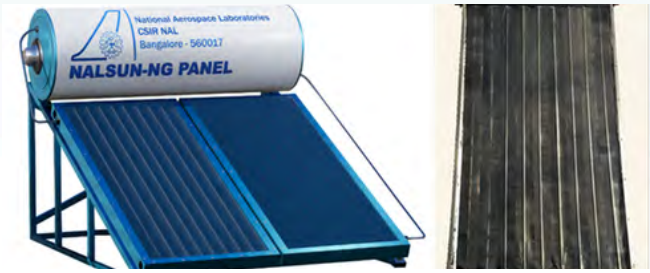
**· TRL-9 ·**

## Overview

Solar energy is an unlimited source of renewable energy, which can be utilized in energy production to generate both heat and electricity. India is a tropical country, and solar energy is abundant throughout the year. Solar thermal conversion is the simplest and most direct method of harnessing solar energy. In the late 1980s, CSIR-NAL developed NALSUN solar absorber coating technology for domestic water heater applications using the electrodeposition method. However, the currently in use conventional coating is carcinogenic owing to hexavalent chromium and its disposal is a challenge. In addition, there is a need to develop a cost effective, eco-friendly, and easily scalable coating technology that is not available in the country.

## Functionalities

The technology uses non-hazardous raw materials and an eco-friendly water-borne coating with novel absorber and protective formulations. It provides high solar absorptance (0.91–0.93), low thermal emittance (0.21–0.30), excellent thermal stability, VOC-free, RoHS/REACH compliance, and a scalable, cost-effective spray coating process.




## USP/Key Features

The technology utilizes non-hazardous raw materials and an eco-friendly water-borne coating with novel absorber and inorganic protective layer formulations. It is free from volatile organic compounds, complies with RoHS and REACH standards, requires a simple effluent treatment process, and offers a scalable, cost-effective spray coating process.

## Implementation Status

NAL-SUN NG Technology has been transferred to Two industries namely M/s Supreme Solar & M/s Helix Solar Pvt. Ltd., Mysuru

## Contact Details

Dr. Abhay Anant Pashilkar
Director, CSIR-NAL Bengaluru
director.nal@csir.res.in
+91-80-25086000

# TEJAS- Composite Parts Indigenized

**· TRL-9 ·**

## Overview

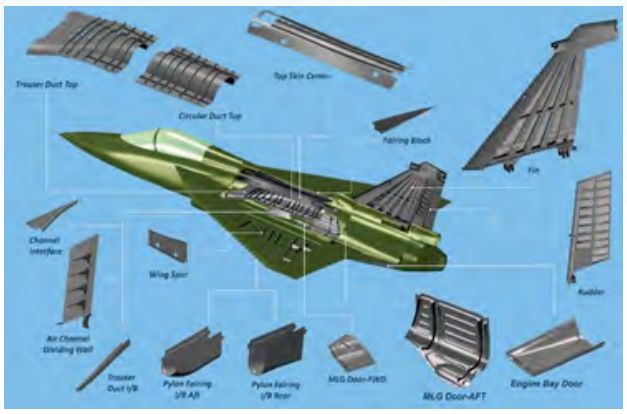
CSIR-NAL has developed advanced autoclave moulding technology for manufacturing primary composite aircraft structures used in fighter aircraft, transport aircraft, and UAVs. The process produces airworthy components with high reliability, fibre loading of 58–60%, and void content below 1%, meeting stringent aerospace quality standards. It has also indigenously developed co-curing technology to fabricate highly integrated structures, reducing part count, eliminating fasteners and stress concentration zones, minimizing assembly time and costs, preventing fuel leakage, and enabling faster production compared to conventional fastened structures, while enhancing structural integrity and overall performance.

## Functionalities

- 165 parts developed by CSIR-NAL
- The usage of high performance composites has reduced the weight of LCA by 20%
- Rate of production enhanced using cocuring, minimizing assembly time
- Production successfully done with TASL NAL/TASL have been involved in production of LCA composite parts, and in April 2026 NAL handed over the first set of centre-fuselage composite parts for LCA AF Mk2 to ADA and HAL.

## Contact Details

Dr. Abhay Anant Pashilkar
Director, CSIR-NAL, Bengaluru
director.nal@csir.res.in
+91-80-25086000




## USP/Key Features

- LCA Fin 200 parts to 15 parts
- LCA Rudder 50 parts to 6 parts
- LCA Centre Fuselage 500 parts to 44 parts
- LCA undercarriage Doors (Aft and Fwd) 40 parts to 5 parts
- Co-curing technology has resulted in more than 20% savings in cost and about 15% reduction in weight.

## Implementation Status

- Technical Service Agreement signed with M/s. TASL, Bengaluru for providing support to Manufacturing of composite components at TASL and supply to M/s. HAL for LCA Tejas-Mk-1A.
- All the composite parts are manufactured at TASL and supplied to HAL. CSIR-NAL providing technical support to TASL.
- An investment of about ₹100 crore resulted in foreign-exchange savings of over ₹3,000 crore.

# Natural Fragrances

**TRL-6**

## Overview

CSIR-NBRI has developed a series of natural fragrances including 'Eau de Perfume' and air fresheners. 'Frotus' is lotus petals based long-lasting unisex perfume opens up with luminous fresh accord of citrus kissed with lavender and pine middle note is glorified with femineity of lotus and rose while base note is fusion of masculinity of musk with enticing apple undertone. Frotus-Kumbh is made up from a unique blend of essential oils with Sangam water during Maha-kumbh (Sacred water). Frotus-Rudra divine essence perfume is a blend of sacred Rudraksh, Tulsi, and Belpatra oils and Frotus-Fresh is an air freshener with floral aroma which instantly eliminates odour.

## Functionalities

- Frotus-Kumbh is made up from a unique blend of essential oils with Sangam water during Maha-kumbh (Sacred water).
- Frotus-Rudra divine essence perfume is a blend of sacred Rudraksh, Tulsi, and Belpatra oils.
- Frotus-Fresh is an air freshener with floral aroma which instantly eliminates odour.

## Contact Details

Dr. Zabeer Ahmed
Director, CSIR-NBRI Lucknow
director.nbri@csir.res.in
91-522-2297802

## USP/Key Features

- It is a plant-based fragrances including permitted excipients.
- All the fragrances are devoid of harmful chemicals.
- Only the permissible allergens are included.

## Implementation Status

Demonstrated through plant-based fragrance products, with potential for wider adoption.

# Agro-Technologies for the Cultivation of Lotus (Namoh 108)

**TRL-8**

## Overview

Lotus 'Namoh-108' is an elite variety developed by CSIR-NBRI, Lucknow. It is characterized by large light pink flowers reaching up to 10 inches in diameter and elevated blooming up to 1.0–1.6 meters above water surface. The variety supports nearly year-round flowering (March–December) through optimized cultivation practices. It is highly rich in nutrients including amino acids, polyphenols, flavonoids, and essential minerals. This technology enhances commercial lotus cultivation, promoting income generation, employment, and sustainable aquaculture-based horticulture systems. CSIR-NBRI has developed value added products from the petals, peduncle and rhizome of the lotus 'Namoh-108' such as herbal tea (Amrita), fermented health drink (Amrit) etc.

## Functionalities

- It provides complete cultivation package including pond preparation, planting material, fertilization, pest management, and harvesting techniques.
- Enables year-round or extended flowering through improved agronomic and environmental management practices.
- Supports propagation through rhizomes/stolon and seeds for scalable production.

## USP/Key Features

- High ornamental and commercial value due to large, visually attractive, year-round light pink flowers.
- Superior nutritional profile with high levels of amino acids, flavonoids, and essential minerals.
- Suitable for adoption by farmers, horticulture industries, and small entrepreneurs.

## Implementation Status

It has been demonstrated and cultivated at various sites.

## Contact Details

Dr. Zabeer Ahmed
Director, CSIR-NBRI Lucknow
director.nbri@csir.res.in
91-522-2297802

# Microbial Biofertilizer

**TRL-8**

## Overview

CSIR-NBRI has developed stress (abiotic and biotic) tolerant biofertilizers for diverse soil and climatic conditions. These formulations are useful as plant growth enhancers for seed, soil, and foliar applications and improve soil health, crop yield, and quality. Biofertilizers treated crops yielded 10-30% more than untreated controls, boosting farmer income by 15-30% through higher yields and reducing up to 40-50% fertilizer usage. CSIR-NBRI has provided the training along with the mother culture of the bacterial strains used in the formulations to the officials of Agriculture department, UP government, UP evaluation at farmer field which cover nine agroclimatic zones of UP and transfer the technology to more than four private firms for production and commercialization.

## Functionalities

- It has an abiotic stress tolerant and efficient plant growth-promoting rhizobium for nitrogen fixation in legumes, azotobacter for non-leguminous crops and Phosphate solubilising bacteria (Pseudomonas putida) for all crops.
- These have also shown promising results in floricultural crops like Gladiolus, Tuberose, Calendula, spices, and medicinal and aromatic crops.
- These different biofertilizers have been optimized with talc-based carriers with a minimum shelf life of 12 months.

## USP/Key Features

- It is developed for agricultural and floriculture crops to increases yield by approximately 20-30% and also enhances the nutritional value of crops.
- It is simple and low-cost technique to treat seeds, seedlings, tubers and other planting materials.
- It enhances productivity, minimizes chemical fertilizers and pesticides usage and promotes organic farming.

## Implementation Status

It has been demonstrated at various sites.

## Contact Details

Dr. Zabeer Ahmed
Director, CSIR-NBRI Lucknow
director.nbri@csir.res.in
91-522-2297802

# Herbal Formulation for Diabetes Management (NBRMAP–DB)

**TRL-9**

## Overview

Herbal formulation for diabetes management (NBRMAP–DB) is a scientifically validated polyherbal product developed by CSIR-NBRI in collaboration with CSIR-CIMAP. It is based on traditional knowledge and consists of aqueous extracts of six medicinal plants for managing Type-II diabetes and related metabolic symptoms. The formulation exhibits hypoglycemic, antioxidant, and immunomodulatory properties, offering a safe and effective herbal alternative for diabetes management. CSIR-NBRI transferred this technology to M/s Aimil Pharmaceuticals Pvt. Ltd. New Delhi, and the company has earned revenue of more than two billion from this product in India in the past 10 years.

## Functionalities

- It helps in regulation of blood glucose levels through hypoglycaemic herbal action.
- It has significant potential in pharma industry and diabetes care markets.
- It supports management of Type-II diabetes and related complications.

## USP/Key Features

- Scientifically validated polyherbal formulation based on traditional knowledge.
- Multi-functional action including anti-diabetic, antioxidant support.
- Popular plant-based formulation to control blood glucose level.

## Implementation Status

The technology transfer has been done.

## Contact Details

Dr. Zabeer Ahmed
Director, CSIR-NBRI Lucknow
director.nbri@csir.res.in
91-522-2297802

# Herbal Gulal

**TRL-9**

## Overview

Herbal Gulal is a non-toxic, plant-based coloured powder developed using flowers, leaves, and other natural sources by CSIR-NBRI. It is free from harmful chemicals and heavy metals and safe for skin application. The product is lightly perfumed with essential oils and offers good skin adhesion while being easily washable. It provides a sustainable and eco-friendly alternative to synthetic Holi colours, promoting safe festive practices and rural entrepreneurship through small-scale production units. CSIR-NBRI transferred this technology to M/s Ganesha Global Gulal Pvt. Ltd., Raipur and they have generated the employment for approximately 500 local women in Chhattisgarh.

## Functionalities

- Produces natural colour powders using eco-friendly extraction and blending processes.
- Ensures safe application with non-toxic, skin-compatible formulation.
- Suitable for SHGs, women entrepreneurs, and cottage industries.

## USP/Key Features

- Completely natural and free from harmful chemicals and heavy metals.
- Skin-friendly formulation with good adhesion and easy removal.
- Value addition of floral waste and other waste plant materials.

## Contact Details

Dr. Zabeer Ahmed
Director, CSIR-NBRI Lucknow
director.nbri@csir.res.in
91-522-2297802

## Implementation Status

The technology has been transferred and implemented.

# Hydrogen Fuel Cell Powered Bus

**TRL-7**

## Overview

An indigenous hydrogen fuel cell powered bus has been designed and developed by KPIT Technologies Ltd. The hydrogen fuel cell stack used to power this bus was developed under the CSIR-NMITLI program through a collaborative public-private partnership effort between CSIR-NCL, CSIR-CECRI and KPIT Technologies. The drive train comprising the fuel cell engine, battery, electric motor, hydrogen storage and control system were designed and integrated by KPIT Technologies.

## Functionalities

- Runs 350 km on single filling of Hydrogen
- Power by Indigenously developed Rare-Earth free Electric Propulsion Technology (Traction Motor)
- Power by Indigenously developed LT PEM Hydrogen Fuel Cell System

## USP/Key Features

- 40 kW fuel cell
- 9 m, 23-Seater, Fully Air Conditioned
- True Zero-Emission, water is the only tail pipe emission

## Implementation Status

Demonstrated through an indigenous hydrogen fuel cell-powered bus, with potential for wider adoption

## Contact Details

Dr Ashish Kishore Lele
Director, CSIR-NCL Pune
ak.lele.ncl@csir.res.in
+91-20-25902028

# Hydrogen Fuel Cell Powered Vessel in Varanasi

**TRL-8**

## Overview

India has begun commercial operations of its first indigenous developed zero emission Hydrogen Fuel Cell Powered Electric Passenger Vessel (Catamaran) in Varanasi on 11 Dec 2025. The vessel was flagged off at Namo Ghat and operates over the Ganga River (National Waterway-1). The Hydrogen Fuel cell stack technology has been developed under CSIR's NMITLI program as a collaborative public-private partnership effort between CSIR-NCL, CSIR-CECRI and KPIT Technologies. The drive train system comprising Fuel Cell, Electric Propulsion, Battery, Hydrogen Storage & the Control have been designed & integrated by KPIT Technologies. The Vessel has been designed and built by Cochin Shipyard Ltd. in collaboration with Indian Register of Shipping.

## Functionalities

- Runs 8 hours on single filling of Hydrogen Storage
- Power by Indigenously developed Rare-Earth free Electric Propulsion Technology (Traction Motor)
- Power by Indigenously developed by 50kW LT PEM Hydrogen Fuel Cell System

## USP/Key Features

- 24 mtr Catamaran Vessel, 50-Seater, Fully Air Conditioned
- True Zero-Emission, water is the only by-product
- Certified by the Indian Register of Shipping

## Implementation Status

One vessel (Catamaran) deployed in Varanasi at Namo Ghat

## Contact Details

Dr Ashish Kishore Lele
Director, CSIR-NCL Pune
ak.lele.ncl@csir.res.in
+91-20-25902028

# Indigenous Catalytic Dehydration of Methanol to Dimethyl Ether (DME) Process Technology

**TRL-9**

## Overview

Developed indigenously by CSIR-NCL, this premier technology uses a selective catalytic dehydration process to convert methanol into Dimethyl Ether (DME), a valuable chemical in pharma industry as well as a vital ultra-clean alternative fuel for cooking, automotive and other applications, especially in view of the recent geopolitical situation. This innovation can catalyse the national "Methanol Economy" mandate. By offering a clean-burning, domestic substitute for LPG blending (from 8% up to 20%) and commercial diesel, it addresses India's critical energy vulnerabilities. The technology drastically reduces reliance on expensive fossil fuel imports, enhances national energy security, and slashes particulate and greenhouse gas emissions, delivering an immediate environmental and economic impact across India's industrial and transport sectors.

## Functionalities

- High-efficiency catalyst for converting methanol into high-purity Dimethyl Ether (DME).
- Continuous, low-maintenance process ensuring stable catalyst performance and reliable operation.
- Produces clean-burning DME suitable for LPG blending or as a diesel substitute in modified engines.
- Successfully validated through fuel-efficient stove development and vehicle testing with a 30% DME–LPG blend.

## Contact Details

Dr Ashish Kishore Lele
Director, CSIR-NCL Pune
ak.lele.ncl@csir.res.in
+91-20-25902028

## USP/Key Features

- Proprietary indigenous catalyst with high selectivity and excellent resistance to water deactivation, ensuring long operational life.
- Cost-effective process with optimized utility consumption and efficient thermal integration.
- Eliminates dependence on imported catalysts and foreign technology, strengthening supply chain security and supporting India's clean energy initiatives.

## Implementation Status

Successfully validated a 250 kg/day pilot plant with factory and site acceptance testing completed, and currently scaling to a multi-tonne demonstration facility.

# Indigenous Continuous Paracetamol Manufacturing Technology

**· TRL-9 ·**

## Overview

CSIR-National Chemical Laboratory (CSIR-NCL) has developed a continuous, cost-effective, and environmentally friendly process for manufacturing paracetamol, reducing dependence on imported controlled raw materials. The process eliminates the use of acetic anhydride, achieves zero effluent discharge, and delivers 99.9% conversion of para-aminophenol with 90–95% yield and 99.8% product purity. Requiring nearly 50% less plant footprint while matching commercial quality standards, the technology offers a sustainable and economically viable alternative for large-scale paracetamol production, strengthening India's pharmaceutical self-reliance.

## Functionalities

- India's first fully automated, continuous, Zero Liquid Discharge (ZLD) paracetamol manufacturing technology.
- Reduces dependence on imported precursors and supports Atmanirbhar Bharat.
- Ensures consistent, high-quality output with 15-20% lower production cost.
- Replaces acetic anhydride and organic solvents, eliminating regulatory and cost-sensitive chemicals.

## Contact Details

Dr Ashish Kishore Lele
Director, CSIR-NCL Pune
ak.lele.ncl@csir.res.in
+91-20-25902028

## USP/Key Features

- Continuous production of paracetamol using an advanced multifunctional reactor system.
- Eliminates the use of acetic anhydride, making the process safer, eco-friendly, and cost-effective.
- Zero effluent discharge process with 50% smaller plant footprint compared to conventional batch processes.

## Implementation Status

- Technology licensed to Satyadeeptha Pharmaceuticals Ltd., Karnataka, with upfront fee and royalty.
- First commercial plant operational; 2800 TPA capacity, scalable to 10,000 TPA.
- Company planning large-scale expansion and overseas exports.
- ~50 direct jobs already generated, with wider indirect employment.

# Indigenous Zeolite for On Board Oxygen Generation System (OBOGS) for Fighter Aircraft MiG-29/Tejas

**· TRL-9 ·**

## Overview

CSIR-National Chemical Laboratory (CSIR-NCL) developed an indigenous solution to restore and enhance the On-Board Oxygen Generation System (OBOGS) of MiG-29 aircraft operated by the Indian Air Force and Indian Navy. By successfully regenerating degraded zeolites, the team increased oxygen purity from 30% to 85%, enabling reliable high-altitude operations. The technology was scaled to process over 100 kg of zeolites, leading to the establishment of rejuvenation facilities at IAF Nashik and Naval Aircraft Yard, Goa. CSIR-NCL is now advancing indigenous Li-LSX zeolite for MiG-29 and LCA Tejas aircraft in collaboration with the IAF and DRDO.

## Functionalities

- Rejuvenated / Indigenous zeolite in OBOGS for selective adsorption of nitrogen ($N_2$) from air.
- Pure (> 90%) medical grade oxygen ($O_2$) as breathing gas to pilot at high altitude flight operation.

## Contact Details

Dr Ashish Kishore Lele
Director, CSIR-NCL Pune
ak.lele.ncl@csir.res.in
+91-20-25902028

## USP/Key Features

- Indigenous zeolite technology enables control on the size (0.2 mm – 10 mm), shape (spherical, extrudate) and composition (type of metal, Si/Al) of the zeolites.
- Indigenous zeolite can be used for other gas separations/ purification such as biogas, syngas and reformate gas.

## Implementation Status

- Rejuvenation of OEM Zeolite from MiG-29 OBOGS – Deployed.
- Indigenous NCL Li-LSX zeolite in MiG-29/Tejas OBOGS–Testing & Validation
- Rejuvenated zeolite deployed in multiple MiG 29k sorties
- Zeolite Rejuvenation Facility- 2 (one each in IAF and Indian Navy bases)

# Affordable, Water-Efficient Sanitation Technologies for Swachh Bharat.

**TRL-6**

## Overview

Poor sanitation remains a major public health challenge, contributing to the spread of diseases and preventable deaths, particularly among children, as highlighted by the World Health Organization (WHO). While India's Swachh Bharat Mission has significantly improved access to sanitation, ensuring cleanliness and hygiene of public toilets remains a critical need. Poorly maintained facilities often become dirty, foul-smelling, and unhygienic, discouraging their use and contributing to open defecation even in areas where toilets-urinals are available. Clean, well maintained sanitation infrastructure is therefore essential to improve public health, hygiene, and user acceptance.

## Functionalities

CSIR-NEERI's patented NEERFLUSH is a hands free, automatic mechanical toilet- urinal flushing system activated by user weight, ensuring regular and compulsory hands free flushing . Suitable for rural and urban settings, it is cost-effective, easy to manufacture, field-tested, and can be installed in public toilets, institutions, transport hubs, commercial complexes, buildings.

## USP/Key Features

Fully mechanical, hands-free flushing system requiring no electricity or electronics parts. Automatically activated by user weight, ensuring regular and compulsory flushing while reducing health risks. Uses minimal water, is low-cost, easily retrofittable, and features a unique dual valve, weight-operated mechanism unavailable in existing flusher systems.

## Contact Details

Dr. S. Venkata Mohan
Director, CSIR-NEERI Nagpur
director.neeri@csir.res.in
+91-712-2249999

## Implementation Status

NEERFLUSH prototypes were demonstrated and field-tested at public locations in Nagpur, including Khapri village, CSIR-NEERI, and VNIT, with user feedback and performance data validating the technology's effectiveness.

# Renewable Hydropower from Drain/ Rivulet Outlet (ReHyDRO)

**· TRL-6 ·**

## Overview

ReHyDRO is a novel pico hydropower system designed to efficiently generate renewable energy from flowing water and wastewater in low-head, low-kinetic-energy environments such as drains, canals, and rivulets. It maximizes tangential velocity, escaping velocity, and RPM to optimize energy output even under minimal flow conditions. Portable, compact, and lightweight, it enables rapid installation without complex infrastructure. By harnessing untapped hydraulic potential in everyday water channels, ReHydro delivers clean, green energy for rural electrification, industrial applications, and decentralized renewable energy generation offering a scalable, sustainable solution aligned with global renewable energy transition goals and India's clean energy mission.

## Functionalities

- Renewable electricity using natural water flow and low-head hydraulic energy sources.
- Sustainable Energy Access for Remote Areas: Suitable for rural and remote communities lacking reliable grid connectivity, enabling localized and low-cost power generation for basic energy needs.
- Integration with Water and Wastewater Infrastructure: Applicable in municipal and waste water management systems for energy recovery from flowing water streams, treatment plants, drainage channels, and gravity-based conveyance systems.

## USP/Key Features

- Optimized pico-hydroturbine design enabling efficient power generation under low-head and low-flow conditions.
- Sustainable non-intrusive installation utilizing natural water flow without major infrastructure changes.
- Compact, portable, and low-maintenance system suitable for off-grid and decentralized applications.

## Implementation Status

The ReHyDRO technology has been successfully developed, installed, and demonstrated under operational conditions for decentralised renewable energy generation using natural water flow at CSIR-NEERI, Nagpur.

## Contact Details

Dr. S. Venkata Mohan
Director, CSIR-NEERI Nagpur
director.neeri@csir.res.in
+91-712-2249999

# Artificial Intelligence Integrated GIS-Based Line Source Emission Inventory (AI-LSEI) Dashboard

**TRL-7**

## Overview

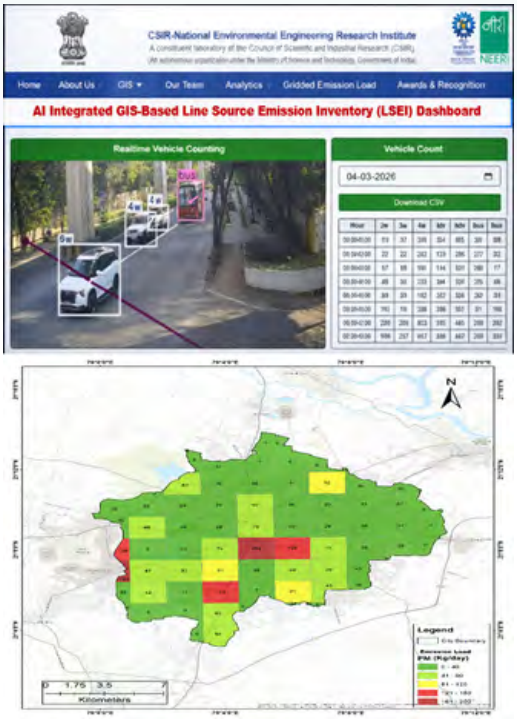
AI-LSEI is an advanced Artificial Intelligence-driven Line Source Emission Inventory developed by CSIR-National Environmental Engineering Research Institute (NEERI) for real-time vehicular emission estimation and environmental surveillance. The platform integrates AI-enabled traffic analytics, computer vision, geospatial intelligence, and scientifically validated emission-inventory methodologies to provide real-time estimates of emission loads from on-road vehicles. AI-LSEI enables the identification of pollution hotspots, quantification of vehicle-category-wise emission contributions, and formulation of strategic mitigation measures to control emission loads. The system delivers real-time, actionable emission data to support immediate policy interventions, traffic management strategies, urban planning, and sustainable air quality governance for smart and environmentally resilient cities worldwide.

## Functionalities

- Performs automated real-time vehicle detection, classification, and traffic activity analysis using AI-enabled CCTV systems.
- Generates dynamic line source emission inventories for key pollutants, including PM2.5, PM10, $NO_x$, CO, and HC, using scientifically validated emission factors and traffic activity data.
- Provides GIS-enabled spatial visualisation, hotspot identification, temporal trend analysis, and decision-support outputs for urban air quality management and transportation planning.

## Contact Details

Dr. S. Venkata Mohan
Director, CSIR-NEERI Nagpur
director.neeri@csir.res.in
+91-712-2249999




## USP/Key Features

- Fully automated AI-driven emission estimation framework eliminating dependency on manual traffic surveys and conventional inventory methods.
- High-resolution, scalable, and near real-time emission analytics platform adaptable for smart cities, highways, industrial corridors, and metropolitan regions.
- Integrates artificial intelligence, geospatial mapping, transportation activity data, and environmental analytics into a unified decision-support ecosystem for sustainable urban governance.

## Implementation Status

Successfully piloted using live traffic surveillance infrastructure and multi-location urban traffic datasets at Gate No. 01, CSIR-NEERI, Nagpur.

# DFAST: Accelerated Faecal Sludge Decomposition Technology

**TRL-7**

## Overview

Faecal DFAST is a bacterio-bio-chemical formulation designed for rapid on-site decomposition and deodorization of faeces, faecal sludge, and sewage sludge. It reduces the time needed for natural breakdown, suppresses pathogens, and produces a stabilized, agronomically useful compost-like product. The technology is suited to rural, remote, low-income, disaster, pilgrimage, and other off-grid settings where safe waste handling and limited infrastructure are major constraints.

## Functionalities

- Accelerates decomposition of faeces, faecal sludge, and sewage sludge.
- Long shelf-life, activation of consortium just before application retains their biodegradation potential at the optimum level
- Deodorizes and decontaminates waste while suppressing pathogen growth and nuisance flies/insects.
- Can be applied as liquid, spray, emulsion, powder, or with adsorbent/deodorizing materials for onsite treatment.

## Contact Details

Dr. S. Venkata Mohan
Director, CSIR-NEERI Nagpur
director.neeri@csir.res.in
+91-712-2249999

## USP/Key Features

- Works in both open and closed environments across mesophilic to thermophilic conditions.
- Produces a stable, high-value agronomic product with fertilizer-like C:N ratio and soil-conditioning benefits.
- Low-energy, scalable, and practical for emergency, rural, municipal, and remote sanitation use with minimal infrastructure.

## Implementation Status

- Public trials have been carried out, and the technology is positioned for commercialization/licensing for decentralized onsite treatment.
- Deployed: Expression of Interest has been floated for transfer of technology.

# Compact Faecal Sludge Septage Separation and Treatment (CFSST) Plant

**· TRL-8 ·**

## Overview

CSIR-NEERI has developed the Compact Faecal Sludge/Septage Separation and Treatment (CFSST) plant for efficient, decentralized faecal sludge and septage management. The technology combines media- and plant-based solid-liquid separation with solids maturation, phyto-biological treatment, and disinfection to produce reusable treated water and manure for agriculture, floriculture, and gardening. Compared with conventional systems, it requires lower capital investment, operation and maintenance costs, and land area while delivering effective treatment. Suitable for urban, peri-urban, and rural settings, CFSST supports Swachh Bharat Mission (ODF++), AMRUT, the UN Sustainable Development Goals, and Viksit Bharat 2047.

## Functionalities

- Integrated faecal sludge and septage treatment through solid–liquid separation, maturation, phyto-biological treatment, wetland filtration, and disinfection.
- Suitable for centralized and decentralized sanitation systems in municipalities, rural areas, institutions, and public toilets.
- Compact, low-energy, modular, and easy-to-maintain for efficient deployment in resource-constrained locations.

## Contact Details

Dr. S. Venkata Mohan
Director, CSIR-NEERI Nagpur
director.neeri@csir.res.in
+91-712-2249999

## USP/Key Features

- Cost-effective, energy-efficient, and low-maintenance solution with minimal electricity requirement, reduced operational costs, durable corrosion-resistant construction, compact footprint, and detachable modular design suitable for decentralised deployment.
- Sustainable circular economy solution with scalable deployment (1–50 KLD) enabling resource recovery through treated effluent and nutrient-rich manure reuse, making it ideal for urban, rural, institutional, and community sanitation applications.

## Implementation Status

- The CFSST Plant was demonstrated at Kavikulguru Kalidas Sanskrit University (KKSU), Ramtek, on 27 November 2025, with a capacity of 1 KLD, validating its operational performance under real-world conditions.
- Its upcoming deployment in five villages under a CSIR mission-mode project highlights its strong potential for scalable de-centralized sanitation solutions.

# Dry Toilet System with Faeces - Urine Separation and Treatment (DToi-FUrST)

**TRL-8**

## Overview

DToi-FUrST is an advanced dry toilet sanitation system engineered for cold and arid regions, integrating waste containment, collection, and treatment within a single compact unit. It enables source-separated collection of urine and faeces, converting them into organic fertiliser and biosolids, promoting circular bio economy principles. Compact, detachable, and manual scavenging-free, it ensures dignified, hygienic sanitation without water or sewage infrastructure. It holds significant market potential for remote and high-altitude communities, supporting Swachh Bharat Mission and SDG 6. About the targeted beneficiary/sectors, it is suitable for various NGOs, public health agencies, and the tourism industry, which will benefit through scalable, eco-friendly, on-site sanitation deployment.

## Functionalities

- Climate-resilient sanitation system for cold, arid, and water-scarce regions.
- Decentralized, off-grid solution for rural and remote communities without sewerage infrastructure.
- Portable, robust, and low-maintenance, ideal for defence camps, disaster relief, temporary settlements, and high-altitude operations.

## USP/Key Features

- Advanced source-separation system for efficient collection of urine, faeces, and wastewater.
- Water-efficient, odour-controlled design compatible with water-based cleansing, requiring no electricity or sewer connection.
- Compact, portable, and easy-to-maintain system for reliable deployment in off-grid and resource-constrained regions.

## Contact Details

Dr. S. Venkata Mohan
Director, CSIR-NEERI Nagpur
director.neeri@csir.res.in
+91-712-2249999

## Implementation Status

Deployed at CSIR-NEERI, CSIR-IHBT CeHAB Lab, Lahaul, and 4 Gram Panchayats for decentralized sanitation applications.

# Eco-Rejuvenation Technology (ERT)

**TRL-8**

## Overview

Eco-Rejuvenation Technology (ERT) is a sustainable, bamboo-based ecological restoration approach designed for the rehabilitation of degraded lands, fly ash dumps, and environmentally stressed ecosystems. The technology integrates phyto-remediation, soil and water conservation, biomass generation, and biodiversity enhancement to improve ecological health and promote climate resilience. ERT supports carbon sequestration, restoration of soil fertility, and sustainable resource utilization while creating livelihood opportunities for local communities and women self-help groups. The technology offers an eco-friendly and scalable solution for environmental restoration, contributing to sustainable development and circular bio-economy initiatives.

## Functionalities

- Restores degraded and fly ash affected lands using bamboo-based ecological methods.
- Improves soil health,moisture retention, and carbon sequestration.
- Supports sustainable biomass production and community livelihoods.

## USP/Key Features

- Nature-based and eco-friendly technology for sustainable restoration of degraded ecosystems.
- Bamboo-driven approach offering rapid growth, carbon sequestration, and phytoremediation benefits.
- Integrates ecological restoration with biomass generation and community livelihood support.

## Contact Details

Dr. S. Venkata Mohan
Director, CSIR-NEERI Nagpur
director.neeri@csir.res.in
+91-712-2249999

## Implementation Status

CSIR-NEERI's Eco-Rejuvenation Technology has been implemented across 1,500 hectares of degraded land, successfully restoring mine overburden, fly ash disposal areas, and wastelands through improved vegetation, soil quality, biodiversity, and ecosystem recovery.

# Himalayan Sewage Treatment Plant (Him-STP)

**TRL-8**

## Overview

The Him-STP is a compact, decentralized sewage treatment solution designed for Himalayan and sub-Himalayan cold climates; it combines a low-temperature anaerobic LTAM process (in an up-flow anaerobic baffled reactor) with a cold-adapted up-flow constructed wetland to treat sewage effectively at 1–20 °C without external heating or aeration, reducing O&M costs and improving effluent quality for small communities and rural settlements.

## Functionalities

- Anaerobic primary/secondary treatment via LTAM in an up-flow anaerobic baffled reactor (U-ABR) that biodegrades carbonaceous load and supports self-granulating methanogenic biomass at 1–20 °C.
- Tertiary polishing with a cold-adapted up-flow constructed wetland (UCW) packed bed supporting biofilm and macrophytes for nutrient removal and final polishing.
- Gravity-driven, low-O&M decentralized operation (screen/oil trap, UDMF, disinfection and treated effluent collection) requiring no external heating, mechanical aeration, or special inoculum additions for routine operation.

## Contact Details

Dr. S. Venkata Mohan
Director, CSIR-NEERI Nagpur
director.neeri@csir.res.in
+91-712-2249999

## USP/Key Features

- Operates effectively at very low liquid temperatures (as low as 1 °C) using induced low-temperature resilient methanogenic (LTRM) biomass in Low Temperature Adapted Methanogenic (LTAM) process.
- Compact, gravity-driven design for decentralized deployment in hilly terrain with low operation and maintenance costs (no heating, no aeration).
- Scalable and portable-demonstrated in 0.1 KLD, 0.25 KLD and 1 KLD (field) units-with LTAM mix dosing protocol to recover or boost performance during cold shocks or start-up.

## Implementation Status

Demonstrated units at multiple sites (examples: 0.1 KLD at CSIR-IHBT, Palampur, HP and 1 KLD at Gondhala Village, Lahaul, HP).

# Low-Temperature Wastewater Treatment Technology

**TRL-8**

## Overview

The LTAM process is a CSIR-NEERI developed anaerobic wastewater treatment know-how that boosts low-temperature resilient methanogenic biomass to treat sewage efficiently at liquid temperatures between 1 and 20 °C. It is designed for cold-climate and high-altitude settings where conventional STPs lose efficiency in winter. The process reduces dependence on heating, external inoculum, and other costly remedial measures, making sewage treatment more practical and affordable for rural, decentralized, and cold-region applications

## Functionalities

- Induces and maintain slow-temperature resilient methanogenic biomass in anaerobic reactors using periodic dosing of LTAM mix.
- Treats sewage and other biodegradable wastewater at 1–20 °C with stable methanogenic activity and biogas generation.
- Supports granulation in anaerobic systems, improving resilience to cold shock and enabling compact operation.
- Granular LTRM bio mass was used to seed Him-STP units demonstrated at field at Lahaul, HP

## USP/Key Features

- Requires no external heating system and no periodic bio-augmentation with psychrophilic inoculum.
- Uses a low-cost, highly soluble LTAM mix made of easily available organic and inorganic inducers.
- Compact and decentralized, with demonstrated applicability for low-cost rural wastewater treatment and cold-climate STPs.

## Implementation Status

- Pilot-scale LTAM units have been developed and operated, including a 250 L system at CSIR-NEERI with performance over 1200 days.

- Deployed: Yes; pilot scale 250 L LTAM unit installed and operated at CSIR-NEERI since May 2023.

## Contact Details

Dr. S. Venkata Mohan
Director, CSIR-NEERI Nagpur
director.neeri@csir.res.in
+91-712-2249999

# Mechanical Dewatering and Drying System (MDDS) for Faecal Sludge and Septage Management (FSSM).

**TRL-8**

## Overview

MDDS technology offers holistic approach for faecal sludge (FS) treatment & management, which uses the concept of dewatering & drying, and complete elimination of pathogens, including recovery of organic fertilizer, which conforms to the Fertilizer Control Order (FCO) India, 2013 Norms. MDDS is specifically useful for on-site sanitation that generate faecal sludge especially after India's Open Defecation Free (ODF) achievement and the construction of 102 million twin-pit toilets under Swachh Bharat Missions (SBMs 1 & 2). The final product has massive domestic demand since 53% of population rely on septic tanks. Organic manure from Faecal Sludge can substantially replace costly chemical fertilizers in agricultural and horticultural markets.

## Functionalities

- Treatment with lime and poly-electrolyte to eliminate the odor and increase filterability
- Dewatering and squeezing of FS to reduce the water content, and
- Finally drying to destroy the pathogens and further minimise the moisture content,

## USP/Key Features

- Achieves complete pathogen removal, unlike other FSSM technologies.
- Produces a value-added product conforming with fertilizer standards.
- Modular and compact system – scalable for higher FS volumes.

## Contact Details

Dr. S. Venkata Mohan
Director, CSIR-NEERI Nagpur
director.neeri@csir.res.in
+91-712-2249999

## Implementation Status

Implemented on full-scale at 65 $m^3/d$ capacity at Chandrapur Municipal Corporation, Chandrapur.
Number of installations: 01

# Up-flow Compact Constructed Wetland (UCCW) Based Sewage Treatment Plant (STP)

**TRL-8**

## Overview

CSIR-NEERI has developed the Up-flow Compact Constructed Wetland (UCCW), a decentralized, modular sewage treatment technology that provides efficient, affordable wastewater treatment through bio-phyto remediation without mechanical equipment. Combining up-flow floating surface and subsurface constructed wetlands, it maximizes wastewater contact with treatment media and plant roots for effective purification. Suitable for rural and peri-urban areas, residential societies, institutions, industries, hotels, healthcare facilities, and small municipalities, UCCW supports national missions such as Swachh Bharat Mission, ODF++, AMRUT, and the UN Sustainable Development Goals, while contributing to CSIR Technology Transfer Commitments-2030 and Viksit Bharat 2047.

## Functionalities

- Integrates preliminary, primary, and secondary wastewater treatment in a single compact, nature-based system with minimal operation and maintenance.
- Produces reuse-quality treated water for centralized and decentralized applications.
- Low-energy, modular, and space-efficient, making it ideal for municipalities, rural communities, institutions, and residential complexes.

## Contact Details

Dr. S. Venkata Mohan
Director, CSIR-NEERI Nagpur
director.neeri@csir.res.in
+91-712-2249999

## USP/Key Features

- Cost-effective, energy-efficient, and low-maintenance solution with minimal electricity requirement, reduced operational costs, least noise and odour, compact
- footprint, and modular design suitable for centralised and decentralised deployment.
- Sustainable with scalable deployment enabling resource recovery through treated effluent and sludge converted to nutrient-rich manure reuse, making it ideal for urban, rural, institutional, and community-based applications.

## Implementation Status

The UCCW-based STP has been successfully deployed and demonstrated at many operational sites:

# Development of Green Firecrackers having reduced Chemicals and Environmental Footprint

**TRL-9**

## Overview

CSIR-NEERI developed green firecracker formulations to reduce air pollution while supporting India's ₹6,000 crore fireworks industry and the livelihoods of nearly 10 lakh people. Free from banned chemicals, these eco-friendly formulations reduce particulate and gaseous emissions by up to 30% compared to conventional firecrackers. In line with directives from the Government of India and the Supreme Court's restrictions on conventional firecrackers, CSIR-NEERI established the National Centre of Excellence for Green Firecrackers (NCoE-GF) at Nagpur for testing and R&D. Today, only green firecrackers based on these formulations are permitted in India, with continued efforts to further reduce emissions.

## Functionalities

CSIR-NEERI, in collaboration with the Tamil Nadu Fireworks and Amorces Manufacturers' Association (TANFAMA) and other Indian Firework Associations, has developed green firecrackers that minimize harmful chemicals & environmental pollution while maintaining festive sound intensity [100 – 115 dB(A)].

## USP/Key Features

- Eco-friendly green firecracker technology using proprietary additives to improve combustion efficiency and reduce emissions.
- Optimized formulations with permitted chemicals and controlled particle size for lower pollution.
- Established testing and R&D infrastructure through SOPs and National Centre of Excellence for Green Firecrackers.

## Contact Details

Dr. S. Venkata Mohan
Director, CSIR-NEERI Nagpur
director.neeri@csir.res.in
+91-712-2249999

## Implementation Status

Licensed and deployed

# Hand Pump Attachable Iron Removal Plant

**TRL-9**

## Overview

As per Ministry of Drinking Water and Sanitation (MDWS), more than 50,000 habitations in 25 states in India are affected due to excess iron in groundwater. Precipitation of soluble iron by oxidation with air followed by sedimentation and filtration is a relatively simple process used for removal of iron from groundwater. Based on this process, NEERI has designed hand pump attachable iron removal plant with 1 $m^3$/hr hydraulic loading. The plant is suitable for 250 persons with 40 lpcd and 10 hrs of operation. The dimensions of the plant are 135 cm diameter and 150 cm height.

## Functionalities

- Oxidizes the dissolved iron: 1-30 mg/L.
- High Removal Efficiency and easy to operate.
- Single Unit System can provide 40 lpcd iron free water to 250 persons and can be installed on existing hand pumps.

## Contact Details

Dr. S. Venkata Mohan
Director, CSIR-NEERI Nagpur
director.neeri@csir.res.in
+91-712-2249999

## USP/Key Features

- No need of chemical addition, skilled operator, electric power and mechanical parts.
- Minimum maintenance with negligible operational cost.
- Pre-fabricated FRP units can be installed quickly.

## Implementation Status

- Nearly 900 plants are already installed by PHED and working satisfactorily in Iron affected areas in Chhattisgarh State
- 240 units were installed in 4 districts of Assam in 1990 under National Drinking Water mission programme in collaboration with PHED, Assam

# High Rate Transpiration System (HRTS)

**TRL-9**

## Overview

The High Rate Transpiration System (HRTS) developed by CSIR-NEERI is a land treatment technology which further enhances the sustainability of effluent management. HRTS involves the use of dynamic, multi component soil system as a live filtration device along with the treatment media laid in the troughs to renovate the wastewater through adsorption, ion exchange, precipitation and stabilization of pollutants through microbial degradation thereby result in removal of pollutants.

## Functionalities

- Reuse of effluent and its nutrient contents for biomass production
- Prevention of ground and surface water pollution
- Green belt development for industries (compulsory norm under Environmental compliance) with concomitant advantages to the environment
- Biomass, fuel wood, timber generation and revenue returns
- Generates sink potential for air pollutants and greenhouse gases
- Works on natural treatment processes and hence eco-friendly

## Contact Details

Dr. S. Venkata Mohan
Director, CSIR-NEERI Nagpur
director.neeri@csir.res.in
+91-712-2249999

## USP/Key Features

HRTS enables sustainable reuse of treated industrial effluent for greenbelt development, supporting biodiversity and carbon sequestration. Suitable for industries meeting land-discharge norms, it treats up to 40 KLD per acre while requiring 50% less land than conventional disposal systems.

## Implementation Status

The HRTS technology has been successfully implemented at field scale in industries including KSPG Automotives, Dana Anand India, Hindustan Coca-Cola Beverages (Vijayawada, Ahmedabad, Hyderabad), and Neosym India Pvt. Ltd., demonstrating its industrial applicability.

# Innovative Patient Friendly Saline Gargle RT-PCR Testing Method

**TRL-9**

## Overview

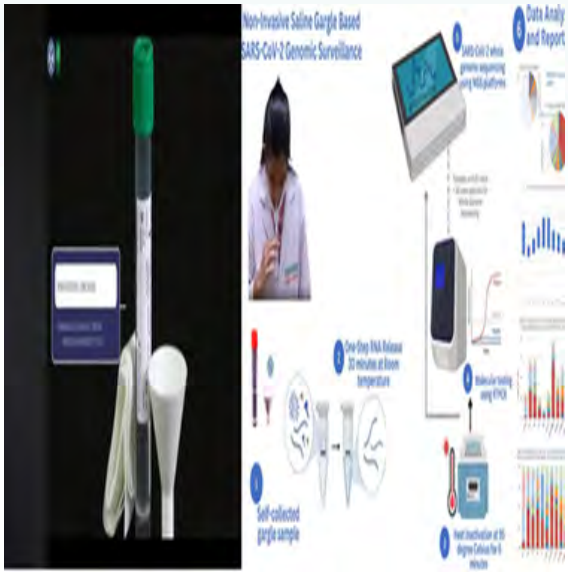
The Innovative Patient-Friendly Saline Gargle RT-PCR Testing Method is a non-invasive molecular diagnostic technology that enables self-collection of samples for COVID-19 and respiratory pathogen detection. The technology replaces invasive nasopharyngeal swab collection with a simple saline gargle process, reducing dependency on trained healthcare personnel and minimizing infection risks. It supports scalable, cost-effective, and patient-friendly diagnostics suitable for rural, tribal, and urban healthcare settings.

## Functionalities

- Enables non-invasive saline gargle sample collection for RT-PCR testing.
- Supports rapid molecular diagnostics with simplified sample processing.
- Reduces biohazard exposure risks and operational burden on healthcare workers.

## Contact Details

Dr. S. Venkata Mohan
Director, CSIR-NEERI Nagpur
director.neeri@csir.res.in
+91-712-2249999




## USP/Key Features

- Self-collection based, patient-friendly alternative to swab testing.
- Single-step nucleic acid extraction reduces infrastructure requirements.
- Commercialized and deployable in resource-limited and high-density settings.

## Implementation Status

- The technology has achieved commercial deployment and has been transferred to two multinational companies and one MSME. It is adaptable to diverse climatic conditions across India and requires minimal operational training with standard RT-PCR laboratory infrastructure.
- Commercialized through two multinational companies and one MSME

# NEERDHUR – Multi-Fuel Improved Cookstove

**TRL-9**

## Overview

NEERDHUR is a MNRE-approved multi-fuel improved cookstove conforming to BIS IS 13152, developed by CSIR-NEERI for rural households, slum dwellers, street vendors, small enterprises, and other decentralized users. It delivers 33.33% thermal efficiency, over 50% fuel savings, and lower PM2.5 and CO emissions, while its insulated design improves safety by reducing outer-body temperature. The stove also reduces smoke exposure, cooking time, and fuel-collection drudgery, especially benefiting women and children in biomass-dependent households. The technology is patented, and its performance and socio-economic benefits have been validated through peer-reviewed publications. Reduced biomass consumption also offers potential for carbon-credit generation.

## Functionalities

- Efficient clean cooking solution reducing fuel consumption, cooking time, and harmful emissions for rural and decentralized users.
- Multi-fuel operation enabling use of biomass, charcoal, and agro-residues through adjustable fuel grate mechanism.
- Enhanced user safety and comfort with insulated design, reduced smoke exposure, and lower outer surface temperature.
- Supports sustainable livelihoods by reducing fuel-collection burden and enabling local entrepreneurship opportunities.

## USP/Key Features

- MNRE-approved and BIS IS 13152-conforming improved cookstove
- 33.33% thermal efficiency with over 50% fuel savings.
- Reduced $PM_{2.5}$ and CO emissions for cleaner cooking.
- Lower biomass consumption, with potential for carbon-credit generation.
- Improves rural livelihoods by reducing smoke exposure, drudgery, and supporting local entrepreneurship.

## Contact Details

Dr. S. Venkata Mohan
Director, CSIR-NEERI Nagpur
director.neeri@csir.res.in
+91-712-2249999

## Implementation Status

30,000+ units have been deployed

# "NEERI-ZAR" – Portable Instant Water Filter

**TRL-9**

## Overview

NEERI-ZAR is a portable water purification system developed by CSIR-NEERI to provide safe drinking and cooking water during floods and other emergencies. Designed to treat a wide range of flood water, a standard unit with two 100-litre vessels can support 20–30 people for up to 10 hours daily. Developed as a societal initiative, the technology has been made freely available without IPR protection, enabling widespread adoption for disaster management while acknowledging CSIR-NEERI through its name and logo.

## Functionalities

- NEERI-ZAR brings down the turbidity of filtered water to less than 3 NTU from raw water in the range 100-300 NTU.
- Removes organic matter and bacterial contamination as well; and no change in dissolved salts in the water.
- Simple to fabricate and be assembled using locally available material. Easy to operate & minimum maintenance.

## USP/Key Features

- Ease of transportation and installation; Reliable for emergency water supply; No power requirement.
- Gravity Operated.
- Produces potable water, within an hour.
- 'NEERI-ZAR' is best fit for emergency safe water supply during flood and cyclones

## Implementation Status

It has been developed as a societal initiative, and has been deployed at various locations.

## Contact Details

Dr. S. Venkata Mohan
Director, CSIR-NEERI Nagpur
director.neeri@csir.res.in
+91-712-2249999

# Solar Assisted Electrolytic Defluoridation (EDF) Technology

**TRL-9**

## Overview

Fluoride contamination in drinking water affects nearly 62 million people in India, including around 6 million children, causing fluorosis. To address this challenge, CSIR-NEERI developed an electrolytic defluoridation technology based on electrolysis using aluminium plate electrodes. During the process, aluminium ions generated at the anode remove excess fluoride through complex formation, adsorption, precipitation, coagulation, and settling. The technology effectively reduces fluoride levels to meet BIS and WHO drinking water standards, providing a simple, reliable, and sustainable solution for fluoride-affected communities.

## Functionalities

- Fluoride removal by active species of hydroxides of aluminium produced by passing DC power through aluminium electrodes.
- Simple to fabricate, easy to operate with minimum maintenance.
- Produces potable water with palatable taste as against the other available chemical treatment methods. Capacity: 2000 litres per batch in 3- 3.5 hours.

## Contact Details

Dr. S. Venkata Mohan
Director, CSIR-NEERI Nagpur
director.neeri@csir.res.in
+91-712-2249999

## USP/Key Features

- Suitable for treatment of raw water with fluoride concentration upto 10 mg/L. Quantity of sludge produced is less (60-70%) than conventional treatment methods.
- Simultaneous reduction in the bacterial contamination in treated water.
- Can be operated using Solar Energy
- Can be configured to any design capacity.
- Operation and maintenance by an unskilled operator
- Successfully implemented in the field, with several plants operating in fluorosis-endemic areas.

## Implementation Status

Around 500 community-based electrolytic defluoridation units have been installed across India. Extensively field-tested, the technology has proven robust, reliable, accurate, cost-effective, and compliant with national and international water quality standards.

# Carbon Quantum Dots

**· TRL-6 ·**

## Overview

CSIR-NEIST has developed a patented technology (US 10,655,061 B2) for producing carbon quantum dots (CQDs) from abundant, low-cost coal. CQDs are nanoscale carbon materials with unique optical and electronic properties, enabling applications in bioimaging, medical diagnostics, biosensing, chemical sensing, photocatalysis, and photovoltaic devices. The technology offers a sustainable, economical, and scalable alternative to conventional CQD synthesis methods by utilizing an inexpensive carbon source. It provides a promising pathway for manufacturing high-value quantum materials to support advanced healthcare, energy, and electronics applications.

## Functionalities

Carbon Quantum Dots (CQDs) exhibit unique optical and electronic properties due to their quantum confinement and edge effects and have a variety of novel applications, such as low-toxicity and photostable fluorescence probes for optical-imaging and bio-imaging for high-end biological applications, biosensing, road stickers, road signs, paints, photographic processing materials, etc. In addition, it could be used for metal ion sensing, optoelectronics, photo-catalysis, and as a nano-fertilizer for plant growth.

## Contact Details

Dr. V.M. Tiwari
Director, CSIR-NEIST Jorhat
director.neist@csir.res.in
+91-376-2370012

## USP/Key Features

- Facile, eco-friendly, single-step and scalable process for producing highly functionalized, water-soluble, non-toxic CQDs from low-quality coal.
- Zero-discharge technology using only water and hydrogen peroxide, with by-products reusable as supercapacitor electrode material.
- Cost-effective and reproducible process requiring simple purification, no post-functionalization, minimal water use, and convenient storage under standard refrigeration.

## Implementation Status

The technology has been licensed to 1 party for commercialization.

# Process for Extraction of Caffeine from Tea Waste

**TRL-6**

## Overview

CSIR-NEIST has developed a process for extracting natural caffeine from tea waste, transforming a major by-product of the tea industry into a high-value resource. India generates over 27.3 million kg of tea waste annually, containing 3–4% caffeine, with the potential to produce about 0.9 million kg of natural caffeine valued at over Rs 500 crore. The technology provides an economical and sustainable source of natural caffeine for pharmaceutical and beverage industries, while promoting waste valorization and meeting the growing consumer demand for natural ingredients over synthetic alternatives.

## Functionalities

- Industrially scalable and commercially viable.
- Energy-saving operation

## Contact Details

Dr. V.M. Tiwari
Director, CSIR-NEIST Jorhat
director.neist@csir.res.in
+91-376-2370012

## USP/Key Features

- Eco-friendly Extraction with zero waste concept
- Waste Utilization and Sustainability
- Purity and quality (>99%)

## Implementation Status

The technology has been licensed to one party for commercialization

# Hybridized Coal-Based Supercapacitor and Li-ion Battery for e-Rickshaw Application

**TRL-7**

## Overview

CSIR-NEIST has developed an indigenous Hybrid Battery Management System (HBMS) integrating coal-based pouch cell supercapacitors with commercial lithium-ion batteries for e-Rickshaw applications. High-performance 500 F supercapacitors fabricated using indigenous activated carbon derived from low-grade North Eastern Region (NER) coal were assembled into a 54 V supercapacitor pack for e-rickshaw operation. The developed hybrid system demonstrated enhanced power delivery with an additional power gain and improved vehicle performance. The technology reduces battery stress, enhances battery life and energy efficiency, promotes value addition of NER coal resources, and supports sustainable electric mobility under the National Electric Mobility Mission Plan (NEMMP) of India.

## Functionalities

CSIR-NEIST has developed indigenous coal-based pouch cell supercapacitors using activated carbon derived from low-grade NER coal and integrated them with lithium-ion batteries through a Hybrid Battery Management System (HBMS). The technology enhances e-rickshaw performance, improves energy efficiency, reduces battery stress, extends battery life, and promotes value addition of low-grade coal for sustainable electric mobility.

## Contact Details

Dr. V.M. Tiwari
Director, CSIR-NEIST Jorhat
director.neist@csir.res.in
+91-376-2370012

## USP/Key Features

An indigenous Hybrid Battery Management System integrating coal-based supercapacitors with lithium-ion batteries to enhance EV efficiency, battery life, and performance.

## Implementation Status

The technology has been licensed to 1 party for commercialization.

# Process for the Synthesis of Graphene from Sub-bituminous North East Indian Coal

**TRL-7**

## Overview

A scalable process has been developed to produce high-grade graphene from subbituminous Indian coal through a simple four-step route involving acid washing, oxidation, ultrafiltration, and reduction. This technology transforms a low-cost indigenous carbon source into high-purity, value-added graphene, enabling large-scale production while serving as a sustainable alternative to coal combustion and helping to mitigate carbon emissions. Its impact is significant for the energy storage and advanced materials sectors, as the graphene can be used in supercapacitors, hybrid energy devices, conductive materials, and reinforcement applications. By reducing dependence on conventional graphite and enabling commercial-scale production, the technology supports cost-effective, sustainable, and indigenous material development.

## Functionalities

- Scalable chemi-thermal process converting low-cost Indian coal into high-grade graphene.
- High-surface-area graphene production for energy storage and advanced material applications.
- Affordable large-scale manufacturing for coatings, composites, and reinforcement sectors.

## Contact Details

Dr. V.M. Tiwari
Director, CSIR-NEIST Jorhat
director.neist@csir.res.in
+91-376-2370012

## USP/Key Features

Converts low-grade Indian coal into high-purity graphene using a scalable, eco-friendly process, reducing graphite dependence and enabling cost-effective large-scale production for advanced industrial applications.

## Implementation Status

The technology has been licensed to 2 parties for commercialization.

# Herbal Anti-Arthritis Formulation

**TRL-9**

## Overview

CSIR-NEIST has developed a herbal anti-arthritis formulation from the rich biodiversity of North East India to address the growing burden of arthritis, a major cause of pain and disability. Arthritis affects nearly 15% of India's population, with rheumatoid arthritis alone impacting about 1% of people worldwide and occurring twice as often in women. The formulation has demonstrated significant effectiveness in managing arthritic conditions across diverse patient groups, offering a natural, plant-based therapeutic option for improving joint health, reducing symptoms, and enhancing quality of life.

## Functionalities

- Effective against osteo and rheumatoid arthritis
- Developed at 22.5 tonnes/annum scale

## Contact Details

Dr. V.M. Tiwari
Director, CSIR-NEIST Jorhat
director.neist@csir.res.in
+91-376-2370012

## USP/Key Features

- No adverse side effects have been found
- Active ingredients derived from plant sources easily available
- Eco-friendly product

## Implementation Status

The technology has been licensed to 6 parties for commercialization out of which two parties had gone into commercial production.

# High Yielding Variety of Citronella, Jor Lab C-5

**TRL-9**

## Overview

CSIR-NEIST has developed Jor Lab C-5, an improved *Citronella* (Cymbopogon winterianus) variety with enhanced citronellal content through EMS-induced mutation breeding. Building on decades of research since the introduction of citronella at the institute in 1964 and the earlier Jor Lab C-2 variety, Jor Lab C-5 offers superior essential oil quality for perfumery, cosmetics, and related industries. The variety was released and dedicated to the nation by the Hon'ble Prime Minister of India, Shri Narendra Modi, during the 75th CSIR Foundation Day celebrations on 26 September 2016.

## Functionalities

- Citronella oil has good market value and the oil finds varied uses in the industry for its aromatic and medicinal properties.
- Citronella oil finds extensive use in soap, candles and incense, perfumery, cosmetic and fragrant industries throughout the world.

## Contact Details

Dr. V.M. Tiwari
Director, CSIR-NEIST Jorhat
director.neist@csir.res.in
+91-376-2370012

## USP/Key Features

- Jor Lab C-5 variety exhibits higher citronellal content, enhancing its quality and commercial value.
- Improved essential oil profile suitable for fragrance, aroma, and industrial applications.
- Higher bioactive compound yield supporting better utilization in related industries.

## Implementation Status

The technology has been licensed to 16 parties till date. Apart from licensing, the technology has been further propagated for rural up-liftment in various parts of NE region under CSIR Aroma Mission.

# High Yielding Variety of Lemongrass, Jor Lab L-9

**TRL-9**

## Overview

Cymbopogon khasianus (Hack.) Stapf ex Bor is an important aromatic crop under the family of Poaceae. It is a vegetatively (also, seed) propagated perennial, multicut crop in the tropics. Methyl eugenol is used commercially for various purposes like insect trapping, perfumery, flavour, condiments, non-alcoholic beverages, hard and soft candy. Presently pharmaceutical industries were dependent on the synthetic methyl eugenol rich variety. CSIR-NEIST has developed a new variety which is a methyl eugenol rich variety of *Lemongrass* will open more scope of commercial cultivation of this Lemongrass variety and provide the raw material to the pharmaceutical industries.

## Functionalities

Lemongrass Jor Lab L-9 variety is very new, unique and registered at ICAR-NBPGR, New Delhi with registration No. INGR-18037.

## USP/Key Features

- A methyl eugenol rich variety of Cymbopogon khasianus.
- This variety contains more than 0.5 percent essential oil with more than 60% methyl eugenol content.

## Contact Details

Dr. V.M. Tiwari
Director, CSIR-NEIST Jorhat
director.neist@csir.res.in
+91-376-2370012

## Implementation Status

The technology has been licensed to 3 parties till date.

# High Yielding Varieties of Patchouli Jor Lab P-1

**· TRL-9 ·**

## Overview

CSIR-NEIST has developed a new high-yielding *Patchouli* variety, Jor Lab P-1, through systematic crop improvement and selection for superior biomass and essential oil yield. The variety has been officially registered with ICAR–New Delhi, highlighting its novelty and commercial importance. Jor Lab P-1 possesses improved herbage productivity, enhanced essential oil recovery, and better oil quality suitable for fragrance and perfumery industries. Owing to its superior field performance and economic benefits, the variety has gained wide acceptance and is currently cultivated in more than 300 hectares by industries and farmers, contributing significantly to income generation and aromatic crop development.

## Functionalities

- Essential oil with high commercial value used in aromatherapy, perfumery, and fragrance industries.
- Rich aromatic profile supporting applications in wellness, personal care, and cosmetic formulations.

## Contact Details

Dr. V.M. Tiwari
Director, CSIR-NEIST Jorhat
director.neist@csir.res.in
+91-376-2370012

## USP/Key Features

- Developed through mutation breeding
- Higher oil yield above 3 %, patchouli alcohol content of 38%
- Fresh Herbage yield of 11-12 tones/ha
- Superior in term of oil yield over the check variety 33%
- Registered with ICAR (Reg. No. INGR 18041)

## Implementation Status

The technology has been licensed to 8 parties till date. Apart from licensing, the technology has been further propagated for rural upliftment in various parts of NE region under CSIR Aroma Mission.

# OP-12 Biofertilizer

**TRL-9**

## Overview

OP-12 is an indigenous, stress-tolerant biofertilizer developed by CSIR-NEIST containing plant-growth-promoting rhizobacteria (RJ12). It naturally improves soil nitrogen and phosphorus levels, thriving in both normal and water-deficient conditions.

Due to its distinctive plant growth-promoting (PGP) traits like nitrogen fixation, phosphate solubilization, potassium solubilization, production of indole-3-acetic acid (IAA) like molecules, ammonia, hydrogen cyanide (HCN), siderophore etc., OP-12 Biofertilizer is used as an effective bio-fertilizer for plant growth promotion in various crops of different agro-climatic regions. It is formulated as Wettable Inert (talc) Powder with CFU count of $2\times10^8$ /g (approx.).

## Functionalities

- Suitable for promoting yield in various agricultural crops.
- Alternative to the excessive use of chemical fertilizers.

## Contact Details

Dr. V.M. Tiwari
Director, CSIR-NEIST Jorhat
director.neist@csir.res.in
+91-376-2370012

## USP/Key Features

- Environment friendly, non-toxic to human and animals.
- Low capital investment, simple production technique, raw materials easily available.
- Effective in different agro-climatic conditions/regions.

## Implementation Status

The technology has been licensed to 4 parties till date. The technology was adopted by the Department of Agriculture, Government of Mizoram, in 2022 on a turnkey basis. Biofertilizer plants based on this technology have been established across all eight States of North-East India.

# Process for Production of Decaffeinated Black Tea

**TRL-9**

## Overview

CSIR-NEIST has developed India's first indigenous process for producing decaffeinated tea using an environmentally friendly and economically viable caffeine extraction method. The process selectively removes caffeine while preserving the tea's original quality and appearance. The decaffeinated tea is free from residual solvents and inorganic contaminants such as arsenic, tin, and mercury, while lead, copper, and cadmium remain well within permissible limits. Pesticide residues comply with EU Regulation (EC) 396/2005, remaining below quantification limits. The technology offers a safe, sustainable, and industrially scalable alternative for commercial decaffeinated tea production.

## Functionalities

- Industrially scalable and commercially viable.
- Eco-friendly extraction of Caffeine with purity >99%.

## Contact Details

Dr. V.M. Tiwari
Director, CSIR-NEIST Jorhat
director.neist@csir.res.in
+91-376-2370012

## USP/Key Features

- Environmentally safer alternative to existing decaffeination methods
- Suitable for producing high-quality, safe, and consumer-friendly decaffeinated tea.
- Eco-friendly extraction of natural caffeine with purity >99%.

## Implementation Status

The technology has been licensed to 2 parties for commercialization.

# CSIR Designer Rice

**· TRL-6 ·**

## Overview

This technology enables the production of nutritionally enhanced designer rice with high protein, increased dietary fibre, a low glycemic index (GI) and essential micronutrients. It addresses the dual challenges of diabetes and hidden hunger without requiring changes in the dietary habits. Suitable for large-scale adoption, this technology enhances metabolic health, improves nutritional security and elevates overall dietary quality among populations that rely on rice as a staple food.

## Functionalities

Enables production of high-protein, low-glycemic index (GI), micronutrient-enriched designer rice using extrusion technology.

## Contact Details

Dr. C. Anandharamakrishnan
Director, CSIR-NIIST Thiruvananthapuram
director.niist@csir.res.in
+91-471-2515226

## USP/Key Features

- >20% Protein content – Substantially higher protein levels compared to conventional polished rice
- Low glycemic index (GI < 55) – Supports improved blood sugar management and metabolic regulation
- Improved dietary fibre – Contributes to digestive health and prolonged satiety
- Micronutrient Enrichment – Includes iron, folic acid and vitamin B12 to address dietary deficiencies

## Implementation Status

Licensed and deployed

# Lightweight and High-strength Al-Mg-Sc Alloy Rolled Sheets for Aerospace Structures

**· TRL-6 ·**

## Overview

The Al-Mg-Sc lightweight alloy is a high-performance material for aerospace, defence, and naval applications, offering low density, superior weldability, excellent corrosion resistance, thermal stability, creep formability, and recyclability. With high mechanical strength (YS: 330 MPa, UTS: 400 MPa, elongation: 12%), it is suitable for aircraft fuselage skin and can replace conventional AA2024 alloy without major design changes. The addition of scandium and zirconium forms nanoscale $Al_3(Sc, Zr)$ precipitates, refining grains and enhancing strength, ductility, and crack resistance by up to 50%. Al-2Sc master alloys are produced from scandium oxides and salts for alloy fabrication.

## Functionalities

- CSIR-NIIST, Thiruvananthapuram has developed the Al-Mg-Sc alloy rolled sheets through gravity casting followed by rolling. Al-Mg-Sc alloy rolled sheets of thickness from 0.7 to 3 mm and length of 1000 mm and width of 150 mm has been successfully developed.
- The indigenously developed Al-Mg-Sc alloy rolled sheet exhibited high mechanical properties.
- The addition of Sc as an alloying element imparts an excellent combination of strength, ductility and enhanced crack growth resistance

## Contact Details

Dr. C. Anandharamakrishnan
Director, CSIR-NIIST Thiruvananthapuram
director.niist@csir.res.in
+91-471-2515226

## USP/Key Features

- CSIR-NIIST, Thiruvananthapuram has developed the Al-Mg-Sc alloy rolled sheets through gravity casting followed by rolling. Al-Mg-Sc alloy rolled sheets of thickness from 0.7 to 3 mm and length of 1000 mm and width of 150 mm has been successfully developed.
- The indigenously developed Al-Mg-Sc alloy rolled sheet exhibited high mechanical properties.
- The addition of Sc as an alloying element imparts an excellent combination of strength, ductility and enhanced crack growth resistance.

## Implementation Status

The technology was transferred to an Indian Industry, M/s. Star Alucast, Mumbai for the commercialization and production of Al-Mg-Sc alloy and rolled sheets of larger dimensions.

# Self-Powered Indoor Air Quality Monitors

**· TRL-6 ·**

## Overview

The self-powered Indoor Air Quality (IAQ) Monitor is an autonomous sensing platform powered exclusively by indoor dye-sensitized solar modules (DSMs) developed by CSIR-NIIST. The system continuously monitors key indoor air quality parameters without requiring external power sources or frequent battery replacement. The technology enables sustainable, maintenance-free deployment in homes, offices, healthcare facilities, educational institutions, and public infrastructure, supporting energy-efficient buildings and healthier indoor environments while reducing electronic waste and operational costs.

## Functionalities

- Continuous real-time monitoring of indoor air quality parameters such as particulate matter (PM), $CO_2$, temperature, humidity, volatile organic compounds (VOCs) and air quality index (AQI).
- Self-powered operation using high-efficiency indoor dye solar modules optimized for low-light indoor environments.
- Eliminating disposable primary batteries and Reducing electronic and chemical waste.

## USP/Key Features

- Fully self-powered system eliminating the need for mains electricity and periodic battery replacement.
- Utilizes high-performance indoor dye-sensitized solar modules capable of efficient energy harvesting under artificial indoor lighting conditions.
- Compact, sustainable, and maintenance-free design suitable for large-scale deployment in smart buildings and IoT ecosystems.

## Contact Details

Dr. C. Anandharamakrishnan
Director, CSIR-NIIST Thiruvananthapuram
director.niist@csir.res.in
+91-471-2515226

## Implementation Status

The technology has been developed and validated through laboratory and field-scale demonstrations. Prototype systems have demonstrated stable operation under typical indoor lighting conditions and have been successfully deployed for long-term monitoring applications
Deployed: Yes

# Automated Biomedical Waste Conversion Rig

**TRL-7**

## Overview

An indigenous, non-incineration-based dual-disinfection-solidification rig has been developed for safe biomedical waste management. The system effectively treats infectious biomedical waste by disinfecting pathogens, immobilizing waste, and eliminating foul odour at point-of-care. Validated for antimicrobial efficacy and non-toxicity, the treated output also improves soil quality. The automated unit minimizes human exposure and prevents the spread of infectious and drug-resistant microbes. With 29 patent applications across 5 patent families and successfully validated at AIIMS, New Delhi, this cost-effective and scalable technology reduces environmental pollution, lowers dependence on incineration, strengthens infection control, and supports safer, sustainable and cost-effective healthcare waste management.

## Functionalities

- Effectively disinfects and solidifies infectious biomedical waste, including blood, urine, sputum, and laboratory disposables, ensuring safe handling and disposal without incineration.
- Features an automated, contactless operation system that minimizes human exposure, controls foul odour using natural fragrance, and prevents the spread of infectious and drug-resistant microbes.
- Produces a non-toxic treated output that enhances soil quality, offering a cost-effective, scalable, and environmentally sustainable solution for hospitals, laboratories, and healthcare facilities

## Contact Details

Dr. C. Anandharamakrishnan
Director, CSIR-NIIST Thiruvananthapuram
director.niist@csir.res.in
+91-471-2515226

## USP/Key Features

An automated, non-incineration biomedical waste treatment system that disinfects and solidifies liquid and solid waste, enhancing safety, reducing pollution, and producing non-toxic disposable output.

## Implementation Status

Commissioned at AIIMS, New Delhi for validation, licensed to M/s Bio Vastum Solutions Pvt. Ltd., Angamaly, for commercial deployment.

# Aluminium–Silicon Carbide Thermal Management Component

**TRL-8**

## Overview

Al-SiC Composite thermal management components are currently imported and used by DRDO in Flight Control Computers of Light Combat Aircraft and other fighter aircrafts. In the present programme, CSIR-NIIST in collaboration with ADE-DRDO has indigenously developed Al-SiC composite thermal management component by liquid metal squeeze infiltration technique matching the thermal properties of the imported thermal management component. About 30 Nos. of Al-SiC thermal management components have been developed and supplied to DRDO. The present indigenous development will contribute towards import substitution and the national mission of Atmanirbhar Bharat in strategic sector of our country.

## Functionalities

Aluminum Silicon Carbide (Al-SiC) metal matrix composites offer lightweight, high thermal conductivity (176 W/mK), low thermal expansion (9.73 × $10^{-6}$/°C), and high stiffness (120 GPa), making them ideal for thermal management in aerospace, automotive, and electronics. CSIR-NIIST has established advanced squeeze casting and liquid metal squeeze infiltration facilities for near-net fabrication of aluminium alloy and composite components.

## USP/Key Features

- Aluminum Silicon Carbide(Al-SiC) metal matrix composites offer lightweight, high thermal conductivity (176 W/mK), low thermal expansion (9.73 × $10^{-6}$/°C), and high stiffness(120 GPa), making
- them ideal for thermal management in aerospace, automotive, and electronics.CSIR-NIIST has established advanced squeeze casting and liquid metal squeeze infiltration facilities for near-net fabrication of aluminium alloy and composite components.

## Contact Details

Dr. C. Anandharamakrishnan
Director, CSIR-NIIST Thiruvananthapuram
director.niist@csir.res.in
+91-471-2515226

## Implementation Status

Al-SiC composite thermal management component developed by CSIR-NIIST was handed over to ADE-DRDO in 2023 for strategic applications.

# Biodegradable Tableware from Agri Biomass

**TRL-9**

## Overview

CSIR–NIIST has developed a sustainable technology for producing biodegradable tableware from agricultural residues and agro-industrial biomass such as rice husk, bagasse, banana pseudo-stem, coconut residues, and plant fibers as an alternative to single-use plastics. The technology converts low-value agro-waste into eco-friendly disposable and reusable products including plates, bowls, trays, and cutlery. The products are biodegradable and food-safe. The process generates minimal effluents and can be implemented in manual, semi-automatic, or fully automatic systems. The technology supports plastic waste reduction, sustainable agro-residue utilization, rural entrepreneurship, and national sustainability initiatives including Swachh Bharat and Atmanirbhar Bharat.

## Functionalities

- Production of biodegradable disposable and reusable tableware products from agro-biomass.
- Utilization of agricultural and food processing wastes for value-added product manufacturing.
- Scalable manufacturing process suitable for manual, semi-automatic and automated production systems.

## Contact Details

Dr. C. Anandharamakrishnan
Director, CSIR-NIIST Thiruvananthapuram
director.niist@csir.res.in
+91-471-2515226

## USP/Key Features

- Eco-friendly, biodegradable alternative to single-use plastics tableware.
- Utilizes abundant agricultural residues, reducing waste burning and environmental pollution.
- Cost-effective and scalable process supporting rural entrepreneurship and sustainable manufacturing.

## Implementation Status

The technology has been developed and standardized at CSIR–NIIST for the production of single-use and reusable biodegradable tableware products using multiple agro-residue feedstocks.

# Bioremediation Technology for Perchlorate

**TRL-9**

## Overview

The CSIR-NIIST Bioremediation Technology for Perchlorate(Patented, US 11390 547 B2, DE 112016006253T5) addresses a critical environmental and public health challenge caused by perchlorate, a persistent oxyanion widely used as an oxidizing agent in defense, space, and industrial applications. The technology utilizes a proprietary microbial consortium of perchlorate-reducing bacteria integrated into engineered biophysical treatment systems for remediation of contaminated groundwater, industrial effluents, and soils. Successfully demonstrated up to pilot scale and supported by internationally patented innovations, the technology provide san eco-friendly, efficient, and scalable solution for perchlorate mitigation, contributing to environmental sustainability and responsible support for India's strategic sectors

## Functionalities

A proprietary microbial technology that degrades perchlorate into harmless products, enabling remediation of contaminated groundwater, industrial effluents, and soils. Validated at community scale, it supports safe water production, environmental sustainability, and scalable public health protection.

## Contact Details

Dr. C. Anandharamakrishnan
Director, CSIR-NIIST Thiruvananthapuram
director.niist@csir.res.in
+91-471-2515226

## USP/Key Features

Validated under CSIR 12th FYP and Jal Jeevan Mission, this scalable technology delivers community-scale safe drinking water and soil remediation, addressing perchlorate-linked thyroid risks while strengthening sustainable environmental management and regulatory preparedness.

## Implementation Status

CSIR–NIIST's perchlorate bioremediation technology was successfully validated under field conditions, restoring a contaminated community well to supply ~2,000 L/day of safe drinking water for six months while remediating ~500 kg of contaminated soil per batch.

# NOWA-NIIST Onsite Wastewater Treatment Technology

**· TRL-9 ·**

## Overview

The NIIST Onsite Wastewater Treatment System (NOWA), patented as WO 2022/130402 A1, addresses the critical gap (~75%) between wastewater generated and treated in developing countries. Untreated discharges pose severe environmental and public health risks, yet wastewater remains a resource-rich commodity. NOWA integrates anaerobic and oxic-anoxic bioprocesses with specific microbial systems, enabling onsite treatment of organic-rich wastewater. Its modular design recovers reuse-quality water, biogas, and organic manure, while minimizing sludge and operational costs. Compact and versatile, NOWA is applicable to discharges from diverse sources, advancing sustainable development and ensuring compliance with environmental regulations.

## Functionalities

- Treats domestic and organic-rich wastewater through an integrated Anaerobic-Oxic/Anoxic bioprocess with unique microbial systems, recovering reuse-quality water, biogas, and nutrient-rich organic manure.
- Suitable for households, apartments, hotels, restaurants, institutions, campuses, agro-based industries, and other decentralized wastewater treatment applications.
- Features a compact, modular, and energy-efficient design with low sludge generation, minimal maintenance, and reduced operational costs.
- Enables and engineered wetland system, supporting water reuse, renewable energy generation, and nutrient recovery while ensuring compliance with environmental standards.

## USP/Key Features

- Compact, modular, and scalable wastewater treatment system with low energy demand, small footprint, and minimal sludge generation.
- Integrates anaerobic–oxic/anoxic bioprocesses for efficient treatment and recovery of reuse-quality water, biogas, and nutrient-rich organic manure.
- Compatible with engineered wetlands, enabling an energy-efficient, nature-based polishing step for enhanced water reuse.
- Handles a broad spectrum of wastewater strengths, from low- to high-organic loads, making it suitable for decentralized applications across residential, institutional, hospitality, and industrial sectors.

## Contact Details

Dr. C. Anandharamakrishnan
Director, CSIR-NIIST Thiruvananthapuram
director@niist.res.in
+91-471-2515226

## Implementation Status

Approved by Kerala Suchitwa Mission and promoted by KRWSA; licensed to 15 industries for water and sanitation applications.

# Plant-Based Leather Alternatives from Agricultural Residues and Biomass

**TRL-9**

## Overview

CSIR–NIIST has developed an innovative and sustainable technology for producing plant-based leather alternatives from agricultural residues, lignocellulosic biomass, fruit and vegetable wastes, and other renewable bioresources. The technology converts low-value biomass into flexible and durable leather-like sheets suitable for applications in footwear, fashion accessories, upholstery, automotive interiors, luggage, handicrafts, and lifestyle products. The technology provides a sustainable alternative to conventional leather and petroleum-based synthetic leather while promoting agricultural waste valorization, circular bioeconomy and sustainable manufacturing.

## Functionalities

- Production of plant-based leather-like sheets from agricultural residues, biomass, and agro-industrial wastes.
- Conversion of low-value agro-waste into high-value sustainable materials for fashion, footwear, automotive, and lifestyle sectors.
- Scalable manufacturing process adaptable to batch, pilot-scale, and continuous production systems.

## Contact Details

Dr. C. Anandharamakrishnan
Director, CSIR-NIIST Thiruvananthapuram
director.niist@csir.res.in
+91-471-2515226

## USP/Key Features

- Sustainable and eco-friendly alternative to conventional leather and petroleum-based synthetic leather.
- Utilizes abundant agricultural and agro-processing wastes, promoting circular bioeconomy and waste-to-wealth initiatives.
- Cost-effective, scalable, and adaptable technology suitable for MSMEs as well as industrial-scale manufacturing.

## Implementation Status

Deployed across 13 industries for producing sustainable plant-based leather alternatives from agricultural residues and biomass for diverse applications.

# Solid-State Biogas Technology

**TRL-9**

## Overview

For decentralized waste-to-energy applications, CSIR-NIIST has developed an advanced Solid-State Biogas Technology (Dry Anaerobic Digestion) for efficient conversion of organic waste into renewable energy. Unlike conventional slurry-based digesters, this compact and water-efficient system operates without added water and enables effective degradation of diverse organic wastes. The technology produces ~200 L of biogas per kg of food waste with >60% methane, providing a sustainable alternative to fossil fuels and enhancing energy security. It also generates odor-free Fermented Organic Manure (FOM), reducing dependence on chemical fertilizers while promoting sustainable waste management and circular resource recovery.

## Functionalities

- Efficiently converts biodegradable wastes into renewable energy through Solid-State Anaerobic Digestion, requiring little or no process water.
- Produces biogas, nutrient-rich digestate, and reusable process water, enabling resource recovery while minimizing waste sent to landfills.
- Operates with high-solids feedstock (>15% TS), resulting in lower reactor volume, reduced leachate generation, and lower operational costs compared to conventional wet anaerobic digestion.
- Designed for decentralized waste management, providing an environmentally sustainable solution for institutions, hotels, municipalities, markets, airports, and food processing industries.

## Contact Details

Dr. C. Anandharamakrishnan
Director, CSIR-NIIST Thiruvananthapuram
director.niist@csir.res.in
+91-471-2515226

## USP/Key Features

- Compact treatment unit (50 kg food waste/day unit will be 2 M3 capacity).
- Minimal freshwater requirement (no water mixing with waste material)
- Generates ~200 L of biogas per kg of food waste (wet basis), Methane > 60% (v/v).
- Less discharge slurry (digestate) volume (only 80% of the input volume)
- Produces stabilized digestate .

## Implementation Status

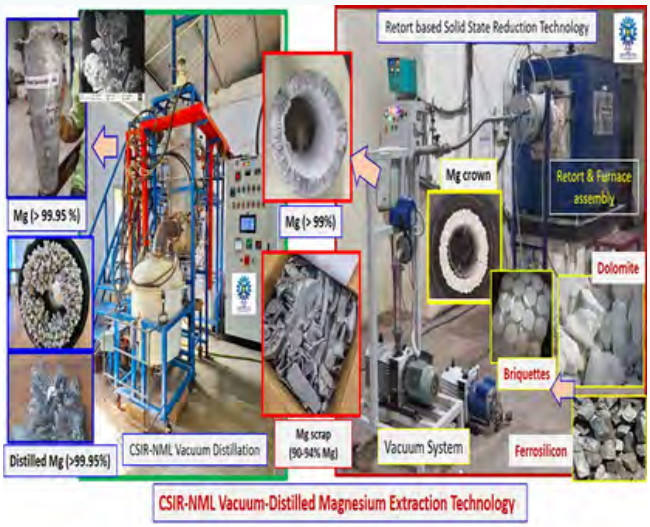
Approved by Kerala Suchitwa Mission and licensed to four waste management industries for wider deployment and implementation.
Large-scale implementation at Trivandrum International Airport, Durg District Chhattisgarh, Small scale at RBI campus Trivandrum, Hospitals, School, etc.

# Vacuum-Distilled Magnesium Extraction Technology

**TRL-7**

## Overview

Magnesium is a globally recognized critical metal with strategic importance for defence, space, nuclear, and advanced engineering sectors. As per recent world bank reports China supplies roughly 85% to 97% of India's total magnesium imports. CSIR-NML has developed indigenous vacuum distillation technology for producing magnesium from Indian dolomite ores, refining high-purity magnesium, and recycling magnesium alloy scrap in a single-stage process. The technology supports applications in titanium and zirconium extraction, lightweight aerospace components, electronics, and die-cast alloys. Bench-scale validation has been completed, and a 100–120 kg pilot plant is under development.




## Functionalities

- Reduction of dolomite for Mg metal crown at bench and pilot scale (under progress) for 99.9% pure Mg (NML's retort technology)
- Vacuum distillation technology for refining commercial Mg to high pure metal suitable for Ti and Zr extraction, developed with AR&DB
- Vacuum Distillation technology for direct recycling of Mg scrap to Mg metal (99.9% purity), developing with AR&DB

## USP/Key Features

- Greener and significant low carbon footprint-recycling technology
- Indigenous technologies/process equipments for reduction and recycling
- Cost of recycling through distillation offers competitive edge over imported price for high purity magnesium metal

## Implementation Status

The technology is still to be deployed.

## Contact Details

Dr. Sandip Ghosh Chowdhury
Director, CSIR-NML Jamshedpur
director.nml@csir.res.in
+91-657-2345209

# Advanced PCBs Recycling Technology

**· TRL-9 ·**

## Overview

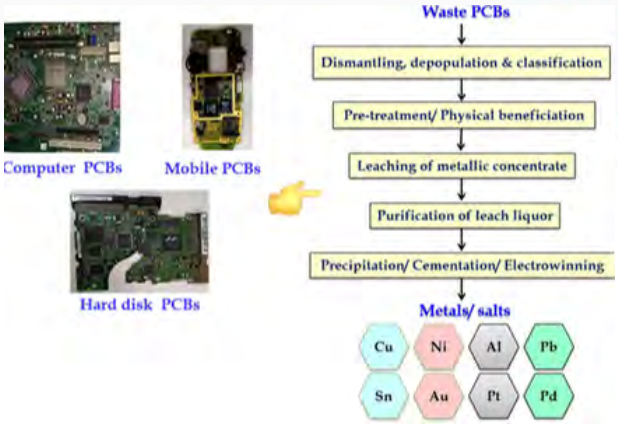
Under its Urban Ore Recycling Centre (UORC), CSIR-NML has developed and transferred advanced indigenous technologies for recycling printed circuit boards (PCBs) to several industries. The process combines dismantling, mechanical pre-treatment, and hydro-electrometallurgy, offering an environmentally friendly alternative to conventional pyrolysis-based methods. The technology is energy-efficient, economically viable, and capable of recovering high-purity metals using cost-effective indigenous equipment. It is readily scalable for commercial deployment and supports sustainable e-waste management. The technology benefits recycling industries, informal sector workers, private enterprises, municipal bodies, cooperatives, entrepreneurs, and other stakeholders engaged in resource recovery.

## Functionalities

- Varieties of PCBs obtained from various electronic devices having different composition, which can be treated to recover non-ferrous (Cu, Ni, Pb, Sn, Al) and precious metals (Au, Ag, Pt, Pd).
- Indigenous fabricated machines makes the plant establishment and process cheaper.
- Hydro-metallurgical recycling process produces high purity saleable products.

## Contact Details

Dr. Sandip Ghosh Chowdhury
Director, CSIR-NML Jamshedpur
director.nml@csir.res.in
+91-657-2345209




## USP/Key Features

- Indigenous technologies developed for all types of waste PCBs.
- Scale-up and pilot scalework has been carried out at UORC of NML.
- Received the CSIR Technology Award 2020.

## Implementation Status

- Under the banner of UORC, various (08 nos.) PCB recycling technologies have been transferred, out of which, 05 have been commercialized and 03 are under pilot trials.
- Scale-up and pilot trials made at UORC in NML premises: TRL-6 Commercial plant trial made at company premises.

# E-waste Recycling Plant

**· TRL-9 ·**

## Overview

Over the past 15 years, CSIR-NML has pioneered application-oriented, zero-waste technologies for recovering valuable metals and materials from diverse e-waste streams. In 2019, it established the Urban Ore Recycling Centre (UORC) to scale up indigenous technologies for recovering non-ferrous, precious, and rare earth metals from secondary resources. The processes integrate dismantling, mechanical pre-treatment, and hydro- and electrometallurgical techniques to recover metals such as copper, aluminium, gold, silver, platinum, palladium, cobalt, lithium, nickel, and rare earth elements from PCBs, lithium-ion batteries, magnets, LCD panels, fluorescent tubes, and other e-waste, benefiting industries, entrepreneurs, and recycling stakeholders.

## Functionalities

- Hybrid process know-how has the capability to be scale-up for commercial exploitation.
- Indigenous fabricated machines makes the plant establishment and process cheaper.
- Hydro-metallurgical recycling process produces high purity saleable products.

## Contact Details

Dr. Sandip Ghosh Chowdhury
Director, CSIR-NML Jamshedpur
director,nml@csir.res.in
+91-657-2345209

## USP/Key Features

- Simple indigenous technologies developed for the recycling of various e-wastes.
- Process can be scale-up easily for commercial exploitation.
- Received the CSIR Technology Award 2020.

## Implementation Status

Under UORC, 16 e-waste recycling technologies transferred; 12 commercialized and 4 undergoing pilot trials with scale-up validation.

# GPS-Independent IST System

**· TRL-6 ·**

## Overview

The GPS-independent IST System is a compact indigenous NavIC based NPLI -disciplined oscillator system developed for autonomous synchronization and traceability to Indian Standard Time (IST). Developed at CSIR-National Physical Laboratory, the national custodian of IST, the system utilizes NavIC timing signals, precision oscillator disciplining, and real-time Common-View GNSS (CV-GNSS) based steering software developed at NPL to provide reliable and continuous timing independent of foreign GPS infrastructure. Designed for operation within India and the NavIC regional coverage area, the system delivers traceability to IST with an accuracy of approximately 30 ns and strengthens national timing resilience, strategic self-reliance, and secure indigenous synchronization capability.

## Functionalities

- Provides compact and autonomous synchronization to Indian Standard Time (IST) using an indigenous NavIC based NPLI -disciplined oscillator architecture.
- Utilizes real-time CV-GNSS based steering software developed at CSIR-National Physical Laboratory for continuous synchronization and stable timing performance.
- Delivers traceability to IST with timing accuracy of approximately 30 ns for users operating within India and the NavIC regional coverage area.

## USP/Key Features

- Completely indigenous compact timing system integrating NavIC-based timing, disciplined oscillator technology, and NPL-developed real-time steering algorithms.
- Provides high-precision IST traceability of approximately ±30 ns with reliable and continuous synchronization capability within the NavIC service region.
- Strategic national capability reducing dependence on foreign GNSS timing infrastructure and strengthening sovereign time dissemination for domestic applications.

## Contact Details

Prof. (Dr) Venu Gopal Achanta
Director, CSIR-NPL New Delhi
director.nplindia@csir.res.in
+91 11 45609201

## Implementation Status

Deployed at NSE, Mumbai from March 13th to April 2nd 2026.

# Laser Cooled Cesium Atomic Fountain Primary Frequency Standard

**TRL-8**

## Overview

The Laser-cooled Caesium Atom based Primary Frequency Standard is a high-precision realization of the SI second using laser cooling and atomic fountain technology. By cooling caesium atoms to ultra-low temperatures, atomic motion and associated uncertainties are significantly reduced, enabling highly accurate and stable frequency measurements. The system serves as the national reference for time and frequency metrology and provides the fundamental basis for generation and maintenance of Indian Standard Time (IST). It also acts as a reliable anchor for the national timescale during disruptions or failures in traceability links to Coordinated Universal Time (UTC), thereby strengthening national timing resilience, metrological sovereignty, and strategic self-reliance in precision timing infrastructure.

## Functionalities

- Realizes the SI second with very high accuracy and stability using laser-cooled caesium atoms and atomic fountain technology.
- Serves as the national primary reference for generation, maintenance, calibration, and dissemination of Indian Standard Time (IST).
- Provides a robust autonomous timing capability and acts as an anchor reference during interruptions or failures in traceability links to Coordinated Universal Time (UTC).

## Contact Details

Prof. (Dr) Venu Gopal Achanta
Director, CSIR-NPL New Delhi
director.nplindia@csir.res.in
+91 11 45609201

## USP/Key Features

Completely indigenous development of a highly complex laser-cooled Caesium Fountain Primary Frequency Standard, achieved through multidisciplinary expertise in atomic physics, lasers, ultra-high vacuum, microwave engineering, and precision metrology. The technology enables autonomous realization and maintenance of the SI second, strengthening India's timing sovereignty by providing an independent, high-accuracy reference for Indian Standard Time (IST).

## Implementation Status

Operational as part of India's national time and frequency infrastructure for realization, maintenance of IST, and high-accuracy frequency measurement at CSIR-NPL.

# National Atomic Timescale

**TRL-8**

## Overview

The National Atomic Timescale, maintained at CSIR-National Physical Laboratory under its statutory mandate as the custodian of Indian Standard Time (IST®), provides a highly stable national reference based on an ensemble of high-performance atomic clocks, precision measurement systems, and advanced timescale algorithms. It enables generation and dissemination of IST® with nanosecond-level precision while maintaining traceability to Coordinated Universal Time (UTC) through satellite-based time transfer links. Indian clock data contributes to international UTC computation by the BIPM. With an uncertainty below 3 ns and IST® maintained within approximately ±4 ns of UTC, it ranks among the world's most accurate national timing infrastructures.

## Functionalities

Generates, maintains, and disseminates Indian Standard Time (IST®) with nanosecond-level precision through a highly stable national timing infrastructure. Maintains traceability to Coordinated Universal Time (UTC) via satellite-based links, contributes Indian atomic clock data to international UTC computation, and achieves time synchronization uncertainty below 3 ns with an IST–UTC offset maintained within approximately ±4 ns.

## Contact Details

Prof. (Dr) Venu Gopal Achanta
Director, CSIR-NPL New Delhi
director.nplindia@csir.res.in
+91 11 45609201

## USP/Key Features

- Indigenous sovereign timing infrastructure with advanced atomic clocks and UTC-traceable timescale generation.
- Ultra-high accuracy national timing system achieving sub-3 ns uncertainty and maintaining IST® precision.
- Strategic capability for generation and dissemination of Indian Standard Time (IST®) supporting national and critical applications.

## Implementation Status

Operationally deployed at CSIR-NPL for continuous generation, maintenance, and dissemination of Indian Standard Time (IST®) through national timekeeping infrastructure.

# Bharatiya Nirdeshak Dravyas (BNDs)

**TRL-9**

## Overview

CSIR-National Physical Laboratory (NPL) has pioneered India's Certified Reference Materials under the trademarked Bharatiya Nirdeshak Dravya (BND®), strengthening national measurement traceability and reducing dependence on imported reference materials. Developed in accordance with international standards, BND® ensures reliable SI-traceable measurements for industry, research, environmental monitoring, and public safety. With 186 certified reference materials developed, BND® supports over 500 testing laboratories, industries, research organizations, and regulatory agencies in meeting ISO/IEC 17025 and ISO 17034 requirements. Serving sectors including water, pharmaceuticals, food, petroleum, coal, healthcare, and infrastructure, BND® advances India's self-reliance and global leadership in chemical metrology.

## Functionalities

BNDs provide SI-traceable certified reference materials for accurate calibration, method validation, and quality assurance, while supporting regulatory compliance, reducing import dependence, strengthening indigenous R&D, and enhancing India's industrial competitiveness and self-reliance.

## Contact Details

Prof. (Dr) Venu Gopal Achanta
Director, CSIR-NPL New Delhi
director.nplindia@csir.res.in
+91 11 45609201

## USP/Key Features

Bharatiya Nirdeshak Dravya (BND®) are India's indigenous, internationally compliant Certified Reference Materials, providing SI-traceable, highly accurate, and reliable measurements. They reduce dependence on imported reference materials, support global acceptance of Make in India products, and strengthen analytical quality, national measurement infrastructure, and the vision of Atmanirbhar Bharat.

## Implementation Status

CSIR-NPL leads the BND® programme to develop indigenous Certified Reference Materials, strengthening quality infrastructure and reducing import dependence through international standard alignment.

# Emergency Retrieval System for Power Lines

**TRL-9**

## Overview

Steel lattice towers support power transmission lines at regular intervals, and their failure can disrupt power supply, causing significant financial losses to utilities and inconvenience to consumers. Permanent "Retrieval" of damaged towers often takes several weeks. To address this challenge, CSIR-Structural Engineering Research Centre (CSIR-SERC), Chennai has developed an indigenous Emergency Retrieval System (ERS) for rapid restoration of transmission lines. The system has been prototype-tested in accordance with international standard IEEE 1070. Earlier, such systems were imported; the indigenous ERS represents a major step under the "Make in India" and "Atmanirbhar Bharat" initiatives while serving as an effective import substitute.

## Functionalities

- Provides temporary support to transmission lines, creating bypass corridors during tower failure events.
- Temporarily elevates transmission lines to enable infrastructure construction projects without disruption.
- Lightweight modular ERS masts can be strategically deployed to support communication equipment, ensuring seamless connectivity in border areas for forces.

## Contact Details

Dr. N. Anandavalli
Director, CSIR-SERC Chennai
director.serc@csir.res.in
+91-44-22549197

## USP/Key Features

- Light weight modular system, simple to fabricate, easy to transport and erect
- Scalable for 33 to 800 kV class power lines
- 40% less cost than imported system

## Implementation Status

Licensed to three manufacturers; secured ₹600+ crore orders for 95+ ERS sets and successfully deployed for emergency power restoration in Jammu.

# Portable Lightweight Foldable Module for Make-Shift Hospitals and Other Needs (PoliTal-M)

**· TRL-9 ·**

## Overview

PoliTal-M, developed by CSIR-SERC, is a foldable, modular temporary shelter system designed for rapid deployment, easy transportation, and quick assembly. Suitable for emergency shelters, disaster relief camps, quarantine facilities, strategic installations, passenger waiting areas, and temporary workforce accommodation, it offers a lightweight, reusable, and adaptable solution for remote and emergency situations. The technology has achieved TRL-9, with a full-scale prototype successfully demonstrated and deployed by licensed industry partners. Its portability, rapid installation, and structural reliability make it valuable for railways, defence, disaster management, construction, and public infrastructure sectors.

## Functionalities

A rapid-deployment, foldable modular shelter system for disaster relief, quarantine, temporary accommodation, and remote infrastructure. Lightweight, reusable, and structurally safe, it enables quick installation, easy transportation, efficient space utilization, and reduced construction time across diverse applications.

## Contact Details

Dr. N. Anandavalli
Director, CSIR-SERC Chennai
director.serc@csir.res.in
+91-44-22549197

## USP/Key Features

- Fully foldable and modular design enabling compact transport, rapid deployment, and easy relocation.
- TRL-9 validated technology with full-scale demonstrations and industry deployment.
- Reusable and versatile infrastructure solution for disaster management, railways, strategic, and temporary facilities.

## Implementation Status

Demonstrated at CSIR-SERC and deployed by licensees at construction and infrastructure sites for temporary shelter applications.

# Acknowledgement

The "CSIR Technologies 2014–2026: From Innovation to Industrial Impact" Compendium has been prepared at the Science Communication and Dissemination Directorate (SCDD), CSIR Headquarters, showcasing CSIR technologies developed and matured during 2014–2026, with a focus on technologies at TRL 6 and above.

The Directors and concerned scientists of CSIR laboratories are gratefully acknowledged for their valuable inputs and for reviewing and validating the information presented in the Compendium.

The guidance and support of the Director General, CSIR is gratefully acknowledged.

We acknowledge the contributions of all those involved in the compilation, editing, design and production of the Compendium.

Dr Love Sharma
Scientist-D, SCDD

**Editor**
Dr Love Sharma

**Reviewers**
Dr Shikha Ambastha
Dr G Mahesh

**Technical Support**
Mrs Preeti

सीएसआईआर
CSIR
भारत का नवाचार इंजन
The Innovation Engine of India

**COUNCIL OF SCIENTIFIC & INDUSTRIAL RESEARCH (CSIR)**

Anusandhan Bhawan, 2, Rafi Marg, New Delhi.

Follow CSIR on Social Media