

CSIR

Compendium of Technologies

(Technologies at TRL 6 or above)



**Research, Project Planning and
Business Development Directorate (RPPBDD)**
अनुसंधान, परियोजना योजना और व्यवसाय विकास निदेशालय
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1.	Dual Energy X-ray Image Analysis Technique for Material Discrimination
	Laboratory: CSIR-Central Electronics Engineering Research Institute
	Executive Summary: Dual energy X-ray image analysis technique is used to inspect passenger luggages/ baggages in important public places as a security measure to detect and identify transport of illegal, banned and dangerous items. Under a sponsored programme from Industry, CSIR-CEERI has developed this material discrimination technique based on atomic number and density of scanned items. This technique has special features which include dual energy image fusion, determination of atomic number & density of the material to classify them into organic, inorganic & metal categories; and displayed as 3 color & 6 color images.
2.	Head Up Display Mk1N-NP and Bore Sighting Equipment
	Laboratory: CSIR-Central Scientific Instruments Organisation
	Executive Summary: Head-Up Display (HUD) is the prime cockpit display system, essentially a transparent display through which the pilot looks normally and at the same time views the crucial multiple flight sensors information and navigation cues required for normal operation, maneuvers, landing and take-off operations, target and weapon information. It aids pilot to take precise decisions quickly in rapidly changing and dynamic environment. HUD Mk1-NP provides an enhanced field-of-view in the elevation required due to the higher nose drop of navy aircraft. The higher over-the-nose-vision requirement through HUD enables safe deck landing of Naval Light Combat Aircraft (LCA).
3.	Head Up Display H-Series for Intermediate Jet Trainer Aircraft
	Laboratory: CSIR-Central Scientific Instruments Organisation
	Executive Summary: HUD is prime flight display used by modern day aircraft pilots which presents flight information/data without requiring pilot to look away from his/her usual viewpoint. The information is projected at infinity using combination of special projection technology comprising optical assembly, folding mirror and the display source. A pair of multilayer semi-reflective optical thin film coated glasses called as beam combiner combines outside view and the flight information such as altitude, airspeed, angle of attack, navigation, weapon aiming and other flight information. HUD H-series provides total field of view of 25° and instantaneous field of view of 20° in elevation and 18° in azimuth.
4.	Anti-Glare Filters for Surface Transport
	Laboratory: CSIR-Central Scientific Instruments Organisation
	Executive Summary: For best situational awareness of the driver towards his/her driving tasks, it is required that he/she should have a clear forward and side visions with minimum/no distractions in the form of impaired/compromised forward vision due to sun reflections or blinding glare. The driver is required to have a clear idea of road-side berms, potholes on the roads, road signs, oncoming vehicles, moving pedestrians or slow-moving carts on road sides, etc. for smooth and hassle-free driving and to avoid accidents. Considering these aspects, Anti-Glare filter (AGF) for automobiles is developed which is mounted on the car/transport vehicle in place of sun-visor or on sun-visor in co-existence of the two to block the blinding glare caused by the sun-reflections and glare cause by the high beam

	light of the oncoming vehicles without compromising on forward and side vision look through the device.
5.	LED based Taxi and Landing Lights for LCA AF Mk2
	Laboratory: CSIR-Central Scientific Instruments Organisation
	<p>Executive Summary:</p> <p>Taxi and Landing Lights are located on the Nose Landing Gear Strut of aircrafts. These lights are turned ON whenever the aircraft is in motion on the ground for greater visibility. LED based Taxi and Landing Lights for LCA developed by CSIR-CSIO Chandigarh will be used as a replacement of existing filament based lights installed on left hand (LH) and right hand (RH) Nose Landing Gear of LCA. Two lights are required per aircraft for Taxi Landing. One shall be installed on port (LH) side of Nose Undercarriage and the other on the Starboard (RH) side. Taxi/ Landing Light shall have three modes of operation i.e. OFF mode, Taxi Mode and Landing Mode. This Light will operate on Aircraft power supply i.e. 28V DC.</p> <ul style="list-style-type: none"> • Light Output in Taxi Mode: ≥ 5.38 Lux at a distance of 300 ft. • Light Output in Landing Mode: ≥ 12 Lux at a distance of 400 ft.
6.	LED based NVG compatible Wing and Fin Navigation Lights for LCA AF Mk2
	Laboratory: CSIR-Central Scientific Instruments Organisation
	<p>Executive Summary:</p> <p>Navigation Light is a colored source of illumination on an aircraft, used to signal aircraft's position, heading and status. Navigation Lighting Systems include: Wing Navigation Lights and Fin Navigation Lights.</p> <p>Wing Navigation Lights includes: A red light mounted on left or port side of the aircraft and a green light mounted on the right or starboard side of the aircraft. Fin Navigation Light is a white light is mounted on fin tip of the aircraft. In a situation, where the paths of two aircraft cross, these lights help each crew determine the other aircraft's direction and indicate who has right-of-way.</p> <p>The existing navigation lights being used in LCA are filament based. These lights require higher power and also the color of the light is imparted by use of an acrylic perspex cover. The developed LED based NVG compatible Wing and Fin Navigation Lights are developed with NVIS/NVG compatibility unlike filament based lights which do not have NVIS/NVG compatibility. In addition, the developed lights also have covert mode operation.</p>
7.	Earthquake Warning System (EqWS)
	Laboratory: CSIR-Central Scientific Instruments Organisation
	<p>Executive Summary:</p> <p>Earthquake Warning System is a technological intervention to avert colossal loss of human life and infrastructure as earthquake forecasting is not yet possible. An earthquake warning system is the solution provided herein to activate the appropriate actions for safety, during impending earthquake. Earthquake warning system (EqWS) is network of a number of seismic sensing nodes (SSN) consisting of seismic sensors, communication, processors. It is devised for regional notification of a substantial earthquake while it is in progress. SSNs communicate to the master server - EqWS Graphical User Interface located at Central Control Room (CCR) for generating alert signals.</p>

8.	Intelligent Seismic Sensing Node for Elephant Movement Detection
	Laboratory: CSIR-Central Scientific Instruments Organisation
	Executive Summary: Intelligent Seismic Sensing Node (eleSeisAlert) is a customizable intelligent system which is capable of interfacing with a number of seismic sensors i.e. geophone arrays for detecting and classifying any minute change in ground vibration generated due to a target source. This system can be adapted for a wide range of ground sensing applications – perimeter monitoring, wildlife surveillance by training the embedded algorithms with target data. Currently the system is deployed for sensing movement of wild elephants at Kansrao range, Rajaji National Park, Uttarakhand. The technology has its usage for reduction of elephant death due to rail accident which not only conserve the bio-diversity but also reduces the loss incurred to Indian railways due to accidents. A spin-off version of the similar technology can be also as an early warning device for prevention of crop-raiding animals in agricultural fields.
9.	Divya Nayan: A Personal Reading Machine for Visually Impaired
	Laboratory: CSIR-Central Scientific Instruments Organisation
	Executive Summary: Divya Nayan is a personal reading machine for visually impaired to access printed or electronic text in many Indian Languages.
10.	AutoCEPH: A Software for 2-D Computerized Cephalometric Analysis as a Web Service
	Laboratory: CSIR-Central Scientific Instruments Organisation
	Executive Summary: Cephalometric Analysis has been used since long in Orthodontic diagnostics and treatment planning. Current trends are to provide Software as a Service (SaaS). Developed in collaboration and validation at AIIMS, New Delhi, AutoCEPH is available at http://ci.csio.res.in . For a country in the Asian region, this would help bring down cost of healthcare along with raising the confidence of both public and private practitioners
11.	Bio-Aviation fuel for defence application
	Laboratory: CSIR-Indian Institute of Petroleum
	Executive Summary: Drop-in biofuel is produced in a single-step using non-precious metal based catalytic process from plant derived oils. Use of bio-aviation fuel and renewable diesel will reduce carbon foot print. Renewable LPG can also be produced for different applications. It is renewable fuel which is expected to boost afforestation and hence soil conservation/improvement. It will also improve livelihood of rural and tribal population dependent on non-edible oil production.
12.	RamJet Fuel T-6 for Brahmos Missile
	Laboratory: CSIR-Indian Institute of Petroleum
	Executive Summary: Despite the fact of low demand of missile fuel in India around 4000 tonnes per year total, the price are very high, around \$2000 per tonne. CSIR-IIP is the first to initiate focused

	research in this area. Sustained efforts and optimization of critical parameters has resulted in a unique technology. CSIR-IIP performed preliminary studies on feasibility studies for the development and production of Ram Rocket Fuel Equivalent to Russian Origin T-6 Fuel as per GOST 12308-89.
13.	Drishti Automatic Weather Monitoring System (DAWMS)
	Laboratory: CSIR-National Aerospace Laboratories
	Executive Summary: DAWMS gives information on weather parameters like Wind speed, Wind Direction, Pressure, Humidity, Temperature, Dew Point and Visibility near the runway. The weather sensors are mounted on a Frangible - Flexible 10 meter eco friendly free standing mast with provision for ease of maintenance of sensors. The system can also work as standalone Automatic Weather Measuring System (AWMS) without visibility measuring instrument useful for surface observatories. The above parameters are very essential for airports aiding safe landing and takeoff operations of Aircrafts.
14.	DRISHTI TRANSMISSOMETER- A Runway Visibility Measuring System
	Laboratory: CSIR-National Aerospace Laboratories
	Executive Summary: Drishti gives runway visibility information to pilots, a mandatory parameter for safe take off and landing of Aircrafts. It is suitable for all categories of Airports viz., CATI, CATII, CAT III A, B & C. DRISHTI meets all requirements and stipulations of International Civil Aviation Organisation (ICAO) and World Meteorological Organisation (WMO).
15.	ARINC 818 FPGA based IP Core
	Laboratory: CSIR-National Aerospace Laboratories
	Executive Summary: This is the first time in the country to design, develop and certify Complex Electronics Hardware (CEH) ARINC 818 IP core compliant to DO 254 DAL A. CEMILAC has approved the FPGA IP Core for use.
16.	NAL FOQA Flight Data Analysis System
	Laboratory: CSIR-National Aerospace Laboratories
	Executive Summary: NALFOQA package involves the analysis of flight data recorded during line operations in order to reveal situations that require corrective action and to enable early corrective action before problems occur. NALFOQA, a software analysis package that reads flight data, transforms the data into an appropriate readable format for analysis, and generates reports and visualizations to assist personnel in analyzing the data. The information and insights provided by NALFOQA program significantly enhance line operational safety, training effectiveness, operational procedures, maintenance, engineering procedures, ATC procedures, and airport surface issues.
17.	Thermal Barrier Lining to Combustion Chamber, Near Net Shaped Throat Insert /Nozzles, Wedge Shaped Fuel Strut
	Laboratory: CSIR-National Aerospace Laboratories
	Executive Summary: Using novel technique of Centrifugal Thermit Process, the following embargo products

	<p>have been developed:</p> <ul style="list-style-type: none"> • Complicated shaped nozzles • Thermal barrier liners for rockets and missile programs • Erosion free - ultra high temperature fuel struts for scramjet engines • Throat inserts and nozzles and other unique complicated shaped components for Scramjet / Ramjet engines
18.	<p>Hard and superhard coatings for high speed machining and solid lubricant coatings for bearing applications</p> <p>Laboratory: CSIR-National Aerospace Laboratories</p>
	<p>Executive Summary:</p> <p>In order to develop high speed machining capabilities of difficult-to-machine engineering materials, and wear protection of critical engineering components, CSIR-NAL has developed several high performance nanostructured tribological coatings on components such as: drill bits, inserts, dies, tapping tools, end mills, micro-cutting tools, gears, piston rings for automobiles, IDCA pistons, stamping tools, watch straps, etc. These coated components exhibit improvement in their performance by many folds. The know-how for development of technology for commercial production of the PVD coatings is available with CSIR-NAL.</p>
19.	<p>High Temperature Solar Selective Coating for Solar Thermal Power Generation</p> <p>Laboratory: CSIR-National Aerospace Laboratories</p>
	<p>Executive Summary:</p> <p>In order to develop manufacturing capabilities of receiver tubes and other CSP technologies, CSIR-NAL has developed several high-temperature spectrally selective absorber coatings on coupon level samples (up to 150×150 mm²) using sputtering processes. These coatings exhibit $\alpha > 0.950$ and $\epsilon < 0.07$ on stainless steel substrates and are stable in vacuum for 1000 h at 600°C and in air for 1000 h at 350°C under cyclic heating conditions. The know-how for development of technology for commercial production of the absorber coatings is available with CSIR-NAL.</p>
20.	<p>NAL MRA 1426 /1427 Giant Magneto Resistive (GMR) Element Technology</p> <p>Laboratory: CSIR-National Aerospace Laboratories</p>
	<p>Executive Summary:</p> <p>The MRA 1427/1426 magnetic sensor utilizes Giant magneto-resistive (GMR) technology, where highly sensitive unshielded GMR elements are configured in a form of single Wheatstone bridge. The Wheatstone bridge generates a differential output voltage with respect to magnetic field gradient along the sensor's sensitive direction. Each resistor has 4-5 kΩ nominal resistance and output of the bridge is purely ratiometric with the power supply voltage. Due to unique technology and design, MRA 1427 is highly sensitive and has the ability to detect signals at the wide air gap. The excellent thermal and voltage stability makes it suitable for challenging environments.</p> <p>The MRA 1427 GMR sensor available in 8T-DFN package with dimensions 3 mm x 3 mm x 0.75 mm. The basic sensors are being used for the development of speed sensor, pressure sensor, displacement sensor and current sensor etc.</p>

21.	Eco-friendly Process for the Preparation of Corrosion Resistant Sealed Anodized Coatings on Aircraft Aluminium Alloy
	Laboratory: CSIR-National Aerospace Laboratories
	Executive Summary: A chromate-free pretreatment process for the corrosion protection of aerospace aluminum alloy
22.	Wear Resistant Nickel based Composite Coating for Aerospace and Automobile Applications
	Laboratory: CSIR-National Aerospace Laboratories
	Executive Summary: Aluminium alloys are being adopted in IC engines for strategic and automotive applications. However, due to the inherently poor wear resistance of these alloys a protective coating is required to enhance the performance of the engines. A nickel based composite coating has been developed through simple electrodeposition process which is comparatively cheaper in comparison to the other methods adopted for depositing such wear resistant coatings. The result is a co-deposited composite coating with a high hardness, due to the presence of carbide particles thereby resulting in enhanced wear resistance. Nickel based composite coating of thickness in the range of 50 to 300µm can be deposited on both rotary and reciprocating engines.
23.	Inexpensive Process to Make Fused Silica Products by Slip Casting Method
	Laboratory: CSIR-National Aerospace Laboratories
	Executive Summary: This technology is for the development of high quality Slip Cast Fused Silica (SCFS) ceramic products (without de-vitrification) through profile slip casting process (cost effective compared to drain casting) and useful not only to manufacture SCFS refractory articles such as crucibles, boats, slabs, saggars, moulds, filters etc., but also useful to manufacture high end SCFS ceramic radomes for missile applications. SCFS ceramic radomes integrated with seeker is very expensive and our country imports SCFS radomes in different sizes for our various missile programmes (ASTRA, NAG, TRSHUL, AKASH, PRTHIVI, PRALAY etc.). If one indigenously manufacture and perfect the SCFS radome technology, one can save huge import cost. This will also bring a self-reliance in this niche technology and defence sector.
24.	Technology for Making PZT Powder for Various Applications
	Laboratory: CSIR-National Aerospace Laboratories
	Executive Summary: Lead Zirconate Titanate (PZT) powder is a piezoelectric material. These materials produce electric charges on application of mechanical stress, therefore, used for sensor applications. Similarly, these materials undergo dimensional change when subjected to an electric field, therefore, used for actuation applications. PZT is a synthetic piezoelectric material with high piezoelectric charge coefficient (d_{33}). PZT powder is used for fabrication of various types of components such as in the form of rings, circular discs, rectangular and square shaped plates, multilayered (ML) stacks, unimorphs, bimorphs etc. These devices are widely used for many engineering applications such as aerospace vibration control, precision fluid flow control, underwater sonar transducers, accelerometers, force transducers, vibration sensors, vibration energy harvesting etc. At CSIR-NAL, PZT powders of high piezo properties were prepared by wet chemical route with piezoelectric charge constant (d_{33}) > 500-700pC/N.

25.	High Purity Alpha Alumina Powder for use in Ceramic Industries
	Laboratory: CSIR-National Aerospace Laboratories
	Executive Summary: The technology is related to a process that produces α - alumina with high purity (>99.5%). This is accomplished by using a Bayer Process intermediate product, alumina tri-hydrate, $Al(OH)_3$, that was initially derived from common Bauxite, processed in a low temperature and low pressure hydrothermal reaction. The final α -alumina product is of equal or better grade than alumina produced by other more expensive methods.
26.	Alumina Tri-Hydrate (ATH) Fillers for Paper and Printing Ink Industry
	Laboratory: CSIR-National Aerospace Laboratories
	Executive Summary: Alumina Tri-Hydrate (ATH) is used for both metallurgical and non metallurgical applications. ATH produced by the Bayer's process is mainly utilized for metallurgical applications such as production of Aluminium metal. For non-metallurgical applications such as fillers in the production of adhesives, glass, ceramics, refractories, catalysts, flame retardant products, cosmetics, tooth pastes, paints, pigments, printing inks, synthetic marbles etc., ATH is to be lighter, fine grained, bright white and of high purity grade.
27.	Multi Zone Hot Bonder
	Laboratory: CSIR-National Aerospace Laboratories
	Executive Summary: Hot bonder is a special purpose equipment that enables in-situ bonded repair of Aircraft / Helicopter structures, wind turbine blades and other advanced composite structures. Multi zone hot bonder enables bonded repairs, simultaneously at multiple locations, while maintaining the temperature uniformity. Using this feature one can carry out, large and complex repairs along with test coupons with very good cure quality.
28.	Desktop Aerospace Autoclave
	Laboratory: CSIR-National Aerospace Laboratories
	Executive Summary: This is a cost effective, affordable composites processing equipment with significant advantages in processing time, energy consumption for processing small sized components that can fit in about 300mm cube. It is provided with a quick lock hinged door with integrated lock ring and door lock safety device. The curing process is automated using a touch screen based PLC – HMI system. It is easy to operate and features fail safe design. It works on single phase supply and fits in less than 1.5 cub.m space. Gland less pressurized fan motor with health monitoring is employed for uniform air circulation inside the autoclave.
29.	Radomes for Airborne FCRs and Ground based DWR Weather Applications
	Laboratory: CSIR-National Aerospace Laboratories
	Executive Summary: Radome is a structural and weatherproof enclosure protecting the radar antenna while causing minimal attenuation to the radar signals. CSIR-NAL has developed cost competitive manufacturing technologies for airborne Fire Control Radars (FCR) of

	<p>strategic importance and ground based weather radomes for societal applications. Nose cone radome of Jaguar maritime aircraft & spherical radome for doppler Weather Radar (DWR) are the outcome of the indigenous effort that have culminated successful technology transfers to industry.</p> <p>Airborn radomes have saved the exchequer crores of money, where in the imported radome cost is 3 times of our costs. Presently Hindustan Aeronautics Ltd. (HAL) is upgrading a fleet of 30-40 Jaguar aircrafts with this technology. Ground based DWR radomes have helped IMD in efficiently predicting the weather / cyclones on time saving numerous lives of fishermen & people residing in the costal line.</p>
30.	<p>Aerospace Class Industrial and Lab Scale Grade Autoclave Systems</p> <p>Laboratory: CSIR-National Aerospace Laboratories</p> <p>Executive Summary:</p> <p>These equipment are designed and developed by CSIR-NAL to cater to the needs of processing of medium to very large scale composite components like Air frame structures, space craft and satellite components and other allied advanced composite structural components for Aerospace Industry. Over the years, with continuous research, the autoclave technology has been brought to the state of the art level with development of advanced insulation, air circulation and control systems. Operating temperatures are being enhanced beyond 400°C with the development of liquid cooled shell and door flanges and special pressurized fan motors with shaft cooling. NAL has not only developed several autoclaves for its own use and also supplied to several Aerospace organisations in the country including private industries generating about Rs.50 crores of revenue as on date, in association with industry.</p>
31.	<p>Process Technology for Continuous Production of Carbon Fiber</p> <p>Laboratory: CSIR-National Aerospace Laboratories</p> <p>Executive Summary:</p> <p>Integrated process technology for standard modulus grade carbon fiber. It has been certified by Centre for Military Airworthiness & Certification (CEMILAC) for its application in aerospace</p>
32.	<p>Manufacturing of High Temperature Resistant Co-cured Composite Structures using Carbon-BMI Prepreg</p> <p>Laboratory: CSIR-National Aerospace Laboratories</p> <p>Executive Summary:</p> <p>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 in such cases up to 200°C service temperature. Processing technology for Carbon-BMI was optimized to achieve better mechanical properties and also adopt for manufacturing monolithic and co-curing process. The carbon-BMI Engine Bay Door was certified for airworthiness and flight trials have been completed. This product is ready for series production. Processing of structures using BMI prepreps has reached maturity.</p>
33.	<p>Vacuum Enhanced Resin Infusion Technology (VERITy) and Product Manufactured Thereof</p> <p>Laboratory: CSIR-National Aerospace Laboratories</p>

	<p>Executive Summary:</p> <p>The VERITY process is better technology for manufacturing of large cocured primary composite structures. The manufacturing process has an added advantage of storing of material at normal storage temperature with infinite life. The VERITY process allows to large scale integration and drastically reduce assembly time and fasteners, provide better aerodynamic outer surface, reduction in part count etc. the above advantages reduce the part manufacturing cost of about 15% over prepreg/autoclave process.</p>
34.	<p>Manufacturing of Cocured Composite Structures for Aircraft with Autoclave Moulding Technology</p> <p>Laboratory: CSIR-National Aerospace Laboratories</p> <p>Executive Summary:</p> <p>Autoclave processing of prepregs is a well-established technology in the aircraft industry. It offers excellent reliability and part quality mandated for airworthy parts. This technique remains a benchmark for competing processing techniques. Parts with fiber loading of 58-60% and void content less than 1% can be produced using this technology.</p> <p>A considerable progress has been made in the country in the area of composite structures with autoclave moulding and its application to national aircraft, rotorcraft and space programs. The realisation of highly integrated structures for LCA-Tejas and SARAS aircrafts at CSIR-NAL shows the understanding and standardization of various tooling and manufacturing aspects of autoclave moulding technology. CSIR-NAL has developed cocuring technology indigenously to realise integral structures for aircraft programs.</p> <p>Manufacturing of primary aircraft composite structures for fighter aircrafts, transport category aircrafts and UAVs.</p>
35.	<p>65 hp Wankel Rotary Combustion Engine</p> <p>Laboratory: CSIR-National Aerospace Laboratories</p> <p>Executive Summary:</p> <p>Wankel Rotary Combustion Engine (WRCE) has gained considerable interest as a viable power plant for small aircraft and Unmanned Aerial Vehicles (UAVs) due to its inherent advantages on many counts. DRDO was importing these engines for their UAV programs, since this technology was not available in the country. CSIR-NAL has established considerable expertise in analysis, materials, manufacture and operation of Wankel engines over the past two decades for strategic application and successfully developed this technology. On successful completion of 55 hp engine, DRDO entrusted CSIR-NAL to develop the 65 hp engine for their PANCHI UAV program.</p>
36.	<p>55 hp Wankel Rotary Combustion Engine</p> <p>Laboratory: CSIR-National Aerospace Laboratories</p> <p>Executive Summary:</p> <p>Wankel Rotary Combustion Engine (WRCE) has gained considerable interest as a viable power plant for small aircraft and Unmanned Aerial Vehicles (UAVs) due to its inherent advantages on many counts. DRDO was importing these engines for their UAV programs, since this technology was not available in the country. CSIR-NAL has established considerable expertise in analysis, materials, manufacture and operation of Wankel engines over the past two decades for strategic application and successfully</p>

	<p>developed this technology.</p> <p>During limited series production it was established that these engines can be manufactured about the half the price of imported engine and more than fifty percent cost saving in spares. In addition, considerable time saving in import of these engines.</p>
37.	<p>Improved Samba Mahsuri (RP BIO 226): A Bacterial Blight Disease Resistant and Low GI (Diabetic Friendly) Rice Variety</p> <p>Laboratory: CSIR-Centre for Cellular & Molecular Biology</p> <p>Executive Summary:</p> <p>Bacterial blight is a serious rice disease. Effective bactericides are not available for controlling bacterial blight. Improved Samba Mahsuri (RP BIO 226) is a bacterial blight resistant derivative of the well-known rice variety, Samba Mahsuri (BPT5204). Improved Samba Mahsuri retains the high yield and fine quality characteristics of Samba Mahsuri. Improved Samba Mahsuri was developed using a biotechnological tool called marker-assisted selection and is not a transgenic plant. Improved Samba Mahsuri is becoming increasingly popular in parts of Andhra Pradesh, Karnataka, Telangana, Tamil Nadu, Uttar Pradesh, etc. where Samba Mahsuri is cultivated and bacterial blight is a problem. Based on impact analysis done by MANAGE, Hyderabad, between 2011-2016, Improved Samba Mahsuri has been cultivated in about 1,30,000 hectares and the value of the produce in farmers' hands was Rs.~1249 crores out of which the trait benefit was Rs.~240 crores. The estimate upto 2018 is that Improved Samba Mahsuri has been cultivated in about 3,00,000 hectares and the value of the produce in farmers' hands is Rs.~2880 crores out of which the trait benefit is Rs. 550 crores (this projection is based on impact analysis done by MANAGE, Hyderabad). Improved Samba Mahsuri has a low glycemic index (GI: 50.99) and is thus good for diabetics. The work was carried out in collaboration with ICAR-Indian Institute of Rice Research, Hyderabad.</p>
38.	<p>Bioactive Molecular Rich Green Coffee Concentrate</p> <p>Laboratory: CSIR-Central Food Technological Research Institute</p> <p>Executive Summary:</p> <p>Green coffee beans are the unroasted coffee beans, a rich source of antioxidants. Green coffee beans are known to have a higher content of Chlorogenic acids(CGA). The extract has the potential to induce weight loss, stimulate liver cells to increase fat metabolism and reduce fat accumulation in the body without causing calorie restriction. The health benefits of green coffee consumption are attributed to the different polyphenols such as chlorogenic acids, caffeic acid, ferulic acid and p-coumaric acids. Over the years, the numbers of cases of lifestyle diseases such as diabetes and obesity have gone up. To combat such ailments, antioxidants and CGA in particular hold an important place, not just as a chemical, but also as a nutraceutical. Green coffee beans remain a promising source of phytochemicals, which can contribute for the improvement in the health and well-being. Enrichment and fortification of other food product using green coffee finds potential avenues in food industry.</p>
39.	<p>MOSPRAY: - A Plant based Mosquito Repellent Formulation</p> <p>Laboratory: CSIR-Central Institute of Medicinal and Aromatic Plants</p> <p>Executive Summary:</p> <p>Mosquitoes are a serious threat because they can cause sickness and even death through diseases like malaria, dengue, chikungunya, yellow fever etc. that are caused mainly by Anopheles, Aedes and Culex types of mosquitoes. According to World Health Organization report (1996), worldwide there are up to 500 million cases of mosquito</p>

	<p>borne diseases every year, and approximately 2.7 million deaths occur annually. In India, more than 40 million people suffer from mosquito borne diseases annually.</p> <p>One of the best solutions is to avoid being bitten by mosquitoes through repelling them. Mosquito repellent products available in the market contain synthetic chemicals with associated health and toxicity issues. As a result of increased awareness the inclination towards using natural products for daily uses is on the rise. Mosquito repellent spray “Mospray” developed by CSIR-CIMAP is a unique combination of essential oils and natural plant extracts supported by scientific evaluation including efficacy (mosquito repellent potential), toxicity (skin irritation) testing. The feedback data has also been generated. This is a safe mosquito repellent formulation that can also act as a room freshener. User study trial data indicated its effectiveness for upto 8 to 10 hours, depending upon the place, climate where the product used. Mospray is a potent repellent used by Fani affected people of Odisha, who are obligated to sleep in the open area.</p>
40.	<p>Painjaa- A Plant based Anti-inflammatory Pain Relieving Gel</p> <p>Laboratory: CSIR-Central Institute of Medicinal and Aromatic Plants</p> <p>Executive Summary:</p> <p>Although separate conditions, but pain and inflammation are always associated with each other. Pain is defined by the International Association for the Study of Pain (IASP) as 'an unpleasant sensory and emotional experience associated with actual or potential tissue damage. Inflammation is the tissue's immunologic response to injury. Acute pain often results from disease, inflammation, or injury to tissues and in some rare instances, it can become chronic. Symptoms of inflammation include redness, swollen joint, joint pain, joint stiffness, loss of joint function, etc. Pain of any type is the most frequent reason for physician consultation. Despite the prevalence of these conditions, the primary options available for their treatment have not changed from steroids, NSAIDs (Nonsteroidal Anti-inflammatory Drugs) and opiates, although all have their drawbacks. The search for new anti-inflammatory and pain relieving agents is currently the subject of intense interest.</p> <p>Based on traditional wisdom, CSIR-CIMAP has developed an anti-inflammatory, pain relieving formulation, which contains active ingredients from plant sources. The commercially available similar type of products mainly contain chemicals and menthol, which gives excess cooling effect and work as local an aesthesia, whereas anti-inflammatory pain relieving gel is a topical formulation that utilizes unique combination of medicinally proven aromatic oils for relieving pain and inflammation along with soothing effect.</p>
41.	<p>RELAXOMAP - A Herbal Anti-inflammatory Pain Relieving Oil</p> <p>Laboratory: CSIR-Central Institute of Medicinal and Aromatic Plants</p> <p>Executive Summary:</p> <p>Aromatherapy refers to the medicinal or therapeutic use of essential oils absorbed through the skin or olfactory system. Although many claims have been made relating to the benefits of aromatherapy, most research has focused on its use to manage depression, anxiety, muscle tension, sleep disturbance, nausea, and pain. Some studies suggest that olfactory stimulation related to aromatherapy can result in immediate reduction of pain. Aromatherapy most commonly works through topical application or through inhalation. When applied topically, the oil is usually added to carrier oil and used for massage. While more than 40 plant derivatives have been identified for therapeutic use, lavender, eucalyptus, rosemary, chamomile, and peppermint are the most</p>

	<p>frequently utilized extracts. Although the benefits remain controversial, many patients and healthcare providers are attracted to aromatherapy because of its low cost and minimal side effects. Essential oils currently available for medicinal uses are generally recognized as safe by the United States Food and Drug Administration (FDA).</p> <p>An aromatherapy based formulation developed by CSIR-CIMAP, in the form of oil, is intended to provide relief from pain and inflammation with soothing effect. Commercially available similar type of products mainly contain synthetic chemicals and menthol providing excess cooling effect whereas this formulation (Relaxomap) is an aromatherapeutic topical formulation utilizing the unique combination of plant extracts and medicinally proven aromatic oils for relieving pain</p>
42.	<p>Ginger Processing Technology</p> <p>Laboratory: CSIR-Central Mechanical Engineering Research Institute</p> <p>Executive Summary:</p> <p>Ginger is a major cash crop in various regions especially in the North Eastern states of our country. Due to lack of proper post-harvest processing and storage facilities, a major portion of present production perishes and the farmers have no other option than to sell at very low price. Therefore, a complete post-harvest processing technology consisting of rotary drum washer (capacity 250 Kg/h), slicing unit (capacity 50 kg/h), and dryer (capacity 50 kg wet ginger slices in 4 to 5 hours' batch, 2 to 5 mm thickness) have been developed. The cost of single set of equipment and machineries is around Rs. 12 lakhs for 100 Kg/day wet ginger processing. It has capability to employ one worker and earn profit of about Rs.1750/- per day. The dried ginger also has a very good export potential.</p>
43.	<p>Cotton Picking Head</p> <p>Laboratory: CSIR-Central Mechanical Engineering Research Institute</p> <p>Executive Summary:</p> <p>In India, most of the cotton, whether rain fed or irrigated, is hand-picked by human labor and it consumes about 1560 man-hours/ha. The use of mechanical pickers will be helpful in minimizing drudgery involved in hand picking as well as enhancing production of cleaner grade of seed cotton and timeliness. Field testing to demonstrate the picking capability of the cotton picker head and quality of picked cotton boll was done at CICR, Nagpur, by mounting the head on the three-point linkage of the tractor and operated by Tractor PTO and moving in the reverse direction. It recorded a field capacity of 0.25 ha/h with a single row and a forward speed of 3.5 km/h.</p>
44.	<p>Advanced Electrostatic Sprayer</p> <p>Laboratory: CSIR-Central Scientific Instruments Organisation</p> <p>Executive Summary:</p> <p>Electrostatic spraying is one of the most promising methods to spray the liquid based agrochemicals to protect the crops and orchards from many dreadful diseases and insects. Electrostatic force field has been exploited in the design and development of an air-assisted electrostatic sprayer for agricultural applications to increase the mass transfer efficiency and bio-efficacy. Electrostatic sprayer provides a uniform deposition onto the directly exposed as well as obscured surface of the crops and orchards and reaches to hidden areas of target canopy. It reduces the drift of active ingredients of agrochemicals from the target and increases the deposition efficiency. It provides a means for efficient use of agrochemicals and natural resources. This nozzle is light weight, highly efficient, reduces pesticide use and human health risks. Electrostatic spraying has revolutionized the industrial spraying technologies by making advances</p>

	and developments via off-target drift control to increase the deposition efficiency, uniformity of deposition and target coverage.
45.	Production of Liquid Seaweed Plant Bio-stimulant (LSPB) from Seaweed (<i>Sargassum</i>)
	Laboratory: CSIR-Central Salt & Marine Chemicals Research Institute
	Executive Summary: In order to have a sustainable and commercially viable alternative to the imported seaweed based bio-stimulants, CSIR-CSMCRI has developed a technology for production of liquid seaweed plant bio-stimulant (LSPB) from the abundantly available brown seaweeds such as <i>Sargassum wightii</i> , <i>Sargassum swartzii</i> and <i>Sargassum tenerrimum</i> . The agro-nutrient rich LSPB is useful as a plant growth promoter. The solid formulations obtained therefrom and applied as soil application and liquid bio-stimulant when applied as foliar spray on crops have shown enhancement in crop yields by 13-28% (onion), 15-26% (cumin) and 18-23% (groundnut) compared to control. The technology enables farmers to use an affordable product for significantly increasing their crop production in an eco-friendly manner, and thereby increasing their income levels.
46.	Integrated Method for Production of Carrageenan and Liquid Fertilizer from Fresh Seaweeds
	Laboratory: CSIR-Central Salt & Marine Chemicals Research Institute
	Executive Summary: CSIR-CSMCRI has developed an integrated method for the production of liquid seaweed fertilizer, commonly called as seaweed sap, and kappa carrageenan from a red seaweed, <i>Kappaphycus alvarezii</i> at one go. While carrageenan has diverse use as thickeners in food industry, pet foods etc., the sap derived from fresh <i>Kappaphycus alvarezii</i> is an effective plant bio-stimulant capable of enhancing different agronomic and vegetable crop yields by 13-36% over and above the recommended dose of fertilizers. The results have been validated through large acre trials by 43 centres of state agricultural Universities and ICAR institute across 20 states in India. The bio-stimulant reduces the diminution in crop yield under drought stress, stimulate soil microbes that play vital role in mineral cycling of soil nutrients and importantly shown to be effective in reducing the usage of chemical fertilizers by 25%.
47.	Herbal Salt Preparation from Different Plant Source with High Potassium Content
	Laboratory: CSIR-Central Salt & Marine Chemicals Research Institute
	Executive Summary: CSIR-CSMCRI has developed a process to produce vegetable salt from the halophyte, <i>Salicornia brachiata</i> , which contains several important nutrients not normally found in sea salt and, therefore, is promising as a health salt, and the Herbal Salt has been appropriately named as <i>Saloni</i> . Two formulations of salt can be obtained. One formulation is white crystalline and free flowing which contains 85-90 % NaCl, along with 5-10 % KCl, 1-2 % Ca, 1-2 & Mg and 50-100 ppm Fe. The other formulation is more nutritious (refereed as <i>Saloni-K</i>) which contains 25-30% KCl from the Kappaphycus/ Eucheuma and 65-70% salt from NaCl. The preparation of plant salt involves – cultivation of plant and processing the plant material for production of salt. CSIR-CSMCRI has conducted different agri-trials for best biomass production. Studies on cultivation of the plant on saline soils of Sartanpar coastal areas near Bhavnagar showed the possibility of 40-50 tons/hectare fresh weight and 10-12 tons dry biomass/hectare. Finally, 2 tons salt/hectare can be achieved with best cultivation practice. The local coastal people are unable to grow any economically important crops because of

	saline soil. To support their weak economic condition, Salicornia cultivation can serve as an alternative source, which will improve economic status of the local people and promote soil reclamation of the area
48.	Tea Catechins
	Laboratory: CSIR- Institute of Himalayan Bioresource Technology
	Executive Summary: Tea leaves contains 15-20% of total polyphenols of which catechins constitute up to 80%. Epigallocatechin (EGC), epicatechin (EC), epigallocatechin gallate (EGCG) and epicatechin gallate (ECG) are the major catechins. These catechins are high value antioxidants with nutraceutical properties. This technology is beneficial for upliftment of tea industry through value addition of tea leaves.
49.	Ready to Serve Tea Concentrates
	Laboratory: CSIR- Institute of Himalayan Bioresource Technology
	Executive Summary: Tea is the second most consumed beverage after water that has gained wide interest due to numerous health benefits. A process has been developed to prepare concentrates from green and black tea with refreshing taste and natural health attributes of tea. These concentrates can be reconstituted with hot as well as cold water. This technology is beneficial for upliftment of tea industry through value addition of low-grade teas.
50.	Agro and Processing Technology of Stevia
	Laboratory: CSIR- Institute of Himalayan Bioresource Technology
	Executive Summary: Worldwide 346 million people are diabetic. As per the 2015 World Health Organization (WHO) report, India has about 69.2 million people with diabetes. CSIR-Institute of Himalayan Bioresource Technology, took the initiative to address this aggravating health issue by introduction of Stevia. In 2017, the Stevia market was about 490.1 million USD, and it is projected to grow at a CAGR of 9.5% to reach USD 771.5 million by 2022. (Markets and Markets Research Private Ltd.). The major problems pertaining to Stevia cultivation were lack of suitable planting material, advance agro-technology for different agro-climates and process technology for extraction of steviol glycosides from the leaves of stevia. Institute has developed and released 'Him Stevia'(CSIR-IHBT-ST-01), a clonal cultivar of stevia, which has a desirable steviol glycoside profile. The cultivar 'Him Stevia' has been developed through hybridization and selection approach. The cultivar 'Him Stevia' has high content of Reb-A (~7.4%) compared to stevioside (~5.8%), Reb-A/stevioside ratio is 1.25 and total glycoside content of about 14.5% (on dry weight basis). Good Agricultural Practices have also been developed by CSIR-IHBT for higher biomass yield (3.5 – 4.0 t/ha/year) for different agroclimatic conditions. Institute has developed the agro technologies like nursery techniques, plant population and geometry, weed management, nutrient management, water management and post-harvest management. The net income from stevia cultivation is about 2 to 2.5 times higher than traditional crops. Institute has developed a green process for converting dry stevia leaf into steviol glycoside powder having purity more than 90%. The salient feature of the technology is water-based extraction process. The average yield of the finished product is around 8 % (w/w basis). In addition to this the product meets the Joint FAO/WHO Expert Committee on Food Additives (JECFA) international guidelines.
51.	Ready to Eat Crispy Fruits and Vegetables
	Laboratory: CSIR- Institute of Himalayan Bioresource Technology

	<p>Executive Summary:</p> <p>India loses about 25% of the fruits and vegetable produce due to inadequate storage and processing facilities leading to poor economic returns to farmers. CSIR-IHBT developed crispy fruit and vegetable technology to reduce the post-harvest losses and also for application of the processed fruits and vegetables as ingredient in packaged foods.</p> <p>India is second largest exporter of processed and preserved fruits and vegetables. Indian dehydrated fruit and vegetables market is estimated to be reach USD 3 billion by 2022 with a compound annual growth rate of 12%.</p>
52.	<p>Canning Technology for Ready to Eat (RTE) Foods</p> <p>Laboratory: CSIR- Institute of Himalayan Bioresource Technology</p> <p>Executive Summary:</p> <p>CSIR-IHBT has developed an indigenous technology for commercial production of ready-to-eat foods (RTE) free from additives and chemical preservatives. These RTE food products are in line with the changing consumer preference for healthy, convenient and on the go foods. The technology was used for successful revival of traditional ethnic foods such as Kangri dham.</p> <p>Indian RTE market is estimated to reach Rs. 2900 crores by 2022 with a compound annual growth rate (CAGR) of 25%.</p>
53.	<p>Cultivation of <i>Shiitake</i> Mushroom and its Enrichment with Vitamin D₂</p> <p>Laboratory: CSIR- Institute of Himalayan Bioresource Technology</p> <p>Executive Summary:</p> <p>The fresh Shiitake mushroom has rich, buttery flavour that makes it different from other mushroom variety. Dried shiitake has meaty texture and smoky flavour, and hence are most prevalent in Asian dishes. Apart from its taste and flavour it is rich in vitamin D precursor ergosterol. Vitamin D deficiency is prevalent in >70% of Indian population. Beyond bone health, the deficiency is associated with cancer, autoimmune diseases, infections, type 2 diabetes, hypertension, cardiovascular disease, etc. For vegetarians, mushrooms are the only food source of Vitamin D. CSIR-IHBT has developed a technology for enhanced production of ergocalciferols (Vitamin D₂) from <i>Shiitake</i> mushroom. The uniqueness of the technology is that it has reduced the cultivation time of the mushroom to 2 months as opposed to 8-12 months. And, the enrichment of Vitamin D₂ is such that a capsule of 500 mg <i>shiitake</i> powder can meet more than 50% RDA of Vitamin D₂. This technology can be a good source of livelihood creation under Micro, Small and Medium Enterprises and Cottage Industry.</p>
54.	<p>Multigrain High Protein Mix</p> <p>Laboratory: CSIR-Institute of Himalayan Bioresource Technology</p> <p>Executive Summary:</p> <p>The prevalence of malnutrition in India is one of the highest in the world affecting majorly the rural population. According to National Family Health Survey 4 (2015-16), malnutrition assessed by the proportion of underweight children below the age of five was 43% and 36% in women of reproductive age in India, higher than in sub-Saharan Africa (28%) and South Asia (42%). Malnutrition contributes to approximately 2.1 million children deaths before the age of ten every year. Inability to achieve minimum dietary intake levels of energy, protein along with deficiency of essential nutrients such as vitamin A, iron, zinc is linked to a higher risk of death. Government has set a target for reduction of underweight by 2% and anaemia by 3% per annum as part of National Nutrition mission. CSIR-IHBT aimed at contributing low cost nutritious food product</p>

	<p>addressing protein and energy malnutrition in children and women of reproductive age.</p> <p>The product is made with simple and nutrient dense ingredients such as pulses, millets, cereals and pseudo-cereals of Himalayan terrain and other parts of India. The product is a multipurpose food ingredient with applications such as beverage and smoothie mix that can be consumed with milk/water/fruit juices and as a protein fortifying food ingredient in breads and ready to eat foods.</p>
55.	<p>Enzymatic Degumming of Rice Bran Oil</p> <p>Laboratory: CSIR- Indian Institute of Chemical Technology</p> <p>Executive Summary:</p> <p>Rice bran oil has a balanced fatty acid profile which is very close to the ideal one recommended by several health organizations. The presence of a host of minor constituents with proven nutritional benefits such as gamma oryzanol, tocotrienols, tocopherols, phytosterols, steryl esters and squalene, along with its excellent oxidative stability account for tremendous importance of rice bran oil as an edible oil. It is well established that physical refining is commercially viable for oils containing high amount of free fatty acids like rice bran oil. Physical refining retains most of the nutraceuticals in the refined oil whereas these components go along with the soapstock during alkali refining. The major gap in the processing technology of rice bran oil was the non-availability of an efficient pre-treatment process before physical refining. Enzymatic degumming process developed by CSIR-IICT solved most of the above problems removing both hydratable and non-hydratable phospholipids. The oil loss during enzymatic degumming is less compared to any other conventional degumming. As this process does not form soapstock, it reduces huge amount of environmental pollution and saves considerable quantities of wash water. This technology was given to 27 clients till now. CSIR-IICT received several awards.</p>
56.	<p>Vitamins C Enriched Chewable Tablets from <i>Hippophae rhamnoides</i> (Sea Buckthorn)"</p> <p>Laboratory: CSIR- Indian Institute of Integrative Medicine</p> <p>Executive summary:</p> <p>Vitamins are substances that our body needs to grow and develop normally. Vitamin-C comes from fruits and vegetables and acts as an antioxidant. It is important for skin, bones, and connective tissue. It promotes healing and helps the body absorb iron. <i>Hippophae rhamnoides</i> (Sea Buckthorn) is abundantly available in Leh and Ladakh region and is enriched with the vitamins including vitamin-C. Although, there are many products available in the form of vitamin-C supplement in market, most of them are derived from synthetic/chemical process. The current product developed is in chewable tablet form and address the issue of vitamin-C deficiency along with other vitamins. The total dosage of product is 750 mg. having 225 mg. of Sea Buckthorn pulp with disintegration time of around 11 minutes. Proposed product is not available in the Indian market.</p>
57.	<p>Saffron based Nutraceutical Product "IIM-141"</p> <p>Laboratory: CSIR- Indian Institute of Integrative Medicine</p> <p>Executive Summary:</p> <p>Age related neurodegenerative diseases like Alzheimer's disease and dementia (memory loss) are new major global challenges, for which there is great unmet medical need. There are approximately fifty-million patients of dementia world over and this number is rising at an alarming rate due to the increase in aging population. All currently available drugs are single targeted agents (cholinesterase inhibitors) and provides only symptomatic relief, without stopping progression of the disease. Because of the complex</p>

	disease pathology, the multi-targeted agents are needed to successfully tackle this disease. "IIM-141" has multi-targeting ability, as it tackles multiple biological checkpoints of the disease progression. It enhances the clearance and degradation of amyloid-beta, provides protection to neurons, reduces neuroinflammation, has antioxidant power, etc. It also enhances learning and memory in the mice model. This product is being launched in market as a dietary supplement.
58.	Argemone Oil Detection Kit (AO Kit)
	Laboratory: CSIR-Indian Institute of Toxicology Research
	Executive Summary: For the detection of Argemone oil contamination in mustard, olive and other edible oils. Consumption of mustard oil adulterated with Argemone mexicana oil is known to cause a disease popularly referred to as Epidemic Dropsy. To detect Argemone oil adulteration in edible oils, a simple & quick field level kit has been developed by CSIR-IITR.
59.	Mustard Oil Check (MO Check)
	Laboratory: CSIR-Indian Institute of Toxicology Research
	Executive Summary: The MO check strips are useful for the detection of an artificial color, Butter Yellow in mustard/edible oils. This can be employed as a handy tool at the retail outlet by cautious dealers, consumers/ house-wives themselves; consumer guidance organization/ societies and for random preliminary checks by food inspectors and health authorities even at the remotest areas. Butter yellow is a known carcinogenic dye therefore the test becomes extremely crucial to ensure safety of edible oils.
60.	Anacardic Acid: A Potential Molecule to Increase Cotton Fibre Yield and Quality
	Laboratory: CSIR-National Botanical Research Institute
	Executive Summary: India tops the world in having largest area under cotton cultivation. However, the yield of cotton in India is destitute being 500 kg/ha compared to the country like Brazil which has cotton yield about 2000 kg/ha. Thus, innovative technologies are needed to improve yield in India which will be a direct benefit to the farmer. CSIR-NBRI has developed a formulation which improves cotton yield. Multi-location trials in different cotton growing states showed 10-15% increase in yield of popular cotton hybrids. This formulation also brings earliness in boll bursting and formulation work by augmenting actions of phytohormones involved in cotton-boll development.
61.	Bio-formulation against <i>Fusarium</i> Wilt of Tomato
	Laboratory: CSIR-National Botanical Research Institute
	Executive Summary: The proposed technology has been developed for the control of <i>Fusarium</i> wilt of tomato, which causes severe annual crop loss. It is an eco-friendly bio-formulation that is a substitute of the chemical fungicides. Only 17 to 20 % disease incidence was found after treatment of the bio-formulation at micro-plot and field trial in infected fields reduced the pathogen infection by 85%. The bio-formulation has the ability to suppress pathogen spore formation and have shelf-life of one year. The bio-control agent and its secreted products present in the formulation are of biological origin, and have no adverse effect on the human health. The ecological toxicity test (soil and water) and the primary skin irritation test carried out at GLP lab validate the same. The field trial of the formulated product is under progress in IGKV, Raipur, Chhattisgarh.

62.	OP-12 Biofertilizer Mediated Plant Health Improvement in Normal and Water Deficit Conditions
	Laboratory: CSIR-North East Institute of Science & Technology
	<p>Executive Summary:</p> <p>Owing to over dependence and excess use of chemical fertilizer resulted in diminution of soil microbes. It is also associated with hazards and other environmental issues. Bio-fertilizers in contrary add nutrients through the natural processes of nitrogen fixation, solubilizing phosphorous and stimulating plant growth through the synthesis of growth-promoting substances. Biofertilizers can be expected to reduce the use of synthetic fertilizers and pesticides OP-12 produces ACC-deaminase which cleaves ACC, thus preventing the effects of high levels of ethylene that produced under stressed condition in plants. This bacteria act as a sink for ACC (1-aminocyclopropane-1-carboxylate) produced as a consequence of plant stress. OP-12 is a biological fertilizer based on selected bacterial strain. This bacteria also possess plant growth-promoting (PGP) traits like nitrogen fixation, phosphate solubilization, production of indole-3-acetic acid (IAA) like molecules, ammonia, hydrogen cyanide (HCN), siderophore and osmotic stress tolerance capacity, it is a very effective bio-fertilizer for plant growth-promotion in all crops of different agro-climatic regions in India under normal and water deficit condition as well. The OP12 Biofertilizer can be applied with seed and or in soil. OP-12 is a cost-effective technology with simple production technique, low capital investment, eco-friendly process, user affable, non-toxic and longer shelf-life for a period of six months in powder formulation.</p>
63.	Organism and Process for Production of Beta Glucosidase (BGL), A Critical Component in Enzyme Cocktail for Biomass Hydrolysis
	Laboratory: CSIR-National Institute for Interdisciplinary Science and Technology
	<p>Executive Summary:</p> <p>β-glucosidase is an important component in the enzyme (cellulase) cocktail for hydrolysis of biomass to generate sugars for biofuels and other applications, as this is the rate limiting enzyme. Availability of enzymes for biomass hydrolysis is important for the future energy security indigenous technologies for enzyme production are warranted. CSIR-NIIST has a solid state fermentation (SSF) technology for production of BGL using the fungus <i>Aspergillus niger</i> demonstrated successfully at semi-pilot scale (up-to 10kg level). The technology would help to produce BGL at a cheaper rate than existing processes, and would help in development of efficient biomass hydrolyzing enzyme cocktails for biorefinery applications</p>
64.	Process for Preparation of White Pepper
	Laboratory: CSIR-National Institute for Interdisciplinary Science and Technology
	<p>Executive Summary:</p> <p>“White pepper”, the de-skinned black or fresh pepper is the most valued form of pepper (almost double value of black pepper). Common method for making white pepper is traditional retting, which affects the product quality significantly.</p> <p>The innovative clean bioprocess from CSIR-NIIST helps in fast and bulk production of white pepper without losing its spicy principles. The process is designed to cleave the pectin molecular bonding between the skin and oil glands of the pepper kernel by the action of enzymes produced in-situ. This is facilitated in tanks by circulating liquid from a reservoir of microbial culture grown on degraded pepper skin medium. This bioprocess completes skin removal in 2 days for green and 4 days for black pepper under designed conditions.</p> <p>Major advantages of the new process are the following:</p>

	<ul style="list-style-type: none"> • Achieves better quality white pepper (No foul smell) • No loss from process damage • Inexpensive and fast • Simple operation and scalability • Pollution free process with recovery of energy and bio manure as by-products
65.	<p>Fresh Ginger Processing Technology</p> <p>Laboratory: CSIR-National Institute for Interdisciplinary Science and Technology</p> <p>Executive Summary:</p> <p>CSIR – NIIST have developed and commercialized Fresh Ginger Processing Technology since 2000 for producing value added products such as ginger oil, dry ginger powder, etc. The institute has set up three processing units in the North East and has transferred this technology to many other industries. CSIR-NIIST provides the knowhow, technical assistance in sourcing of the machinery, engineering consultancy, training the operating staff, assist in erection & commissioning and troubleshooting. Same technology can be adopted for post-harvest operations of other spices like turmeric, cardamom etc. Considering the climatic conditions of North east, cost effective mechanical drying of the various agri crops can also looked into for value addition and shelf life enhancement</p>
66.	<p>Simultaneous Production of US Grade Gasoline and High Purity Benzene from Unprocessed C₆ Heart Cut of FCC Gasoline</p> <p>Laboratory: CSIR-Indian Institute of Petroleum</p> <p>Executive Summary:</p> <p>CSIR-IIP's technology for simultaneous production of 'Benzene Lean Gasoline' and 'High Purity Benzene from unprocessed FCC Gasoline' is first of its kind in the world. This breakthrough technology produces gasoline containing very low benzene content (< 0.4 wt. %) and high purity benzene as a product from benzene rich FCC Gasoline. The gasoline produced from this technology is clean and will cause substantially less benzene (carcinogenic) emissions. The technology is much superior than other similar technologies are being used worldwide in terms of lower CAPEX and OPEX. A 0.7 Million Metric Ton per annum plant based on this technology was successfully set-up in May 2016 at Reliance Refinery at Jamnagar. The plant has been operating consistently at a throughput of 120-150% of design. The annual profit of refinery from the sale of products is of the order of ~ US \$ 51 Million with a payback period less than 1.5 years. The technology is closely guarded by 6 International and one National Patent.</p>
67.	<p>Aromatic Extraction for Production of Benzene and Toluene (B, T) using Sulfolane Solvent</p> <p>Laboratory: CSIR-Indian Institute of Petroleum</p> <p>Executive Summary:</p> <p>CSIR-IIP and Engineers India Limited (EIL) have jointly developed a Solvent Extraction based Technology for production of 'Benzene' and 'Toluene' using Sulfolane solvent. This technology is capable of producing high purity (> 99.95 %wt.) benzene and toluene from aromatics rich refinery streams such as reformate and hydrogenated pyrolysis gasoline. Benzene and Toluene are important precursors for petrochemicals. This technology was commercialized at BPCL Mumbai Refinery and at BPCL Kochi Refinery. Throughput of the respective units are of the order 250000 Tonnes/annum and 150000 Tonnes/annum. This technology can also be applied for production of aromatics from Straight Run Naphtha. The technology has won several awards like the CSIR Technology Award 1990 and awards of repute from NRDC, ICMA and FICCI.</p>

68.	Solvent De-waxing/ De-oiling Technology
	Laboratory: CSIR-Indian Institute of Petroleum
	Executive Summary: <p>CSIR-IIP and Engineers India Limited (EIL) have jointly developed state-of-the-art 'Wax De-oiling Technology' to produce 'Paraffin' and 'Microcrystalline' waxes from petroleum streams. Waxes are used for wide variety of applications such as for making candles, polishes, food packaging, paints, tire, leather, cosmetics etc. Based on this indigenous technology, Numaligarh Refinery Limited (NRL), Assam has set-up a grass root 'Wax De-oiling Plant' with the investment of Rs. 676 Crore. The NRL wax plant has capacity to produce 50,000 MTPA of 'Paraffin Wax'. After commercialization of this technology, the Gross Refinery Margins (GRM) of Numaligarh Refinery has increased to the tune of USD 0.53/bbl which is equivalent to Rs 77.0 crore annum. It also cut down the wax import in India by 50% and saved the foreign exchange of the order of Rs. 300 crore/annum. NRL has also started export of wax to more than 40 countries. This wax plant has generated direct and indirect employment in 'North-East region of India' also. This Numaligarh Wax plant was dedicated to the nation by Hon'ble Prime Minister of India on 5th February, 2016. Production of paraffin wax is a great success under 'Make in India' program propelled by 'Government of India'.</p>
69.	Up-gradation of FCC Recycle Oil through Solvent Extraction
	Laboratory: CSIR-Indian Institute of Petroleum
	Executive Summary: <p>CSIR-IIP and Engineers India Limited (EIL) have also developed a low - investment and a tailor made technology for a Petroleum Refinery for value addition of its Fluid Catalytic Cracking (FCC)-Clarified Oil. IIP has combined two independent technologies for up-gradation of FCC Clarified Oil. This new technology produces additional quantity of clean feed (low sulfur and aromatics) for FCC unit and premium quality Carbon Black Feed Stock (CBFS) simultaneously from FCC-Clarified Oil, which is otherwise going to be blended into fuel oil pool – a low value product. The technology has been successfully implemented at one of the SEUs of M/s Hindustan Petroleum Corporation Limited (HPCL), Mumbai refinery. By adopting this technology, the annual profit of HPCL refinery increased to the tune of Rs. 66.7 crores which resulted in increased Gross Refinery Margins (GRM) of US\$ 0.074 per bbl.</p>
70.	Lube Oil Base Stock (LOBS) production through NMP
	Laboratory: CSIR-Indian Institute of Petroleum
	Executive Summary: <p>CSIR-IIP along with EIL and CPCL has developed NMP Lube Extraction Technology for production of Group-I Lube Oil Base Stocks. This process uses N-Methyl Pyrrolidone (NMP) solvent to selectively remove low Viscosity Index (VI) aromatic hydrocarbons from Vacuum distillates/ Deasphalted Oils (DAO) and produces paraffinic rich raffinate and Aromatic Extract. Raffinate is used as a feed for Solvent De-waxing Unit to produce Group-I lube base oils or as a feed for isodewaxing/wax isomerization unit to produce high performance Group-II/III lube base oils, while Aromatic Extract can be utilized as feed stock for carbon Black, rubber extender oil, petroleum pitches and premium quality petroleum coke. The salient features of this technology is solvent composition which can be tailor made for processing of wide range of lubes (spindle, LN, IN, HN, BS) and other applications, low solvent-to-feed ratio, low operational temperatures as compared to furfural extraction, better heat integration in the solvent recovery sections, better products quality etc. India is the second country to develop this technology followed by USA. A grass root NMP Lube Extraction Unit of combined throughput 3,50,000 TPA had been commercialized at IOCL-Haldia Refinery.</p>

71.	Sweetening Catalyst – Thoxcat ES
	Laboratory: CSIR-Indian Institute of Petroleum
	Executive Summary: <p>The presence of mercaptans in petroleum products like LPG, naphtha, gasoline, aviation turbine fuel (ATF) and kerosene is undesirable due to their foul odor and highly corrosive nature which also may affect the activity of catalysts used in downstream processes. In commercial practice, the low molecular weight mercaptans present in LPG are first extracted with alkali and subsequently oxidized catalytically to disulfides. The process for converting mercaptans into less deleterious disulfides is termed as sweetening. CSIR-IIP in collaboration with BPCL has developed a homogeneous catalyst, Thoxcat ES™, which sweetens LPG cost-effectively.</p> <p>The rights of production have been licensed to LONA Industries, Mumbai. This catalyst has been commercialized in 2007. This catalyst is covered by 9 Indian and International patents and running successfully in 10 refineries including one abroad. To increase our market share, CSIR-IIP and BPCL (R&D) are jointly working to implement the catalyst in refineries outside India also (starting with the relatively easily accessible Middle East (M.E.).</p>
72.	Soaker Internal Visbreaking Technology
	Laboratory: CSIR-Indian Institute of Petroleum
	Executive Summary: <p>Visbreaking is a mild thermal conversion process exercised in the refinery for production of fuel oil. This fuel oil is mostly used in marine ship and refinery internal heating. Initially, CSIR-IIP has developed “soaker visbreaking technology ”and it was commercialized in seven different Indian refineries for the production of around 80% fuel oil in India. Subsequently, this soaker visbreaking technology has been upgraded by “soaker internal technology .’In this upgraded technology, soaker 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. This technology increases the production of LPG, petrol, and diesel by maximum 2, 7 and 12 wt% respectively. LPG is used as cooking gas, petrol is marketed as a transportation fuel for light vehicles and diesel has a wide range of usages in our society including in the agricultural sector .This technology is presently in use at HPCL-Vizag, and IOCL-Mathura and IOCL-Haldia refineries. By implementing this technology, refineries are gaining a considerable amount of revenue due to the extra productions of LPG, petrol, and diesel.</p>
73.	Electrochemical Synthesis of Perfluorobutane Sulfonylfluoride
	Laboratory: CSIR-Central Electrochemical Research Institute
	Executive Summary: <p>The technology is electrochemical perfluorination of sulfolane to perfluoro butane sulfonylfluoride. The structural unit of this product is similar to perfluoro octane sulfonyl fluoride and can be used as an intermediate to synthesis various fluoro surfactant. Its alkali salt (C₄F₉SO₃K) is one of the best fluoro anion surfactant, flame retardant for polycarbonate, semiconductor and a photo-acid generator for photolithography. It may substitute for perfluoro octane sulfonate in various applications. Indigenous technology with single step and with minimal energy. Cost of production is Rs. 9000/- per kg with 28% return on investment. By this technology, Foreign exchange may be saved. Current demand is met by import.</p>

74.	Process for Production of High Purity Salt in Solar Salt Works
	Laboratory: CSIR-Central Salt & Marine Chemicals Research Institute
	Executive Summary: <p>CSIR-CSMCRI has been engaged in improving the yield and quality of salt and recovery of marine chemicals for over six decades. Continuing the discovery of an integrated process for the recovery of salt and marine chemicals from brine (US Patent 6,776,972 dated 17 August 2004), developments were further made towards production of ultrapure solar salt in the pans that dealt with significant improvement in purity and whiteness brought through treatment of brine with alum prior to charging into crystallizers for solar salt production. The improvements realized are partly on account of elimination of suspended impurities like gypsum and clayey matter in the brine, and partly due to the improved crystal size and morphology that minimizes embedded impurities in the salt (US Patent No. US 8,282,690). In an additional development the ratio of Ca^{2+} to Mg^{2+} from a value > 1 to a value in the range of 2-3 is altered, as desired by chlor-alkali and soda ash industries. The improved process involves the adjustment of pH of clarified brine with aqueous HCl so as to carry out salt crystallization at a pH of 6.5 instead of at natural pH 7. The pH adjustment reduces Mg^{2+} impurity in salt while slightly raising the Ca^{2+} thereby achieving the desired ratio.</p>
75.	A Cost-effective Process for Recovery of Low Sodium Salt from Bittern
	Laboratory: CSIR-Central Salt & Marine Chemicals Research Institute
	Executive Summary: <p>CSIR-CSMCRI has developed a process for recovery of low sodium salt (~75% NaCl and ~25% KCl), good for addressing hyper tension and K-assisted CNS mediated activities, directly from bittern comprising desulphatation of bittern (by-product of salt industry), evaporation of bittern in solar pans and processing of solid mixture with water to produce a mixture of sodium and potassium chlorides and optionally preparing 'free flowing' and iodized versions of them, by known techniques. Though such low sodium salt is commonly prepared by homogeneous mixing of NaCl and KCl, the process developed by CSIR-CSMCRI prepares directly using bittern, the mother liquor left out after salt production in solar salt works. Furthermore, the process offers the flexibility of tailoring the required specification of low sodium salt by controlling the ionic composition of desulphated bittern during its processing.</p>
76.	Technology for the Production of Sulphate of Potash and Refractory Grade Magnesia from Sea Bittern
	Laboratory: CSIR-Central Salt & Marine Chemicals Research Institute
	Executive Summary: <p>Sulphate of potash (SOP) being a multinutrient (K & S) fertiliser with low salinity index, offers significant advantage over Muriate of Potash (MOP) with respect to sustainable agricultural productivity. CSIR-CSMCRI's integrated SOP technology utilizes kainite type mixed salt, obtained upon progressive evaporation of sea bittern, for recovery of sulphate of potash and refractory grade magnesia in an integrated manner. This patented technology was successfully demonstrated & licensed to M/s Archean Chemical Industries and M/s Tata Chemicals Limited. This technology is suitable for implementation in low humidity (arid) regions such as Greater Rann of Kutch, Gujarat.</p>
77.	A ZLD Management with Value Added Products for Molasses-based Alcohol Distilleries
	Laboratory: CSIR-Central Salt & Marine Chemicals Research Institute
	Executive Summary: <p>Effluent from sugarcane molasses based distilleries (spent wash) pose serious</p>

	<p>environmental threat for contamination of groundwater & water bodies. This is the single biggest impediment for ethanol capacity expansion in Indian context. CSIR-CSMCRI's ZLD compliant spent wash management technology, scaled up & validated in partnership with M/s Chem Process Systems Private Limited, allows distilleries to produce various value added marketable products (viz., FCO grade potash fertiliser, cattle feed binder etc.) from spent wash. This zero waste process opens up new opportunity for indigenous potash fertiliser production (ca. 5 lakh t/ year across the country) and offers attractive financial benefit (project payback period about 3 years, additional revenue of ₹ 5/Litre of alcohol) while improving ecological sustainability of the distillery sector by recycling water and resolving long standing environmental issues of spent wash. Apart from direct economic/ environmental impact(s) this technology is likely to facilitate ethanol capacity expansion, a pre-requisite to meet India's Ethanol Blending Programme target.</p>
78.	<p>Double Fortified Salt Technology for Fortification of Salt with Iron and Iodine</p> <p>Laboratory: CSIR-Central Salt & Marine Chemicals Research Institute</p> <p>Executive Summary:</p> <p>Iron and iodine are essential elements for the human body. Iodine deficiency disorder (IDD) and iron deficiency anaemia (IDA) are caused by insufficient intake of iodine and iron, respectively that have serious detrimental effects on human physiology and adversely contribute to economic and social development of the Nation. Globally 1.88 billion people are at risk of Iodine deficiency disorders (IDD) due to insufficient iodine intake and 2 billion people suffer from iron deficiency with India having a larger share for the latter. CSIR-CSMCRI has developed an IP-secured innovative process for fortification of salt with iodine and iron using inorganic matrix compound. This inventive process helps in retaining the white colour of the salt and preserving the effective concentration of iodine and iron intact over a long period of time. It showed 85% positive impact in Hb value and with improved iodine indicators over a 10 month trial tested for over 300 volunteers, and is significantly better than those available currently in the market. Process has been scaled up and the production cost of DFS is ₹2/Kg. Customer feedback studies are being taken up to make this product available in the market on faster track.</p>
79.	<p>Preparation and Applications of Non-hazardous Brominating Reagent</p> <p>Laboratory: CSIR-Central Salt & Marine Chemicals Research Institute</p> <p>Executive Summary:</p> <p>CSIR-CSMCRI has developed a process for green brominating reagent - a superior alternative to hazardous liquid bromine. The reagent has been designed to cater three main functionalities namely: 1) Brominating reagent for substitution (BR-S); 2) Brominating reagent for addition reactions (BR-A); and 3) Brominating reagent for oxidations (BR-O). The key features of green brominating reagent are: (i) avoids the use of corrosive elemental bromine; (ii) safe, easier to handle & transport; (iii) avoids the need of special MoC for equipment; (iv) avoids the need of catalyst; (v) maximize bromide atom efficiency; (vi) operates under ambient reaction conditions; (vii) easier to scale-up for the processes development; (viii) avoids formation of undesired by-products; (ix) easier effluent discharge without any treatment; (x) economically competitive and readily available; hence a truly green and environment-friendly. The reagent can thus be used for diverse chemical transformations that involve bromine in the domain of fine & specialty chemicals</p>
80.	<p>Catalytic Process for 2-Phenyl Ethanol from Styrene via Styrene Epoxide obtained through a Non-chloride Route</p> <p>Laboratory: CSIR-Central Salt & Marine Chemicals Research Institute</p>

	<p>Executive Summary:</p> <p>2-phenylethanol (2-PEA) is a naturally occurring rose fragrant chemical currently used as aroma chemical in perfumery, cosmetic industries and in pharmaceutical formulations. 2-PEA is also a starting material for many industrially important aroma chemicals (e.g., synthetic Kevra) and bio-active compounds. 2-PEA is obtained from styrene via epoxidation to styrene oxide followed by hydrogenation. The industry uses Pd/C as hydrogenation catalyst for the production of 2-PEA from styrene oxide which is pyrophoric besides producing several by-products, and due to its low physical strength there is physical loss of the catalyst during recovery operations. CSIR-CSMCRI has developed a novel hydrogenation catalyst where Pd was loaded on an inorganic solid base (2% loading) and the catalyst thus developed has high physical strength, stable under ambient condition, non-pyrophoric and does not give any by-products. The catalyst has performance over 100 recycle use in hydrogenation process and Pd from the spent catalyst is easily recoverable that makes the entire process economical for industrial application. The process has been licensed to four perfumery companies who have started making these chemicals recently.</p>
81.	<p>Multi-Fab Micro Fabrication Machine Technology</p> <p>Laboratory: CSIR-Central Mechanical Engineering Research Institute</p> <p>Executive Summary:</p> <p>CSIR-CMERI has developed micro fabrication machine which costs 10 times lesser. Additional features such as conducting for operations are not available in machines imported. Indigenization of machine is achieved in terms of controller and software.</p>
82.	<p>12 HP Krishishakti Tractor</p> <p>Laboratory: CSIR-Central Mechanical Engineering Research Institute</p> <p>Executive Summary:</p> <p>Suitable for India, since the size of the farms are very small. Indigenously developed.</p> <p>Low turning Radius (2m), compact gearbox, comparable ground clearance (280mm) and lower fuel consumption.</p>
83.	<p>Intelligent and Powered Wheelchair</p> <p>Laboratory: CSIR-Central Mechanical Engineering Research Institute</p> <p>Executive Summary:</p> <p>It has differentially steered and six-wheel configuration. It has fully electronic soft touch control. It has Infrared based safety warning and has safety belt. On board charging facility. Can be disassembled into parts for traveling and transportation.</p>
84.	<p>Mobile Bridge Inspection Unit (MBIU)</p> <p>Laboratory: CSIR-Central Mechanical Engineering Research Institute</p> <p>Executive Summary:</p> <p>Simple and robust articulated steel structure unit mounted over 25-ton TATA truck chassis with modified suspension system and additional rear axles. MBIU can be easily operated / maintained by semi-skilled manpower. Programmable logic controller (PLC controlled electric) drives for all six joints. Operating safety embedded in the PLC controller for adequate safety.</p>
85.	<p>Fire Retardant Water Based Transparent Coating for Wood and Wood Based Interiors</p> <p>Laboratory: CSIR-Central Building Research Institute</p>

	<p>Executive summary:</p> <p>Wood and wood based materials are combustible in nature, when exposed to fire, they ignite easily, spread flames, contribute to heat, generate dense smoke and toxic combustion products. Most of Indian wood when exposed to surface spread of flame, show medium or rapid flame spread (class 3 or 4) with fire propagation index in the range of 30-38. The developed Fire Retardant Water Based Transparent Coating, when applied on existing or new wooden structures (i.e. doors, windows, false ceilings, partitions etc.), the fire performance enhanced to next level (Class O) in fire behaviour ratings. The coating can be made available at affordable price at par with normal emulsion paint. The spread rate of normal paint is approximately 5 m²/lt while Fire Retardant Water Based Transparent Coating developed gives 10 m² / lt. Hence cost-effective also.</p>
86.	<p>Hybrid Rebar Coupler</p> <p>Laboratory: CSIR–Central Building Research Institute</p> <p>Executive summary:</p> <p>A rebar coupler is used to connect two adjacent rebars in new construction and in retrofitting works. This can be used to connect the new rebar with extended rebars in the existing concrete elements. However, in several cases the performance of conventional rebar couplers was not found satisfactory during the earthquake. To improve the performance of spliced region, hybrid rebar coupler has been developed at CSIR-CBRI. This coupler consists of a cylindrical steel sleeve with internal threads to offer frictional resistance between the rebar and sleeve. The cylindrical sleeve has provisions for vertical and inclined bolts to apply lateral pressure. It can be used to connect precast structural elements at the potential hinge region of framed structures.</p>
87.	<p>Process Know-how for the Preparation of Silica Nanoparticles</p> <p>Laboratory: CSIR–Central Building Research Institute</p> <p>Executive Summary:</p> <p>Nanotechnology in construction sector is gaining widespread attention as it provides a suitable alternative to fulfil the present need of sustainable construction without compromising the strength and cost of the concrete.</p> <p>Applications of silica nanoparticles (SNPs) in cementitious system results in three major advantages i.e. (1) Higher early stage strength, yielding to speedy construction; (2) Improvement in microstructure leading to higher performance against environmental constituents and (3) Modification in C-S-H structure, thereby exhibiting to enhanced durability.</p> <p>CSIR-CBRI has developed an improved, cost-effective and facile process for the preparation of silica nanoparticles for use in cement based materials.</p>
88.	<p>Building Products from Kotastone Waste</p> <p>Laboratory: CSIR–Central Building Research Institute</p> <p>Executive Summary:</p> <p>Every year about 10 to 12 Million Ton of Kotastone waste is discharged into local convenient places which poses major environmental and ecological problems which affects the human health such as (i) Ground water contamination caused due to land filling, (ii) Air pollution due to increased level of suspended particulate in atmosphere, (iii) Choking of drain in rainy season due to unorganized disposal etc.</p> <p>This technology is helpful to stone Industry in disposing off the huge generated solid and slurry wastes economically without effecting the environment. There is tremendous scope for setting up secondary industries for recycling and using such solid wastes in</p>

	construction materials. The developed technology is ~35-45% cost-effective as compared to the conventional tiles/blocks.
89.	Horizontal Boring Machine for Making Underground Bores
	Laboratory: CSIR–Central Building Research Institute
	Executive Summary: The machine developed by CSIR-CBRI is capable of making 180mm dia holes upto 17m under the buildings/ roads for laying underground services like sewer pipelines, conduits, water pipelines etc. without disturbing the surface structures. The machine is environment friendly and reduces the traffic jam and the dust due to underground boring. Being the low price product, it is best suitable for small to medium contractors engaged in building and allied construction activities.
90.	Know- how for the Production of Ambient Cured Geopolymer for Making Concrete and Building Materials
	Laboratory: CSIR–Central Building Research Institute
	Executive Summary: The concrete industry faces challenges to meet the growing demand of Portland cement due to limited reserves of limestone and increasing carbon taxes. The requirement of cement in India is likely to touch 550 million tonnes by 2020 with a shortfall of 230 million tonnes due to increased infra-structural activities. The options to meet these challenges are either to lower the clinker factor of the binders using supplementary cementitious minerals or to find out new alternative to Portland cement. Geopolymer provides one route towards these objectives as it is produced from industrial by-products such as fly ash, GGBFS, metakaolin etc. replacing 100% cement in concrete
91.	Cost Effective Durable Water Tanks using Flowable Cement Mortar
	Laboratory: CSIR-Structural Engineering Research Centre
	Executive Summary: The technology aims producing cost-effective, easy-to-build and durable water tanks for domestic needs. The tanks can be easily constructed with flowable cement mortar by labour force having minimum skills in construction. The tanks can be constructed either as cast in-situ or assembled from thin precast concrete panels. The facility to assemble from panels eliminates any requirement for additional lifting mechanism for placing the tank on the roof of a building. As a water tank meets the basic needs of a built environment, there is likely to be large demand for the product made from this technology. Further, the technology has the potential to impact on the quality of life in noticeable manner.
92.	Innovative Disaster Resistant Light Weight Prefabricated Building Systems using EPS Panels
	Laboratory: CSIR-Structural Engineering Research Centre
	Executive Summary: With the Government Initiatives like “Housing-for-all” and “Smart Cities”, the Indian construction industry is in need of rapid and economical methods of construction in order to meet the huge demand for housing in both rural and urban environments. The building construction time can be considerably reduced by using the technology and hence it has the potential for application during rehabilitation measures after a natural disaster.

	<p>The light weight panels are of sandwich construction with expanded polystyrene as core and self-compacting concrete skins. Laboratory tests done on a sufficiently large scale model of a G+1 building made from these panels by applying a combination of loads, which are likely to be experienced by the building during service, to confirm its suitability.</p>
93.	<p>Emergency Retrieval System for Power Lines</p>
	<p>Laboratory: CSIR-Structural Engineering Research Centre</p>
	<p>Executive Summary:</p> <p>The technology on Emergency Retrieval System (ERS) for Power Lines is <i>first-of-its-kind</i> attempt in the country to develop an import-substitute product.</p> <p>The system provides an alternative solution for transmission of power in the aftermath of failure of the transmission power lines during a cyclone. The system has light weight modular structural panels, which are used as temporary support structure to restore the power within a few days. The system is designed as reusable and to facilitate quick fabrication with minimum hardware by way of introduction of innovative simple connections and compatible ready-to-construct foundation systems.</p> <p>The proposed technology contributes in a major way to achieve a disaster resilient society.</p>
94.	<p>Textile Reinforced Concrete Prototyping Technology (TRCPT)</p>
	<p>Laboratory: CSIR-Structural Engineering Research Centre</p>
	<p>Executive Summary:</p> <p>The Textile reinforced concrete prototyping technology (TRCPT) developed by CSIR-SERC can be used to produce useful structural or non-structural products of common use. TRCPT can serve as an effective indigenous technological solution for pre-cast construction industry to achieve economical mass production of TRC products. This technology can be used to make wide range of products for different purposes. The other attractive features are due to enabling mass production, products of standard quality, etc. Huge economic benefit can be achieved by using TRCPT technology in large scale construction sites to produce various textile reinforced concrete structural, non-structural and architectural elements.</p>
95.	<p>Toilet Unit using Thin Precast Concrete Segmental Panels</p>
	<p>Laboratory: CSIR-Structural Engineering Research Centre</p>
	<p>Executive Summary:</p> <p>A novel technology to construct cost-effective, durable and ecologically safe toilets using thin precast concrete segmental panels. The panels can be joined together using a bonding material. A septic tank can also be built using the same thin precast panels. Assembling of panels and erection of toilet can be completed in just three hours duration with only minimum equipment. This technology can also be implemented for mass production with mechanised methods and ideally supports rural mass housing schemes.</p>
96.	<p>Manufacturing Hybrid Green Composites Materials for Multifunctional Applications</p>
	<p>Laboratory: CSIR- Advanced Materials and Processes Research Institute</p>
	<p>Executive Summary:</p> <p>Hybrid Green Composites are developed to reduce consumption of timber. They have variety of application such as doors, false ceiling, floor tiles, partition wall, wall tiles, furniture and other architectural interiors. The advanced composite green materials are</p>

	stronger than teak wood and synthetic wood, highly durable, environmental friendly and cost effective. Addition of industrial wastes enhances the surface finish, density, modulus of rupture and resistance to moisture, abrasion, wear and fire. The composites can replace teak wood and poor quality country wood.
97.	Anticorrosive Treatment for Steel Reinforcement Rods
	Laboratory: CSIR-Central Electrochemical Research Institute
	Executive summary: Under extreme operational conditions such as saline environment it is necessary to give a protective coating to steel reinforcements before they are laid in concrete. Since the steel reinforcement embedded in concrete is surrounded by an alkaline medium, a coating based on cement is expected to be more combatable. Keeping both economy and efficiency in view, CSIR – CECRI has developed a coating based on Portland Cement slurry admixed with corrosion inhibitors which offers excellent corrosion inhibition.
98.	Corrosion Resistant Inhibitive Admixture for Portland Pozzolana Cement
	Laboratory: CSIR-Central Electrochemical Research Institute
	Executive Summary: Reinforced Cement Concrete [RCC] is the most commonly used construction material. These structures show signs of deterioration such as spalling of cover concrete and cracking, steel cross section reduction and the degradation of steel–concrete bond due to corrosion of rebars. This technology involves addition of suitable organic and inorganic inhibitors in powder form during the manufacture of cement.
99.	Multicoat Protective Scheme for Concrete Structures and Bridges
	Laboratory: CSIR-Central Electrochemical Research Institute
	Executive summary: It is a protective cum anticorrosive coating system for concrete surface. It has been used in all fly overs, bridges, culverts across the country in important structures. Ex. Annalindra Gandhi Bridge, Thane Creek Bridge etc. Multicoat system consists of: Primer - Epoxy Red oxide; Undercoat-Epoxy MIO; Top Coat – Epoxy TiO ₂ ; finish Coat – Aliphatic PU, is performing well in aggressive marine environmental conditions It has been licensed to 16 companies. The specification of the coating system has gone into the Ministry of Road Transport & Highways (MoRTH) for painting bridges.
100.	Electropolishing of AISI 304 Stainless Steel
	Laboratory: CSIR-Central Electrochemical Research Institute
	Executive Summary: Electropolishing technology is cost effective and simple process. It provides very smooth surface with pleasing appearances. It is useful in various sectors such as domestic (kitchen utensils), atomic energy (for nuclear decontamination in nuclear reactor pipelines) medical (for produce ultra-smooth surgical needles surface), engineering (surface smoothed valves) etc. This may be customized as per the requirements like surface finishing and component geometry etc. More than 15 companies are using our technology for various applications.

101.	Commercial Process for Manufacture of Cold Setting Fly Ash Building Bricks
	Laboratory: CSIR- Institute of Minerals and Materials Technology
	Executive Summary: Mineral cementation is a multi-component reaction process that forms two-dimensional layer structures of silicon-oxygen tetra-hedra with OH bearing characteristics exist in hydration of Portland cement and other cementitious materials are also rock forming silicate minerals. These mineral phases are also prepared in alkaline condition by inter co-ordination of SiO ₂ , Al ₂ O ₃ , Fe, Ca, Mg and SO ₄ bearing are suitable for mineral cementation reaction to make building products. The mineral cementation phases are hydrous calcium silicates of xonotlite, gyrolite and hydrous calcium aluminium silicates of hydrogarnets, stratlingite and its solid solution structures. In this process the binding strength develops by hydraulic reaction in presence of water.
102.	Utilization of Mining and Industrial Wastes in Manufacture of Building Bricks
	Laboratory: CSIR- Institute of Minerals and Materials Technology
	Executive summary: A Non-fired green process has been developed for sustainable utilization of mining and industrial solid wastes as well as low grade minerals in manufacture of building materials for resource conservation and minimization of environmental pollution to save the planet earth. This process has been adopted for utilization of high volume fly ash, red mud, blast furnace slag, L.D. slag, gypsum, beneficiated tailings, ferrochrome flue dust and locally available raw materials in manufacture of cold setting building materials such as brick, block and tiles
103	Stabilization of Cr+6 in Sodium Dichromate Plant Residue and its Utilization in Manufacture of Building Materials
	Laboratory: CSIR- Institute of Minerals and Materials Technology
	Executive summary: An innovative technology has been developed for treatment and stabilization of Cr+6 of chrome chemical waste and its effective utilization in building material application. The process is suitable to stabilize the water leachable Cr+6 of the solid materials into stable non-leachable mineral phases by sintering reaction. The sintered materials are like stone aggregates which are suitable to use as a cementitious material in replacement of clinker for cement production and as a construction material in manufacture of brick/block/concrete and as an additive in cement
104.	Construction of Underpasses under the Live Road/Rail Loading Conditions by "Soil Nailing Technique"
	Laboratory: CSIR-Central Road Research Institute
	Executive summary: Underground structures are generally constructed by conventional cut and cover method involving large-scale excavation which, sometimes are highly disruptive to sudden collapse and harmful to neighboring properties. At the same time such methods are time consuming and relatively costlier. To overcome the deficiencies, CSIR-CRRI has innovated a novel technique for the construction of underpasses under the live road/rail loading conditions. The combo technique 'soil nailing with box jacking' for construction of underpass through the collapsible soils without disturbing the ground structure has been undertaken. This technique reinforces the ground by insertion of designed soil nails at the desired site. During the process of underpass construction the soil nailing increases the load bearing/tensile capacity of existing soil, restrained the lateral as well as vertical displacements and also prevents the sudden collapsible behaviour of soil under loading

	<p>conditions. Therefore many rail/road underpass projects (rail underpass- (i) Yamuna bazar, (ii) Apsara Border, Delhi , (iii) Shahibabad, and road underpass- (iv) Delhi-Gurgaon National Highway near IGI airport) through the collapsible (sandy soil) have been successfully and safely completed using the soil nailing with box jacking</p>
105.	<p>Electrochemical Defluoridation of Drinking Water</p> <p>Laboratory: CSIR-Central Electrochemical Research Institute</p> <p>Executive summary:</p> <p>The removal of fluoride in drinking water through electrochemical route has been developed. The process provides the most effective defluoridation media that has selective high efficiency fluoride removal properties. The total system is simple for operation and maintenance and does not affect the other parameters of water quality. This process does not involve addition of any chemical and has unit operations such as settling and clarifying as in conventional chemical precipitation.</p>
106.	<p>Removal of Anions/Cations like Chloride/Sulphate/Sodium/ Calcium/ Magnesium Ions from RO Reject/Waste Water by Electrodialysis</p> <p>Laboratory: CSIR-Central Electrochemical Research Institute</p> <p>Executive Summary:</p> <p>Electrodialysis is green and environmentally safe process for the removal of anions and cations from various types of industrial RO reject or waste water. It avoids usage of large amounts of chemicals for treatments/ purification/ separation, has high removal efficiency and easy to separate unwanted ions and preparation of value added products. After electrodialysis the water can be reused or recycled for other unit operations.</p> <p>This indigenous process technology finds applications in chemical industries like pharmaceutical, sugar, food products, petrochemical and fine chemicals.</p>
107.	<p>Process Technology for Separation of Phosphor Material from CFL Waste/ Recycling of Waste CFLs and Tubelights</p> <p>Laboratory: CSIR - Central Scientific Instruments Organisation</p> <p>Executive Summary:</p> <p>Compact Fluorescent Lamps (CFLs) and Tube Lights are still widely used for domestic as well as outdoor lighting. After their life span, the CFLs and Tube lights waste needs to be appropriately addressed. CFLs, like all fluorescent lamps, contain mercury as a vapor. Therefore, it is very important to develop suitable closed loop technologies to address complete recycling of CFL and Tube Light wastes. The present process, after safely breaking the waste in a bulb-eater, allows convenient separation of waste in to phosphor and glass products. Unlike other acid treatment-based technologies, the present process involves safer and more environmentally friendly steps. Recovered products can be mixed with virgin material or used as such for different applications. Thus, overall burden of producing fresh phosphor and glass can be minimized. Hence, the technology offer both economic and environmental benefits.</p>
108.	<p>Water Quality Monitoring (Nitrate, Fluoride and Arsenic) Watchdog Pod in Potable Water</p> <p>Laboratory: CSIR - Central Scientific Instruments Organisation</p> <p>Executive Summary:</p> <p>There are various parameters of water which should meet the quality standards set by different organization such as World Health Organisation (WHO), US EPA (Environmental Protection Agency) etc. An alarming 80% of India's surface water is polluted. Thus, regularly monitoring water quality is a crucial part of identifying any</p>

	<p>existing problems, or any issues that could emerge in the future. Some of the hazardous water contaminants of relevance include nitrate, fluoride, and arsenic. Many part in India such as Rajasthan, Maharashtra, West Bengal and Bihar are affected with Fluoride, Nitrate and Arsenic contamination, respectively. These contaminants are health hazardous and associated with blue baby syndrome, fluorosis, and heavy metal ions such as arsenic is carcinogenic if consumed consistently. Therefore monitoring of water quality (nitrate, fluoride and arsenic) is very important which can be done by this technology.</p>
109	<p>Domestic Water Desalination Unit with Improved Protocols for Water Desalination to Produce Mineral-Balanced Alkaline Water</p> <p>Laboratory: CSIR-Central Salt Marine Chemicals Research Institute</p> <p>Executive Summary:</p> <p>Domestic water desalination unit of capacity 12 L/h capable of retaining nutritious minerals and producing alkaline water (pH 7.9 to 8.1) has been developed. The indigenously developed polyethylene inter poly based ion exchange membranes coated with PANI are used to desalinate water by electrodialysis. The product water can retain Ca^{2+}, Mg^{2+}, K^+, SO_4^{2-} ions. The pH of product water can be tuned from pH 7.5 to 8 by slightly changing the potential from 1.5 volt/cell pair to 1.7 volt/cell pair. This water is suitable for people suffering from acidity problem.</p>
110.	<p>Electro-deionization Unit for Producing Ultrapure Water (Resistivity: 18.2 MΩ. Cm)</p> <p>Laboratory: CSIR-Central Salt Marine Chemicals Research Institute</p> <p>Executive Summary:</p> <p>Ultrapure water of high resistivity (18.2 MΩ. cm) has a high demand in pharmaceutical industry and electronic industry. We have developed electro-deionization unit for producing ultrapure water of capacity 12 L/h and 50 L/h using our indigenously developed polyethylene interpolymer based ion exchange membranes and mixed bed ion-exchange resin. A high potential is applied (18-20 volt/cell pair) to the unit for water splitting. The resin is thus in situ regenerated by water splitting. The quality of the water is at par the water produced by commercial Milli-Q unit marketed by Merck.</p>
111.	<p>Production of Alum from Waste Aluminium Dross</p> <p>Laboratory: CSIR-Institute of Minerals and Materials Technology</p> <p>Executive Summary:</p> <p>Aluminium dross is the mixture of metallic aluminium and nonmetal part mostly aluminium oxide. Majority of dross is disposed of in landfill sites, which could result in leaching of toxic metal ions into ground water causing serious pollution problems.</p> <p>However, CSIR-IMMT has developed a process where the alumina and aluminium metallic fines are brought to solution by aggressive sulphuric acid leaching at 85-95°C. The leached slurry is passed through filter press to separate out leached solutions from the un-reacted residues. The aqueous aluminium sulphate obtained after solid liquid separation is crystallized aluminium sulphate hydrate called alum ($\text{Al}_2(\text{SO}_4)_3 \cdot 15\text{H}_2\text{O}$). The plant is equipped with all pollutions control measures to control pollution due to solid, liquid and gases by providing wet scrubbers, treatment plants, exhaust fans, collection pits, recycling facilities.</p> <p>For 50000 Tons per Annum Alum Production Capex will be around 6.0 Crores excluding the land cost and Opex will be Rs 5000 per Ton of alum. In this process the payback period is 1.5 to 2 years depending on the production capacity. Higher the production capacity lower will be the payback period. However, the alum produced from waste dross residue will be strictly use for industrial purpose only and not for drinking water</p>

	applications.
112.	<p>City Air Pollution Monitoring and Prediction System – CAMPS</p> <p>Laboratory: CSIR-Institute of Minerals and Materials Technology</p> <p>Executive Summary:</p> <p>The uniqueness of the present development lies in its portability and mobility that can acquire sensor generated air pollution records from various locations within an area at different time intervals through a moving node and then perform real-time analysis to constantly create and update a grid overlaid on the map of the region presenting the levels of pollution.</p> <p>Other factors like Temperature, Humidity and Pressure are also considered. Further, the GPS location along with date & time stamps are sent to the central server for analysis and finally a web application to disseminate all the data.</p> <p>The prototype has been thoroughly tested on experimental sites and the results are comparable to real-time acquisition of a large array of sensors.</p> <p>The developed device can be mounted on Public Transport system for data generation and aggregation.</p>
113.	<p>Multi-fuel Improved Cook Stove “NEERDHUR”</p> <p>Laboratory: CSIR-National Environmental Engineering Research Institute</p> <p>Executive Summary:</p> <p>632 million people in India would continue to depend on solid unprocessed biomass for cooking and space heating needs. Global Burden of Disease 2016 ranked air pollution as a leading cause of death and disability in India. Majority of rural households’ use solid fuels using inefficient earthen stoves or use open pits in poorly ventilated kitchens, resulting in very high concentrations of indoor air pollutants. NEERDHUR, a natural draft multi-fuel improved cookstove has been developed with high overall thermal efficiency, reduced fuel consumption and reduced emissions through design improvements and has adjustable fuel grate for multi-fuel applications. NEERDHUR is capable of both top and front fuel loading and is certified by MNRE, GoI to meet BIS 2013 Cookstove norms. 1000 units of NEERDHUR cookstoves have been deployed in 10 villages across 4 states, namely Maharashtra, Madhya Pradesh, West Bengal and Gujarat with over 4000 beneficiaries. The benefit-cost ratio was found range between 4 and 6 depending upon the cookstove’s life.</p>
114.	<p>An Improved Ecofriendly and Energy Efficient Electric Sanitary Pad Incinerator “Greendispo”</p> <p>Laboratory: CSIR-National Environmental Engineering Research Institute</p> <p>Executive Summary:</p> <p>Over one billion sanitary pads are disposed every month in India. The segregation of sanitary pads remains a challenge as currently these comes under Municipal Solid Waste (MSW) and find their way to landfill in composite form along with other household/domestic wastes. Most the sanitary pads available in the market contains SAP, and looking at the available capacity and infrastructure of centralized bio-medical treatment facilities in India, it is necessary to promote quality decentralised solutions for safe disposal of these wastes.</p> <p>CSIR-NEERI has developed an eco-friendly Electric Incinerator <i>GreenDispo</i> for disposal of used sanitary napkins with improved operational efficiency, reduced power consumption and emissions in an automatic way. This device incinerates used sanitary pads at a temperature more than 800 °C with a post combustion unit for emission control. This is needed for safe and eco-friendly disposal of used sanitary napkins. The</p>

	product is tested for exhaust emissions at CSIR-NEERI and found to comply with the recommended emission levels as recommended by CPCB for total particulates, CO, SO _x and NO _x .
115.	A Low Cost & Affordable Technology for Improving the Sanitation & Hygiene (NEER-FLUSH)
	Laboratory: CSIR-National Environmental Engineering Research Institute
	Executive Summary: As per World Health Organisation (WHO), the poor and lack of sanitation facility would led to various associated health diseases such as cholera, diarrhoea, dysentery, hepatitis A, typhoid etc. which may lead to deaths of many. This creates' need for developing the proper sanitation facility in the 'Rural' as well as 'Urban' areas, and <i>more importantly maintaining it clean and hygienic</i> , in order to <i>enhance its usability</i> . Understanding this, CSIR-NEERI has developed <i>sanitation technologies "NEERFLUSH" and 'NEERSWACHH"</i> , which offers low cost and affordable solution for improving sanitation facility, and overcomes limitations/drawbacks of the existing technologies available in the market, such as expensive sensor based flusher, waterless urinals, tap or knob fitted mechanical flushers, etc. Further, hands-free flusher operation eliminates the exposure to disease-causing bacteria/germs in urinals-toilets, and also ensures water conservation as uses minimum requisite quantity of water per flush.
116.	Nano Swadis Bottle for Microbial Contamination Free Water
	Laboratory: CSIR-National Environmental Engineering Research Institute
	Executive Summary: CSIR-NEERI developed a water purification system "Nano SWADIS bottle "suitable for pathogen inactivation, particularly for waters with turbidity of <30 NTU. The "Nano SWADIS BOTTLE" provides bacteriologically safe water for drinking and cooking purpose.
117.	SWADIS - Compound Parabolic Collector
	Laboratory: CSIR-National Environmental Engineering Research Institute
	Executive Summary: SWADIS-CPC is a device for rural community/urban areas inhabited by rural population (slums). It is used for providing bacteriologically safe drinking water. Synergistic effect of exposure to UVA rays of sunlight and the heat produced due to radiation of immobilised nanoparticles which converts light to heat with consequent temperature upto 55°C.
118.	WAYU - A Device for Air Pollution Control
	Laboratory: CSIR-National Environmental Engineering Research Institute
	Executive Summary: The air quality at traffic intersections is one of the worst as vehicles typically undergo long idling, acceleration and deceleration which increases the quantity of air pollutants emitted by the vehicles at intersection. This severely impacts the health of the population within the vicinity of such locations. 'Wind Augmentation and purifYing Unit (WAYU)' which works on principles of wind generation for dilution and active pollutant removal, improves the air quality at urban intersections and can be integrated in a way that it can work with solar power. WAYU is capable of removing CO, PM and VOCs through a combination of filtration and chemical processes such as oxidation and adsorption. It has a potential to lower the ambient

	concentrations of PM and VOCs by 50- 70%. It has been successfully tested across 4 locations in Mumbai and 5 locations in Delhi.
119.	Portable Instant Water Filter - NEER-ZAR
	Laboratory: CSIR-National Environmental Engineering Research Institute
	Executive Summary: <p>'NEERI-ZAR' is the water purification system suitable for potable water supply particularly under emergency situation with a wide range of flood water quality.</p> <p>The NEERI-ZAR meets drinking and cooking water requirements on emergency basis and serves as a disaster management tool during floods.</p>
120.	Compact Anaerobic Digester for Treating Organic Solid Waste
	Laboratory: CSIR-National Institute for Interdisciplinary Science and Technology
	Executive Summary: <p>This is a patented microbial process for treating organic wastes in a compact digester working on dry digestion principle. It can treat any organic waste without any water addition, and it produces more biogas.</p> <p>The design of the system prevents mosquito breeding and the highly stable slurry (odour free) can be used as organic manure. Unlike the conventional biogas plants, this can operate under higher organic loading rate with better volatile solid removal efficiency (~90%). This scalable process unit presently operates from 5kg to 500 Kg/day wet weight of organic waste in the field.</p>
121.	RENEU- Restoration of Nallah With Ecological Unit
	Laboratory: CSIR-National Environmental Engineering Research Institute
	Executive Summary: <p>CSIR-NEERI has design, developed and demonstrated in-situ nallah treatment technology known as RENEU - Restoration of Nallah with Ecological Units.</p> <p>RENEU refers to "treatment of sewage in the running flow without displacing/disturbing the shape/structure of Nallah; and by employing physical and biological operations in the aerobic and facultative environment to degrade sewage. Physical operation includes silt-trap, screening and sedimentation and biological operations include aeration, microbial and phytoremediation.</p> <p>RENEU is an in-situ treatment technique which does not change the geometry of the existing Nallah and drains and installs the technology within the existing boundary. RENEU has been successfully implemented at six drains of Prayagraj during Kumbh Mela and at NIT Garden Nagpur.</p>
122.	Electrolytic Defluoridation Technique for Fluoride Removal in Water
	Laboratory: CSIR-National Environmental Engineering Research Institute
	Executive Summary: <p>Electrolytic defluoridation process is a water purification system suitable for fluoride affected areas.</p> <p>This is a simple technique and easy to fabricate and operate with minimum maintenance. It can treat water upto 2,000 litres per batch in 3 to 3 ½ hours.</p> <p>It is advantageous over conventional measures as quantity of such produce is less. It can handle fluoride concentration upto 10 mg/litre.</p>

123.	Hand Pump Attachable Iron Removal Plant
	Laboratory: CSIR-National Environmental Engineering Research Institute
	Executive Summary: <p>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.</p> <p>CSIR-NEERI has designed hand pump attachable iron removal plant. This is simple no cost natural based system and does not require skill operator, electric power and does not involve any mechanical parts. This system has minimum maintenance and operation cost. It is suitable for removal of excess iron in groundwater.</p>
124.	High Rate Transpiration System for Zero Liquid Discharge - HRTS
	Laboratory: CSIR-National Environmental Engineering Research Institute
	Executive Summary: <p>CSIR-NEERI has developed an eco-friendly & low cost solar energy driven treatment and disposal system for treatment of Wastewater.</p> <p>The NEERI-HRTS can treat a much larger volume of wastewater on a much smaller land area than other land treatment concepts. The design of the NEERI-HRTS depends up on the characteristics of wastewater, soil and site climatic conditions.</p>
125.	Phyto Rafter for Lake In-situ Treatment
	Laboratory: CSIR-National Environmental Engineering Research Institute
	Executive Summary: <p>Floating rafters are modification of Phytoid beds which are applied on the water surface. The plant beds are constructed on material which can float on water and then anchored in the lake bed/water channel. The wastewater treatment mechanisms of floating rafters are a synergistic effect of physical, chemical and biological process. It is generally acknowledged that using floating rafters to treat polluted water is to utilize aquatic plants' developed roots to contact water, forming a concentrated natural filtering layer, as well as absorption, adsorption, transformation and degradation of the water pollutants including nutrients. Aerobic zone is near roots of the plants, as plants transports oxygen from air to the roots and in-turn into water for biochemical oxidation.</p>
126.	Phytoid SWAB Technology for Sewage Treatment
	Laboratory: CSIR-National Environmental Engineering Research Institute
	Executive Summary: <p>Existing technological concepts with respect to Indian climatic conditions and negates the drawbacks of conventional systems as clogging, insufficient treatment, huge land requirement and cost. It is a hybrid of MBBR systems and Phytoid wastewater treatment systems with much enhanced hydrodynamic flow regime. A major requirement of this technology is being felt in the country right now as all the existing STPs have, by law, to be upgraded to meet the new regulation of discharge standards. Existing technological options make this upgradation prohibitively expensive but with SWAB the same can be achieved in a much more economical manner. The salient features of SWAB are cost-effective, negligible operation and maintenance, minimum electricity requirement, smaller footprint, recycle and reuse of treated water, no foul odour and no mosquito nuisance.</p> <p>Phytoid Technology is a self-sustaining technology developed by CSIR-National Environmental Engineering Research Institute (NEERI) that works on the principles of natural wetland.</p>

127.	Passive Ambient Air Rejuvenating System for Indoor Air Pollution Control
	Laboratory: CSIR-National Environmental Engineering Research Institute
	Executive Summary: PAARS is an air purification system which works on the principle of passive removal of pollutants and dilution of air. It also consists of solar system to provide energy and a battery to restore energy when not in use. It can be positioned in an industrial complex, household, commercial buildings and road intersection/divider
128.	Gas Biofilter: Technology for Industrial Odor Control
	Laboratory: CSIR-National Institute for Interdisciplinary Science and Technology
	Executive Summary: This technology relates to a biological filter for the purification of waste gases and purification of air or gas streams (Volatile Organic Compounds (VOCs)) containing odorous or toxic compounds by passage through a porous solid media containing micro-organisms which convert the contaminant compounds to oxidised products, thereby effecting the desired purification. The process achieves superior performance as a biofilter by enabling the adjustment of the pressure drop to a desired value, by providing adequate water retention, by providing a conducive environment for microbial growth, by using constituents which are natural, stable and environmentally compatible, by reducing the cost of media, and by reducing the cost of transportation media.
129.	Seabed Resident Event driven Profiling System (SREP)
	Laboratory: CSIR - National Institute of Oceanography
	Executive Summary: SREP is an optimized approach to profiling in coastal waters from seabed to sea surface during the calm and rough seas. It consists of a seabed unit with a winch system and a tethered instrumented profiler. The winch system launches and retrieves the profiler based on a timed or a forced event. The profiler records the water column data (Conductivity, Temperature, Depth, Dissolved Oxygen, Chlorophyll and Photosynthetically Active Radiation) during the ascent and periodically transmits to the seabed unit using an underwater acoustic modem for safe keeping of data. On reaching surface the profiler can be equipped to transfer data to a shore based station using satellite communication. SREP can be seamlessly used to monitor coastal events/variations (e.g. coastal upwelling and natural fertilization of these waters resulting in large fish yields) on a long term basis. Additionally, the acquired data serves in the understanding of climate change studies.
130.	Wind Solar Hybrid (WiSH) Systems (1 kW class)
	Laboratory: CSIR-National Aerospace Laboratories
	Executive Summary: The 1 kW class WiSH system is a spin-off technology based on CSIR-NAL's in-house Aerospace knowledgebase. It has been customized to perform optimally in low wind and dusty conditions prevailing in sub-tropical countries such as India. The key innovation of this product is the wind turbine with CFRP based light weight and aerodynamically efficient blades. The WiSH system comprises of Wind Turbine, Solar PV modules and a charge controller. The charge controller serves the purpose of combining the power

	<p>output from the wind turbine and the solar PV panels and stabilizing the same. It can work in on-grid, off-grid and micro-grid mode. At present, 5 nos. of this system are deployed at Educational Institutions in and around Bangalore. They are serving as full scale teaching aids and are part of the academic curriculum. The technology (ToT) and its scaled up versions (10 kW class and 30 kW class) are available for private industries. Commercialization of these systems would support <i>Make In India</i> initiative of GoI, NITI Aayog's <i>Sustainable Development Goal – 7</i> of Affordable & Clean energy, and National Policy for Renewable Energy based Micro and Mini Grids targeting 500 MW capacity installation by deploying 10,000 RE based hybrid systems by 2021.</p>
131.	<p>Process for the Catalytic Dehydration of Methanol to DME</p> <p>Laboratory: CSIR-National Chemical Laboratory</p> <p>Executive Summary:</p> <p>CSIR-NCL has patented clean burning dimethyl ether (DME) production technology from methanol dehydration. It is ready for pilot plant demonstration at TRL6 level. DME can be blended with LPG (max. 20% and contributes to PM's Ujjwala scheme) and diesel (20-40%). Commercial production (5-8 metric tons/day) of DME is expected to save large Forex. Clean burning increases the fuel efficiency and minimizes the pollution. Smaller production units can be accommodated in ships and DME can be used for entire energy requirement of navy and would contribute to commercial ships under Sagarmala scheme. DME can also be utilized as clean and cheap fuel by Indian army.</p>
132.	<p>Solar Photovoltaic Thermal (PVT) Cogeneration System</p> <p>Laboratory: CSIR-Central Electronics Engineering Research Institute</p> <p>Executive Summary:</p> <p>Conventional Solar Photovoltaic (PV) panels operate with an efficiency close to 15% under field conditions losing most of the incident solar energy as heat. The key idea of a solar PVT (PV-Thermal) system is to effectively harness this waste heat for co-generation of electricity and thermal energy using a single system. Solar PVT technology holds significant potential for both residential and industrial customers where rooftop area is a premium. Solar PVT system is anticipated to provide >20% cost savings and >50% roof space savings compared to standalone solar PV and solar thermal systems. The technology has been non-exclusively licensed to a start-up who have commercialized the technology. The technology is available for licensing to other interested MSMEs/companies. Solar PVT system can be manufactured indigenously contributing to "Make in India" initiative and can play a key role in meeting the National solar energy mission target of 40 GW of rooftop solar and also to satisfy the energy demand of >500 ktoe/annum for low temperature heating applications there by helping in significant reduction of CO₂ emissions.</p>
133.	<p>Technology for Production of Soft Coke</p> <p>Laboratory: CSIR-Central Institute of Mining & Fuel Research</p> <p>Executive Summary:</p> <p>The Soft Coke ovens, made of standard refractory bricks, are arch shaped having a 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 is partly 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 hindrance created by special design resulting higher sole temperature which helps to burn out the remaining volatile matters and eliminate the tarry matter in the gas before being drained through the chimney. The circulation of the flue gas generated during low/medium temperature carbonization of increases sole temperature and hence reduces coking time and reduces pollution.</p>

134.	Technology for Non Recovery Type Coke Oven, Drag Type Coke Oven with Stamp Charging and Coke Quenching
	Laboratory: CSIR-Central Institute of Mining & Fuel Research
	Executive Summary: Coal is converted into hard coke broadly in two types of ovens viz oven without byproduct recovery i.e., Non-Recovery and those with recovery of byproducts. Non Recovery Ovens are also known as Beehive Ovens. Non-Recovery Ovens are generally preferred due to less capital investment and flexibility in operation compared to By Product Ovens. Non-Recovery ovens can be easily started up or closed down as they are made of firebricks. Further to increase productivity, quality of coke and use of inferior coal for coke making the Stamp Charging System with Coke Quenching System has been developed. Non Recovery Coke Ovens with Stamp Charging and Coke Quenching System accommodates use of indigenous inferior coals with similar properties of coke produced as that of by use of prime imported coking coal, hence coking coal import may be reduced. Due to retrofitting of Stamp Charging System production may be enhanced up to 30%.
135.	PEM – Based Water Electrolyser for Hydrogen Generation
	Laboratory: CSIR-Central Electrochemical Research Institute
	Executive Summary: This PEM based water electrolyzer will deliver pure hydrogen (99.999%) and oxygen (99.999%) safely, cleanly, noiselessly and efficiently at normal to 5 bar pressure without external gas compression.
136.	Industrial Energy Management System based on LonWorks Technology
	Laboratory: CSIR-Central Scientific Instruments Organisation
	Executive Summary: Developed Industrial Energy Management System based on LONWorks Technology monitors energy and other parameters (Nodes) in real time, stores the data, analyses the data for alarms, generates control and reports. This system is very useful for medium and large-scale industries and big Commercial establishments such as IT parks where the number of nodes are upto 4096. The WEB enabled system with userfriendly GUI and can be easily upgraded to Industry 4.0. The developed system is an useful tool for maintenance and service people for evaluating the utilities by monitoring the energy data which gives an indication of health of the system. By proper maintenance and control, it has potential to save energy and avoids break downs by generating alarms in case of any abnormalities. The networking protocol is widely used for building automation systems.
137.	Industrial Energy Management System based on MODBUS Technology
	Laboratory: CSIR-Central Scientific Instruments Organisation
	Executive Summary: Developed Industrial Energy Management System based on MODBUS Technology monitors energy and other parameters (Nodes) in real time, stores the data, analyses the data for alarms, generates control and reports. This system is very useful for small and medium scale industries and Commercial establishments as the number of nodes can be around 32. The data can be viewed online in the WEB portal with friendly GUI. The developed system is an useful tool for Maintenance and service people for evaluating the utilities by monitoring the energy data which gives an indication of health of the system. By proper maintenance and control, it has potential to save energy and

	avoids breakdowns by generating alarms in case of any abnormalities.
138.	Induction Motor Efficiency Monitoring System (IMEMS)
	Laboratory: CSIR-Central Scientific Instruments Organisation
	Executive Summary: Induction motors are considered to be the largest users of electrical energy among all motors. Developed IMEMS uses current signature techniques to estimate efficiency of existing three-phase induction motors in the field without removing the motors from the location. The developed system is a useful tool for maintenance persons to identify the motor's Best Operating Point (BOP) in order to conserve energy. Also helps in identifying the motor's energy efficiency for refurbishment, replacement, rewinding etc., This helps to operate the motor around its best efficiency and also helps in preventive maintenance. The developed system has energy saving potential up to 5%.
139.	Pump Efficiency Monitoring System (PEMS)
	Laboratory: CSIR-Central Scientific Instruments Organisation
	Executive Summary: CSIR-CSIO, Chennai Centre developed Pump Efficiency Monitoring System (PEMS) based on the thermodynamic principle using the latest state-of-art instrumentation. On-site constraints often make it difficult to accurately measure pump efficiency under installed conditions by the same method that pump manufacturers traditionally use for works tests. This method does not use flow as a parameter and without detaching the pump from line with MODBUS Protocol for digital communication. The developed system has the potential to save time and costs assessment of pumps in comparison with conventional methods. Online monitoring optimizes maintenance intervals and reduced plant shutdown periods etc.
140.	Anaerobic Gas lift Reactor (AGR): A High rate biomethanation technology to treat organic solid waste for the generation of biogas and bio manure
	Laboratory: CSIR-Indian Institute of Chemical Technology
	Executive Summary: CSIR-IICT has made intensive research efforts and developed a state of art high rate biomethanation based on "Anaerobic Gas lift Reactor (AGR)" (PT-609/0207NF2012) for the generation of biogas and bio-manure from organic solid waste. Presently 15 plants (capacities in the range of 250 k to 10 tons per day) are working across India for the treatment of food waste, market vegetable waste, landfill leachate, organic fraction of MSW, poultry litter, cattle manure etc. AGR Technology developed by CSIR-IICT treats organic wastes while concomitantly generating biogas (for replacing conventional fuels) and soil conditioner (for replacing inorganic fertilizers) for use making it remunerative and sustainable.
141.	Simple, Cheap and Easy to use Bacterial Detection Kit from any Water Sample
	Laboratory: CSIR-Central Salt and Marine Chemicals Research Institute
	Executive Summary: CSIR-CSMCRRI has developed an IP-secured, user-friendly and cost-effective PVDF membrane based bacterial detection kit that determines the bacterial load in water systems by a simple visual indication. The membrane is embedded with a carbon source and dye wherein if bacteria is present in the test water, they get attached to the membrane, start using the carbon that results in the pH change and in turn change the colour from colourless to pink. The time taken to change the colour determines the approximate bacterial load. This kit is useful for determining bacterial contamination in drinking water, aquaculture water, swimming pool water etc. and can easily be used by

	layman without an aid of microbiology lab. This award winning technology is recently licensed to an entrepreneur who proposes to use in aquaculture farm. The approach is being extended towards making anti-bacterial tiles.
142.	Molecular Assays for Diagnosis of Genetic Diseases (138 Molecular Assays for 58 Disorders)
	Laboratory: CSIR- Institute of Genomics and Integrative Biology
	Executive Summary: Genetic diseases cumulatively affect over 7.0 Crore Indians. In majority of the cases, an appropriate diagnosis is not arrived at, due to lack of general awareness on genetic diseases, lack of access and high-cost of appropriate genetic diagnostic services. The availability of affordable genetic tests would go a big way to significantly reduce the disease, social and economic burden due to these debilitating disorders. The portfolio includes 138 molecular genetic assays for 58 disorders. Over 25,000 genetic tests have been carried out benefiting 5000+ needy patients as a proof -of-concept. For more information please visit http://gomed.igib.in .
143.	Mitochondria-Targeted Esculetin as an Anti-atherosclerotic Agent
	Laboratory: CSIR-Indian Institute of Chemical Technology
	Executive Summary: Increased mitochondrial 'oxidative damage' is a major feature of several human diseases including atherosclerosis, a major debilitating cardiovascular disorder. Recently CSIR-IICT has synthesized a novel mitochondria-targeted esculetin (Mito-Esc) molecule and showed that Mito-Esc administration greatly regress atherosclerotic plaque formation in pre-clinical mouse models of high fat-diet, angiotensin-II, and age-associated atherosclerosis. Overall, Mito-Esc shows promise in the treatment of inflammation-mediated diseases.
144.	Glucocorticoid Receptor (GR)-Targeted Liposomal Platform for Aggressive and Drug-resistant Cancer
	Laboratory: CSIR-Indian Institute of Chemical Technology
	Executive Summary: Drug resistance together with excessive aggressiveness is the hallmark of relapsed and in very advanced stage of cancer, for which there is no definitive chemotherapeutic treatment available. The present technology is designed to treat patients with relapse that exhibit drug-resistance to conventional drugs and exhibit aggressive and advanced stage. The present technology on the basis of a key discovery, which shows that cancer cell-associated glucocorticoid receptors (GR) are selectively activated, can drug-sensitize the drug-resistant cancers. Using this platform, multiple drugs are not only be reused against the same cancer with acquired resistance but also it can be repurposed to treat many other cancer types to which the said drug is conventionally never used. Taken together, the technology has the potential to expand life expectancy of relapsed cancer patients and also reduce the immediate burden of developing new drug discovery which is prohibitively cost-provocative.
145.	S007-867 (Anti-platelet) -To Prevent Platelet Aggregation in the Patients of Coronary Artery Disease/Thrombotic Cerebral Stroke
	Laboratory: CSIR- Central Drug Research Institute
	Executive Summary: As per the estimates in the World Health Organisation's non communicable disease

	<p>(NCD) Country Profile 2014, Cardio-vascular disease (CVD) is the leading cause of deaths in India and accounts for 26% of all deaths. Vascular endothelial damage induces platelet activation by the exposed collagen, thus initiating a chain of events that may lead to thrombosis, transient ischemic attack (TIA), myocardial infarction and stroke. A small anti-thrombotic molecule S007-867 developed by CSIR-CDRI acts in a collagen specific manner and therefore may inhibit early platelet activation. It Acts in collagen specific manner and Higher efficacy at comparable doses of Aspirin. Target specific action with reduced bleeding risk at comparable standard dose.</p> <p>This anti-thrombotic molecule has potential usage in transient ischemic attack, stroke and myocardial infarction.</p>
146.	<p>Invention of Novel Anti-osteoporosis Drug Candidate CDRI-99/373 (Centhank) Laboratory: CSIR- Central Drug Research Institute</p> <p>Executive Summary:</p> <p>International Osteoporosis Foundation (IOF) suggests that around the world 1 in 3 women and 1 in 5 men over the age of 50 will suffer an osteoporotic fracture. In fact, a bone will break every 3 seconds because of this disease. Since loss of bone strength leads to fragility fractures therefore this has an enormous human and socio-economic impact. There are multiple mechanisms underlying the regulation of bone remodelling and one of this involve targeting osteoclastic cells. Skeletal fragility can result from excessive bone resorption resulting in decreased bone mass and microarchitectural deterioration of the skeleton. CSIR-CDRI has identified a novel small molecule abbreviated as 99/373 which is aryl naphthyl derivative. It specifically inhibits differentiation of bone marrow cells to osteoclasts and disrupt actin ring formation, a surrogate for bone resorption activity by the osteoclasts. This molecule in its category has been found to be more effective than Raloxifene available in the market. This anti-resorptive molecule has potential application in reducing the risk of postmenopausal osteoporosis.</p>
147.	<p>Novel Processes for Synthesis of Key Intermediates and APIs Eribulin Laboratory: CSIR-Indian Institute of Chemical Technology</p> <p>Executive Summary:</p> <p>Eribulin being the most popular drug for breast cancer, development of cost effective synthesis of the drug is necessary to serve the market demand. Although, presently there is an approach for its synthesis, development of novel, economically viable non-infringing efficient synthetic process is highly desirable. CSIR-IICT has developed the process all the three major fragments of Eribulin and coupled them to get the final target molecule. After optimization of the process for all fragments, each fragment was made in kilo-gram scale. Coupling of fragments was achieved to make the gram sample. New enzymatic process for one of the key fragments is achieved (Patent filed). Impurities identification and characterization was also achieved with industrial partner. The enzymatic process has been demonstrated to the industry.</p> <p>This development and integration of all fragments have good market potential. Industrial partner for Eribulin has already identified and made an agreement to commercialize the product. The process has already been demonstrated.</p>
148.	<p>Mupirocin + IIM-1133: A Topical Formulation for Improved Bioefficacy Laboratory: CSIR-Indian Institute of Integrative Medicine</p> <p>Executive Summary:</p> <p>Mupirocin is a topical antibiotic used against Gram positive bacterial infections. Increasing use of this drug has resulted in high-level mupirocin resistance. IIM-1133 is a potent broad spectrum inhibitor of efflux pumps of <i>Staphylococcus aureus</i>. The</p>

	<p>combination of mupirocin with IIM-1133 has not only enhanced the activity of mupirocin but also reduced the emergence of mupirocin resistance. IIM-1133 has no anti-bacterial activity of its own, therefore there are no chances of bacteria developing resistance against the compound.</p> <p>A formulation of 2% mupirocin with 0.5% IIM-1133 was more efficacious in clearing the infection in a dermal infection model of mice when compared with standard 2% mupirocin formulation which is commercially available. All the IND directed studies on the combination including GLP regulatory safety studies have been completed.</p>
149.	<p>Mother's Plasma Gelsolin Estimation Kit To Predict Premature Birth Product – ELISA Plate and Reagents based Diagnostic Kit</p> <p>Laboratory: CSIR-Institute of Microbial Technology</p> <p>Executive Summary:</p> <p>About 0.35 million babies are born prematurely (>34 weeks) in India spontaneously i.e without any prior indication. 28% of them do not survive and most of these losses are in lower income group settings. CSIR-IMTECH solved the challenge of making a reliable, field-implementable estimation prototype and its trials in PGI Chandigarh, Laddha Hospital Banskara, and Joshi Hospital in Indore (in collaboration with initial commercial partner) showed a positive correlation of 0.85 in fifth month of pregnancy with period of gestation. It is relatively non-invasive as two drops of blood from finger tip of mother is used. Cost per test is estimated to be around 600-1200 rupees depending on test format, and is expected to lower on mass production. All SOPs from test manufacture to field trial, and data analysis is optimized. Since this predictor is not in the list regulatory bodies of India, the commercial partner is applying for Form28 to proceed.</p>
150.	<p>Serum and Urine-based Rapid Diagnostic Tests for Human and Canine VL and PKDL in Field Settings</p> <p>Laboratory: CSIR-Indian Institute of Chemical Biology</p> <p>Executive Summary:</p> <p>The available field adaptable diagnostics for diagnosis of kala-azar and PKDL are mostly invasive and are based on detection of antibodies from serum samples. Development of a field adaptable test which is equally effective in all endemic areas is been a thrust for decades. CSIR-IICB has developed serum and urine-based lateral flow tests (LFTs) for rapid diagnosis of human and canine visceral leishmaniasis (VL) and post kala-azar dermal leishmaniasis (PKDL) in field settings. This test has also been evaluated in India, Sri Lanka, Nepal, Spain, Ethiopia and Brazil and found better than commercially available tests. CSIR-IICB has also developed a urine-based LFT for non-invasive diagnosis of VL and PKDL. Antibody titre decreases significantly in urine after treatment thus urine-based test showed its affectivity as a test of cure.</p>
151.	<p>VIBHRA: Virtual Intelligence based Rehabilitation Assessment System for Cerebral Palsy Kids</p> <p>Laboratory: CSIR-Central Scientific Instruments Organisation</p> <p>Executive Summary:</p> <p>VIHBRA is a virtual intelligent platform for motor rehabilitation of persons with disabilities. It combines experience from virtual reality and knowledge from machine intelligence to enhance neural reorganization that optimizes the physical rehabilitation outcomes in individuals with disability. It provides stimulating sensory feedback to promote motor learning and encompasses tools that help to understand the biology of disability. The degree of interaction during physiotherapy is maximized using virtual rehabilitation resulting better recovery & efficacy.</p>

	<p>The developed system consists of an in-house developed force platform, the kinect device and software that help to improve balance and neuromuscular functions of persons undergoing physiotherapy. It also quantifies motor disability by presenting the individuals with situations/tasks that require use of groups of muscles and body parts as in conventional Function Reach Test in physiotherapy. The system is useful for the patients with condition ranging from musculoskeletal problems, to stroke induced paralysis to cognitive deficits</p>
152.	<p>Finger Gesture based Control Module for Intelligent Patient Vehicle</p> <p>Laboratory: CSIR-Central Scientific Instruments Organisation</p> <p>Executive Summary:</p> <p>In the modern world, due to lifestyle disorders, certain diseases and accidents, there are millions of disabled people worldwide who are suffering from partial to full body disabilities, which include motor-disability, due to which such people are unable to drive mobility aids without caregivers. The available solutions that Indian powered wheelchair manufactures are using are all imported joysticks based, very costly and not suitable for such persons.</p> <p>Finger gesture based alternative drive solution has been developed to address the needs of providing independent assistance to paraplegic people having weak upper limb due to which they are unable to drive a wheelchair. The developed alternate drive controller is an industry ready solution based upon finger gestures on the capacitive touch screen for maneuvering the motorized wheelchair. It consists of an indigenous motion drive and controller incorporated with rear collision detection. It is an affordable drive solution in comparison of the imported version of general purpose drive controllers and it will significantly reduce cost of powered wheelchair manufacturing in India.</p>
153.	<p>Exoskeleton Device (ExoD) for Rehabilitation of Mobility Impaired Patients</p> <p>Laboratory: CSIR-Central Scientific Instruments Organisation</p> <p>Executive Summary:</p> <p>Exoskeletons are the devices that come in the category of wearable robots. Exoskeleton is an external structural mechanism with joints and links corresponding to those of the human body. Exoskeleton with their applications in rehabilitation medicine and virtual reality simulation, offer benefits for both disabled and healthy populations. Exoskeleton device can be used as a capability magnifier or as assisting device for spinal cord injury patients, stroke patients, and the elderly.</p> <p>The developed exoskeleton system consists of a wearable exoskeleton suit, powered by actuators and a closed loop control system to drive the mechanism depending on the desired pattern for movement of the limbs. The device is meant for therapeutic use under the supervision of a therapist or clinician. It has the functionality for exercise of the individual joints of the lower limb.</p>
154.	<p>Postural Stability Assessment System</p> <p>Laboratory: CSIR-Central Scientific Instruments Organisation</p> <p>Executive Summary:</p> <p>Postural stability system assesses the standing balance of a person. Postural stability is achieved by maintaining an upright body alignment against gravitational force and preserving the equilibrium of the centre of mass (CoM) in an individual's base of support. It requires proper coordination of our sensory system comprising visual, somatosensory, and vestibular modalities as well as motor control systems. Assessment of standing balance is essential to the treatment of instability in the neurologic patient.</p> <p>The developed system assesses pressure fluctuations produced by the heels and toes</p>

	<p>of the subject standing on a platforms having force sensors placed at the specific locations for each foot. Calculated parameters help in assessing interactions of the neurophysiological and neuro-anatomic subsystems involved in balance control and further treatment for instability. It gives the projection of body's center of mass on the ground by estimation of center of foot pressure. The developed system can also be used to estimate gait events like balance stability and lateral fall and thus can be used as a training tool for sit-to-stand, stand-to-sit, joint movements for stance and gait analysis during rehabilitation therapy for muscle spasticity.</p>
155.	<p>ICB-104 for the Management of Gastric Ulcers</p> <p>Laboratory: CSIR-Indian Institute of Integrative Medicine</p> <p>Executive Summary:</p> <p>The global antiulcerant drugs market is approximately \$33.0 billion and is expected to grow at an annual growth rate of 2.5%. The category of antiulcerant drugs includes proton pump inhibitors, H₂ receptor antagonists, gastric mucosal protective drugs, antibiotics and antacids. ICB-014 A002 is an hydroalcoholic extract of flowers <i>Woodfordia fruticosa</i>, standardized using three chemical markers (Gallic Acid, Quercetin and Kaempherol). The lead is being positioned as an extract of a single plant material exhibiting anti-secretory, proton pump inhibitory activity with additional anti-<i>H.pylori</i> activity. A capsule formulation has been developed which is under phase I clinical trial. <i>Woodfordia fruticosa</i> is a plant of Indian origin and is well known for its medicinal properties. It grows well in the tropical climatic zone. Use of its flowers for medicinal purpose will promote the economy of plant growers</p>
156.	<p>Herbal Formulation for Lung Cancer Treatment</p> <p>Laboratory: CSIR-North East Institute of Science and Technology</p> <p>Executive Summary:</p> <p>The herbal formulation is prepared in the form of inhaler for treatment of lung cancer. This inhalation therapy is completely non-invasive treatment for lung cancer. Inhalation of the herbal formulation significantly reduce lung cancer cell proliferation and cure pain associated with the lung cancer. The inhalation therapy can be used with other treatment. It has been found that inhalation therapy can reduce the problems of patients accompanied with chemotherapy. This is a low cost, simple and affordable way of treating lung cancer with no side effects.</p>
157.	<p>Herbal Anti-Arthritis Formulation</p> <p>Laboratory: CSIR-North East Institute of Science and Technology</p> <p>Executive Summary:</p> <p>The herbal drug developed by CSIR-NEIST, named as 'Anti-Arthritis', is formulated as an ointment, oil, cream and spray which is effective against both Rheumatoid and Osteoarthritis. This product, after application in affected site of body, is considerably reduced arthritic associated pain. The mode of working is fast and effect is visible within sort time. It has been found that the product can reduce the pro-inflammatory cytokines of blood serum of patients significantly.</p>
158.	<p>URO-05: A Potential Herbal Combination for Alleviating Urolithiasis, Nephrolithiasis and Post Lithotripsy Conditions (ESWL)</p> <p>Laboratory: CSIR- National Botanical Research Institute</p> <p>Executive Summary:</p> <p>The formulation produces synergistic action, which is effective in reducing stones' formation as well as increases the elimination of stones from kidney and urinary tract. The formulation is also effective in post lithotripsy conditions, prophylaxis and future</p>

	recurrence. It consist limited number of ingredients and is cost effective, reduced dosage than existing market brands, better stone crystal clearance, promotes the healing of tissue damage.
159.	An Ayurvedic Proprietary Formulation (NBRMAP-DB / BGR-34) for the Management of Type-II Diabetes and Associated Symptoms
	Laboratory: CSIR-Central Institute of Medicinal and Aromatic Plants & CSIR- National Botanical Research Institute,
	Executive Summary: A novel polyherbal formulation prepared from six well known medicinal plants and is effective against newly diagnosed type-2 diabetes mellitus. The anti-diabetic activity of this standardized polyherbal formulation was validated through pre-clinical and clinical study. Data from animal studies and clinical study revealed that it possesses potent anti-hyperglycaemic activity that is at par with Metformin, a standard drug used for management of diabetes. This formulation is available in the market under the trade name BGR-34. The formulation contains 34 phytoconstituents derived from 6 medicinal plant species. The synergistic effect of this unique polyherbal combination controls the blood glucose level and keeps it near normal in cases of newly diagnosed diabetes. The dose of BGR-34 is 2 tablets twice a day (before meals). It is not recommended in patients with diabetic complications.
160.	Saffron based Nutraceutical Product "IIM-141"
	Laboratory: CSIR-Indian Institute of Integrative Medicine
	Executive Summary: Age related neurodegenerative diseases like Alzheimer's disease and dementia (memory loss) are the new major global challenges, for which there is great unmet medical need. There are approximately fifty-million patients of dementia world over and this number is rising at an alarming rate due to the increase in aging population. All currently available drugs are single targeted agents (cholinesterase inhibitors) and provides only symptomatic relief, without stopping progression of the disease. Because of the complex disease pathology, the multi-targeted agents are needed to successfully tackle this disease. "IIM-141" has multi-targeting ability, as it tackles multiple biological check-points of the disease progression. It enhances the clearance of amyloid-beta, increases amyloid-beta degradation, provides protection to neurons, reduces neuroinflammation, has antioxidant power, etc. It also enhances learning and memory in the mice model. This nutraceutical product will be specifically beneficial for people, who are at higher risk of developing Alzheimer's or dementia, including the patients with early onset of disease.
161.	Herbal Mosquito Repellent Vaporizer
	Laboratory: CSIR-North East Institute of Science and Technology
	Executive Summary: The technology herbal mosquito repellent vaporizer is developed from easily available plant materials. Besides having significant repellent property to mosquito, the vaporizer also provides mosquito knockdown property. Very pleasant in fragrance, the vaporizer last for longer period (>300 hrs with 40 ml). Low cost in production, the vaporizer is found affordable to consumers.
162.	Herbal Mosquito Repellent Spray
	Laboratory: CSIR-North East Institute of Science and Technology

	<p>Executive Summary:</p> <p>The herbal mosquito repellent spray is prepared from easily available plant materials for repelling mosquitoes. The spray can be used in indoor as well as outdoor condition. Fragrance of the spray is pleasant and therefore, it can also be used as room freshner. The spray provides considerable repellent property to mosquitoes with significant protection time. The appearance of the spray formulation is transparent and like water, which give special attraction to the consumers.</p>
163.	<p>Foods for Diabetics</p> <p>Laboratory: CSIR- Central Food Technological Research Institute</p> <p>Executive Summary:</p> <p>The products prepared from wheat and legumes, blended with special edible ingredients having hypoglycemic characteristics will be useful as ready-to-cook (RTC) or ready-to-eat (RTE) foods or as dietary supplement for the population of physio-pathological conditions with non-insulin dependent <i>Diabetes mellitus</i> (NIDDM) or Type 2 diabetes. Both RTC and RTE foods may be used as wholesome food, food supplement or as meal replaces by these subjects. The RTC food could be cooked in the form of traditional or other recipes of choice for consumption as breakfast, lunch and dinner, whereas, RTE food could be used as snacks in convenient form or as part of meal with other commonly available non-sugar adjuncts.</p>
164.	<p>Nutra Chikki with Added Spirulina</p> <p>Laboratory: CSIR- Central Food Technological Research Institute</p> <p>Executive Summary:</p> <p>Chikki is a ready to eat traditional sweet snack consumed by all sections of population in India. The product can be utilized under the label ready to eat sweet snack or enriched snacks and supplied to school children or pre-schoolers or any other specific target group as a ready to eat food and a concentrated source of energy and protein. <i>Spirulina</i>, a blue green alga (cyanobacterium) has been extensively studied and is now in widespread usage throughout the world as a health food and a dietary supplement. <i>Spirulina</i> is a concentrated source of protein, vitamins, especially B₁₂, Provitamin A (β carotene) and Vitamin E, minerals, especially iron. It is also rich in gamma linolenic acid (GLA), an omega 3 fatty acid.</p>
165.	<p>A Process for Low Glycemic Index Noodles</p> <p>Laboratory: CSIR- Central Food Technological Research Institute</p> <p>Executive Summary:</p> <p>Noodles and Pasta are major group of food products consumed all over the world. Noodles are considered to be high glycemic foods because of its high release of sugars during digestion and absorption. Incorporation of low glycemic index ingredients to these noodles will lower the glycemic response. The reason for the same is due to increase in the dietary fiber and also protein content. Rajma is well known low GI ingredients and not used in noodle processing so far. Dietary fibers (both insoluble and soluble) from rajma shown to reduce the rise in blood glucose and increase insulin sensitivity following carbohydrate meals. The developed Low GI noodles formulation could be used for normal and diabetic population. The Low GI noodles have increased fiber content by 3-4% compared to normal noodles. It can be consumed along with tastemaker as a main course.</p>
166.	<p>A Process for Gluten Free Bakery Products</p> <p>Laboratory: CSIR- Central Food Technological Research Institute</p>

	<p>Executive Summary:</p> <p>The gluten free cookies have golden brown crust colour, medium sized islands, creamish white crumb colour, crisp texture and typical taste of cookies. The shelf life of the product (cookies) is about three months. The Gluten Free Muffin has good volume, medium fine crumb grain and soft texture. The shelf life of the product (muffins) is about 5 days. Further, cookies and muffins developed are gluten free and hence these can be considered as immunologically safe for celiac disease patients as well.</p>
167.	<p>Low GI Beverage for Diabetics</p> <p>Laboratory: CSIR- Central Food Technological Research Institute</p> <p>Executive Summary:</p> <p>Diabetes is one of the major metabolic disorders affecting all strata of society which is characterized by altered carbohydrate, lipid and protein metabolism. Sustained hyperglycemia leads to micro and macro vascular complications which include nephropathy, retinopathy and neuropathy. Hence maintaining optimal blood glucose levels becomes imperative to prevent long term deleterious complications associated with diabetes. The process developed at CFTRI for the development of low GI milk re-constitutable product was screened for its ability to reduce basic diabetic parameters. The product can be used as a beverage by reconstituting with warm milk and can be consumed preferentially before breakfast and snacks at least twice a day.</p>
168.	<p>A Process for the Preparation of β- Carotene and Mineral Fortified Buns (PDRU)</p> <p>Laboratory: CSIR- Central Food Technological Research Institute</p> <p>Executive Summary:</p> <p>Fortified buns are ready formulation containing β - carotene and mineral. Buns are made by using the specified ingredients. Buns are soft with good volume and fine uniform grain. These buns are packed in polypropylene pouches. It keeps mold free for a week.</p>
169.	<p>Copper Plating of Stainless Steel</p> <p>Laboratory: CSIR-Central Electro Chemical Research Institute</p> <p>Executive Summary:</p> <p>In numerous industrial usages, stainless steel needs an added functional layer made up of copper. Successful plating of copper on stainless steel is usually a very difficult process as it involves poor adhesion issues. CSIR-CECRI has improved the process of the copper plating and offers a unique bath process technology which enhances the adhesion of copper to Stainless steel products.</p>
170.	<p>Electro-polishing of AISI 304 Stainless Steel</p> <p>Laboratory: CSIR-Central Electro Chemical Research Institute</p> <p>Executive Summary:</p> <p>Surface finishing is an important aspect in metallic product Industry. Chemical polishing or electro-polishing, instead of mechanical polishing, are recommended for the attainment of metallic surface polishes without the introduction of contaminants or tensions in the surface layers of the metal. CSIR-CECRI has developed and offers a technology to get mirror finish on Stainless steel products.</p>
171.	<p>Electroplating of Gold</p> <p>Laboratory: CSIR-Central Electro Chemical Research Institute</p> <p>Executive Summary:</p> <p>Gold plating is a vital technology for artificial jewelry, Zari making and electronics industry including aerospace industry. CSIR-CECRI has developed and offers a</p>

	technology based on Potassium Gold Cyanide for effective Gold plating of varying metallic products, avoiding in formation of any fragile layer.
172.	Lead Free Electroplating Process for Engineering Components
	Laboratory: CSIR-Central Electro Chemical Research Institute
	Executive Summary: Lead has long been proposed to be hurtful to the human nervous system. As a result, there are increasing regulations against Pb-ion elution from lead-containing products. Conventional lead electroplating is virtually impossible today because of environmental regulations. Understanding the concern CSIR-CECRI has explored various commercial lead-free plating alternatives for a number of industrial usages. It has developed and offers lead free ecofriendly plating process on alloys like copper used in bearings for railways and automobile industries.
173.	Metal Oxide Impregnated Fabrics for Surgical Mesh
	Laboratory: CSIR-Central Electro Chemical Research Institute
	Executive Summary: Fabrics for wound healing pads/ surgical mesh with metal oxide impregnation have been developed in CSIR-CECRI. These Metal Oxide impregnated fabrics are non-toxic in nature, antibacterial and washable.
174.	Rib and Roof Bolt Based Breaker-line Support (RBBLs) Design for Mechanized Depillaring (MD)
	Laboratory: CSIR-Central Institute of Mining and Fuel Research
	Executive summary: These Rib and RBBLs are the two main geo-technical elements in mining which isolate and protect the working area from encroachment by hazardous zone (goaf). RBBLs has replaced the conventional wooden support and reduced the cost, contributing to the green economy. Indigenous empirical formulations have been developed for design of rib and RBBLs considering the complex and unique geo-mining conditions of Indian coalfields. The introduction of this MD technology in underground coal mines, has improved production (from 1000 to 50,000 tons' average per month), efficiency and safety in coal mining. These are now being widely getting into practice in Indian coalfields.
175.	Process for the Preparation of Finely Divided Precipitated Silica
	Laboratory: CSIR-Central Salt and Marine Chemicals Research Institute
	Executive Summary: CSIR-CSMCRI has developed a process for the preparation of precipitated silica having more than 75% particles finer than 10 µm on 5 kg batch scale. The process involves treatment of neutral grade sodium silicate solution with mineral acid and silica sol in different steps under controlled rates in presence of an electrolyte. Precipitated silica with fine particle size and narrow particle size distribution finds many applications in polymer/elastomer, thixotropic agent in paints, cosmetics, and carrier for insecticide and pesticides.
176.	Processes for the Utilization of Kimberlite Waste for the Manufacture of Sodium Silicate, Detergent Grade Zeolite A and Precipitated Silica
	Laboratory: CSIR-Central Salt and Marine Chemicals Research Institute
	Executive Summary: National Minerals Development Corporation is involved in the mining of diamonds from

	<p>Panna mines in Madhya Pradesh. It is observed that for mining of 10 carats of diamond, about 100 tons of Kimberlite is generated. Currently enormous quantity of kimberlite waste is available in Panna where major constituents of this mineral waste is magnesium silicate mineral of serpentine group. The conversion of the waste to value added products based on magnesia, silica and titania make diamond mining more resource-driven besides making it environmental friendly. There is a scope of preparation of magnesia and titania based products as well.</p> <p>CSIR-CSMCRI has developed processes for the utilization of kimberlite waste for the preparation of sodium silicate, for the preparation of detergent grade zeolite-A and precipitated silica using the sodium silicate obtained from the kimberlite waste. Similar approach can be extended to sources of Kimberlite from other diamond mines for producing these value added materials (including titania based ones) with augmented focus on Zero Liquid Discharge (ZLD) compliance.</p>
177.	<p>Manufacture of Zeolite-A (Detergent Builder) from Bauxite or Bauxite Leachate (Bayer Liquor)</p> <p>Laboratory: CSIR-Central Salt and Marine Chemicals Research Institute</p> <p>Executive Summary:</p> <p>CSIR-CSMCRI has developed technologies for the process of zeolite-A independent of the raw material, initially from bauxite leachate for M/s National Aluminum Company (NALCO; 10000 TPA, Damanjodi, Odisha) and recently from low grade bauxite mine ore for M/s Gujarat Credo Minerals Industries Ltd (GCMIL; 10000 TPA, Bhuj, Gujarat). CSIR-CSMCRI while undertaking these developments built capability of exploiting various other raw material sources both in India and abroad for the successful manufacture of Zeolite-A. Though the current prevalence of Zeolite-A as detergent builder, in an endeavor to substitute polluting phosphate based builders, it has humongous promise in future for developing markets like India.</p>
178.	<p>Preparation of Halogen Scavenger Grade and Pharmaceutical Grade Synthetic Hydrotalcite (SHT)</p> <p>Laboratory: CSIR-Central Salt and Marine Chemicals Research Institute</p> <p>Executive Summary:</p> <p>Synthetic hydrotalcite (SHT), also known as anionic clays or layered double hydroxides, are two-dimensional materials that are anion exchangers. Owing to this property, they find potential applications as halogen scavenger in heavy-metal free stabilizer systems, anion-exchangers as adsorbents, removal of acidic anionic moieties from several chemical processes like Ziegler-Natta reactions, ant-acid, fire-retardant, catalyst supports and stabilizer for anions with improved bio-availability to name a few.</p> <p>CSIR-CSMCRI has developed processes for MgAl hydrotalcite (halogen-scavenging grade and pharmaceutical grade) from bittern and aluminium sulphate as precursors through hydrothermal synthetic protocols. The developed technology is licensed to M/s Heubach Colour Pvt. Ltd., Gujarat which is currently producing 1000 TPA valorizing inexpensive and polluting streams from their premises as raw materials.</p>
179.	<p>Technology for the Production of High Grade Synthetic Rutile from Low Grade Ilmenite</p> <p>Laboratory: CSIR-National Institute for Interdisciplinary Science and Technology</p> <p>Executive Summary:</p> <p>Ilmenite (FeTiO_3) and rutile (TiO_2) are the natural minerals exploited worldwide for the production of pigment grade TiO_2 and titanium metal. CSIR-NIIST has developed environment friendly process which is superior in terms of pollution abatement, technology and the grade of synthetic rutile.</p>

	<p>This technology has been successfully demonstrated at two private industries where around 700 metric tons of Ilmenite has been processed to obtain 570 metric tons of metallized ilmenite (83-85%) with two commercial Direct Reduced Iron (DRI) rotary kilns of capacity 50 TPD and 130 metric tons of synthetic rutile has been produced. The process conditions of individual operations have been tailor-made to suit the available various grade of Indian ilmenite.</p>
180.	<p>VIRTUAL CASTING – Affordable State-of-the-Art Software for Casting Process Design. Commercial name: FLOW+ module in AutoCAST X1</p>
	<p>Laboratory: CSIR-National Institute for Interdisciplinary Science and Technology</p>
	<p>Executive Summary:</p> <p>‘FLOW+’ module in AutoCAST X1’ is a completely designed software with code developed by the computational modelling and simulation group of CSIR-NIIST based on “Virtual Casting Solver” Technology of CSIR-NIIST. After testing for industrial case studies and benchmarking with other commercial software like FLOW3D and NovaCAST, with joint collaboration with IITB and 3D Foundry Tech Pvt. Ltd., this technology was transferred to 3D Foundry Tech Pvt. Ltd., (3DFT).</p> <p>AutoCAST-X1 with FLOW + is one of the very few products entirely designed and developed in India. This product is positioned as an easy-to-use, world class, yet affordable simulation software to Indian foundries and gives them the competitive edge of simulation at an affordable cost (compared to similar products) to deliver defect free castings right first time and every time. Major benefits of using this product in foundries is reduction of lead time for first good sample casting, very less rejection rates and better customer satisfaction.</p>
181.	<p>Functionally Graded Aluminum Alloy and Composite Products and Process Technology</p>
	<p>Laboratory: CSIR-National Institute for Interdisciplinary Science and Technology</p>
	<p>Executive Summary:</p> <p>CSIR- NIIST has developed and thus offers a Functionally Graded Materials (FGM) technology for the design and fabrication of lightweight aluminum composite based components for automotive applications with improved location specific mechanical and wear properties. The technology has been used to fabricate and demonstrate the automotive components of brake rotor disc, cylinder liners and gear housing piston rings in collaboration with user industries. The lightweight brake disc components can be used in automotive for enhanced braking performance, handling and driving performance of the vehicle. The Al- FGM cylinder liners can provide low coefficient of friction and enhanced wear behavior which in turn improves fuel efficiency and controlled emission.</p>
182.	<p>Process Know How for the Development of Ceramic Microfiltration Membranes for Separation Applications</p>
	<p>Laboratory: CSIR-National Institute for Interdisciplinary Science and Technology</p>
	<p>Executive Summary:</p> <p>Low cost process know-how available for Multi-channelled ceramic membrane tubes (1 m length and 0.034 m diameter) for microfiltration (80-100nm) applications including juice clarification and industrial water recycling. It gives clear water flux in the range of 100-225 LMH and with >99% turbidity removal.</p>
183.	<p>Specialty Optical Fibers</p>
	<p>Laboratory: CSIR-Central Glass & Ceramic Research Institute</p>

	<p>Executive Summary:</p> <p>Now-a-days, specialty optical fibers are the driving force for development of different varieties of fiber optics based optical components and devices ranging from communications, oil and gas exploration to laser surgery, high power lasers, automotive and aerospace. Specialty optical fibers serve as a heart of any kind of fiber optic based devices such as fiber laser, optical fiber amplifier, broad band light source etc. In India, CSIR-CGCRI is only R & D Lab involved towards development of different specialty optical fibers for optical amplifier, fiber laser, broad-band sources etc. CGCRI has developed erbium doped single mode fiber for low power optical amplifier, Er/Yb codoped double clad fiber for high power optical amplifier, Non-linear Photonic Crystal fiber for broad-band sources, Double clad Ytterbium doped fiber for high power fiber laser at 1064nm as per International standard. CSIR-CGCRI sold more than 15.0 km of erbium doped fiber to its industrial partner M/s. SFO Technologies Pvt. Ltd. Cochin, Kerala for development of EDFA module and ready to make any kind of custom designed based specialty optical fibers.</p>
184.	<p>Er-doped Fiber Amplifier (EDFA)</p> <p>Laboratory: CSIR-Central Glass & Ceramic Research Institute</p> <p>Executive Summary:</p> <p>EDFA is one of the key components for both community-antenna television (CATV) signal broadcasting and Fiber-To-The-Home (FTTH) Technology. Erbium doped fiber amplifier (EDFA) jointly developed with M/s. SFO Technology Pvt. Ltd. Cochin is already in the market. It is an assembly of a special kind of optical fiber and a series of electronic inputs with controls which when fitted intermittently along optical fiber cable lines restores energy loss during transmission and ensures high quality picture, sound and connectivity. CSIR-CGCRI was entered into a commercial agreement for developing completely packaged EDFA for Cable TV Network with M/s. SFO Technologies Pvt. Ltd., Cochin. Till now more than 500 EDFA modules (4 ports EDFA having output power +16 dBm on each port with signal power -10 dBm to 10 dBm) was sold by M/s. SFO Technology Pvt. Ltd. to different CATV companies in India and even in USA.</p>
185.	<p>Specialty Borosilicate Glass Bead : An Innovative Material For Nuclear Safety</p> <p>Laboratory: CSIR-Central Glass & Ceramic Research Institute</p> <p>Executive Summary:</p> <p>High level radio-active liquid waste produced in nuclear plant contains undesirable long life radio isotopes. The preeminent way to immobilize such isotopes for safe disposal is to use material with unique molecular structures and physical shapes. CSIR-CGCRI has developed, implemented, and commercialized specialty materials that has become ultimate choice for management of radioactive waste in a closed nuclear fuel cycle. These are of preferred sizes with stringent physical, chemical and mechanical specifications.</p> <p>The innovative technology enables remote control of the entire operation of immobilization process at nuclear plants. It also assists in recovery and recycles of valuables during nuclear waste immobilization and is of significant importance for nuclear power programs. The entire process is non-hazardous to the operating personal. CSIR-CGCRI has also evaluated the productivity of the materials in terms of desired material performance, resulting from large scale bulk manufacturing.</p>
186.	<p>High Density Radiation Shielding Window Glass for Nuclear Hot Cell Application</p> <p>Laboratory: CSIR-Central Glass & Ceramic Research Institute</p> <p>Executive Summary:</p> <p>Radiation Shielding Window Glass (RSW) are used in nuclear reactors and nuclear</p>

	processing units. CSIR-CGCRI has developed a technology for producing homogeneous and defect free high density RSW glass blocks (ceria stabilized as well as un-stabilized) of varying sizes. The laboratory has ventured into establishing pilot scale facility of 180kg melt size per batch for technology demonstration and producing the materials to meet the indigenous demand.
187.	Low Moisture Castable (45-75% Al₂O₃)
	Laboratory: CSIR-Central Glass & Ceramic Research Institute
	Executive Summary: Conventional shaped refractory requires high shutdown/ installation time, suffer limitation of geometry and has lower energy efficiency. Developed low moisture castable (45-75% Al ₂ O ₃) is prepared from different high alumina aggregates, high alumina cement and reactive aluminas. These can be installed with low cement/water resulting high hot strength, flexibility on-site installation of difficult shapes. Compared to conventional shaped refractory, these castables can be manufactured without special mixing instruments and less inventory. The technology has been transferred to several industries.
188.	Mag-Chrome Refractory Aggregates from Friable Chrome Ore
	Laboratory: CSIR-Central Glass & Ceramic Research Institute
	Executive Summary: Mag- chrome refractories exhibit exceptional resistance to high temperature corrosion. This spinel refractory is generally produced from calcined magnesia and chrome ore. However, the Indian chrome ores are not dense- its friable nature poses major difficulty in ceramic processing. Thus it is challenging to prepare dense Mag-chrome aggregates using friable chrome ore. The patented technology however, overcomes this challenge. This technology can convert sintered MgO and friable chrome ore into dense mag-chrome refractory aggregate through single step heat treatment with the judicious use of oxide additive. The dense aggregates derived from this method can be used to prepare shaped refractory blocks for different critical applications like steel ladle, copper smelter and cement rotary kiln. The technology has been transferred and commercialized.
189.	Mullite Refractory Aggregates from Bauxite
	Laboratory: CSIR-Central Glass & Ceramic Research Institute
	Executive Summary: Indian Bauxite is not suitable for high temperature application as it contains detrimental impurities like CaO, Fe ₂ O ₃ , SiO ₂ and TiO ₂ . Conversion of these low grade natural bauxites through structural modification to high alumina aggregates has been realised through judicious formation of mullite phase before the development of low melting phases from bauxite. The detrimental effect of impurity oxides in raw bauxite is sequestered by converting them into high temperature solid solution by judicious incorporation of additives. This improves the RUL value by almost 100°C. The ultimate high alumina aggregates thus developed is much superior compared to directly calcined bauxite in terms of physical, micro-structural and thermo-mechanical properties. The final product is characterized by compact and homogeneous microstructure with an average grain size of 3 micron and refractoriness under load value of 1600°C. The technology is ready for transfer.
190.	Mag-Al Spinel Refractory Aggregates
	Laboratory: CSIR-Central Glass & Ceramic Research Institute
	Executive Summary: Mag-Al spinel refractories offer high temperature strength and excellent high

	<p>temperature corrosion resistance along with low thermal expansion. This refractory is an eco-friendly alternative to Mag-chrome refractory. However, formation of dense spinel aggregates is challenging due to high thermal expansion associated with spinelisation reaction from magnesia and alumina. The developed technology utilises formation of dense spinel aggregates through a single stage thermal treatment using a novel additive to facilitate the formation of dense spinel. These dense spinel aggregates find use in different areas of high temperature processing industries such as clinkering zone of cement rotary kiln, steel convertors etc. The technology has been validated in several industries.</p>
191.	<p>Lime Refractory</p> <p>Laboratory: CSIR-Central Glass & Ceramic Research Institute</p> <p>Executive Summary:</p> <p>Lime refractories offer high corrosion resistance at moderate basicity, high vacuum stability and used in AOD vessel for secondary steel refining. Despite offering highest thermodynamic stability at high temperature among the oxide refractory, the applicability of lime refractories suffered from low hydration resistance. This limitation has been overcome by judicious selection of oxide additive and thermal treatment to engineer the microstructure of the sintered lime aggregates. The developed lime refractory shows significantly lower hydration resistance due to lower amount of grain boundaries. The technology has been validated through 100T plant trial and is ready for transfer.</p>
192.	<p>70-90% Alumina Cement Free Dense Self Flowing Castable</p> <p>Laboratory: CSIR-Central Glass & Ceramic Research Institute</p> <p>Executive Summary:</p> <p>Dense self-flowing castables are the most important unshaped refractory used in cement, petroleum, steel and thermal power plants. The developed castable is composed of various grades of sintered/ fused alumina aggregates of different purity level, calcined bauxite and clays along with reactive alumina. This requires no vibration for its flow, less inventory and offer quick and controlled cold setting property. It has been already transferred to several industries.</p>
193.	<p>Orbital Eye Ball Implant</p> <p>Laboratory: CSIR-Central Glass & Ceramic Research Institute</p> <p>Executive Summary:</p> <p>CSIR-CGCRI has developed Orbital eye ball implant for functional and cosmetic rehabilitation (in which implanted artificial eye can almost exactly mimic that of healthy eye) of huge numbers of ailing single-eyed patients in India. It is light weight, highly porous orbital implants made using bioactive material hydroxyapatite. The implant comes in different sizes to suit different patients. Implants are made using innovative and economical process. The high porosity of the implant enables tissue in-growth thereby provides natural eye movement that is synchronized with other normal eye.</p>
194.	<p>Manufacture of Plasma Spray Grade Hydroxyapatite (HAp) Granules</p> <p>Laboratory: CSIR-Central Glass & Ceramic Research Institute</p> <p>Executive Summary:</p> <p>CSIR-CGCRI has developed a simple and economical technology to make HAp. These are high-purity, crystalline and porous granules with various sizes and can be used to fill bone, dental and soft tissue defects. These can be tailor-made depending on the exact requirement and are freely flowable. Composition of the Plasma spray grade HAp is as per ASTM spec., cost-effective, affordable. Granules have excellent tissue bonding properties and has been launched in the market. It fulfills a major requirement of</p>

	orthopaedic industry for plasma spray coating on hip stem, shell, etc.
195.	Ceramic Biomedical Implants (Hip Joint Prosthesis)
	Laboratory: CSIR-Central Glass & Ceramic Research Institute
	Executive Summary: CSIR-CGCRI has developed ceramic biomedical implants (hip joint prosthesis) for total hip replacement (THR) based on ceramic head and polymer acetabular cup. Dense alumina based modular femoral head of different diameters to suit are available for total hip replacement. The products have been clinically tested and is as per ISO spec., low wear, suits Indian patients. The technology has been launched in market. Equivalent metallic implants have been discarded world-wide, ceramic THR is gaining importance, thus huge market potential exist for the technology and the products.
196.	Bioactive Glass Coating for Dental Application
	Laboratory: CSIR-Central Glass & Ceramic Research Institute
	Executive Summary: CSIR-CGCRI has developed bioactive glass/ hydroxyapatite coating on metallic tooth root part (total dental implant). Cement-less fixation compared to the polymer cement fixation of bare metallic dental implants, gives rise to many advantages that include absence of heat generation during implantation, non-requirement of secondary surgery to remove the bone cement after some time, faster bone resorption, etc. It is mechanically strong, adherent bioactive coating on metallic implant substrates including titanium and its alloys. It can be used on surgical grade stain.
197.	Synthetic Bone Graft Material
	Laboratory: CSIR-Central Glass & Ceramic Research Institute
	Executive Summary: Synthetic bone graft material technology of CSIR-CGCRI find application in making porous scaffolds, granules, powders for bone development/ faster augmentation, dental filler, perodontic applications while having superior osteo-conductive/ inductive properties. The material can be used with pharmaceutical drugs or growth-factors, freely flowable granules can also be used for plasma spray purposes. It is effective for intra-medullary bone development.
198.	Optical Fiber Bragg Grating (FBG) based Sensors for Smart Infrastructure and Industrial Process Monitoring
	Laboratory: CSIR-Central Glass & Ceramic Research Institute
	Executive Summary: FBG sensors are optical fiber based sensing devices that can measure strain, temperature, pressure and vibration and many more parameters depending on its configuration and design. These optical sensors are generally used for process control and health monitoring applications. These sensors are free from electromagnetic interference. These are operable in harsh environments where conventional sensors are unusable and can be used in distributed form i.e., over hundreds of sensors in a single optical fiber. These sensors are easily embeddable in structures during fabrication leading to development of intelligent infrastructure. Few systems have been developed using FBG sensor technology with direct industry participation.
199.	Moisture Sensor (5-95%RH) Moisture Meter (5-100 ppm Moisture)
	Laboratory: CSIR-Central Glass & Ceramic Research Institute

	<p>Executive Summary:</p> <p>Sol-gel derived microporous as well as nonporous alumina thin film based capacitive moisture sensors (humidity meter with sensor head and trace moisture analyser with sensor head) with fast response and recovery have been developed indigenously by CSIR-CGCRI. The weight is about 200g to 300 g. The power requirement is 220V/50Hz or 9 V DC, <10mA. The display is digital/LCD as per the customer requirements.</p>
200.	<p>Water Purification through Ceramic Filters</p> <p>Laboratory: CSIR-Central Glass & Ceramic Research Institute</p> <p>Executive Summary:</p> <p>CSIR-CGCRI has developed and offers ceramic membranes modules technology which can be used to replace the sand filter and disposable cartridge filters for feed pretreatment of brackish water, ground and sea water. These are useful for removal of arsenic (including the process for media preparation) and Iron from ground water. Ceramic membrane based high capacity modules can be used for pre-treatment of turbid water for polishing of iron and arsenic contaminated water using micro filtration technique; and pre-treatment of river water for turbidity and suspended particulate removal. The process technology has been transferred to M/s Entech Metals Pvt. Ltd., Kolkata to manufacture Arsenic and Iron Removal Plants of 500-20,000 LPD capacity. Eleven entrepreneurs purchased the plants and set up industries under SSI sector with self/bank financing for regular production of bottled (5 & 20 liter) drinking water.</p>
201.	<p>Pottery and Low Cost Earthen Wares</p> <p>Laboratory: CSIR-Central Glass & Ceramic Research Institute</p> <p>Executive Summary:</p> <p>Pottery is commonly used by all class of people. Pottery process which is being made generally at 1250°C has been converted to energy efficient processed earthen ware at 1080-1100 ° C. These wares are cheaper than normal pottery. It has opened a new door to new comers generating employment. Almost 20-30 units in Khurja are manufacturing this pottery after our T&D programs. It has scope to get spread to other clusters.</p>
202.	<p>Scaled-up graphite oxide production technology starting from natural flake graphite</p> <p>Laboratory: CSIR-Central Mechanical Engineering Research Institute</p> <p>Executive Summary:</p> <p>Graphene is having potential to open up new markets and even substitute current technologies mainly due to large application areas i.e. energy, electronics, defence, desalination etc., all stems from its remarkable properties. But producing graphene on a large scale, while controlling and maintaining its unique properties, is a challenge yet to be realized. This uniqueness of CSIR-CMERI's technology is the low cost production of graphite oxide with commercially available graphite flakes. We have optimized the process with significantly lesser amount of acid i.e H₂SO₄ (15 ml/g). It is noteworthy that we have successfully produced high quality graphite oxide with > 90 % conversion rate and oxygen content in graphite oxide is ~30%.</p>
203.	<p>Scaled-up Technology for Graphite Oxide Production from Natural Graphite</p> <p>Laboratory: CSIR-Central Mechanical Engineering Research Institute</p> <p>Executive Summary:</p> <p>Graphene is having potential to open up new markets and even substitute current technologies mainly due to large application areas i.e. energy, electronics, defence, desalination etc., all stems from its remarkable properties.</p> <p>But producing graphene on a large scale, while controlling and maintaining its unique</p>

	<p>properties, is a challenge yet to be realized.</p> <p>This technology is an industrially scalable technology developed for the large scale production of graphite oxide in a single indigenous reactor embedded with reaction conditions controlling attributes. CSIR-CMERI has further reduced the amount of H₂SO₄ acid used (14 ml/g) for the oxidation of natural flake graphite. It is noteworthy that we have successfully produced high quality graphite oxide with conversion rate of 80-90 % and oxygen content in graphite oxide is 25-30%.</p>
204	<p>IMMT Column Flotation System for Coal and Iron Ore Fines</p> <p>Laboratory: CSIR-Institute of Minerals & Materials Technology</p> <p>Executive summary:</p> <p>Column Flotation Technology developed by CSIR-IMMT is specifically designed and optimized for beneficiation of coal and iron ore fines. It has been scaled up to 2 meter in diameter and 10 meter height column size, which can deliver a throughput for beneficiation of 50 TPH of iron ore fines. The column has been tested and demonstrated at plant site at several industries and has delivered excellent performance with ease of control, operation and maintenance.</p>
205.	<p>Development of Process Know-How for Low Grade Iron Ore Beneficiation</p> <p>Laboratory: CSIR-Institute of Minerals & Materials Technology</p> <p>Executive Summary:</p> <p>During mining iron ore below 10mm size and the fraction that is below 61% Fe grade is now being dumped at the mine site without further utilization. The percentage of low grade ores in ROM increases day-by-day. Hence a beneficiation technology has been developed to beneficiate low grade ores (55-61% Fe) to achieve around 64% Fe. The beneficiation study has been carried out on a number of samples at different locations in India. Finally based on CSIR-IMMT flowsheet, M/s Essar Steel, Barbil (15 MTPA), SMPL, Barbil (15 MTPA), BRPL, Barbil (6 MPTA), BPSL, Jarsuguda (4.5 MPTA), BMM Ispat, Hospet (2 MPTA), Usha Martin, Jamshedpur (2 MPTA) and GM Steel, Rairangapur (0.15 MPTA) have set up beneficiation plants. Other industries like M/s Altrade Minerals, Barbil, IPPL, Bhubaneswar, Bhushan Steel, New Delhi etc. have taken the process for beneficiation of low grade ores. At present, JSW, Bellary has taken the process to set up 60 MPTA plant in Odisha to produce 50 million tonne pellet.</p> <p>The processes have been implemented for enrichment of iron values from the following:</p> <ul style="list-style-type: none"> • High clay content Hematitic iron ore • Low grade Goethitic-Hematitic iron ore • Fine & ultrafine iron ore tailings & slimes
206.	<p>Maximising the Recovery of Flaky Graphite in Beneficiation Process</p> <p>Laboratory: CSIR-Institute of Minerals & Materials Technology</p> <p>Executive Summary:</p> <p>Graphite is beneficiated by flotation process after grinding to suitable size to liberate the gangue minerals. Graphite content in the ore varies from 2% onwards. It is available in flaky, fine or amorphous forms. During size reduction of graphite in beneficiation process, flaky particles reduce to fine form. As flaky graphite (-600+210 micron) demand is high and cost is more in comparison with fines, it is necessary to recover the flaky particles prior to grinding. Hence CSIR-IMMT has developed a scrubbing technique to recover flaky graphite particles before comminution. The flaky particle is floated separately and beneficiated to achieve high carbon content (93-96%) depending on the mineralogy of the ore. This process has been transferred to M/s Tirupati Graphite Plc. London to set up a plant at Madagascar. The plant has been set up and process has been successfully</p>

	commissioned. As all graphite mines are in closed condition in India, it will take some time to transfer this technology in commercial level.
207.	IMMT Designed Screw Scrubber Equipment for Mineral Processing
	Laboratory: CSIR-Institute of Minerals & Materials Technology
	Executive summary: Iron ore, chromite ore and manganese ore contain good amount of clay particles. Because of clay content the viscosity of pulp increases drastically during grinding of these ores. The hydrodynamics of slurry also changes seriously so that the proper grinding does not take place. To improve the grinding, the ore is scrubbed in the beginning by screw scrubber, so that below 150 micron particles associated with ore are classified. The screw scrubber is designed in such a manner that the coating of clay on the surface of mineral phase is removed, while simultaneously breaking the coarse particles in the boundary layer of different minerals, so that the clay is removed from the new surface area created. Size reduction of around 10% takes place in the scrubber. The equipment has been designed and scaled up to pilot scale to treat ores @ 3 tonnes per hour. A number of tests have been carried out to validate the capacity and generate process data to scale up to commercial scale to treat 200 TPH.
208.	Improved IMMT Hydraulic Jig
	Laboratory: CSIR-Institute of Minerals & Materials Technology
	Executive Summary: Hydraulic jig is used for beneficiation of coarse particles (above 1 mm size), particularly to recover iron ore, coal and metals from ferro-chrome or ferro-manganese slag. An improved hydraulic jig has been developed and tested for iron ore, coal and metal recovery of ferro-chrome slag.
209.	Maximisation of Iron Recovery from Lean/Low Grade Iron Ore Resources by Reduction Roasting Technique
	Laboratory: CSIR-Institute of Minerals & Materials Technology
	Executive Summary: Low grade iron ore (< 55%Fe) and lean grade ore (BHQ/BHJ/BGQ) do not respond to the conventional physical beneficiation process. To recover iron values from these types of iron ore, reduction roasting has been done to change the iron phase minerals i.e., hematite and goethite to magnetite phase under specific thermodynamic conditions. Tests have been carried out in pilot scale at 70-80TPH on various mineralogically different low-grade ores/slimes/tailings/BHQ/BHJ/BGQ. Based on these tests it is concluded that the following benefits can be realized: <ul style="list-style-type: none"> • Increases 15-20% extra yield • Increases grade of the concentrate • Reduces the grinding energy by a minimum of 30% margin • Maximizes the recovery of process water by filtration for both concentrate and tailings • Handling of the reject is easy and it does not require tailings pond • Transportation through pipeline is easy. • Easy to make pellet with 20-30% reduction of energy consumption in the pelletisation process due to exothermic reaction in the conversion from magnetite to hematite • Improves the pellet quality from magnetite concentrate • Reduces the consumption of ores per tonne of production of concentrate • Reduces the tailings generation • Improves ore conservation and reduces environmental impact

210.	Flaking of LD Slag
	Laboratory: CSIR-Institute of Minerals & Materials Technology
	Executive Summary: LD slag is a steel plant waste containing mainly iron, lime and phosphorus. It is accumulating in all steel making processes over the years. It is extremely hard and hence highly energy intensive to grind and granulate. LD slag contains high amount of phosphorus. So, it can also be used as a fertilizer after removal of metal and lime. Trial runs at 10 kg scale have been made in the present process to make the slag highly flaky at industrial site. Pilot scale studies in 100 kg scale are to be taken up. The resulting product can be used in cement plant.
211.	EYE-ON-PELLET : Online Pellet Size Analyzer for Pelletization Industries
	Laboratory: CSIR-Institute of Minerals & Materials Technology
	Executive summary: Preparation of iron ore fines/concentrates, as feed to blast furnace, involves production of spherical pellets of typically 8mm -18mm diameter is called pelletization. The productivity of a pelletization plant depends on a process which generates spherical pellets with a proper strength in a specific size range. Presently, in many pelletization plants in India the size monitoring and control is being carried out by human supervision leading to sub-optimal productivity. CSIR-IMMT's Instrument (named as EYE ON PELLET) is capable of online monitoring of the size of pellets during its production and provides a size distribution trend. The system also can give alarm if production size is too small or big. By viewing the size distribution trend the operator can control process parameters to enhance the productivity. System is field trialed and demonstrated at leading pelletization industries TATA, BRPL, JSW, ESSAR, MSPL etc. Technology is transferred to an Indian company who is marketing the instrument.
212.	Column Flotation Technology for Processing of Fine Minerals and Ores
	Laboratory: CSIR-National Metallurgical Laboratory
	Executive Summary: CSIR-NML has advanced a column flotation technology, a new mineral beneficiation method developed on strong scientific principles for processing of fine minerals and ores. The merits of the technology include improved metallurgical performance in terms of grade and recovery, effective cleaning of froths, small foot print, low capital investment, less operation and maintenance costs with user friendly controls.
213.	Eco-friendly Flotation Reagents for Sillimanite, Limestone and Coal
	Laboratory: CSIR-National Metallurgical Laboratory
	Executive Summary: Currently in mineral processing industry, reagents (collectors and frothers) used for flotation of minerals and coal is synthesized from organic/inorganic source materials, classified as cationic, anionic and non-ionic. Majority of reagents being used at present in the industry are not environmentally compatible and are non-biodegradable. The reagent developed by CSIR-NML is eco-friendly and bio-degradable for the flotation of various mineral such as sillimanite, limestone, iron ore fines and coal. The performance of new reagents is evaluated in comparison with existing reagent practices.
214.	Nanosized Hydroxyapatite Powder
	Laboratory: CSIR-National Metallurgical Laboratory
	Executive Summary: Hydroxyapatite is a bioceramic powder widely used as bone graft material in Orthopedic

	<p>and Dental implants. Most of the available products are imported brands with prohibitive price in India. The novelty in process for the production of nanosized hydroxyapatite powder lies in the in-situ synthesis of hydroxyapatite particles in protein matrix revealing an optimum degree of crystallinity. The protein matrix controls the hydroxyapatite particle size, morphology and regulates the precipitation process. The inventive step of the present invention is the attraction of calcium ions to specific sites in the protein matrix. In Load bearing biphasic calcium phosphate nanocomposite blocks as bone grafts and scaffolds, the novelty lies in the usage of biomimetic hydroxyapatite nanoparticles as an injectable basic building block. Biomimetic hydroxyapatite nanoparticles are well established because of its bioactivities suitable for bone tissue engineering.</p>
215.	<p>Anti-Tarnishing Lacquer for Silver and Copper-based Alloys</p> <p>Laboratory: CSIR-National Metallurgical Laboratory</p> <p>Executive Summary:</p> <p>Anti-tarnishing lacquer developed at CSIR-NML is a one component fast drying interior lacquer for use on brass, copper, bronze and silver surfaces. It prevents tarnishing (blackening) and provides a durable finish resistant to water, acid and alkali environments. The formula contains active corrosion inhibitors chemically bonded to acrylic polymer backbone, hence prevents tarnishing of copper, brass, bronze and items for long durations of several years.</p>
216.	<p>Dip Cleaner cum Brightener for Gold and Diamond</p> <p>Laboratory: CSIR-National Metallurgical Laboratory</p> <p>Executive Summary:</p> <p>Gold and diamond jewellery dip cleaner developed at CSIR-NML can be used to clean, brighten and enhance glitter of used gold & diamond jewellery at home. The advanced formulation is free from harmful mineral acids and other harsh chemicals making it safe for domestic use.</p>
217.	<p>Highly Metallised Low Sulphur Directly Reduced Iron(DRI) from Iron Ore Slime and Rejected/Middling Coal</p> <p>Laboratory: CSIR-National Metallurgical Laboratory</p> <p>Executive Summary:</p> <p>This innovation is useful for converting steel plant wastes such as iron ore slime/fines, middling and rejected coal containing more than 25 % ash into a highly metallised (Metallisation > 96%) low Sulphur (0.006%S) DRI. The DRI produced from these waste raw materials is suitable as a substitute of scrap for induction furnace, electric arc furnace and basic oxygen furnace for steel making.</p>
218.	<p>Development of Synthetic Flux and a Process for De-phosphorization of Steel in Induction Furnace</p> <p>Laboratory: CSIR-National Metallurgical Laboratory</p> <p>Executive Summary:</p> <p>Approximately 90% of nearly 15 million tonnes of steel produced in Indian induction furnaces, using DRI as the major feed material and containing phosphorous in the range of 0.08 - 0.11 %, is used as structural material. Both BIS and ASTM standards stipulates P in the range of 0.03 - 0.06%, depending upon the application.</p>
219.	<p>MagStar: A Portable Magnetic Hysteresis and Barkhausen Emissions based Electromagnetic Device for Non-Destructive Evaluation of Steel Structure/Component</p>

	Laboratory: CSIR-National Metallurgical Laboratory
	Executive Summary: The developed electromagnetic NDE device works by exciting the sensor by an alternating current source. The sensor is to be placed on test body to get signal corresponding to the characteristics of the test objects. The output signals from the sensor are the measure of the magnetization, coercivity and magnetic noise (Barkhausen emissions) which change with microstructure and stress state of the materials.
220.	MagSys: A Portable Giant Magneto-Impedance (GMI) based Magnetic Sensing Device for NDE Applications
	Laboratory: CSIR-National Metallurgical Laboratory
	Executive Summary: MagSys is a portable magnetic sensing device where nanostructured Fe-Co based magnetic wires of diameter 80-120 micron prepared by in-rotating water quenching technique is used as a core material in the probe-head. The magnetic wire material exhibit Giant Magneto-Impedance (GMI) properties. The output signal of the sensor is proportional to the magnetic field generated by the test object. If there is change in composition, microstructure or residual stress of the test object due to in-service operation, the magnetic properties also change and hence the output signal of the sensor.
221.	FlawGuard.: A Cost Effective Device for Defect Detection in Wire during Cold Drawing
	Laboratory: CSIR-National Metallurgical Laboratory
	Executive Summary: Presence of transverse cracks in wires leads to premature failure. This system 'FlawGuard' developed by CSIR-NML detects crack during fabrication of wires and works based on the principle of encircling coil differential probe eddy current. This is installed in the drawing line and wire passes through the core of the probe. Probe diameter can be changed based on the wire diameter. Real time data availability in ASCII format for defect type identification in high speed drawn wires and low cost makes it unique and viable for large scale implementations.
222.	Microwave – IR Sort: Rapid, Reliable, Non – invasive Technology for Iron Ore Compositional Analysis
	Laboratory: CSIR-National Metallurgical Laboratory
	Executive Summary: Fast, Reliable non-invasive technique to detect alumina/Fe in iron ore. This technology relies on the conversion of microwave energy to heat energy based on the dielectric properties of the mineral constituents of iron ore. Thermal behaviour of the ore is imaged using Infra-red camera with high temperature sensitivity and the average temperature rise is related to the weight percentage of alumina/iron in iron ore.
223.	PABI: Potable Automated Ball Indentation System
	Laboratory: CSIR-National Metallurgical Laboratory
	Executive Summary: CSIR-NML has developed and offers a 'Portable Automated Ball Indentation (PABI) System' for in-situ evaluation of mechanical properties of metallic components. The device has the ability to estimate hardness, yield stress, yield ratio, tensile strength, strain hardening constant and fracture toughness- all in just one test.

224.	Ultrasonic Flow Gauge: A Device for Fluid Flow Rate Measurement through a Narrow Tube
	Laboratory: CSIR-National Metallurgical Laboratory
	Executive Summary: <p>CSIR-NML has developed a flow rate measurement device which is now used in Spacecraft propulsion systems, essential for orbit raising, station keeping, attitude correction/ reaction control and de-orbiting. The conventional methods (like pVT and book keeping) are used to calculate the remaining propellant after orbit transfer whereas more than 80% of the propellant is consumed during apogee raising manoeuvres. As both pVT and bookkeeping methods are starting their evaluation at the beginning of satellite orbital life, the accuracy of the remaining propellant mass prediction is eventually driven and limited by the precision in the estimation on the quantity of propellant consumed during Liquid Apogee Motor firing. The developed ultrasonic flow gauge is integrated in the spacecraft for on-board propellant gauging. It can also be used as a gas and liquid flow meter for ground based applications.</p>
225.	Ferronickel from Spent Nickel Catalyst
	Laboratory: CSIR-National Metallurgical Laboratory
	Executive Summary: <p>The simple smelting process is developed for recovery of nickel as ferronickel of various grades from different nickel catalysts containing nickel in the range, 8 - 18%. By controlling the parameters and the process techniques, ferronickel of 20 - 75% Ni grade have been produced with above 90% Ni recovery. mixture to get ferro-nickel.</p>
226.	Nickel Sulphate from Spent Nickel Catalyst
	Laboratory: CSIR-National Metallurgical Laboratory
	Executive Summary: <p>Nickel catalysts used in various operations become spent after several cycle of use, for which a very simple and innovative process is developed at NML for recovery of nickel. The processing step consists of direct acid leaching in presence of a promoter followed by impurity removal to produce nickel salt/metal.</p>
227.	Recovery of Lead from Zinc Plant Residue
	Laboratory: CSIR-National Metallurgical Laboratory
	Executive Summary: <p>Subsequent to zinc extraction with sulphuric acid from various zinc secondaries, insoluble lead in the form of sulphate remained in the leached residue. The residue containing appreciable amount of lead is treated as hazardous waste and is presently being dumped inside the plant premises.</p>
228.	Production of Ferrite and Pigment Grade High Purity Monodispersed Iron Oxide from Waste Chloride Pickle Liquor and other Iron Rich Sources
	Laboratory: CSIR-National Metallurgical Laboratory
	Executive Summary: <p>A simple process is developed at CSIR-NML for production of highly dispersed red iron oxide of uniform size and shape from variety of waste sources including chloride pickle liquor. The major processing steps consist of oxidation of ferrous iron followed by conversion to desired grade iron oxide. The developed process takes care of the impurity present in the starting material and can produce high purity iron oxide suitable for various other high end applications in making soft ferrites, catalysts, sensors etc.</p> <p>The process produces very uniform size iron oxide in the range 100-2000 nm of different</p>

	shapes and colour. Due to highly dispersed and very uniform nature of the particles, the produced iron oxide gives very high colour purity and matches with the colour of different standard grade high end iron oxide available in the market.
229.	Yellow Tungsten Oxide and Tungsten Metal Powder from Heavy Alloy Scraps
	Laboratory: CSIR-National Metallurgical Laboratory
	Executive Summary: CSIR-NML has developed the process technology for recovery of high pure products (YTO, W-metal powders & other metal salts/powders) from waste/end-of-life WC-hard metal tool bits/drill bits/inserts etc. and heavy metal alloy scraps/swarf. Tungsten is an vital strategic metal, having low resources in India.
230.	Paving Blocks from Fly Ash, Blast Furnace Slag, Steel Slag, and other Industrial Wastes
	Laboratory: CSIR-National Metallurgical Laboratory
	Executive Summary: These Paving blocks are produced by the geopolymerisation of industrial wastes such as fly ash, granulated blast furnace slag, steel slag, and red mud independently or in in different combinations.
231.	Geo-polymer Cement
	Laboratory: CSIR-National Metallurgical Laboratory
	Executive Summary: Geo-polymer cement developed by CSIR-NML is a new type of alumino-silicate binder and considered as an alternative to Portland cement. During synthesis, the alumino-silicates present in feedstock undergo polymerization and polycondensation resulting into hard ceramic like material with good longevity.
232.	Process for Production of Ferric Sulphate from Copper Slag for Arsenic Removal
	Laboratory: CSIR-National Metallurgical Laboratory
	Executive Summary: About 2.2 ton of waste copper slag is generated for every tonne of copper produced which is currently being dumped near the plant site. CSIR-NML developed a very unique process by which the slag is converted to two commercial products namely ferric/ferrous sulphate and silica powder. About 5 kL of ~35% ferric sulphate solution and ~300 kg SiO ₂ powder for every tone of slag treated, is produced. Ferric sulphate is an important ingredient for arsenic removal from toxic waste stream of copper industries and silica produced from the process is useful for phosphoric acid plant. Implementation of the process will not only take care of environmental norms but also will make the industry independent on availability of chemicals for critical operation of treating effluents.
233.	Energy Efficient Coke Brass and Bell Metal Melting Furnace
	Laboratory: CSIR-National Metallurgical Laboratory
	Executive Summary: The existing traditional brass melting furnaces are fuel inefficient. The operators are exposed to toxic flue gases; the flue contains high suspended particulate matter (SPM) causing serious health hazards for the artisans. These also contribute to atmospheric pollution.

234.	Recovery of Cobalt from Discarded Li-ion Batteries of Mobile Phone
	Laboratory: CSIR-National Metallurgical Laboratory
	Executive Summary: A process has been developed by CSIR-NML developed for the dissolution of metals from discarded lithium ion batteries (LIBs) of mobile phone. Diluted sulfuric acid in the presence of an oxidant was used to leach out ~99.99% cobalt along with other metals in 60 min at elevated temperatures. Leach liquor generated was further processed through solvent extraction, precipitation, electro-winning techniques.
235.	Aluminium Composite Foam Panels for Blast Resistance Applications and Construction Sectors
	Laboratory: CSIR- Advanced Materials and Processes Research Institute
	Executive Summary: CSIR- AMPRI has developed Aluminium alloy composites foamed using TiH_2/CaH_2 foaming agent. Foaming is carried out in liquid conditions and after foaming the foamed structure is cooled very fast to avoid foam drainage. After optimizing, the process parameters, foam billet of size 35 kg in a single heat is made and daily ` 100 kg foam can be made in the laboratory. The foam billets are sliced, joined (through welding or through adhesives) to required size and the foam plates are then used as core for making sandwich panels. FRP, Aluminium alloys and steel sheets and plates are used fas face sheets to make the sandwich panels. Full size prototype door panels are made using these sandwich panels. The specific strength, bending stiffness and flexural strength increased by more than 50% as compared to the solid dense plates of face sheet materials. These are light weight, cost competitive, fire retardant and moisture resistant materials having excellent vibration and noise attenuation characteristics as well as shock absorbance capabilities.
236.	Aluminium (Al)- Composite Brake Drum for Automobile Applications
	Laboratory: CSIR- Advanced Materials and Processes Research Institute
	Executive Summary: CSIR-AMPRI as developed a liquid metallurgy stir-casting process used for making Al-composite @60 kg per heat. The process parameters for making composites are optimized with a 95% repeatability. The strength of the product is equivalent to cast iron and mild steel. Modulus is around 95 to 100 GPa. The Al-SiC composite then pressure die cast to make brake drums of actual dimension in single step. It needs no machining with mterials yield as 90%.
237.	Aluminium Foam for Crashworthiness
	Laboratory: CSIR- Advanced Materials and Processes Research Institute
	Executive summary: CSIR-AMPRI has the foam making technology where the blocks have been made and also foam sliced are cut from the foam billet. The foam blocks are filled inside crash box and foal sliced are filled in side bumper strips using nut and bolt arrangement and the adhesive joining. The crash box bumper assemble after FEM simulation for crash energy absorption, were filled with Al-composite foam. These assembly absorbed 200KJ which is much higher than that required for a car moving at a speed of 75 KM and collide with stiff heavy body. Only 1.5 to 2 kg foams which may be costing around Rs 2000/- to Rs 3000/- is required. It will help in safety of engine, driver and the passenger on board and reduce casualties.

238.	Al-SiC Composite Torpedo's Nose Cone for Defence Applications
	Laboratory: CSIR- Advanced Materials and Processes Research Institute
	Executive Summary: Liquid metallurgy stir-casting process used for making Al-composite @60 kg per heat. These components are replacement of aluminium alloy based components to improve strength and damping capacity. AS per as weight saving there would not have any weight saving. But there is improvement in damping capacity by 50% in the composite materials. Cost wise aluminium alloy and composite are comparable. A set of Nose cones after pressure die casting have been supplied to NSTL, Vishakhapatnam for performance evaluation in actual conditions.
239.	Joint Free Radiation Shielding Tiles for Diagnostic X-ray and CT Scanner Rooms
	Laboratory: CSIR- Advanced Materials and Processes Research Institute
	Executive Summary: CSIR-AMPRI has prepared radiation shielding tiles by mixing red mud with appropriate amount of high Z metal compound and binder and subsequent sintering at 900°-1100°C. The attenuation characteristics of developed tiles indicated that 6 mm thickness of tiles possess attenuation characteristics (100 kVp) equivalent to 0.9 mm lead. Shielding thickness at 100 kVp in terms of half value layer (HVL) is 1.6 mm which is equivalent to 15 mm of concrete. This material was accredited by Atomic Energy Regulatory Board (AERB), Mumbai and included in a list of materials for making diagnostic X-ray and CT scanner rooms. Developed tiles are installed in 2600 sq feet area of X-ray & CT scan rooms and Cath Lab of one of the biggest hospital, M/S Saideep Healthcare Pvt Ltd, Ahmednagar in Maharashtra for attenuating X-rays. Tiles were approved and certified by AERB during their radiation survey report.
240.	Development of Patient Specific Orthopaedic & Maxillofacial Implants
	Laboratory: CSIR-Central Scientific Instruments Organisation
	Executive Summary: Patient Specific Implants (PSI) also known as custom Implants are developed on "One Implant One Patient Philosophy. It is required when available implants are not able to provide solution optimally or altogether implants are not available for specific requirement, due to which the patient can be crippled or bed ridden for life. Design to manufacturing expertise for PSI at one place is only available at CSIR-CSIO in India. PSI are developed using patient's own CT-Scan data, converting the scan data to 3D model than developing the implant specifically according to once anatomy. Designed implant is then 3D printed in biocompatible Ti6Al4V ELI Titanium alloy. Expertise of the laboratory made possible economic availability of PSI in India at almost 50% of cost as compared to foreign service providers.
241.	Economical Production of Highly Porous Metal Organic Frameworks (MOF) from Zinc Scrap
	Laboratory: CSIR-Central Scientific Instruments Organisation
	Executive Summary: Conversion of metal scraps in to economically attractive products is a key to drive the growth of Recycling sector. From this perspective, the present technology aims to convert the waste electrode powder of spent alkaline batteries in to an expensive metal-organic framework (MOF) end product. MOF have tremendous potential as adsorption material in different industrial applications such as gas separation, gas storage and catalysis. About 80% of annual battery waste is contributed by Zn-Alkaline primary batteries

	<p>utilized in various household devices. Due to inefficient recycling processes, most of these batteries end up in land-fill sites. The process developed at CSIO can recover a high cost MOF (specifically Zinc-imidazolate framework or ZIF-8) from the waste electrode powder of spent alkaline batteries. After chemical leaching, the recovered zinc is converted in to ZIF-8 utilizing simple steps at ambient conditions. The recovered product is more than 99% pure as verified by several instrumental techniques. It may be highlighted here the ZIF-8 is a high cost chemical (about 6-8 Lakhs per kg).</p>
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