

## Technologies ready for licensing

1. Disposal of Municipal Solid Waste utilizing high temperature Plasma
2. Large Scale Production of Graphene Oxide (200 g/batch)
3. Plasma Disposal of Plastic Waste & Generation of Syngas
4. Solar Artifact
5. Solar Power Tree
6. Fluidized Bed Dryer for Agro Crops
7. Mobile Bridge Inspection Unit
8. Small Tractor-KrishiShakti
9. Cabinet Dryer for ginger & turmeric
10. Rotary drum washer for ginger & turmeric
11. Smart Card operated Prepaid Energy Meter
12. Pluggable Smart Energy Meter
13. Semi Continuous Biodiesel Plant
14. Five Axis Micro Milling Machine
15. High Speed Spindle for micro milling and drilling operations
16. Improved Iron Removal Plant
17. Metal Detector
18. Salivary Fluoride Detection Kit
19. Pedal Assisted High Power e-Rickshaw
20. Process for Solidification/Stabilization of Arsenic contaminated sludge
21. Domestic arsenic water filter
22. Domestic filter for defluoridation of water
23. Screen Printed Electrode (SPE)
24. Pneumatic Precision Planter for vegetables
25. Inter-row Rotary Cultivator for wide row crops
26. Programmable Irrigation Scheduler
27. Cotton Picking Head
28. Reconfigurable Micro Factory
29. Autonomous Intelligent Robotic Wheel Chair- low end low cost model
30. Autonomous Underwater Vehicle (AUV) operational upto 150 m.
31. Serpentine Robot
32. Austempered Ductile Iron (ADI) Technology
33. Metal Injection molding

<b><i>Title of Technology</i></b>	<b>Disposal of Municipal Solid Waste utilizing high temperature Plasma</b>
<b><i>IPR Details</i></b>	<ol style="list-style-type: none"><li>1. Copyright of the process filed</li><li>2. Design registration of Non-transferred Plasma Torch already filed</li><li>3. Patent filing is under process</li></ol>
<b><i>Application/Uses</i></b>	Effective utilization of high temperature (>3000 °C) Plasma arc forecofriendly disposal of municipal solid waste material generated on daily basis and generation of fuel gas containing predominantly CO and H <sub>2</sub> .
<b><i>Salient Technical Features</i></b>	<ul style="list-style-type: none"><li>• Mechanized handling of waste to avoid health hazard to the associated workers</li><li>• Eco-friendly disposal of municipal solid waste through utilizing high temperature ionized gas /electric arc with significantly low level of toxin generation</li><li>• Large volume reduction, slag is 1/250<sup>th</sup> of the volume of processed solid waste</li><li>• Generation of fuel gas containing predominantly CO &amp; H<sub>2</sub></li><li>• Unique gas cleaning system to minimize the dust accumulation in the generated fuel gas</li><li>• Special design consideration to prevent leakage of gas from the system during regular operation</li><li>• Storing facility of generated fuel gas</li><li>• Energy harvesting from generated gases through generation of electricity</li><li>• Utility of slag as construction material</li></ul>
<b><i>Level/Scale of Development</i></b>	Technology Readiness Level, TRL-7. Technology already demonstrated & licensed to one Indian Industry on non-exclusive basis for commercialization.
<b><i>Environmental Considerations</i></b>	Eco-friendly disposal with generation of fuel gas containing insignificant amount of toxin.
<b><i>Status of Commercialization</i></b>	Technology transferred to M/s Positronics Innovation Pvt. Ltd, Kolkata, WB.
<b><i>Major Raw Materials, Plant Equipment and Machinery Required</i></b>	Major components: Shredder, Inclined Bucket Conveyor, Plasma Cracker, Plasma Torch, Catalytic Convertor, Redox Reactor, Scrubber, Condenser, Induced draft fan, compressor, Gas holder, Gas Engine etc. Complete steel structure fabricated using Mild Steel & Stainless Steel
<b><i>Techno-Economics</i></b>	Safe disposal of solid waste without generating toxins for atmospheric pollution is the main objective of this development. It also produces electric power at the rate of 7 KW from 25 Kg/h MSW input
<b><i>Technology Package</i></b>	Technical Information containing process flow, detail Engineering, components specifications, operation and maintenance details, troubleshooting etc.



Fig: Municipal Solid Waste Disposal Plant

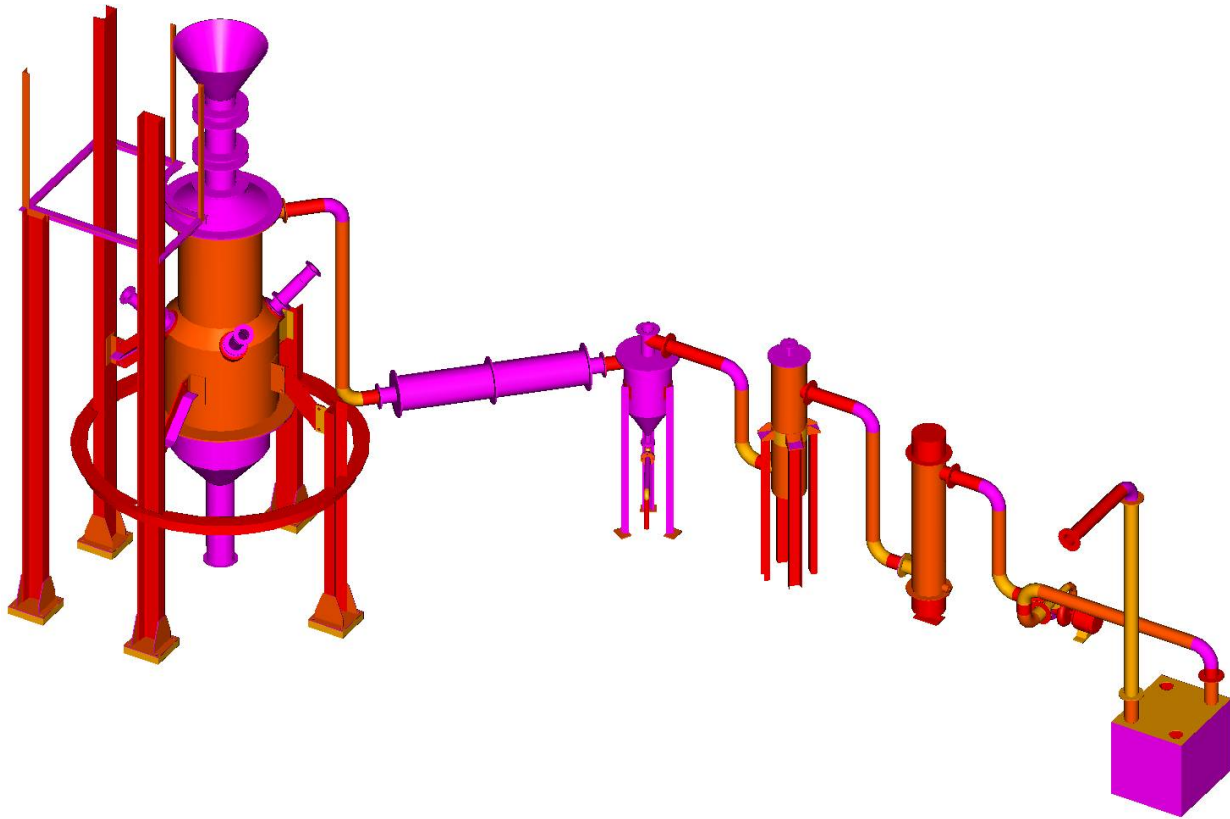


Fig: 3D Model of Municipal Solid Waste Disposal Plant

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1. Title of Technology Large Scale Production of Graphene Oxide
2. IPR Status  
Patent/Copyright/  
Trademark  
Secured in India/Abroad  
IPR Details **Patent:** Kuila, T.; Jana, M.; Samanta, P.; Murmu, N. C.  
Development of scaled-up graphite oxide production technology starting from natural flake graphite. Docket no. 36326. CBR. No. 20266, Patent office application no. 201711019808 (Ref. No. 0045NF2017).
3. Application/Uses/Problem being addressed **Application/Uses:** Graphene oxide is extensively used in energy storage devices, polymer composites, desalination of water, conducting ink, aqueous lubrication, nano-coolant, additive for phase change materials, etc.  
**Problem being addressed:** The cost of commercially available graphene oxide is very high (Rs. 35,000 for 0.2 g) and thus it is very difficult to use it in the aforesaid areas. Therefore, scaled-up production of graphene oxide at reasonable price without compromising the quality is a challenging task. The developed technology demonstrates the production of graphene oxide starting from natural flake graphite (200 g/batch) without pre-treatment.
4. Salient Technical Features including Competing Features  
Production yield = 80%  
Thickness = 1-1.8 nm  
Number of layers: Few layer (3-4 layers)  
Dispersible in water and most of the polar organic solvents  
Oxygen content = 25-28%
5. Level/Scale of Development 200 g/batch
6. Environmental Considerations, if any Sulphuric acid is used for the oxidation of graphite. The un-reacted acid is stored in a tank, so, there is no environmental concern.  
***Graphene oxide is not toxic and hazardous for the environment.***
7. Major Raw Materials to be Utilized Natural flake graphite (preferably 100 mesh), sulphuric acid, potassium permanganate, hydrogen peroxide, hydrochloric acid.
8. Major Plant Equipment and Machinery Required Mechanical stirrer, Glass reactor (customized design), distilled water plant, freeze dryer
9. Techno-Economics (Broad) Graphene Electronics Market worth \$1512.10 Million by 2020 as per Market Survey. Energy storage (LIB and Supercapacitor) application is also expected to be the fastest growing segment, registering a CAGR of 93.2% during the forecast period.
10. Technology Package (IPR, CSIR-CMERI will not provide raw materials and the equipment required for the graphite oxide production, purification, drying,

Process etc.)

storage, etc.

CSIR-CMERI scientist will demonstrate the graphene oxide production technology (200 g graphite oxidation/batch) at the site of the customer. CSIR-CMERI scientist will also help to buy the machinery/equipment, raw materials, glass ware etc are to be provided to for setting up the process plant.

11. Photographs (please provide high quality photographs of proof of concept & validation)



## *Title of Technology*

**Plasma Disposal of Plastic Waste & Generation of Syngas**

## *IPR Details*

Under Process

## *Application/Uses*

Disposal of solid waste in eco-friendly way.

## *Salient Technical Features*

- Energy recovery system- contributing saving of resources
- Provides volume reduction of the waste streams
- The extreme high temp. of plasma kill stable bacteria
- Uniform gasification, Offers a single step treatment
- Complete destruction of plastic waste
- Reduce the need for landfill
- Provide electricity to power the process
- Supply excess electricity for sale
- Safer disposal of plastic waste
- Formation of complex molecules , such as dioxins, is prevented

## *Level/Scale of Development*

Level-8, prototype developed, know how transferred to two number of licensees. It is incorporated for commercial production by one licensee.

## *Status of Commercialization*

- Technology has been licensed to two Indian Industries
- Two number of pilot projects has been taken up by one licensee

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## *Major Raw Materials, Plant Equipment and Machinery Required*

- Solid waste, Plasma arc
- Plasma flame generator, control system, high temperature plasma reactor, cyclone separator, redox reactor, catalytic convertor, cooling tower, booster *etc.* Rs. 40 lakhs for 01 ton/day

## *Techno-Economics*

For a 2 tons/day capacity the Capital investment is 1.2 crore with Pay back of 5 years.

## *Technology Package*

Includes general engineering, operation and maintenance, procedure, vendor list



## *Title of Technology*

### **Solar Artifact**

## *IPR Details*

Under Process

## *Application/Uses*

To bring visibility to solar technology and to enhance the beautification of a site, presently CSIR-CMERI is developing solar artifacts. Similar to solar tree, solar artifacts can be installed in various places to provide electrical power but these are having better aesthetic view for beautification of the place where these will be installed.

Design of two solar artifacts namely, Attapatram (Umbrella) and Surya Banaspati have been completed and manufacturing of the prototypes will be started soon. The capacity of Attapatram is 1kW and can provide 0.5kW electricity for 3 hours. These can be installed in the beaches, river banks, parks and even in the lawn of a bungalow. On the other hand, Surya Banaspati is 5kW capacity and can be installed in the road side, parks and other remote areas to provide electricity.

## *Salient Technical Features*

### **Surya Attapatram (Umbrella)**

Specifications:

- Max Power: 1kW
- Load Capacity: 0.5 kW for 3 hours

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- Power Supply : 220V AC
- Dimension: 5 m x 2.5 m approx.

## **Surya Banaspati**

### Specifications:

- Max Power: 5kW
- Load Capacity: 1 kW for 10 hours
- Power Supply : 220V AC
- Dimension: 8 m x 5 m. approx.

### *Level/Scale of Development*

Ready for licensing

### *Environmental Considerations*

Environment friendly

### *Status of Commercialization*

Technology has already been licensed to One Indian Industry.

### *Major Raw Materials to be Utilized*

Structural Steel Pipes, solar photo voltaic panels, inverter, batteries & necessary wirings

### *Major Plant Equipment and Machinery Required*

General Engineering Workshop,

### *Techno-Economics*

The cost of a Solar Artifact is around Rs. 1.5 lakhs per kW.

### *Technology Package*

Technology Transfer Documents (TTD) consisting of specifications of Products, Drawings, Design Details etc.



### *Title of Technology*

**Solar Power Tree**

### *IPR Details*

Received Certificate of Registration of Design from The Patent Office, Govt. of India  
**Design No.251575 Dated 11/02/2013**

### *Application/Uses*

Solar SPV method seems to be the only successful method of tapping sun for practical purposes but it consumes vast amount of land surface. Land is the greatest crisis of Earth today. Rotating Solar Power Tree is the perfect solution to the question of availability of the land in the future - It take up only 1% of space consumed by conventional systems.

The “Solar Power Tree” Technology developed in CSIR-CMERI for auto tracking of solar power occupying minimum land space.

Solar Power Tree rotates on its axis with all the solar panels together that generates 10-15% extra power from the sun with direction from East to West. Rotation is given to the solar panels by rotating the trunk of the tree from its root and also by manually.

## *Salient Technical Features*

- It gives 100 times more solar power compared to conventional SPV layout – consumes 1% of land surface for same power.
- It holds the panels at a higher height – gets more sun.
- It can be facilitated with water sprinkler at the top of the SPT.
- Even the paddy lands, agro-gardens, roads or parks can be utilized for production of megawatts of solar power without hampering any cultivation work .
- It can produce 25% to 30% more power as because - all panels may be rotated by 180<sup>0</sup> in the afternoon and morning towards the east and the west by an easy mechanism.

## **DESIGN PARAMETERS**

- Capacity / Requirement of Power (KWp)
- Height of SPT
- Size and Numbers of Panels
- Wind Pressures
- Steps of Branches
- Phyllotaxi pattern of panels
- Orientation of Panels
- Maintaining Tilt-Angle
- System of tracker incorporation
- Circuit layout for final out-put (Voltage & Current) from SPT On & Off-grid system

Ready for licensing.

## *Level/scale of Development*

## *Status of Commercialization*

Technology has already been licensed to four Indian Industries

## *Major Raw Materials to be Utilized*

Structural Steel Pipes, solar photo voltaic panels, inverter, batteries & necessary wirings

## *Major Plant Equipment and Machinery Required*

General Engineering Workshop

## *Techno-Economics*

The cost of a SPT of 3kw capacity would be around Rs. 3.0 lakhs



## *Technology Package*

Technology Transfer Documents (TTD) consisting of specifications of Products, Drawings, Design Details etc.



## *Title of Technology*

### **Fluidized Bed Dryer for Agro Crops**

## *IPR Details*

Under Process

## *Application/Uses*

For drying in a safe desired level, storage & further processing of different oilseeds such as mustard, sunflower, soybean, groundnut etc and other agro crops, this dryer is used extensively by

- State Oil & Oilseed Federations, Oilseed Growers Association, Oil Mill and Solvent Extraction plants, - for drying of oilseeds
- Agencies dealing with storage of seeds, agrocrops, etc., - for drying of Agro crops Food Corporation of India.
- Drying of other items like tea, coffee, ginger, spices etc.

## *Salient Technical Features*

- Compact plant
- Short drying time
- Almost zero maintenance
- Better product quality, uniformity in temperature and moisture content
- Higher energy efficiency
- Simultaneous cleaning
- Not much skill required

## *Level/Scale of Development*

Ready for licensing of the technology

## *Environmental Considerations*

Nominal environmental hazards.

## *Status of Commercialization*

Ready for licensing of the technology

## *Major Raw Materials, Plant Equipment and Machinery Required*

Different oil seeds, harvested/wet seeds

## *Techno-Economics*

Licensed to one Indian Industry.

## *Technology Package*

It contains details manufacturing drawings, specifications of materials and operation & maintenance schedule



***Title of Technology***

**Mobile Bridge Inspection Unit**

***IPR Details***

PATENT NO: 2984DEL2012

INDIAN

TITLE: VEHICLE MOUNTED AUTOMATIC CONTROLLED M  
BRIDGE INSPECTION DEVICE

***Application/Uses***

Device for the inspection of the Road bridges.

***Salient Technical Features***

- Simple & Robust articulated steel structure unit mounted over TATA truck chassis with modified suspension system and additional rear axles.
- MBIU can be easily operated / maintained by semi-skilled manpower.
- PLC controlled electric drives for all six joints. Operating logic is embedded in the PLC controller for adequate safety.
- Special electrical geared drive to maneuver the inspection unit forward / rearwards for continuous inspection between pillars & unfolding the unit.
- Dedicated power supply system (15KVA, 3 Phase) to power MBIU for remote area inspection.
- Online chassis load sensors for sensing structural load distribution during structure folding / unfolding & inspection.
- Online Wind speed monitor.
- Touch screen based twin control units for MBIU structure folding & Unfolding.
- Integrated parking assistant system at MBIU drivers cabin.

***Level/Scale of Development***

Prototype developed & demonstrated

***Environmental Considerations***

Device can be operated in normal outdoor weather conditions (Up to 100 Km/hr. Wind speeds)

## *Status of Commercialization*

Technology is ready for Commercialization

## *Major Raw Materials to be Utilized*

- TATA 2515EXL TRUCK CHASSIS
- HENDRICKSON PNEUMATIC SUSPENSIONS (10 TONS EACH CAPACITY)
- 15 KVA 3-PHASE KIRLOSKAR GENSET
- 3-Phase GEARED MOTORS.
- TATA STRUCTURA Weather Resistant Steel Hollow Sections.
- Machined SCREW JACK Units.
- COMBINED ROLLER BEARINGS
- SLEWING RING
- AUXILIARY CHASSIS
- WIRE ROPE WINCH
- PLC AUTOMATION CONSOLE.

## *Major Plant Equipment and Machinery Required*

Conventional Fabrication industry machinery.

## *Techno-Economics*

The indigenously designed inspection device costs approx. 1 crore whereas similar imported hydraulic machine costs 6-7 crores.

## *Technology Package*

Working Prototype / Design documents & CAD models / Standard brought-out components / Operation & Maintenance manuals.



## *Title of Technology*

### **Small Tractor-KrishiShakti**

## *IPR Details*

Copyright on Manufacturing drawings and Technical document copyright, Trademark for “krishiShakti”

Received copyright for drawings of Gear box (*Ref. No. IPMG/Copyright/2005-06/3*) Front axle assembly (*Ref. No. IPMG/Copyright/2006-07/10*) and Technical documents (*Ref. No. IPMG/Copyright/2006-07/9*)

Received trademark of “krishiShakti” (*Ref. No. IPMG/TM/2006-07/1*)

## *Application/Uses*

Farming & Transportation

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## *Salient Technical Features*

- Small, compact and easily maneuverable tractors
- Perfect for small size lands
- Low cost tractor
- Lower operational cost

## *Level/Scale of Development*

Prototype developed and Tested at Laboratory level. Received CMVR certificate from CFMTTI, Budni

## *Status of Commercialization*

Technology has been transferred to M/s. Singha Components, Howrah on non-exclusive basis and they are in process of commercializing the same

Structural steel, Cast Iron, sheet metal, Tyres, tubes, rim etc.

Similar to a tractor industry

## *Techno-Economics*

It depends on number of production. However if the number of production is 2000 per year, production cost is Rs. 1.8 lakh per tractor and selling price may be Rs. 2.2 lakh per tractor.

## *Technology Package*

Manufacturing drawings, Technical documents cum operation manual



## *Title of Technology*

## **Cabinet Dryer for ginger & turmeric**

## *IPR Details*

Copyright application filed on 13-04-2009; Reference No: IPMG / Copyright / 2009 / 01.

Application filed for Indian Patent on 09-07-2009; Reference No. 0090NF2009.

## *Application/Uses*

Drying of freshly harvested ginger and turmeric to reduce their moisture content and thereby preventing the loss in quality and quantity of cash-crops during storage.

## *Salient Technical Features*

- Batch type; 50 kg per batch
- Moisture reduction from 85-90% to less than 10% in 4-5 hrs.
- Perforated SS trays with zigzag travel of hot air
- Uniform drying

Available general purpose dryers have been found to take about 15 hours for drying of ginger / turmeric slices, which consumes more

energy, and also results in degradation of the quality of the product due to mould growth. Thus, they are not at all suitable for processing of high moisture content agro-crops like ginger/turmeric.

The developed dryer enables faster drying (4-5 hrs.) with more uniform product quality

## *Level/Scale of Development*

Prototype developed, successfully tested and technological knowhow transferred on non-exclusive basis.

## *Environmental Considerations*

Reduces human drudgery in open air sun drying, which causes quality degradation of the crop as well.

## *Status of Commercialization*

Technology transferred on non-exclusive basis with one time license fee and royalty on the sold items using the technology.

## *Major Raw Materials, Plant Equipment and Machinery Required*

- Freshly harvested ginger and turmeric for drying
- No major equipment is required; only food-grade stainless steel sheets, fin-type electrical heaters and a small capacity exhaust fan are required to assemble the cabinet dryer.

## *Techno-Economics*

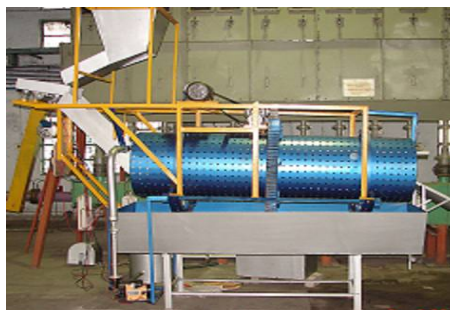
The value addition to the cash-crops by reducing their moisture content enables a payback period of only two years.

## *Technology Package*

The technology package consists of a complete semiautomatic solution to post harvest processing of cash-crops like ginger, turmeric, etc right from washing of the freshly harvested crop to slicing, drying, grinding and packaging of the finished product.



<b><i>Title of Technology</i></b>	<b>Rotary drum washer for ginger &amp; turmeric</b>
<b><i>IPR Details</i></b>	Copyright application filed on 18-11-2008; Reference No: IPMG / Copyright / 2008 / 05. Application filed for Indian Patent on 28-06-2010; Reference No. 0151NF2009.
<b><i>Application/Uses</i></b>	Continuous hopper-fed washing of freshly harvested ginger and turmeric
<b><i>Salient Technical Features</i></b>	<ul style="list-style-type: none"><li>➤ Perforated rotary drum with spray nozzles to wash intricate-shaped ginger and turmeric</li><li>➤ Uniform washing @ 500 kg/hr.</li><li>➤ Recirculation of the used water with mud filter and pump</li></ul> <p>No such existing technology is found on search. Manual washing of such intricate shapes is next to impossible for large scale application.</p>
<b><i>Level/Scale of Development</i></b>	Prototype developed, successfully tested and technological knowhow transferred on non-exclusive basis.
<b><i>Environmental Considerations</i></b>	Reduces human drudgery and consequent environmental pollution by automatic washing in an enclosed vessel. Recirculation of the used water conserve the natural resource.
<b><i>Status of Commercialization</i></b>	Technology transferred on non-exclusive basis with one time license fee and royalty on the sold items using the technology.
<b><i>Major Raw Materials, Plant Equipment and Machinery Required</i></b>	<ul style="list-style-type: none"><li>➤ Freshly harvested ginger and turmeric for washing.</li><li>➤ No major equipment or machinery is required; a feeding hopper, an electric motor with rotating mechanism for the drum and a small pump for recirculation of the used water after cleaning are all that required to run this continuous mode washer.</li></ul>
<b><i>Techno-Economics</i></b>	The value addition to the cash-crops enables a payback period of only two years.
<b><i>Technology Package</i></b>	The technology package consists of a complete semiautomatic solution to post harvest processing of cash-crops like ginger, turmeric, etc right from washing of the freshly harvested crop to slicing, drying, grinding and packaging of the finished product.



Rotary drum washer

***Title of Technology***

**Metal Detector**

***IPR Details***

Under Process.

***Application/Uses***

This metal detector can be utilized for :

- Metals buried under loose soil
- Metals submerged in muddy / turbid water
- Metal hidden in walls/roofs/ pillars and large object detection.
- Detection of ferrous & non-ferrous metals for defense, state police and other security agencies.

***Salient Technical Features***

- Audio-visual indication for metal detection
- Interchangeable configurations from deep search / handheld to vehicle / mobile robot mounting using separate coils
- Efficient and stable detection with long endurance using Li-ion battery
- Can detect submerged and buried metals in water and concrete/plasters etc.
- Lightweight and cheaper
- Longer endurance for continuous & remote (vehicle/mobile robot based) operation

***Level/Scale of Development***

Laboratory scale

***Environmental Considerations***

Normal environmental conditions

***Status of Commercialization***

Ready for commercialization and also licensed to one Indian Industry

***Major Plant Equipment and Machinery Required***

General purpose workshop

***Techno-Economics***

Multiple activities can be performed using the same technology without any major change.

***Technology Package***

- Circuit diagram, bill of materials, source & approx. price of components
- PCB Layout
- Dimension of the coil based
- Operation & Maintenance Manual



<i>Title of Technology</i>	<b>Domestic filter for defluoridation of water</b>
<i>IPR Details</i>	Patent: "A spinel alkaline earth metal ferrite impregnated activated alumina adsorbent and a process thereof" Filed on April, 2016
<i>Application/Uses</i>	Filtration of fluoride contaminated water for drinking purpose
<i>Salient Technical Features</i>	<ul style="list-style-type: none"><li>➤ Domestic type adsorption based multi-stage water filtration unit</li><li>➤ Comprised of AA+FIA+SIAC adsorbents</li><li>➤ Effective reduction of F<sup>-</sup> concentration from ~ 5 ppm to below permissible limit (~1.5 ppm)</li><li>➤ Simultaneously useful for bacterial remediation since standard SIAC is used</li><li>➤ No electricity</li><li>➤ Flow rate: ~ 5-6 L / hour</li><li>➤ Adsorbent life (average): ~2000 L</li><li>➤ Storage capacity: ~15 L</li></ul>
<i>Level/Scale of Development</i>	May be considered TRL-5 since the prototype (integrated system) is verified in the laboratory
<i>Implementation Status and scale of implementation</i>	The developed defluoridation unit will be deployed among the fluoride affected areas of Birbhum, West Bengal for the necessary feedback from the users
<i>If commercialized then status of Commercialization</i>	NA
<i>Major Raw Materials to be Utilized and their estimated costs</i>	<ul style="list-style-type: none"><li>• Activated alumina (Cost~ Rs. 200/ Kg; Requirement: 3 Kg)</li><li>• Ferrite impregnated activated alumina (Cost~ Rs. 250/ Kg; Requirement: 1 Kg)</li><li>• Silver impregnated activated carbon (Cost: Rs. 200/Kg; Requirement: 200 g)</li></ul>
<i>Major Plant Equipment and Machinery Required and their estimated costs</i>	Stainless body filter unit with feed through, strainer and nozzle Total cost of the filter unit including raw materials and packaging
<i>Techno-Economics and Competitiveness</i>	The commercial filtration unit addressing the defluoridation of water is rarely available in the market. The developed filtration unit could be promising for commercialization





*Title of Technology*

## **Domestic arsenic water filter**

*IPR Details*

Patent: “Arsenic water filtration device, method and nanometal-oxide coated adsorbent medium therefor” Filing under process.

*Application/Uses*

Filtration of arsenic contaminated water for drinking purpose

*Salient Technical Features*

- Domestic type adsorption based multi-stage water filtration unit
- Remove both arsenic (III) and arsenic (V) to the desired permissible limit (~10 ppb) of drinking water
- No electricity
- No running water required
- Flow rate: ~ 4-5 L / hour
- Adsorbent life (average): ~1800 L
- Storage capacity: ~25 L

*Level/Scale of Development*

May be considered TRL-5 since the prototype (integrated system) is verified in laboratory scale

*Implementation Status and scale of implementation*

The developed arsenic filtration unit will be deployed among the areas of West Bengal where arsenic level is high for the necessary feedback from the users

*If commercialized then status of Commercialization*

NA

*Major Raw Materials to be Utilized and their estimated costs*

Mixed metal-oxides (copper oxide, iron oxide) modified activated rice husk char nanocomposites  
Iron impregnated alumina  
Activated carbon  
Clean sand

Food grade plastics

*Major Plant Equipment and Machinery Required and their estimated costs*

None

*Techno-Economics and Competitiveness*

The water purifier market in India is estimated at Rs. 3,200 crore and may cross Rs. 7,000 crore by 2016. The present arsenic water purifier (~Rs 900.00) is mainly targeted to the population of over 500 million in world including Ganga-Meghna-Brahmaputra delta regions of India where there is no access to arsenic free safe drinking water. The available arsenic purifiers, priced between Rs. 2,000 and Rs. 40,000, using UF membrane technology does not have complete capabilities to remove arsenic at affordable cost, which posed a serious threat to the human society. Thus, there is plenty of opportunity with this purification device to come up as commercial product that can compete with high-end water treatment products to remove arsenic contaminants from drinking water.

*Technology Package*

One filter unit and one replaceable cartridge



*Title of Technology*

**Process for Solidification/Stabilization of Arsenic contaminated sludge**

*IPR Details*

**Patent filed** on “Process for Safe Disposal of Arsenic-rich Sludge Generated from Arsenic removal Plant” – **CSIR Patent No.0265NF2015, Application No. 201611014779; dated 28/04/2016**

**Copyright filled** on “Process for Stabilization/Solidification of Arsenic contaminated Water Treatment Residuals” – IPMG/Copyright/2015/03

*Application/Uses*

This process is for safe disposal of arsenic-rich sludge generated from arsenic removal plants. In these plants, large quantity of sludge is

generated which contains about 5-7 kg. of arsenic per cubic meter of sludge. This sludge is hazardous as per the Resource Conservancy and Recovery Act (RCRA) of USEPA and it contains arsenic much above the permissible standard (0.2 g./m<sup>3</sup>) for its direct disposal into the inland water environment (CPCB-MEF, GoI, 1995–1996) as it has very high leaching potential.

Arsenic contamination in groundwater and its consequences to the human health have been reported as one of the world's biggest natural groundwater calamities known to mankind.

This process is designed for stabilization of arsenic contaminated water treatment sludge for its environmental safe disposal and converting it into products having commercial uses like bricks, concrete blocks, pavement tiles etc. It is very practicable, economical and long lasting. The solidified products meet the specified strength requirement for use in civil construction works and leaching of arsenic is far below the permissible limit.

*Salient Technical Features including Competing Features*

The salient features of Arsenic solidification process are:

- It provides safe disposal of arsenic contaminated sludge particularly obtained from arsenic removal water- treatment plants.
- Minimizes potential of arsenic to leach back to ground and mix with surface & under-ground water through solidification/stabilization using portland cement.
- Minimizes the effect of arsenic poisoning in human body i.e arsenicosis, causes due to drinking of arsenic-rich water results in various health effects including skin cancer, diseases of the blood vessels of the legs and feet etc.
- Provides technically and economically efficient method towards safe landfill of arsenic contaminated water treatment sludge.
- Provides cost-effective, environmentally safe and easy to handle method of arsenic solidification / stabilization.
- Provides a long term, permanent treatment of arsenic contaminated sludge management.
- Manufactures usable construction materials like pavement blocks, concrete blocks etc, and consuming significant quantity of arsenic sludge for field application.
- Generation of employment through implementation of this new process for production of commercial items in different villages/municipalities.

*Level/Scale of Development*

Level 6 – Prototype system verified

*Implementation Status and scale of implementation*

Ready for field implementation for the benefit of the society.

*If commercialized then status of Commercialization*

Correspondence with different private construction industries are in progress.

## *Major Raw Materials to be Utilized and their estimated costs*

1. Portland Slag Cement, Coarse aggregate, Fine aggregate, Lime (CaO), - for preparation of concrete and cement mortar. Approximate cost Rs.7500/- per cum
2. Soil – for preparation of Bricks. Approximate cost Rs.3000/- per cum
3. Arsenic contaminated sludge – for stabilization can be obtained from water treatment plants with standard transportation cost.

## *Major Plant Equipment and Machinery Required and their estimated costs*

Major equipments required are:

Concrete mixture and Compressive strength measuring machine.

Estimated cost of the machines is Rs.6.0Lakhs

## *Techno-Economics and Competitiveness*

The Techno-economics of this process lies in its ability to provide safe disposal of arsenic contaminated sludge obtained from arsenic removal water- treatment plants. There are no such patented processes available in India or abroad for stabilizing arsenic sludge. The process minimizes the potential of arsenic to leach back to ground and mix with surface & under-ground water. On implementation of the process the effect of arsenic poisoning in human body i.e arsenicosis, skin cancer etc will reduces.

The process is technically & economically efficient and environmentally safe for landfill of arsenic contaminated sludge by manufacturing usable construction materials like pavement blocks, concrete blocks etc.

Employment generation through implementation of this process for production of commercial items in different villages/municipalities will uplift the society and people.

## *Technology Package*

Addition of arsenic sludge in derived percentage by volume of cement for safe and long term disposal of arsenic through solidification/ stabilization is the technology package of the present process.



<b><i>Title of Technology</i></b>	<b>Screen Printed Electrode (SPE)</b>
<b><i>IPR Details</i></b>	Under Process
<b><i>Application/Uses</i></b>	<ul style="list-style-type: none"><li>➤ A novel disposable electrochemical sensor is designed and developed using screen printing technique for possible applications in chemical, biological and environmental species detection.</li><li>➤ Electrolysis, detection of redox, chemical and biomolecular detection with electrode surface modification</li><li>➤ The electrodes were screen-printed on a non-tearable, flexible polyester film using commercially available inks and characterized by cyclic voltammetry in different redox probe.</li><li>➤ Extremely useful in various R &amp; D organizations and universities for developing electrochemical sensors for a specific analyze detection.</li></ul>
<b><i>Salient Technical Features</i></b>	<ul style="list-style-type: none"><li>➤ The electrode is developed using a flexible polyester film substrate support material to make a highly sensitive electromechanical sensor.</li><li>➤ It is an indigenously developed, easy to fabricate, low cost electrode in comparison to commercially available expensive imported electrode.</li><li>➤ Experimental results are reliable and stable</li><li>➤ Wide scope of contribution to the other relevant supported projects like “MEMS based immune sensor for the determination of antigen”.</li></ul>
<b><i>Level of Development</i></b>	Performance of the developed screen printed electrodes is characterized since last one year from various angles. Electromechanical performance of the developed SPEs is compared with different similarly available imported electrodes and it is observed that the laboratory developed SPEs are highly sensitive, inexpensive, easy to fabricate and flexible compare to imported devices.
<b><i>Status of Commercialization</i></b>	Under process
<b><i>Major Raw Materials to be Utilized</i></b>	<ul style="list-style-type: none"><li>● Carbon as a working and counter electrode material</li><li>● Silver/silver chloride as reference electrode material</li><li>● Polyester coated with a translucent matte ink-receptive layer as supporting material</li></ul>
<b><i>Techno-Economics</i></b>	<ul style="list-style-type: none"><li>➤ Cost effective and reliable</li><li>➤ Indigenously designed and there is a vast scope of foreign exchange saving</li><li>➤ Highly sensitive and easy to fabricate which reduces the manufacturing cost</li></ul>
<b><i>Technology Package</i></b>	<ul style="list-style-type: none"><li>➤ Guidelines for the installation of manufacturing process</li><li>➤ Operational instructions</li></ul>

➤ Performance analysis guidance



*Title of Technology*

**Salivary Fluoride Detection Kit**

*IPR Details*

Applied and under process.  
Patent Application No: 201611039325 of 18<sup>th</sup> Nov, 2016

*Application/Uses*

The indigenous salivary fluoride level detection kit and sensor station is unprecedented in its kind towards diagnosis of salivary fluoride level for the welfare and betterment of the society.

*Salient Technical Features*

The salivary fluoride detection kit has mainly two components:

1. **Solution Kit:** After synthesization a simple chemical compound that could exclusively detect fluoride from human saliva. The solution kit has been prepared by employing this chemical compound where a colour chart has been provided for the convenience of the users. One can easily operate and determine the range of fluoride level present in the body by simply tallying the colour change of the solution with the provided colour scale in the sachet.
2. **Sensor station:** The developed sensor station has the potential to transmit the vivid transition in colour after mixing the saliva and the chemosensor into a readable digital output signal. This is immensely helpful since a person by own can carry out the test without the aid of any trained personnel or experts in related domain. This sensor station has been fabricated for the application in community level.

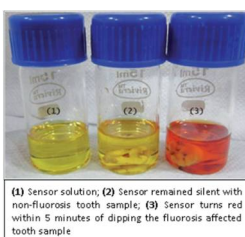
Competing Features:

- User friendly
- Light weighted
- Portable
- The solution kit is available at a very low cost (Rs. 3/unit)
- Methodology is very simple
- It can be deployed as a kiosk in any rural hospital/ school/ health centre at an affordable cost and with a user friendly manual operation.

*Level/Scale of Development*

Developed and ready for transfer

<i>Environmental Considerations</i>	NA
<i>Status of Commercialization</i>	Ready for licensing of the technology
<i>Major Raw Materials to be Utilized</i>	Readily available chemicals, sensors
<i>Major Plant Equipment and Machinery Required</i>	--
<i>Technology Package</i>	It contains details manufacturing drawings, specifications of materials and operation & maintenance schedule



*Title of Technology*                      **Improved Iron Removal Plant**

*IPR Details*                                      Patent Title: A device for groundwater iron removal and the process thereof [Patent No.1059 DEL 2015]

*Application/Uses*                              Improved iron removal plant (IIRP) accommodates a force & lift type arrangement fitted with the existing India Mark-II hand pump, number of holes around the aeration chamber, pre-settling chamber, settling chamber and a outlet tap to collect the safe iron free drinking water.  
Advanced iron removal process from ground water

- |                         |                  |   |
|-------------------------|------------------|---|
| <i>Salient Features</i> | <i>Technical</i> | <ul style="list-style-type: none"> <li>➤ Naturally available sand and gravels used for removal</li> <li>➤ No electric power requirement- Implementable in remote villages</li> <li>➤ Useful to community service: a small village may cover for drinking purpose only</li> <li>➤ Attachable to the existing Mark-II hand pump</li> <li>➤ Simple in design-Operation and Maintenance</li> <li>➤ Instant iron free water</li> <li>➤ Cost effective</li> </ul> |
|-------------------------|------------------|---|

*Level/Scale of Development*                      Ready for licensing

*Environmental Considerations*                      Free from Environmental hazard

*Status of Commercialization*

Ready for transfer of Technology

*Major Raw Materials, Plant Equipment and Machinery Required*

Standard materials available in market

*Techno-Economics*

Ready for commercialization

*Technology Package*

It contains details manufacturing drawings, specifications of materials and operation & maintenance schedule



*Title of Technology*

**Smart Card operated Prepaid Energy Meter**

*IPR Details*

Prepaid Smart Card operated electronics energy meter with online load optimizer for solar power application.

Country: India

Abroad: South Africa

No: 2009/03660; Grant date 31-MAR-10

*Application/Uses*

The smart card operated prepaid energy meter uses embedded technology to dispatch electricity at the consumers end. It displays the consumption of electricity (KWH) along with balance amount (Rs) through a front end display fitted into the meter. It facilitate improved cash flow management in energy utilities and can reduces problem associated with billing for consumer particularly living in isolated rural area where electricity is generated and distributed solar mini grid.



<b><i>Salient Features</i></b>	<p>The meter reduces deployment of extra man power for taking meter reading, payment collection and removes the entire infrastructure for electricity bill collection system. Thus the technology saves a substantial amount of money for the service provider which is added to the electricity bill apart from consumption. Once this additional amount is removed the consumers will be benefited and bill will be reduced to a great extent. Apart from this the technology manage optimal load dispatch through an in built programmable load limiter to avoid grid collapse due to over load.</p> <p>The system having a portable battery powered card recharging unit which can recharge the card against money for door to door card selling. It can also recharge in terms to KWH to limit load based on seasonal condition. The card selling , supervision and training to the consumer about new technology may lead to a good business model for employment of Indian rural population where technology awareness is poor. The battery powered card recharger may be fitted on a bicycle for card recharging / selling at the consumers' door step which may be a more effective model of business and technology promotion in remote areas. This may help to remove any unauthorized electricity connection violating the rule.</p>
<b><i>Level/Scale of Development</i></b>	Early stage commercial model is ready and working in the laboratory.
<b><i>Status of Commercialization</i></b>	Technology is licensed for commercialization to one Indian Industry.
<b><i>Major Raw Materials, Plant</i></b>	Integrated circuit, current transformer, low power display, Microcontroller, casing etc.
<b><i>Equipment and Machinery Required</i></b>	Accurate energy meter calibrating equipment, power analyzer, printed circuit board design and fabrication unit etc.
<b><i>Techno-Economics</i></b>	Cost effective, affordable and user friendly system.
<b><i>Technology Package</i></b>	Low power embedded system based energy management system.



<i>Title of Technology</i>	<b>Pluggable Smart Energy Meter</b>
<i>IPR Details</i>	PREPAID SMART CARD OPERATED ELECTRONICS ENERGY METER WITH ONLINE LOAD OPTIMIZER FOR SOLAR POWER APPLICATION. Country: India Abroad: South Africa No: 2009/03660; Grant date 31-MAR-10
<i>Application/Uses</i>	<ul style="list-style-type: none"><li>➤ Enables switching the battery charger as well as metering of power and energy consumption through smart phone and payment against charging through an app.</li><li>➤ Extremely useful for charging E rickshaw and the other battery driven vehicles especially in the congested areas.</li><li>➤ Unused solar energy from the roof top PV cells of the multistoried buildings can be utilized for the emergency charging of the battery driven vehicles at the corresponding open parking lots.</li><li>➤ Each and every source of unused energy can create a source of income to the owner of the PV cells.</li></ul>
<i>Salient Technical Features</i>	<ul style="list-style-type: none"><li>➤ Single phase 230 V/ 50 Hz AC motor with prospective load limiter.</li><li>➤ Efficient and digitized energy meter with wireless access.</li><li>➤ Smart and remote access for monitoring</li><li>➤ Scope of Innovation and talent pooling</li><li>➤ Shared meter system</li></ul>
<i>Level of Development</i>	Early stage commercial model has already been developed with proper testing.
<i>Status of Commercialization</i>	Under process
<i>Major Raw Materials, Plant Equipment and Machinery Required</i>	Integrated circuit, current transformer, low power display, Microcontroller, casing etc.  Solar PV, Accurate energy meter calibrating equipment, power analyzer, printed circuit board design and fabrication unit, power supply, charger, Microcontroller chip etc.
<i>Techno-Economics</i>	<ul style="list-style-type: none"><li>➤ Cheaper, Greener and Simpler</li><li>➤ Automatic control of energy meter</li><li>➤ No hard copy billing is required which saves a lots papers</li><li>➤ Recover money owed (debt)</li><li>➤ No need to chase payment</li><li>➤ Satisfactory load and demand side management</li><li>➤ Energy is harvested from the solar energy conversion system</li></ul>

## *Technology Package*

- Specifications to make the system
- Assembly Instruction
- Operation guidelines



## *Title of Technology*

### **Five Axis Micro Milling Machine**

## *IPR Details*

Under Process

## *Application/Uses*

Use to cutting highly accurate miniaturized components with dimensions ranging from few hundred microns to few millimeters is increasingly in demand for electro-optics, bio-optics, biomedical, semiconductor, aerospace, jewelry industry etc. Micromechanical cutting process is acting as intermediate link between macro domain and neon domain and profoundly cost effective.

## *Salient Technical Features*

The design specification of five axis  $\mu$ -milling machine is based on motion and positioning accuracy, dynamic stiffness and stability which are very much dependent on control system. The graphical user interface has been revamped for better interaction with machinist and easy navigation of menus. The user can use any commercial CAD/CAM software to generate the micro machining codes creating CAD model of the components and generate CNC codes using CAM software.

## *Level/Scale of Development*

Initial prototype has been done. Further development will be taking into commercial grade development.

## *Status of Commercialization*

The brochure of Five Axis Micro Milling Machine already has been sent to some CNC Milling Machine Companies in India through Resource Planning & Development Group of CSIR-CMERI. And we are very much hopeful that we will have some positive feedback regarding transfer of know-how of this product from those Companies.

# CSIR-Central Mechanical Engineering Research Institute

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**Major Raw Materials, Plant Equipment and Machinery Required** Air spindle, liner stage, servo motor, NI labview system (National Instrument), control card, air compressor.

**Techno-Economics** Yet to be explored in this regard. However, preliminary studies show that it has potential.

**Technology Package** Initial packaging (Experimental packaging) has been prepared. Further packaging will be required to make it commercial grade.



**Title of Technology**

**High Speed Spindle for micro milling and drilling operations**

**IPR Details**

Under Process

**Application/Uses**

Use for drilling and cutting operations

**Salient Technical Features**

Successfully running speed of maximum 2.75 lacs rpm. However, system can run stably in the range of 60-70k rpm.

**Level/Scale of Development**

Initial prototype has been done. Further development will be taking placed as per customer requirements.

**Status of Commercialization**

Ready for licensing of Technology

**Major Raw Materials, Plant Equipment and Machinery Required**

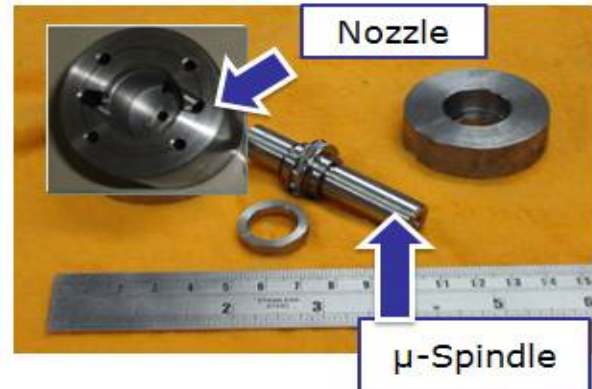
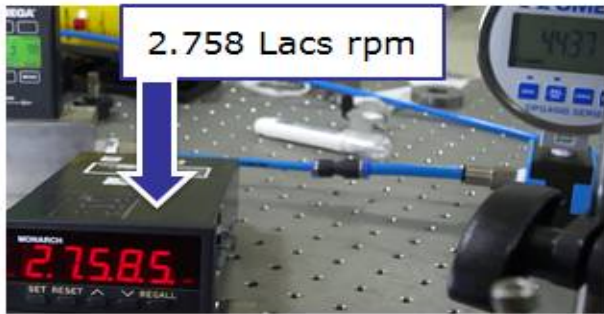
INCONEL 718 material

**Techno-Economics**

There is a market demand for the product. There is good competition.

## Technology Package

Initial packaging has been done.



## Title of Technology

## Semi Continuous Biodiesel Plant

### IPR Details

Under Process

### Application/Uses

- Especially in rural areas and for other areas also for converting any oil to Biodiesel irrespective of its FFA content to supplement convention diesel
- Micro Energy Centre in remote areas

### Salient Technical Features

- Produce biodiesel from any oil or fat irrespective of its FFA content
- Produces 600 litre of biodiesel (Minimum) in 24 h
- Minimum manual intervention
- Possibility of scaling up to industrial model
- Peak power requirement is 3kW
- Low cost
- Biodiesel produced is per ASTM / BIS standard and suitable to be used in Gen set / Tractor / Diesel vehicles

### Level/Scale of Development

Pilot Scale

### Environmental Considerations

Environmental friendly final product.

### Status of Commercialization

Commercialized. Technology taken by four parties:

- M/s Best Engineering Technologies, Hyderabad
- M/s Fab Con Engineers , Chennai
- M/s Hindustan Biodiesel Pvt. Ltd., New Delhi
- M/s York Steel Fabricators, Ludhiana

## *Major Raw Materials, Plant Equipment and Machinery Required*

- For plant construction: SS 304, Valves (Solenoid/ Gate), Electrical / Electronic Control Unit, GI pipelines, Pumps, Motors, Liquid Level Indicator etc
- As feedstock: Any Oil or Fat
- General workshop including sheet metal shop and plumbing

## *Techno-Economics*

Pay Back period is of 1 yr (considering the cost of feedstock is Rs. 33 per litre)

## *Technology Package*

Design drawings (Working prototype is with CMERI)



## *Title of Technology*

### **Inter-row Rotary Cultivator for wide row crops**

## *IPR Details*

Under Process

## *Application/Uses*

### **Precision Agriculture**

Intercultural operations in wide row crops like vegetables, sugarcane, maize, cotton, soybean, peas, grams etc.

### **Features**

- Adjustable Working Width
- Adjustable Working Depth
- High Ground Clearance
- Adjustable Row Spacing
- Suitable for Indian Conditions
- Adaptable to small & marginal farmers [suited for 35-45 hp tractors]

### **Specifications**

- Machine Width: 2000mm
- Row Spacing: 40 – 60 cm
- No. of Rows: Three
- Working Width: 300 – 460 mm
- Weight of machine: 450 kg.

***Level/Scale of Development***

Prototype.

Exhaustive Field Testing Completed by IARI, New Delhi

***Status of Commercialization***

In Process.

Three SMEs submitted EoI.

***Major Raw Materials, Plant Equipment and Machinery Required***

- Common Steels, Steel Castings,
- Sheet metal fabrication
- General Engineering Workshop,
- Vendors for Castings

***Techno-Economics***

Prototype Cost Rs. 60,000/-

***Technology Package***

Detailed Manufacturing Drawings, Operators Manual, Manufacturing process of Critical Parts, Illustrated Parts Catalogue



***Title of Technology***

**Programmable Irrigation Scheduler**

***IPR Details***

Under Process

***Application/Uses***

Precision & Conservation Agriculture

Automatic Irrigation scheduler along with pump operation.

## *Salient Technical Features*

### *Features*

- Irrigation Controller for small and marginal farmers
- 8 Stations with Pump Operation
- Greenhouse / Open Field / Orchard

### *Specifications*

- Irrigation Program : Number of Valves up to 8, Sequential or grouped
- Control : Single Pump
- Irrigation Method : Time based
- Day Access : Odd/Even day, Weekly; up to 30 days

## *Level/Scale of Development*

Prototype.

Exhaustive Field Testing &

Farmers Field Trials [IARI, New Delhi]

## *Status of Commercialization*

In Process for licensing on non-exclusive basis.

## *Major Raw Materials, Plant Equipment and Machinery Required*

- Electronic Components
- Electronic Manufacturing Facilities.

## *Techno-Economics*

Very low cost controller. Prototype Cost Rs.10,000/- .

## *Technology Package*

Software Code and Hardware List. Manufacturing Drawings, Operators Manual.





*Title of Technology*  
*IPR Details*  
*Application/Uses*

**Pneumatic Precision Planter for vegetables**

Under Process

**Precision Agriculture**

Direct planting/seeding of small/irregular vegetable seeds

**Features**

- High Singulation accuracy
- Designed for Indian Crop Production Practices
- Direct Seeding of small/irregular seeds at uniform depth
- Empower Indian small & marginal farmers [suited for 35-45hp tractors]

**Specifications**

- Singulation of seeds at least 95%
- Planting of seeds of diameter : less than 4 mm
- Row spacing-35 cm (minimum)
- Modular planting units adaptable for all tractors
- Depth controlling and profile following mechanism
- Speed of planting - 4-5km/h

*Level/Scale of Development*

Prototype.

Exhaustive Field Testing [IARI, New Delhi]

Environment friendly

*Environmental Considerations*

*Status of Commercialization*

In Process.

Three SMEs submitted EoI.

*Major Raw Materials, Plant Equipment and Machinery Required*

- Common Steels, Aluminum Castings, Sheet metal fabrication like *aspirator*.
- General Engineering Workshop,
- Vendors for Castings,
- CNC – EDM / Wirecut / Milling machine

*Techno-Economics*

Prototype Cost Rs.1.2 Lakhs for a three-row machine against imported equipment of Rs.6.0 Lakhs & above.

*Technology Package*

Detailed Manufacturing Drawings, Operators Manual, Manufacturing process of Critical Parts, Illustrated Parts Catalogue



***Title of Technology***

**Cotton Picking Head**

***IPR Details***

Under Process

***Application/Uses***

Cotton can be directly picked using spindle type cotton picker head either using tractor or self-propelled machine.

***Salient Technical Features***

- Spindle type, Two Inline Drums Mechanical Cotton Picker Head
- Picking efficiency: 85%-90%
- Trash content: 10%-12% seed cotton basis and 30%-35% lint basis
- Row spacing: 70-100 cm
- Productivity: 0.25 ha/hr (single row)
- Power requirement: up to 45 hp (single row)

***Level/Scale of Development***

Technology is developed and ready for transfer

***Status of Commercialization***

Ready for licensing

***Major Raw Materials to be Utilized***

Common Steels, Steel Castings, Sheet metal fabrication

***Major Plant Equipment and Machinery Required***

General engineering workshop

***Technology Package***

Includes detailed manufacturing design and drawings of the technology.



*Title of Technology*

**Reconfigurable Micro Factory**

*IPR Details*

Under Process

*Application/Uses*

Capable of manufacturing micrometer (~100 - 500 $\mu$ m) scale features such as holes, channels etc. over range of materials. These micro scale patterns have wider applications in sensors, consumer electronics, biomedical devices, etc. where miniaturized products are getting much importance in recent days

*Salient Technical Features*

This Micro factory has been designed to perform three operations:  $\mu$ -milling,  $\mu$ -turning, and  $\mu$ -EDM. The test bed consists of four workstations; each workstation is built-in with 3-axis translation features. The z-axis is used for feeding tool/energy sources. In order to minimize the ramp-up-time for reconfiguration of this micro factory for different part families, these translation stages have been mounted on semi-kinematics links. The feature based methodology for process sequencing and operation clustering has been developed in-house to design appropriate reconfiguration planes to use micro factory for different product mix. The key aspects of this new development include design modularity, multi-operational capabilities and desktop micro manufacturing system with 600mm x600 mm footprint.

*Level/Scale of Development*

Lab scale first generation prototype has been demonstrated.

*Environmental Considerations*

This is ultra precision micro machine comprises several electro-mechanical systems which functions in a clean environment.

*Status of Commercialization*

This prototype has been developed under 11<sup>th</sup> FYP project NWP-30. Demonstrated in lab scale. Translational research studies as identified are further required to make it industrially viable product.

- Need for development of customized sub-components in-house, presently many of these subsystems of the micro factory systems have to be sourced from third parties
- Need for detailed performance and reliability studies
- Rigours performance test, scale up, validation and co-development of the technology in partnership with industry

*Major Raw Materials, Plant Equipment and Machinery Required*

- This system uses several electro-mechanical devices of third party make.
- Ultra precision Tool room comprising vertical CNC machining center, electronics, software and ultra-precision metrology and condition monitoring facilities are required to make such precision micro machines. However, few opportunities exists to outsource or to buy as a third party components

*Techno-Economics*

- In India, industrial deployment of micro-nano systems/devices is at very early stage. However, with the rapidly growing interest in

miniaturized precision optical systems, solar cells and biomedical devices, demands for cost effective manufacturing systems in micro scale over multi-material is expected to grow.

- On the other hand, this microfactory prototype is expected to become a cost effective test bed for the engineering schools.
- These systems can be used , to manufacture micro-components used in different sectors such as healthcare, consumer goods and Energy. Currently no supplier exists who can supply micro-factory systems commercially.
- Micro-factory / Desktop Factories are the new manufacturing concepts; still it is in research bed level globally and not reached to industrial deployment in bulk. Therefore, currently no supplier exists who can supply micro-factory systems commercially.

## *Technology Package*

CSIR-CMERI will provide the following so that these systems could be manufactured in batches.

- Engineering drawing
- Specification and makes of subsystem
- Assembly instructions
- Operation guidelines



## *Title of Technology*

**Autonomous Intelligent Robotic Wheel Chair- low end low cost model**

## *IPR Details*

Under Process

## *Application/Uses*

- Personal mobility vehicle for physically challenged persons with various levels of disability as well as aged and ill persons
- Joystick based intelligent control system reduces or eliminates the user's task of driving a wheelchair.
- Rehabilitation purpose.

## *Salient Technical Features*

- Differentially steered, six wheel configuration with active suspension

- Fully electronic soft touch control
- Joystick based command
- Infrared based safety interlock for emergency stop
- On board charging facility
- Totally Modular design with easy & quick maintenance. Active suspension on all wheels
- Collapsible foot rest
- Interchangeable seating
- Longer endurance (12hrs for intermittent running)
- Specialized design package to suit customized fabrication for various levels of disability.

## *Level/Scale of Development*

This project was undertaken to design and develop technology for powered wheelchair by utilizing the advantage of robotic technology for physically challenged persons.

## *Status of Commercialization*

Ready for licensing of technology

## *Major Raw Materials, Plant Equipment and Machinery Required*

- Standard materials commonly used for engineering product development, such as various categories of steel, aluminium alloy, carbon composite, FRP etc.
- Standard component includes servo motors, servo actuators, sensors, single board computers/ micro-controllers, wireless data communication modules, other active & passive mechanical & electrical components, batteries, bearings, Brakes, Castor wheels etc. majority of which are commercially available at component level detailed in the design document/ technical report.

Sophisticated Mechanical & Electrical Fabrication & Testing Facilities such as:

- Capability in handling CAD & Analysis packages
- Minimum 3 axis CNC machining Centre, CNC Vertical Jig Boring and Milling Centre, CNC Universal Grinding machine, Standard Pipe bending machine and other general purpose manufacturing workshop equipments
- Capability in using electronic tools for multilayered PCB design, fabrication & testing
- Precision Metrological Measurement capability
- Capability in software development, digital data communication, system integration & testing

## *Techno-Economics*

Being a very advanced mobility aid for physically challenged persons, techno-economic considerations are not important. Besides, in India, there is no manufacturer of similar advanced systems for physically challenged persons.

## *Technology Package*

Design & drawing, Technical report, Bill Of Materials, Publication List/IPR



*Title of Technology*

**Autonomous Underwater Vehicle (AUV) operational upto 150 m.**

*IPR Details*

Copyright filed on

- Software Design for Autonomous Underwater Vehicle operational upto 150 m.
- Drawings for Autonomous Underwater Vehicle operational upto 150 m.

*Application/Uses*

AUV-150 can be deployed for seabed mapping, coastal surveillance, mine counter measure and oceanographic measurements during adverse weather conditions.

It can perform various jobs related to underwater inspection with camera, surveying etc.

## *Salient Technical Features*

- Modular streamline structure helps to integrate additional payloads with very less efforts with reasonably lesser drag without changing the original configuration.
- It is stable against roll motion making it suitable for the sea-bed mapping application in addition to relevant scientific data collection.
- Degrees of Freedom (DOF) have been reduced from six to five through mechanical design, thereby balancing the roll motion of the system and reducing control complexity.
- Design for slight positive buoyancy for better diving control and safety i.e., prevention of AUV getting lost on the sea due to any malfunctioning.
- Controllability of a system with large dimensions (Length 4.9 m., Diameter: 0.5 m.)
- Dual communication including both RF and Acoustic communication.
- Emergency handling with power management and leak detection subsystems.
- Single ground reference point (SGRP) for electrical Isolation and Grounding of the complex AUV system.
- Capable of autonomous navigation through and pre-defined trajectory.

## *Level/Scale of Development*

Post processing of trial data as obtained during sea testing indicates that the performance of the developed AUV prototype is very much satisfactory.

## *Status of Commercialization*

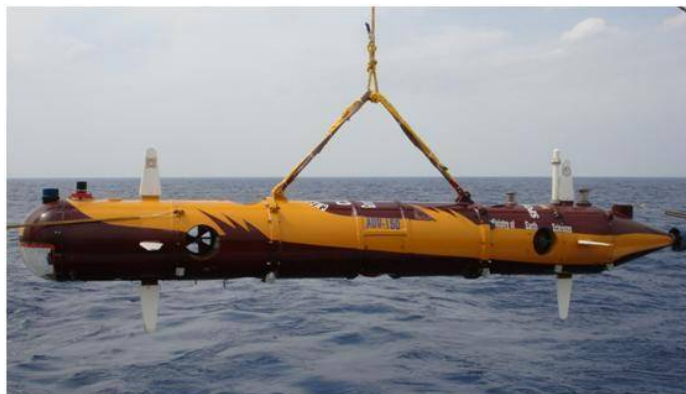
Ready for licensing of Technology

## *Major Raw Materials, Plant Equipment and Machinery Required*

- Standard materials commonly used for engineering product development
- Standard components

## *Technology Package*

Technical Specifications, Technical Manual, Operation Manual and Manufacturing Drawings



# CSIR-Central Mechanical Engineering Research Institute

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*Title of Technology*

**Serpentine Robot**

*IPR details*

Copyright (Ref. No. O21CR2012)

Design Registration

(Ref. No. CSIR-CMERI/IPMG/ DR/2012/2)

*Application/user*

Technology demonstration prototype showing limited autonomous surveillance capability.

*Salient technical features*

Remote surveillance

*Level /scale of development*

Experimental prototype mobile robot which has been demonstrated at lab scale.

*Environmental Consideration*

System was designed using environment friendly components and also required air-conditioned lab facility for Electronics & Software works.

*Status of commercialization*

Ready for licensing of technology

*Major Raw Materials, Major plant equipment and machinery required*

- Standard materials commonly used for engineering product development, such as various categories of steel, aluminium alloy, carbon composite, FRP etc.
- Standard component includes servo motors, servo actuators, sensors, single board computers/ micro-controllers, wireless data communication modules, other active & passive mechanical & electrical components, batteries etc. Majority of which are commercially available at component level detailed in the design document/ technical report.

Sophisticated Mechanical & Electrical Fabrication & Testing Facilities such as:

- Capability in handling CAD & Analysis packages
- Minimum 3 axis CNC machining Centre, CNC Vertical Jig Boring and Milling Centre, CNC Universal Grinding machine, Standard Pipe bending machine and other general purpose manufacturing workshop equipments
- Capability in using electronic tools for multilayered PCB design, fabrication & testing
- Precision Metrological Measurement capability
- Capability in software development, digital data communication, system integration & testing

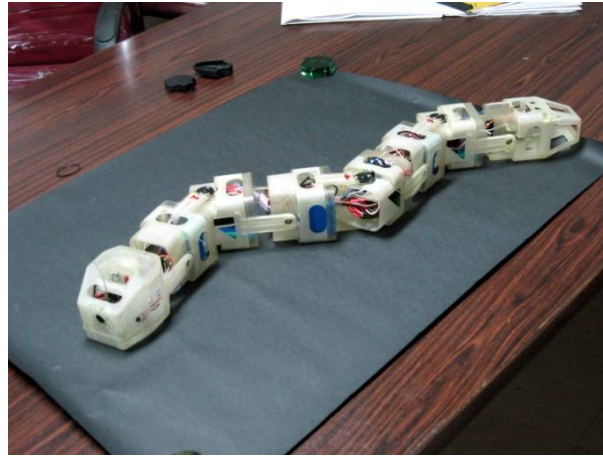
*Techno-economics*

Ready for licensing of technology



## *Technology package*

Design & drawing, Technical report, Bill Of Material, Publication List/IPR



## *Title of Technology*

### **Austempered Ductile Iron (ADI) Technology**

## *IPR Details*

Copyright of the process technology for casting of large volume of **L - Type** rotavator blades is ready and will be submitted shortly.

## *Application/Uses*

Austempered Ductile Iron (**ADI**) can be used for manufacturing of wide range of components for the following engineering sectors

- Automobile Sector
- Mining machinery
- Agricultural machinery and implements
- Construction equipment

## *Salient Technical Features*

Advanced manufacturing methods which produce the components closer to its final geometry in minimum number of stages is known as Near Net Shape (**NNS**) manufacturing. **NNS** technologies are now getting wider acceptance all over the world for obvious benefits like maximum utilization of raw material, minimum energy requirement and competitive price of the final product. One of the **NNS** technologies is - Manufacturing of Engineering Components through **ADI** route. **ADI** components are now being used in different types of engineering machinery because it offers a combination of design flexibility, higher strength-to-weight ratio, good toughness, superior wear resistance and low cost of production. Design innovation and development of new process technology for manufacturing of **ADI** components will benefit simultaneously the manufacturing industries and user segments.

**ADI** is a new class of engineering material which is being manufactured from **SG Iron** through Austempering process. Austempering is an isothermal heat treatment process applied to ferrous materials to produce a microstructure that is stronger and tougher than the structures resulting typically from

conventional heat treatment. Mechanical properties of ADI product depends mainly on composition and heat treatment parameters. ADI manufacturing technology consist of Computerised methoding- Pattern making- Selection of raw material – Melting and Casting of SG iron component – Machining of component - Austempering treatment – Finishing operation- Inspection. By controlling the process parameters and composition it is also possible to produce high quality SG iron castings which is essential for manufacturing **ADI** products. Based on the mechanical properties, ADI materials are classified into 6 different grades (as per ASTM 897-06). Each grade can be produced through closer control of composition, casting parameters and heat treatment parameters.

CSIR- CMERI has successfully developed the comprehensive process technology for manufacturing of ADI components like L type Rotavator blades for agricultural sector, Crank shaft for 35 hp tractor engine, Hammers for mining sector and Gudgeon pin for heavy duty compressor. Field trials of these components revealed encouraging results.

#### **Advantages of ADI technology –**

- Easy to produce complex geometry components
- Mechanical properties comparable to some grades of steel
- 20% Cheaper than forged steel parts
- Needs less energy than forged steel parts
- Superior wear / abrasion resistance
- 10% lighter than steel

#### *Level/Scale of Development*

#### **The following ADI Components have been successfully developed at CSIR – CMERI for Engineering Applications**

1. **Rotavator blades:** ADI blades have been developed for agricultural application to replace imported steel blades. 1<sup>st</sup> & 2<sup>nd</sup> phase field trials carried out at PAU, Ludhiana and GB Pant University of Agriculture and Technology, Pantnagar during **Jan-Feb 2013** and **Feb-June 2014** respectively. Results are encouraging. ADI blades shows superior wear resistant property than commercial forged steel blades. ADI blades are cheaper than steel blades.

**L type ADI Blades**





**Rotavator fitted with ADI blades**

2. **ADI crankshaft:** ADI crankshaft has been developed for 3 cylinder 35hp Sonalika tractor engine. The ADI crankshaft was assembled in the 35 hp sonalika engine and 500 hrs accelerated endurance test was carried out at ITL Hosiarpur. During the entire test no abnormalilites noticed on the performance of the engine and no defect was noticed in the critical location of the ADI crankshaft.



**Photo of ADI Crankshaft after 500 hrs test**

3. **ADI hammers:** Swing hammers were developed through ADI process route and deployed to Goa iron ore mines for crushing of iron ore. Crusher fitted with ADI swing hammers were operated for 158 hrs and processed 10100 tons of iron ore which is 30 % more than the conventional crusher fitted with steel hammers. Both the productivity and life of ADI hammers were better than steel hammers for crushing of high silica iron ore.

**ADI Swing hammers**



**Crusher fitted with ADI hammers  
After 158 hrs of operation**



4. **Gudgeon Pin:-** ADI gudgeon pin 150 mm length and 50mm OD, has been developed and fitted in Feb 2010, in a heavy duty compressor of a

cold storage plant. Till date it has accumulated more than 800hrs of operating hours. No abnormalities noticed.



**ADI Gudgeon Pin**



**The heavy duty compressor where the gudgeon pin has been fitted**

## *Environmental Considerations*

Electrically operated furnaces are acceptable to our industries for regular production of large volume of engineering components through casting and heat treatment route. Total energy requirement for ADI process route is much less compared to the total energy required to produce steel parts. ADI process technology environment friendly. More over the ADI parts can be easily recycled by local MSME.

## *Status of Commercialization*

Discussion is under progress for transfer of technology with different Indian Industries.

## *Major Raw Materials, Plant Equipment and Machinery Required*

Steel scrap, High quality Pig iron, foundry returns, ferroalloy and foundry chemicals like sodium silicate, CO<sub>2</sub> gas and silica sand, refractory paints. Heat treatment salt

- Induction melting Furnace,
- Converter/ladle for Mg treatment of liquid iron
- Heat treatment furnace,
- Fettling equipment,
- Lathe and Milling machine

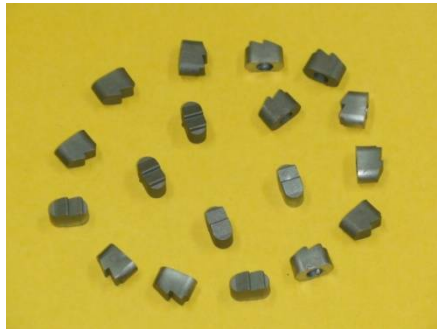
## *Techno-Economics*

ADI components are 20-30% less costly than steel counter parts

## *Technology Package*

Technology package for above ADI components can be handed over to the industries as and when required. The ADI process technology developed at CSIR –CMERI, can also be extended for manufacturing of other complex geometry engineering components.

<i>Title of Technology</i>	<b>Metal Injection molding</b>
<i>IPR Details</i>	Under Process
<i>Application/Uses</i>	Space, electronics, automobile, medical and defense sector
<i>Salient Technical Features</i>	Hybrid manufacturing process for manufacturing of small and complex shape components out of metals in large quantity which are otherwise difficult to process through the conventional manufacturing route
<i>Level/Scale of Development</i>	Laboratory scale
<i>Status of Commercialization</i>	Ready for licensing
<i>Major Raw Materials to be Utilized</i>	metal powder, thermo plastic polymers, Canberra wax and paraffin wax
<i>Major Plant Equipment and Machinery Required</i>	Sigma blade mixer or twin screw extruder, injection moulding machine, debinding furnace and sintering furnace.
<i>Techno-Economics</i>	Mass production process



**Latch, made of stainless steel through metal injection moulding (MIM) route**

