CSIR 800 CLUSTER

Scientific Excellence

Granito Ceramic Tiles: A Success Story of Innovation by CSIR-CGCRI, Naroda

CSIR-CGCRI developed an alternate body mix for granito tiles production and thereby replaced the expensive imported Ukraine clay with indigenous clay that has immensely benefitted the tile industries of Morbi, Wankaner and Himatnagar regions in Gujarat. Ukraine clay by nature is a combination of several minerals and possesses some unique properties. Unfortunately available raw materials in India individually cannot provide the same attributes. However, CSIR-CGCRI has shown that a combination of sericitic pyrophyllite and Bikaner clay in suitable proportion could compensate for the same. About 75 trial bodies, two optimized compositions were selected and passed on to M/s Decolite Ceramics, Morbi for plant trial. The properties of trials produced bodies were found to be almost identical to those of the production body.

Fig.1.138 Fired tiles coming out of roller hearth during manufacturing

Seaweed farming

More than 100 family belonging to the category of Below Poverty Line (BPL) in the districts of Ramnathapuram (Akkalmadam and Pamban), Pudukkottai (Kottaipattinam) and Tanjavore (Chatram and Palakudi) of Tamil Nadu were trained by CSIR-CSMCRI for offshore cultivation of *Kappaphycus* seaweeds. As a result they were able to earn their livelihood from this cultivation. Based on survey data, compiled by CSIR-CSMCRI the Gujarat Livelihood Promotion Co. Ltd (A Gujarat government undertaking is planning to promote seaweed cultivation through Self Help Groups (SHGs) in Jafrabad coast of Amreli District in a big way.


Fig.1.139 Seaweed farming

Multi-institutional demonstration trials showing efficacy of liquid seaweed sap from *Kappaphycus alvarezii* and *Gracilaria edulis* on different crops

Kappaphycus and *Gracilaria saps* were tested by CSIR-CSMCRI at different centres of 22 Agricultural Universities and ICAR Institutes belonging to different agro-ecological regions and different soil types to demonstrate their efficacies towards

improvement in production and nutritional qualities of different crops viz., rice, maize, sesame, soybean, green-gram, black-gram, sugarcane, fodder/grass and potato. Marked improvement in productivity of different crops was observed by application of *Kappaphycus* and *Gracilaria* sap over control (water spray + recommended dose of fertilizers). Application of *Kappaphycus sap* recorded yield improvement in rice of 8.4% (ICAR-CRRI, Cuttack centre), 18.2% (ICAR-CRRI, Gerua, Assam centre), 11.2% (at GKVK, Bangalore), 28.3% (Regional Rice Research Station, Navsari Agriculture University, Navsari, Gujarat). Yield improvements in maize of 15.9% (GKVK, Bangalore) and 25.8% (RAU, Samastipur) were recorded, while significant improvement in yield of potato by 14-18% with corresponding starch content improvement of 33.2% (TNAU, Coimbatore) and by 26.6% (PSB, Shantiniketan, WB) were also obtained. Sesame recorded ca. 5% improvement in seed yield and oil content (TNAU, Coimbatore), while ca. 20% improvement in seed yield were reported at 2 different agro-climatic conditions (Nadia and Birbhum districts) of West Bengal. At TNAU, green-gram yield was increased by 10.3%, while the increases recorded at GBPUAT, Pantnagar and BCKV, W.B were 33.0 and 39%, respectively, over control. *Gracilaria sap* also responded favourably for many of the crops. Farmers in general were highly benefited through improved productivity of the food crops and have evinced tremendous interest in it.

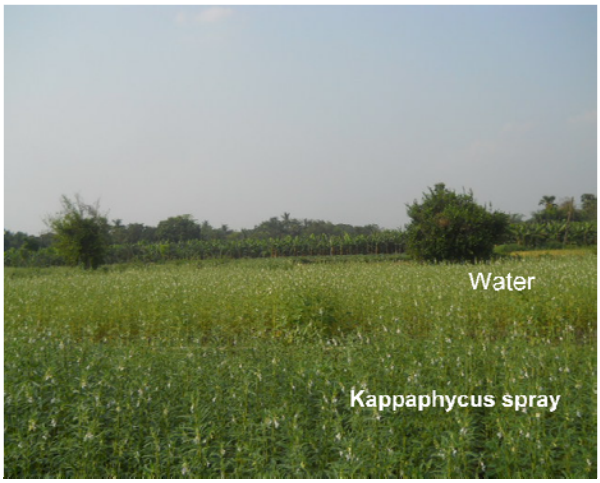

Fig: 1.140 Sesame crop showing difference in the vigour and leaf colour due to Kappaphycus -sap application

Raising Social Awareness for Arsenic Prone Areas in West Bengal

It was observed that only 15-20% of exposed individuals develop arsenic-induced skin lesions. A case-control study was conducted by CSIR-IICB scientists in West Bengal, involving 206 cases with arsenic-induced skin lesions and 215 controls without arsenic-induced skin lesions. Data infers that possession of at least one Met allele (Met/Met and Thr/Met) imparts significant protection towards the development of arsenic-induced skin lesions. CSIR-IICB has organized 136 Medical Camps in last seven years in Arsenic affected and unaffected areas in West Bengal and provided free essential medicine and suggestion through expert physicians to approximately 20,000 patients. CSIR-IICB also extended active co-operation to the physicians in operating skin cancers of 56 arsenic cancer patients in last seven years at free of cost to save their lives.

Installation of Iron Removal (IR) plants

Hand pump attachable IR plants based on the CSIR-NEERI's technology have been installed at 66 locations by Public Health Engineering Department, Rajnandgaon, Durg and Kanker districts of Chattisgarh. Raw water and treated water iron concentrations were 3-8 mg/L and less than 0.1 mg/L respectively which indicate satisfactory performance of the plant. Capacity of the plant is about 1000 L/hr.

Fig: 1.141 Hand Pump attachable iron removal plants installed in Durg district

Solar energy based electrolytic defluoridation unit for potable water supply

Defluoridation technique based on electrolysis has been developed by CSIR-NEERI.

Fig: 1.142 Solar power based EDF plant at the Adiwasi Kanya Shiksha Parisar, Chhindwara

The performance of the plants is being monitored continuously. The plants which are operated on batch mode have two reactors of 1000 L capacity each which takes about four hours to complete the process of electro-coagulation and settling.

Two solar energy based Electrolytic Defluoridation (EDF) demonstration plants have been installed at village Usarvara, Balod Block, Durg District, Chhattisgarh and Sargapur village in Seoni district and at the Adiwasi Kanya Shiksha Parisar, Chhindwara in Madhya Pradesh in collaboration with respective PHEDs. CSIR-NEERI has transferred the "Know How" to the following six agencies:

- M/s HES Water Engineers (India) Pvt. Ltd. Nagpur;
- M/s L.TEK Systems, Nagpur;
- M/s Nagpur Chemicals, Nagpur;
- M/s SRE Senthil Engineering Company, Coimbatore; and
- M/s Spectrapure Hi-Tech Concepts, Ranchi.

Safe drinking water

The database created earlier by CSIR-NML on naturally occurring minerals for remediation of toxins (www.safewater.in) is continuously updated. Arsenic and fluoride information page has been added which contains various arsenic and fluoride related issues and its mitigation.

A plant of a 25000 litres per day capacity coal mine water reclamation procedures has been installed at Putki colliery, Dhanbad which could be handed over to M/s Bharat Coking Coal Limited, Dhanbad after competion of field trials.

A colorimetric kit has also been developed for field estimation of fluoride. Both quantitative and semi quantitative estimation can be carried out . This is a simple and user friendly protocol providing a broad analytical range. The method will be sensitive, interference free and would be ideally suitable for drinking water.

Fig:1.143a Installation of 25000 litres/day coal mine water reclamation plant in progress

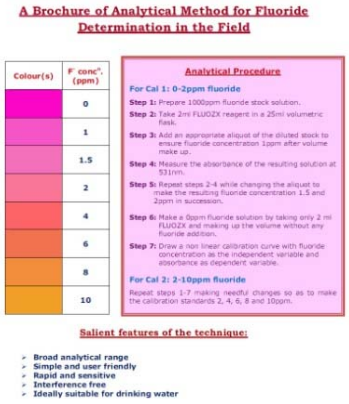

Fig: 1.143b Calorimetric analysis of fluoride reference template

Pure drinking water

CSIR-CSMCRI has fabricated and installed 65 domestic de-arsenification units in the houses of Maslandapur, Ghoshpur and Merudandi villages of 24 pargans (N), West Bengal. Five community scale de-arsenificating units with a production capacity of 250 litres per hour have been installed and the units cater to healthy drinking water requirement of 50 families in the region. 250 arsenic test kits to check arsenic in drinking water were prepared and distributed to beneficiaries along with domestic and community scale dearsenificating units.

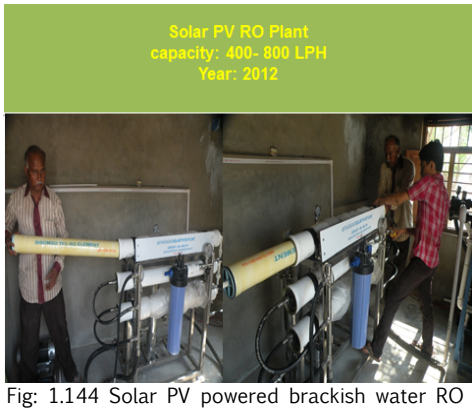

Fig: 1.144 Solar PV powered brackish water RO plant installed at Solawata village

Two solar PV powered brackish water RO plants were installed in Bhopa ki Dhani and Solawata villages of Ajmer

district in Rajasthan. 6000 LPH seawater RO plant was also installed at Narayan Sarovar of Kutch region in Gujarat.

Sustainable remediation process for mitigation of arsenic contamination in groundwater

Arsenic in natural waters is a worldwide problem. In India, high concentration of arsenic in ground water from the vast tract of alluvial aquifers in the Bengal Delta plains covering the eastern part of West Bengal, Assam, Uttar Pradesh, Jharkhand and parts of Chhattisgarh has been one of the most recent and major environmental issues in the subcontinent. CSIR-NEERI has developed a household arsenic removal unit using Fenton's reagent. It is suitable for provision of safe potable water in arsenic affected areas. Arsenic removal unit is operated at domestic as well as community level.

The arsenic removal unit works on a simple principle of co-precipitation of arsenic with iron and adsorption of this precipitate on iron oxy-hydroxides, followed by further retention of this precipitate in treated sand. Fenton's reagent used for arsenic removal works as a first level treatment to oxidise As(III) to (V), through the formation of the powerful oxidant OH• radicals and Fe(II) is oxidised to Fe(III) which forms a precipitate that gathers all the As(V), followed by further retention of this precipitate in treated sand.

Fig: 1.145 Resin-based community scale arsenic removal units installed in mosques in West Bengal

Anti-tranishing lacquer coating for brasswares: Moradabad brass ckyster

A cost effective but efficient anti tarnishing lacquer has been developed by CSIR-NML. A new copolymer with very good corrosion inhibition properties for copper and its alloys was synthesized and was used for preparation of the lacquer. Field tests (outdoor and indoor exposure) of the partly coated brass panels reveal that the developed lacquer is very efficient to prevent tarnishing for long durations (AAC_4). Accelerated tarnishing test using ASTM B 809 procedure confirms that the developed lacquer is comparable or more efficient than INCRALAC, the internationally available lacquer. The lacquer was applied to all the brass panels attached to the doors of CSIR-NML building to maintain the luster of the panels (AAC_5). The lacquer was also produced in bulk scale (10 L) and was supplied to the brass artisans of

Moradabad Brass Cluster, Uttar Pradesh for their use in collaboration with National Innovation Council of India.

Paving blocks from steel slag

CSIR-NML has set up a state-of-the-art pilot plant for the production of paving blocks using a geopolymerisation process. This pilot plant is being used for the generation of large size of samples for limited market trials. The pilot plant is operational and working with more than 95% efficiency. 1000 numbers of paving blocks are being produced every day (8 hours shift). More than 50 tons of product have already been produced which will be laid at different places for field evaluation. The process parameters and storage conditions has been optimized. Specifications of steel slag, granulated blast furnace slag and fly ash have been prepared. Studies on the shelf life of alkalies have also been completed. It was found that rejection rate is less than 5%, and efforts to reduce it further are being made. The product complies with the USEPA (United States Environment Protection Agency) limit for leaching of toxic metals and is environmentally safe.

Family size compact anaerobic digester cum biogas plant

The anaerobic or biogas plants of small or medium sizes currently in use need large volumes of water and the solids are fed directly on or after grinding. Such plants discharge large quantities of effluent containing partially and undigested organic matters including fats and fatty acids with less than 5% solids. Management of such digesters is extremely difficult due to the voluminous discharge of effluents with malodour, and regular requirement of precious water.

The newly developed anaerobic digester by CSIR-NIIST is a complete treatment system for the biodegradable household wastes. The digester of 350 litre volume is sufficient to treat around 3 kilograms wastes a day. It produces 250 to 600 litre of methane rich biogas daily by loading of 1 to 3 kg wastes as input. The biogas produced can be conveniently stored in biogas balloons, waste tubes or in the digester itself. There is no need of adding water or wastewater. Hard waste materials such as bones are fed through the attached crusher and its central axis rotated by hand for a few times to enable its thorough mixing with other biomass wastes. The wastes loaded through the inlet port travels more than 200 days in the digester before reaching the outlet. The horizontal design of the digester facilitates the slow movement of wastes, thereby enabling decomposition of large sized wastes materials. The digested discharge from the outlet is thick slurry free from acidic foul smell unlike the discharge from widely used household biogas plants. The discharged slurry can be easily collected and stored conveniently for direct soil applications upon requirement.

Fig: 1.146 Household Wastes Digester cum Biogas plant

Decorative roofing tiles

CSIR-CGCRI has been applauded by Secretary, Murlu Clay Tiles Cluster Industrial Co-operative Society Ltd, Bankura (West Bengal) for successful implementation of decorative roofing tiles technology. The suggested formulation of locally available clay blended with fly ash curtailed the fuel consumption by 10 % in view of lightweight products that proved to be 40 % lighter.

Fig: 1.147 Decorative roofing tiles manufactured by K K Potteries in Murlu Clay Tile Cluster based on the CSIR-CGCRI formulation

Technology Dissemination

Energy saving low mass kiln furniture: helping hand to ceramic MSMEs

CSIR-CGCRI's Outreach Centre at Naroda disseminated the low mass kiln furniture technology. 22 ceramic industries of the Micro Small and Medium Enterprises (MSMEs) in Gujarat took the technical knowhow through the technology dissemination programme. A revenue of `1.65 lakh has been towards dissemination fees. The salient feature of the technology lies in the use of low cost locally available raw materials in crockery making.

Fig: 1.148 Technology being disseminated to crockeryware manufacturers

Application of Ceramic Coating on Glass Fibre Fabric

Three participants of M/s URJA Products Pvt. Ltd, Ahmedabad joined a programme conducted by CSIR-CGCRI. The main objective of the programme was to demonstrate making of ceramic coating on glass fabric which would provide sufficient strength, stiffness and fumeless coating as compared to uncoated fabric to improve filtration properties during casting.

Programme for Rural Potters

Village artisans were given hands-on training by CSIR-CGCRI on various shape making techniques, various raw materials, process related matters along with firing,

productivity and quality aspects of terracotta wares. The artisans were exposed to modern processing methods so that they would be able to pass on the knowledge gained to other artisans in rural ambience. The programme was sponsored by the Matikaam Kalakari & Rural Technology Institute, Gandhinagar.


Fig:1.149 Rural potters undergoing training

Glass Beaded Bracelet Making & Manufacturing of Beaded Jewellery

In India, about 4 Lakh people are engaged in the manufacture of glass bead/beaded products which lead to annual export (direct /indirect) worth `1600 crores. The uniqueness of this activity is that there is no institute or organization in the country for glass beaded jewellery making. CSIR-CGCRI helps to generate self employment for the backward and low income groups of population. One such programme was held at Keymore, Katni, Madhya Pradesh.

CSIR-CGCRI has also provided hands-on training to artisans of Glass Beaded Jewellery Making, Glass Beaded Flower Making and Glass Beaded Bouquet making and fixing of Rhinestone for glass on sari and suits.

Fig:1.150a Training programe at Keymore, Katni

Fig: 1.150b Training programme at Village Harra, Meerut

Crop diversification in vetiver through intercropping for higher productivity

Oil of vetiver (khus) is used in high grade perfumery and flavouring products. Field studies have been conducted at CSIR-CIMAP to study the production potential of vetiver intercropped with Sweet Basil, Tagetes, Mentha, etc. The cropping systems were highly productive in terms of land equivalent ratio (LER)-1.33, land use efficiency (LUE)-1.33% and monetary equivalent ration (MER)- 1.58 and a net return of `2.50 lakh to `2.70 lakh. Results of intercropping of vetiver with Aonla orchard indicated that plant population of vetiver @ 1,11,000 plants/ ha and application of

80:40:40 kg NPK/ ha were suitable for achieving highest vetiver oil yield (13.5 kg/ ha).

Search for alternative to Jiget powder used in Agarbatti industry

Under a CSIR-National Innovation Council (NInC) joint initiative for cluster development, CSIR-CIMAP has made an attempt to find out the alternative for Jiget (bark of *Litsea glutinosa*) under a project in Tripura Bamboo Cluster, Agartala as dwindling supply of this essential ingredient used as 'binder' or 'adhesive' is posing a grave threat to the survival of about `3000 crores strong agarbatti (incense sticks) industry in India. Some potential combinations developed and tried by CSIR-CIMAP indicates the possibility of reduction of use of jiget and improving the quality of agarbattis. Trial-cum-demonstration of one such combination of CSIR-CIMAP was organised during the year at Agartala in which 25 women engaged in making of charcoal powder based agarbattis participated. The results of the demonstration indicated that there was a reduction of consumption of Jiget by about 9% in CSIR–CIMAP combination containing flower powder and jiget made in the ratio of 5:1 as compared to the traditionally used Agartala combination of charcoal powder and jiget made in the ratio of 3:1. Also, number of agarbattis made and burning time of the agarbattis made from CSIR-CIMAP combination was found to be about 25-30% higher as compared to charcoal powder based agarbatties. Being completely devoid of charcoal powder, the CSIR-CIMAP flower based combination was found to be 'skin friendly' by the women and also keeps their hands and work place clean.

Economic analysis of Menthol mint cultivation at farmers' field

The study carried out by CSIR-CIMAP in the Barabanki district of Uttar Pradesh has shown that the major portion of operational cost in cultivation of menthol mint *(Mentha arvensis)* is shared by hired labour, interculture operations, distillation charges, irrigation and machine / tractor charge. The overall benefit to cost ratio has been found to be 2.55, which indicates a higher profit for farmers on less investment in mint cultivation. The independent variables like human labour, machinery, manures and fertilizer, irrigation charges and intercultural operations have shown a positive and significant impact on the returns of mint crop in the study area. The major problems faced by the farmers were high input cost, erratic supply of electricity, lack of adequate information, infrastructural facilities, regulated markets and energy - efficient distillation units.

Public Private Partnership model for contractual cultivation of *Artemisia annua*

Fig: 1.151 *Artemisia annua* crop in the farmer's field

The anti-malarial drug plant *Artemisia annua* variety 'CIMAP Arogya' was cultivated in more than 1200 acres of land in different districts of Uttar Pradesh and Uttarakhand. The purchase of the dried herb was facilitated by M/s IPCA Lab, Ratlam who signed consultancy agreement with CSIR-CIMAP for contractual cultivation of the crop. About 1100 tonnes of dried herb was produced during the crop season by about 800 farmers and company purchased and lifted the material worth about `360 lakhs from the farmers' field.

Development of North East Ethnic Material and Leather Combination Products

The people of north east India make lots of products but, they are unable to reach the market and earn profit in large scale because of the lack of Aesthetic appeal and Standardisation. A need was felt to transform this knowledge into wealth by increasing the value of the products without losing its real essence. CSIR-CLRI in collaboration with CSIR-NEIST has carried out a comprehensive survey in the North eastern region. Based on the inputs from the survey, designers at CLAD Design Studio designed and developed new range of products. The handbags are crafted and designed with the ethnic materials of the North East and the inspirations are derived from Ornaments, Dresses & Artifacts adorned by tribal folks of the northeast India. The products were displayed in various national/ international fairs and attracted many enquiries.

Fig: 1.152 Fashion Hand Bag-Inspired from Head Gear

Industrial Grade Salt

Through the model salt farm established at Humma in Odisha the salt manufacturers of Odisha could visualize the importance of the production of good quality salt with double the productivity. Many salt producers of Humma region have already adopted the salt manufacturing methodologies being advocated by CSIR-CSMCRI and the society under whose premises the model was established, has earned additional revenue of `600 – 700/- per ton of salt. About 25000 acre of saline land has been identified in Odisha. If the entire area is fruitfully utilized for salt production activities the annual salt production in Odisha is expected to touch 6 lakh MT whereas the present salt production of the state is 15 – 20 thousand MT per annum.

With the technical guidance of CSIR-CSMCRI 16 marginal salt producers of Rajula region in Gujarat could produce very good quality salt with > 99% NaCl and on an average the marginal salt producers could market their salt to user industries @ ` 700 – 1200- per ton of salt as against ` 200 – 250 per ton.

Bio-degradable Nursery Pots from Forest Waste

CSIR-CBRI has developed a new technology for making biodegradable nursery pots using forest waste. The prototypes of the developed product are shown below.

Fig: 1.153 Prototypes of developed Bio-degradable Pots

An additional product has also been developed which is suitable for thermal insulation in buildings. This product is made by using the dried leaves of the forest waste and bio-degradable. The technology is available for transfer at laboratory level.

Fig: 1.154 Prototypes of thermal insulation sheets from forest dried leaves waste

Outreach programs for School Teachers towards preparedness for Natural Hazards

CSIR-NGRI has conducted several outreach programs for the teachers of south western Maharshtra under Western India Schools Earthquake Lab Program. Under this program, 85 low version seismographs were installed by CSIR-NGRI in schools spread over 8 districts in Satara, Sangli, Kolhapur, Ratnagiri, Raigad, Osmanabad, Latur and Nanded of Maharashtra. This project has been executed in south western and south eastern parts of Maharashtra due to protracted earthquake activity. The mission of the project is to create awareness about earthquakes and hazard mitigation among school children. Two courses were conducted during the year to train around 50 teachers and the educational seismographs were installed at 80 schools. The training included lectures on basic seismology, Earthquake

preparedness and safety and Tsunami. The lectures were followed by practical training on operation of seismographs, seismic data retrieval and data analysis.

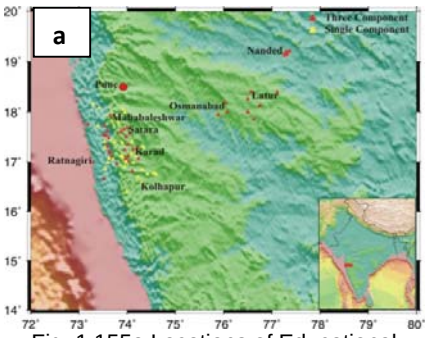

Fig: 1.155a Locations of Educational Seismographs in Maharashtra

Fig: 1.155b Teacher's training program