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50 years Technologies









1961-2011

CSIR IN THE NORTH-EAST
50TH YEAR OF DEDICATED SERVICE

CSIR-NORTH EAST INSTITUTE OF SCIENCE & TECHNOLOGY

JORHAT

Connecting Science & Technology for a Brighter Tomorrow

First Published 2011
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Produced by
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CSIR-North East Institute of Science & Technology

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Printed at
Saraighat Offset Press, Guwahati
Industrial Area, Bamunimaidam
Guwahati 781021

50 Years Technologies

CSIR-North East Institute of Science & Technology, Jorhat

Small and Medium Scale Enterprises (SMEs) play a crucial role in the process of economic development by value addition, marginal capital intensity, employment generation, equitable distribution of national income, regional dispersal of industries, mobilization of capital and entrepreneural skills and contribute to export earnings. Considering the industrial scenario of the region, SMEs are the only suitable option for economic development and CSIR-NEIST will develop technologies suitable for this sector and help in industrialization of the region.

Vision Document 2010, CSIR-NEIST

I have great pleasure in dedicating this publication to:
The Scientific Community
The Industry
And
The Historians of Science & Technology

P G Rao
Director

CSIR-NEIST

CSIR-NEIST, situated at a distance of 7 km west of Jorhat town by the side of the AT road, is one of the major national R&D institutes of CSIR in the North Eastern region with a glorious existence of 50 years ever since 18 March, 1961 when it was established. With more than 100 technologies developed, most of which have been commercialized, and innumerable agrotechnologies that have benefited thousands of farmers and agro-industry of the region, the CSIR-NEIST has been a major player in the economic and societal upliftment of NER in particular and the country as a whole.

PREFACE

CSIR-North East Institute of Science & Technology, formerly known as Regional Research Laboratory, Jorhat is completing 50 years (1961-2011) of its existence, and therefore, celebrating 2010-2011 as its ***Golden Jubilee Year*** by organizing various events and activities. One of such activities is production of several publications of different form and style, like Pictorial History of the Institute, Souvenirs and Technology Stories.

Here, we are presenting 50 technologies representing 50 years of the Institute's existence. Although we have developed more than 100 technologies during this span of time, for this publication we have meticulously selected only 50 technologies keeping in mind its impact on the society and Industry, ability to bring benefits to the rural sector of the population, novelty, innovation, capability to utilize agricultural and Industrial wastes, ecofriendliness and contribution to the economy of the nation. At the present time some of the technologies listed here may look to be irrelevant, but at one time such products like Carbon Paper, as a stationery item and Paper slate for spread of literacy amongst the poorer section of the society, played definite developmental role, and hence these have found places in this publication. In this endeavour, let me also put on record a word of special appreciation for one of our former colleagues, Mr A K Hazarika who worked in tandem with our editorial staff for giving shape to this important publication.

P G Rao,
Director

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Bio-organo Fertilizer – soil fertility enhancer and plant-growth promoter


Fertilizer application for more yield

It may be an easy and short-cut method to apply different chemical fertilizers to the soil and obtain more and better yield. But consequences may be disastrous if fertilizers and pesticides are not applied judiciously in order to get maximum crop from our land. Population pressure on our cultivable land may compel us to take extreme steps to yield more and more crops, but it may damage the soil irrepairably. Keeping all these points in mind **CSIR-NEIST** developed a simple technology, which does not need any major equipment, to prepare a ***BIO-ORGANO FERTILIZER*** suitable for all types of cultivation including tea which is a major cash-crop of Eastern India.

Novelty of the Technology:

It is a product of bio-active and organic compound.
It enhances soil fertility, and is a plant growth promoter.
It protects the soil and its beneficial microbes.
Eco friendly.
No major equipments needed.

Project Economics:

Capital investment:

Rs. 30,000.00 (for 100kg/day)

Recurring (300day/single shift)

Rs. 42,000.00

Profitability/ benefit:

20% net profit
The product improves the soil and benefits the environment.

Technology status:

Transferred to 7 parties in the rural sector and in commercial production.

Training module:

Training provided at NEIST (including Branch Laboratory and sub-station) or in site as per the convenience of the entrepreneurs. For SHGs, NGOs and SC/ST training is provided in groups at mutual convenience.

Bacterial Plant Growth Promoter-BPPS

The young tea bushes treated with BPPS grew much faster

Exactly 28 years ago, NEIST, then known as RRL Jothat had been undertaking soil microbiological studies under the project, "Microbial response to biodegradable pesticides in cultivated soil." While conducting these studies the scientists had come across some interesting findings. The experiments had yielded a product which showed a great potential for increasing the production of food, tea, tobacco and other plantation crops. The product was formed through the action of selected soil microorganisms which were beneficial to soil fertility. When these organisms were grown in a nutrient solution, they produced a product very similar to the way alcohol was produced during fermentation of the yeast. When the product formation was completed, it's extract was supplied to the users. The extract did not contain any live bacteria. The product was applied on the soil surrounding the plants in concentrations estimated on the basis of the size of the plants. For instance, tea bushes required 10% concentration whereas rice plants needed only 5%. BPPS was not a substitute for chemical fertilizers in over-cultivated lands like tea and rice plantations but was found to have a synergic effect on increasing the growth of plants.

Technology Transfer Status:

The know-how had been released through NRDC of India, New Delhi to M/S Bioproducts for commercialization. It was in production. The product was received very well by many parties, specially the tea Industry in the N.E.R. It was observed that young tea bushes grew much faster when treated with B.P.P.S

THE PROJECT HAD SINCE BEEN ABONDONED AND HENCE NO MORE LICENSING.

Killing two birds with one stone: Bio fertilizer from aquatic weed

Water hyacinth invading a large portion of a lake

Water hyacinth (*Eichhornia crassipes*) is a prolific aquatic plant which spreads at an alarming rate and tends to occupy vast areas of our fresh water-bodies rendering these unproductive. Due to its vegetative propagation and extremely high growth–rate, the menacing weed spreads rapidly, clogging drains, ditches and even interferes with shipping.

However, NEIST has endeavoured to turn the disadvantages associated with its alarming growth to a distinct advantage for effective utilization of this biomass by developing a technology to prepare a biofertilizer. NEIST developed the process to manufacture an environment-friendly organic fertilizer from the roots and leaves of this nuisance weed, water hyacinth. NEIST technology envisages control of the weed in one hand and production of an eco friendly, organic fertilizer on the other. *Thereby it kills two birds with one stone.*

Capital investment:

Rs. 5,06,000.00 (for 12,500 kg/month)

Profitability /Benefits:

Rs. 1,80,000.00 /year
Helps in control of the weed and frees the water-bodies.

Advantages:

No major equipment needed.
Eco-friendly.
Substitute for synthetic fertilizer.

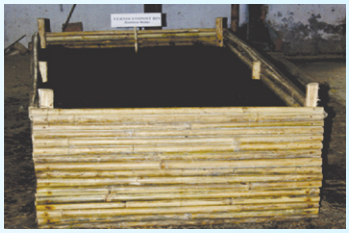
Close view of the weed complete with roots

Not an innocuous worm, but a mini fertilizer-factory

We are talking of that insipid worm which very often than not is used as a bait for hooking fish from ponds, streams and rivers. But as we have started realizing the importance of using organic fertilizer in our soil so as to avoid soil degradation we have started realizing the importance of this innocuous worm, the earth worm, which we are talking about. Earth worm can serve us as mini factory for producing an organic fertilizer which is nothing but its excreta. This excreta is a source of the present-day ***vermicompost.*** NEIST has developed bins for artificial culturing of earth worm species to produce a compost known as Vermicompost.

Vermicompost contains all essential plant nutrients.
It is rich in beneficial microflora.
It is free from pathogens and toxic elements.
It minimizes attacks of pests and diseases.
It contains important constituents like vitamins, enzymes and hormones.
It is free from bad odour and easy for its application in crops.
It increases organic matter in soil.
It improves soil structure and increases moisture-holding capacity of the soil.

Training on vernicompost production



Low cost vernicompost bin developed at NEIST Branch, Itanagar

Finished vermicompost being packeted from vermicompost reservoir

Project economics:

The vermicompost bin as developed by NEIST Branch costs only Rs. 650.00 which is cheaper than that of other bins available in the market.

Technology status:

NEIST Branch established three units at Arunachal Pradesh which are operated by private parties for commercialization. 25,000 vermicultures were distributed to various beneficiaries. The beneficiaries not only mastered the technique but also earned Rs. 10,00000.00 during the last 2 years.

Training:

Training was provided to 58 S.T. women from different villages in Arunachal Pradesh for production of vermicompost using the African earthworm Eisenia fooetida.

A Health care product from the soil of North-East

Dioscorea cultivation at Borhapjan, a remote village in Upper Assam

The genus *dioscorea* belonging to the family Dioscoreaceae is a native of tropical and subtropical, warm regions of the world. In the North-Eastern region the Dioscorea plant of different species grow in abundance and wild at places like Tripura, Assam and many others. These are tuberous, herbaceous, perennial vines growing very tall and luxuriant.

With this background in mind NEIST Jorhat explored the possibilities and started investigations for promoting organized Cultivation of ***Dioscorea Composita*** and ***Dioscorea Floribunda*** in the hills and plains of North-East. The reason for chosing these two species bears out of the fact that these two are an excellent source of diosgenin which is a valuable material for synthesis of steroidal drugs e.g. corticosteroids, sex hormones, oral contraceptives and anabolic steroids. There is a very good demand of diosgenin all over the world. India's demand of diosgenin far exceeds 100 tonnes out of which only a small fraction i.e. about 1/10th is produced in the country. Therefore, the nation had identified the ***cultivation of Dioscorea*** and *Solanum* species for large-scale cultivation. The agro-climatic conditions of the N.E region appears to be ideally suited for its commercial cultivation and NEIST (RRL) Jorhat but naturally intensified its efforts for the ***development of farming technology*** and to undertake ***promotional activities of*** *Dioscorea floribunda* ***and*** *Dioscorea composita*.

It is worthwhile to mention that NEIST Jorhat embarked upon a collaborative project for the cultivation of medicinal and aromatic plants at Sipahijala near Agartala in Tripura way back in 1976 and launched a joint programme with the Government of Tripura for large-scale cultivation of ***Dioscorea floribunda***.

Agropractices:

Well-drained sandy loam upland soil, having pH 5-6
The crop is best propagated through tubers
The best suited time of planting is Feb-March
Sprouted tubers are planted at a spacing of 90×60 cm
Extra irrigation not necessary
NPK@ 100:60:60 kg/ha as basal dose in two split doses
Deep ploughing is necessary to obtain better yield

A Dioscorea tuber weighing 18 kg harvested from NEIST farm

Project economics:

Cultivation cost /ha/ 3 years = Rs. 20,000.00

Profitability/benefits:

Expected profit / ha = Rs. 10,000.00
Rural poor particularly marginal farmers can be financially benefited.

Technology transfer status:

Farming technology released to a large number of parties in the N.E region for commercial cultivation.

Birth of a new variety

The North-Eastern region having copious rainfall and peculiar climate with gradations from humid alluvial valley through evergreen forests to the snow-line produce an immense variety of flora and fauna. Arunachal Pradesh located on the North-Eastern- most part of India, with its border with China and Myanmar, is a treasure-trove of a variety of plants having therapeutical and aromatic values.

Years back, while making a botanical exploration to Tawang, Arunachal Pradesh with the help of the state government and Assam Rifles, a para-military formation under the Govt. of India the NEIST (then RRL) Scientists had observed that in certain places like Lumla of Arunachal Pradesh lemon grass grows naturally in abundance. NEIST surmised that, naturally therefore, Arunachal Pradesh would be the right place to promote cultivation of improved variety of lemon grass and extraction of the oil. It is worthwhile to mention that oil obtained from lemongrass contains constituents having extensive use in pharmaceutical and aroma-industries. Depending upon the seasonal and locational variations the oil can be used for synthesizing vitamin A and for making perfumeries or flavoring agents.

Cultivation of the BLI-ARUN strain of lemongrass in Arunachal Pradesh

Villagers carrying lemongrass to distillation unit at Namteseting village in Arunachal Pradesh

Meanwhile, NEIST was working on different varieties of lemongrass like *Cymbopogon var flexuosus* and *Cymbopogon var arunachalis*. NEIST Scientists found out that the first variety contains oil which is high in citral yield but low in oil yield and the second one is high in oil yield but low in citral yield. Then NEIST Branch Itanagar developed a **strain of lemon-grass BLI-ARUN** by hybridization method which possesses the best of both the varieties. Market evaluation of the products obtained from the new strain had more than 85% citral contents and had a ready export market.

Agrotechnology of this strain had been released to four entrepreneurs who began large-scale cultivation. One of the entrepreneurs, M/S Shelly Welfare Society, Doimukh, Arunachal Pradesh had installed a 600kg/batch capacity distillation unit at Sonajuli.

Uses:

Lemon grass oil is extensively used in pharmaceutical and cosmetic industries and as a flavouring agent. The oil contains citral which is a principal source of -ionone for synthesis of vitamin-A.

Distinct advantages of the new strain:

Cultivation in Jhum land in Arunachal Pradesh

Recently due to the non availability of a strain having higher biomass, oil and citral content India started losing international market. Now the situation is likely to improve due to the strain developed by NEIST which has high biomass, higher oil contents and higher yield of citral which comes to more than 80%.

Project economics:

The cost of cultivation of the crop per hectare is Rs. 15,000/- per year.

Return / Benefits:

Net return is Rs. 20000/- per ha/year. Provide employment opportunities in remote, rural areas to unemployed, unskilled and semiskilled youths. Hills people are encouraged to take up this settled cultivation of lemongrass instead of *jhum* cultivation. The crop is also suitable for mountain slopes and other degraded waste-lands.

Lighting up the Dark Alleys

*Bapuram and his wife Keteki were sitting on a cot placed in a corner of the room. That was their drawing room, bedroom, dining room all rolled in one. Their mud plastered thatched house has only one room and a covered veranda which they call `Randhani Sal' (Kitchen). Bapuram and Keteki were a dejected lot. How to make both the ends meet!

It was raining incessantly for the last ten days. They could not go out in search of work; even if they went, they came back empty handed because nobody engages daily wagers on rainy-days. No work, no pay, and therefore no meals. Hungry, sad and forlorn they were looking at each other, without even a murmur, cursing their fate and blaming God for not extending a helping hand to the needy and the poor.

"Bapuram!" Somebody shouted from outside. Reverie broken, no longer in a trance, they looked up and out through a make-shift peep-hole which they call window.

"Oh Gaon Burha!" "Ahok – Ahok" ("Oh Headman! Come, please come in!") Bapuram opened the door. The guest was offered a wooden stool. Grumbling about the weather the old man wiped his face and head with the end of the *Gamocha* (indigenous towel), He gave a low cough, cleared his throat, and started speaking - "Bapu! some knowledgeable people are coming from Jorhat to address a meeting tomorrow morning at our village football field. They are good people and I am told, are coming for a good cause. Come and attend the meeting. Both of you. It may be useful! I am alerting the entire village". After staying for a few more minutes the Headman left for the next house.

The old man did a good job. He could marshal a large number of villagers for the meeting. Yes, some Scientists were coming to speak to the villagers. They were from NEIST, Jorhat i.e. North East Institute of Science & Technology. When all the villagers, numbering about two hundred, settled down peacefully, the meeting started. The Gaon Burah acted as the President and after lot of shouting and cajoling could bring some semblance of order into the place. Without mincing words, the Scientists started speaking about the pathetic plight of the rural poor as a whole and of that particular village of which 80% were below the poverty line (BPL), deprived and depraved. "So, we cannot accept this lying down". The NEIST people said, "We are to do something. Therefore, we, the Scientific Community are coming forward 'to do something', to ameliorate your sufferings as best as we can. You are mostly landless farm-labourers. You have no land of your own, but definitely, you have access to paddy-straw and such other agricultural wastes. We see here a lot of marshy area full of water hyacinth. You can collect paddy-straw and dried-water hyacinth and with those you can start cultivation, although you have no land of your own". The Scientist-Speaker's lecture was interrupted by raising a ruckus of taunting laughter and cat-calls. "Please do not laugh", said the speaker forcefully. "Do not make fun. Be serious. I know, people have a tendency of making fun with

Mushroom farming

*The story is real, but the names are changed

anything new and novel. At first we make fun of it, then make sense of it and then make use of it. I am repeating. You can cultivate a crop inside your bedroom, in your cow-shed or any such covered area. You do not need land and bullocks to plough. This wonder crop can be grown, harvested and consumed within 15-20 days after sowing (spawning). If you are hungry, you can pluck it out, cook and eat it right then and there; and if you are in need of money, we are sure, all of you need money, you can sell it in the market or in top class hotels". This time the people cheered. No taunting remarks. "Now, I will talk straight", the speaker continued, "I am talking about cultivation of edible mushroom. It may be Oyster mushroom, White button mushroom or any other edible mushroom for that matter. It can be cultivated inside your room, hanging by ropes from the ceiling. It does not require *Mati* (land) to grow. It can be grown on paddy-straw, dry grass, dried water-hyacinth or even sugar-cane bagasse." The Scientists then explained about the economics of the crop. The villagers were told about the nutritional quality of the food – that it is rich in proteins, minerals and vitamins. It is two times richer in protein than fish and one and a half time richer than meat. Good for people suffering from blood pressure and diabetes. As it

Edible mushroom

Mushroom spawns

is rich in iron it is good for anaemic persons. Even toothless old people can eat it, it is so soft and easily digestible. Most important, it is a money spinner. By scientifically cultivating mushroom you can earn upto three to four thousand rupees per month." The villagers were told that NEIST, Jorhat was the first to introduce the cultivation of mushroom in the North East. The technology was initially transferred to Kohima village near Kohima town of Nagaland. The spawns suitable for the agro-climatic conditions of the area were distributed free of cost. Intensive training was given first at the laboratory at Jorhat and later on at the sites in villages. In 1983, four families mastered the art (the farming practices) and took-up the cultivation in a commercial scale who produced and marketed five tones of mushroom valued at Rs. 1,20,000/- (in 1983). That means Rs. 30,000/- per family. By proper management, using different varieties, mushroom can be grown round the year, in any weather conditions.

A small family may easily earn an amount of Rs. three to four or even five thousand rupees per month and augment their financial resources. The Scientists of NEIST encouraged the rural people of that sleepy village by citing similar activities in other places of the North East. The villagers were told about the success story in Arunachal Pradesh, where the NEIST Branch, Itanagar distributed

2500 bags of mushroom spawns to 130 beneficiaries to start the cultivation. Within a short time the villagers could earn a total of Rs. 6.20 lakh, which was a great thing for the penniless tribal poors of that remote area. By the effort of NEIST, Science could reach the interior of the North Eastern border of India. The Research and Development activities of CSIR could light-up the hearths and home of the hitherto forgotten tribal people of the North East. No doubt, it is a humble beginning, but it is a right step in a right direction.
A leap forward!

The meeting ended. The Scientists of NEIST could drive home their point. Mission accomplished, they left the place promising to come again after a week to demonstrate and distribute bags of spawn (seed material). The villagers were advised to keep the things (substrate, etc.) ready.

Exactly after a year. The same people, the same place and the same environment! But the scene has changed. Bapuram and Keteki are no longer down and out. They are no longer forlorn and hopeless. They are bathed in a brighter sunshine of monetary solvency and are looking forward *to a brighter tomorrow*.

Bapuram and Keteki from Assam are not alone. Now, through the untiring efforts of the NEIST, Jorhat, Science & Technology could reach the remotest corners of other North Eastern states like Arunachal Pradesh, Nagaland, Meghalaya, Mizoram, Manipur and Tripura. Like Bapuram, *Mrs Lulan Lotha of Nagaland, Y Nyodu of Arunachal Pradesh, Konumoni and Nekhni Mao of Manipur, Renheln and Thauka of Mizoram, Mrs Uma Sarkar of Tripura, Mrs Jyotsna Bashumatary of Karbi Anglong and thousands of other villagers are reaping the benefits of Science and Technology and could augment their limited financial resources.

An ideal entrepreneur

Mushroom Man-Pranjal Baruah

"Veni Vidi Vici". Yes, he came, he saw and he conquered. A city-bred educated young man Baruah had an ambition to tread on an uncharted path. His searching mind zeroed in on Edible Mushroom, an invaluable futuristic food. He explored, enquired and searched with an inquisitive mind. He found that China has captured the world market of mushroom worth billions of dollars. In 2006 China produced and marketed 35% of the total world-production, whereas India's share was only 20%. The North-East has a tremendous potential because of its unique agro-climatic conditions and human-behavioural pattern arising out of hot, humid and rainy weather conditions which invariably favours indoor activities.

Pranjal Baruah gathered some information from different sources and further, to augment his knowledge he approached NEIST, formerly known as RRL (Regional Research Laboratory), Jorhat. He got in touch with Dr R K Adhikary, Scientist, NEIST and enriched his knowledge further about edible mushroom. Finally he took the mushroom technology from NEIST in 1995 and mastered the finer details of mushroom spawn production and cultivation. From then on he never looked back. Young entrepreneurs may be surprised to know that Baruah could repay his bank-loan of Rs. 2.45 lakh within a period of six months. In 1996 he shifted his spawn producing laboratory `Protein Food' from Jorhat to Guwahati, and was producing more than 1000 packets per day and was capable of increasing its capacity to 4000 packets per day, depending upon the demands. His turnover has

**real names, real places*

Edible mushroom

upped to several crores of rupees. Pranjal Baruah not only did pioneering job in this field, but his contribution towards societal work was also commendable. He developed a well-oiled system to link up marginal farmers and market to maintain its sustainability. He helped forming a cluster of 1000 families screened from as many as 50 villages. The farmers got an assured market and a sustainable income. Baruah successfully built a brand `Mushfill' and under its umbrella sold a variety of mushroom food items like dry and fresh mushrooms, protein powder, pickles, papads and soups. Because of his activities on mushroom Shri Baruah is nationally as well as internationally recognized. He received the prestigious Ashoka fellowship from U S based organization Ashoka Innovators for the Public in 2003. In 2004, Baruah received a grant of US $ 15,000 by Clarence Foundation, USA in an international competition for finding the best solution on alleviation of poverty. In December 2009 he won the prestigious "Wantrapreneur09" business plan award organized by Villgrow.

In fact, Pranjal Baruah is emerging as a role model to hundreds and hundreds of young entrepreneurs from the North East.

NEIST IN NORTH-EAST – A True Story

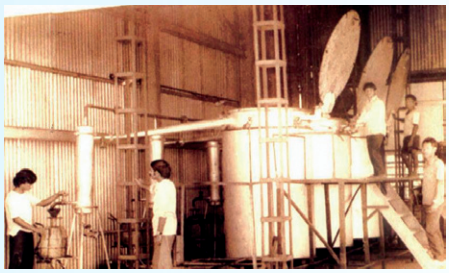
Armed to the teeth, bristling with razor-sharp long-handled*Daos* of various sizes and shapes, their feathered head-gears dancing menacingly, the war-like Nagas were marching and making a bee-line towards the village *Yaongyimsen, in Mokokchung district of Nagaland, a trouble-torn (then) state, beset with problems arising out of geographical isolation, difficult terrain coupled with insurgency and its remoteness from the main land. Nagaland is a small state, made out of a district of undivided Assam, nestling in a corner of the North-Eastern region. Yes, the Nagas were marching – but not on a war-path. It is a peace-march. They are marching in their typical, disciplined tribal tradition, to the village centre of Yaongyimsen.

Naga villagers at Yaongyimsen marching in traditional dress

Director and Scientists from RRL (NEIST) Jorhat, a CSIR Laboratory with a national style and character, charged with the responsibility of bringing the benefits of Science and Technology to the poor rural people of the North-Eastern states are visiting this hilly village Yaongyimsen. With the active support of the Government and people of Nagaland, CSIR-NEIST scientists were going to talk to the villagers about cultivation of various aromatic plants specially citronella in Nagaland. In order to demonstrate the farming practices, supply of planting materials and processing of the end-product CSIR-NEIST proposed to adopt the Yaongyimsen village as a CSIR-NEIST village and set-up permanently a sub-station equipped and staffed by Scientists, and technicians armed with necessary infrastructural facilities. The meeting was a grand success. An instant bon-ho-mie was established between CSIR-NEIST and the people and Government of Nagaland.

Done as said. A model farm for systematic scientific cultivation of citronella grass was established and a 500 kg/batch centralized distillation unit for processing citronella oil was set-up by CSIR-NEIST on turn-key basis. By the year 1972 over 150 families in and around Yaongyimsen were cultivating citronella, the aromatic grass, covering an area of 200 hectares. Seeing these developments, the Government of Nagaland realized the futility and the inherent hazards associated with the Jhum (cutting, slashing and burning) system of cultivation in Nagaland. The Government sought to dissuade the farmers of Nagaland not to resort to Jhum cultivation. Instead they had been told to accept and practice settled

Citronella farm in Yaongyimsen



Distillation plant in Yaongyimsen

*Yaongyimsen is a small village in the district of Mokokchung tucked away at a height of 4000 ft. above the sea level, inhabited by a population of 3800 Naga tribals belonging to Ao sub-tribe.

cultivation like citronella and other aromatic plants which were easy to grow and earn money in a relatively short period of time. In this matter the help of CSIR-NEIST was sought by the Nagaland Government. CSIR-NEIST launched a special campaign in Mokokchung district of Nagaland for cultivation of citronella. The result was the stabilization of the population and the crop there.

Jhum (shifting cultivation) land (left) and citronella cultivation in fallow Jhum land at Hime village, Arunachal Pradesh (right)

Meanwhile, CSIR-NEIST organized awareness and training camps in remote areas of the North East, organized and assisted farmers to form cooperatives and above all supplied them with improved varieties of planting materials.

While launching the campaign, the simple people of the rural areas were explained by the CSIR-NEIST Scientists, as best as possible, the use and usefulness of the citronella, the farming and processing of which would bring economic prosperity to the people at the grass-root level. CSIR-NEIST also trained the trainers who would horizontally transfer the information to the other people. The trainers had been told that Java citronella is the best source of citronella oil from which citronellal, hydroxy citronellal, geraniol and other similar high-value perfumery bases can be made. The oil and its derivatives are used in a variety of products like scented soaps, sprays, deodorants, detergents, polishes and in mosquito repellants. Citronella oil is endowed with typical characteristics, and is used as antiseptic, antibacterial, antifungal, anti-inflammatory, insect-repellant, anti-rheumatic and anti-arthritic.

The way to Pengeri, the village which derived its prosperity through cultivation of citronella

After attaining resounding success in Nagaland and some parts of Assam, CSIR-NEIST then extended its activities to other states of the North-East. CSIR-NEIST took up on a systematic manner to industrialize the entire Pengeri village in Upper Assam which was surrounded by thick forests populated by hordes of wild elephants. Because of the marauding elephants which cause large scale depredation of cultivated paddy, the villagers

Large scale citronella cultivation in Pengeri area, Upper Assam

were at a loss what to do. CSIR-NEIST thought of entering the scene at that stage, because citronella being an aromatic grass would not be eaten by elephants or any other herbivores. Consequently within a short period of time the Pengeri village could boast of having a cluster of 250 families cultivating and marketing citronella oil worth of about Rs. 1 crore per year. So much so, that the Pengeri village earned the sobriquet as an "oil town". The village had several distillation plants of various capacities and therefore the farmers found a market to sell the grass at their door-steps. One could see villagers carrying citronella grass on bicycles and bullock-carts. The cultivation of Cironella was gradually extended on a massive scale in Assam, Arunachal Pradesh, Meghalaya and Nagaland with the involvement of State departments and NGOs.

Villagers carrying citronella grass to distillation plant at Pengeri using various modes of transport

Citronella cultivation at Palin (left) and Hime (right), Arunachal Pradesh

Citronella distillation plant at Tipi, Arunachal Pradesh (left) and Chumukedima, Dimapur, Nagaland (right)

The employment generation and economic gain in NER through citronella technology

Period	Area under Cultivation (ha)	Employment provided (no)	Prod. of oil (tones) year	Value of oil (Rs. In Cr.)
1970-73	850	4260	30	0.1
1974-78	2350	11,790	50	0.6
1979-83	2770	13,850	200	2.1
1984-88	3260	16,300	250	3.2
1989-93	3770	18,850	389	3.8
1994-98	3320	19,900	445	6.5
1999-03	3260	19,360	436	7.9
2004-07	3400	19,800	460	10.8
2008-10	3600	20,000	500	17.5

CSIR-NEIST's developmental activities have also been able to utilize 2000 hectares of low grade land (waste land) like mountain slopes, averted Jhum cultivation in some of the hill-areas, created employment for about 12,000 people in remote areas, generated local resources valued at Rs. 8 crores annually.

CSIR-NEIST's work was appreciated, endorsed and subsequently recognized by all and sundry. The state governments of the North Eastern region were fully cooperative and providing funds for centralized distillation units at several places. The Federation of Indian Chambers of Commerce & Industry awarded the FICCI award for Science and Technology in 1982 and FICCI award for rural development in 1985. CSIR had provided a special grant to proliferate the work further. The Department of Biotechnology, Govt. of India provided a special fund over the period 1997-2007 for a similar purpose and the support is still continuing.

Besides providing agro-technologies and basic market information CSIR-NEIST Jorhat provides extensive training to growers. During 2000-2009 special training programmes were conducted by CSIR-NEIST for 1158 beneficiaries from 8 districts of Assam, 607 beneficiaries from 18 districts of Arunachal Pradesh and 82 from 2 districts of Nagaland.

"The intention of RRL, Jt was not to derive revenues from this work for CSIR but to contribute S&T

inputs for the social and economic development of a remote and backward region of the country. Even valued as a 'private good' with a deemed 'surrogate royalty of 5% on the value of oil produced, the revenues to RRL, Jt would have been far in excess of Rs. 100 lakhs, the expenditure it incurred. The other additional intangible returns that have resulted are the social costs of employment generation and stabilization of population in a difficult region." ("Reinventing the CSIR")

Non -Technical Information

Citronella- a commercial crop which on steam distillation yields essential oil containing Citronellol, geraniol and hydroxyl citronellal and other high value perfumery bases.

Propagation

It is propagated by splitting the clumps into slips. Planting by vegetative slips at 60x60 cm spacing during April-September. About 25,000/- slips are required for planting in one hectare. Irrigation is necessary according to season.

Soil & Climate

Citronella requires moderately humid climate with abundant sun light and water throughout the year. It is grown in a wide range of soil conditions from sandy loam to sandy soils.

Advantages

- Low investment
- Eco-friendly
- Can be grown on barren/waste land (Wasteland utilization)
- Having export potential

Technology package

Offered on consultancy mode
Technical service charge: Rs.25,000/-
Service tax @ 10.3% to be paid extra

Technology transferred: to more than 97 entrepreneurs

Techno-economics

Cost of cultivation = Rs.25,000/ha/year
Net Return = Rs.40,000/ha/year

Training module

Training is provided to the entrepreneurs at NEIST (including in Branch Laboratory at Itanagar and Substation at Manipur). For SHGs, NGOs and backward class (SC/ST) beneficiaries the training is provided in groups.

CSIR - NEIST Distillation Plants

(For extraction of essential oils from oil bearing leaves, grass etc)

Distillation still designed by CSIR-NEIST

CSIR-NEIST at Jorhat, has done considerable work on development of distillation plant suited to local conditions in N. E region. In the process of steam distillation, the green leaves or dried leaves are charged into a retort called 'still' and exposed to steam generated in a separate steam generator/boiler. The leaves/grass are fed to the brim in a distillation still (made of 304 grade Stainless Steel), maintaining an uniform pressure all the while by pressing on the leaves when the feeding is in progress. Next, the lid is put in place and steps are taken to ensure that it is airtight. The spout of the lid through which the vapour from the still is to pass, is then connected to the mouth of the condenser. The still is connected at the top to a water-cooled condenser through a short piece of conical pipe called venturi.

The steam while passing through the green leaves or dried leaves causes evaporation of essential oil along with moisture contained in the leaves. The steam laden with oil vapour while passing through the venture and condenser gets condensed and attains liquid state. The condenser is a mixture of oil and water and is separated out by means of a separator. This technology has been released to different parties of North East India.

Production of essential oils of citronella, lemongrass, patchouli, geranium, palmarosa, vetiver, cinnamomum etc. will play an important role in export promotion. The organized cultivation of oil from these crops will give impetus to the rural population in providing employment/self employment and revenue generation.

Tentative cost:

Cost of Plant & Machinery in India (exclusive of Land, Boundary Wall & Office Building)			
Material of construction of Distillation still	**Extraction of essential oil from grass like Citronella, Lemongrass etc.**	**Extraction of essential oil from leaves like Patchouli, H. aromatica etc.**	**Extraction of essential oil from flower like Geranium, Cinnamomum etc.**
	Plant Capacity=1000 kg per batch (500x2)	Plant capacity=400 kg per batch (200x2)	Plant capacity=800 kg per batch (800x1)
Stainless Steel	Rs. 5,70,000/-	Rs. 6,60,000/-	Rs. 4,50,000/-
Mild Steel	Rs. 4,10,000/-	Material of construction of distillation still is SS	

Plant Growth Regulator- Chloro Choline Chloride

Plant growth regulators (or hormones) are a group of organic compounds other than the plant nutrients, which in miniscule amount, inhibit or otherwise modify certain physiological processes in plants. Apart from fertilizers and plant protection chemicals, these growth regulants play very important role in agriculture.

Out of a host of plant growth regulators, ***Chloro Choline Chloride (CCC),*** lndole Acetic Acid, gibberrelic acid and ethephon were mainly used in India commercially. In view of meeting the increasing demand of plant growth regulators NEIST (then Regional Research Laboratory), Jorhat developed a process know-how for manufacture of Chloro Choline Chloride or 2-Chloroethyl Trimethyl Ammonium Chloride under the sponsorship of M/S Vividh Pharmaceuticals Pvt. Ltd, Bombay.

As a plant growth regulator, Chloro Choline Chloride plays an unique role by making the plants sturdier and smaller which characteristics make the plants resistant to wind and consequent lodging. It increases the yield and makes the plants resistant to pests and insects, draught and frost, and variations in temperature. It also prevents transpiration and water loss from the plants.

Project Economics:

(Based on estimates made in 1973-75)
The imported price of the chemical was Rs. 25,000/ Tonne (1975)

Demand: 30 Tonnes/annum (1975)
50 Tonnes/annum (1978-79)

Cost: Rs. 2.4 million (1975)
Rs. 4.0 million (1978-79)

Project Investment:

(Based on 1978-79 estimates)
Rs. 14 lakhs / CCC unit of 15TPA.

Technology Transfer Status:

The work on CCC was initiated in NEIST during the early part of 1975 and the know-how was developed at Lab-Scale and later upgraded to Pilot Plants Scale. The know-how was successfully demonstrated to M/S Vividh Pharmaceuticals Pvt. Ltd, Bombay in August 1978. The process was proved commercially.

The technology was kept in abeyance and therefore no further licensing.

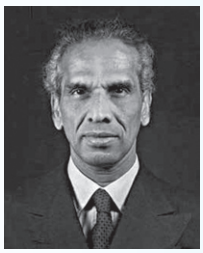
Cement, the versatile building material

Cement plays a very important role in shaping the material facet of our present day civilization. Consumption of steel and cement may be a yard-stick to measure our extent of developments. Like other developed countries, with rapid industrialization and urbanization India's consumption of cement is also increasing with rapid intensity and vigour.

30 tpd v.s..k cement pilot plant at RRL(NEIST)

CSIR- North East Institute of Science & Technology (NEIST) Jorhat is one of the pioneering institutes to undertake R&D work on vertical shaft-kiln cement plants for manufacture of portland cement. The V.S.K plants of moderate size and capacity has an advantage of utilizing small pockets of limestone deposits scattered here and there in remote areas. NEIST Jorhat (former RRL Jorhat) therefore developed technology to manufacture 30 to 50 tonnes cement per day mini V.S.K plants, complete with basic and detailed engineering.

Genesis:



V K Krishna Menon the then Defence Minister of India.

Late Dr. M.S Iyengar former Director RRL(NEIST) Jorhat

During 1957-62 when V.K. Krishna Menon was the Defence Minister of India, ominous war-clouds were hovering over the Northern-border. Border disputes were hotting up along the India-China frontier. In one of those crucial days Krishna Menon was visiting one of the CSIR laboratories. While visiting that lab he was talking with some of the Senior Scientists regarding problems for carrying various defence materials through the difficult terrain to those areas where there were practically no roads. Cement was required to make pill-boxes (a concrete emplacement for machine guns and anti tank weapons) for our soldiers for defending the border. He further said that in stead of wasting time and money to carry cement all the way to the border why not manufacture it right there near the border area where small lime-stone quarries are available. One of the Senior Scientists who heard Krishna Menon with rapt attention happened to be none other than Late Dr M S Iyengar. It was so ordained that Dr Iyengar came to RRL Jorhat (NEIST) as Director who brought with him a sincere and dedicated Scientist, Late S.N Dutta. With profound knowledge about V.S.K Technology both of them along with other dedicated workers set about the task of developing a full-fledged technology. Within a couple of years they set-up a 30 tonnes/day pilot plant for manufacture of cement by V.S.K process. Later on Sri U.C Borah, Senior Scientist and his group completed the detailed engineering and made the package of the technology ready to be transferred in a complete form.

Late S.N Dutta, former Scientist NEIST (RRL)

IPR Status:

The Technology is protected by a series of patents granted in India, U.S.A, Iran, Peru and Vietnam.

Raw materials & utilities (per tonne of product) :

Lime Stone ----------1.36 tonne
Clay ----------0.17 tonne
Coke Breeze ----------0.25 tonne
Gypsum ----------0.05 tonne
Additive ----------0.017 tonne
Power ----------112 kwh
Water ----------1.00 M^3
Land ----------3 to 4 Hectares for a 50tpd plant

Project Economies:

Capital cost and production cost varies form place to place and are dependant upon the infrastructural facilities available at the site and the distance from the source of limestone. Tentative total project cost for a typical 50 TPD VSK plant is estimated at Rs. 6.5 crores.

The engineering consultancy offered by NEIST:

- Techno-Economic Feasibility Report.
- Detailed Engineering.
- Design of plant Lay-out.
- Civil construction and foundation design.
- Electrical Lay-out and design.
- Raw material evaluation and raw mix design
- Inspection during construction and installation.
- Commissioning of the plant.

Technology Transfer Status

Bharat Cement Industries, Ahmedabad, based on NEIST Technology

Transferred to 39 parties spread all over India – Gujarat, Rajasthan, Madhya Pradesh, Maharashtra, Haryana, Himachal Pradesh, Andhra Pradesh. Tamilnadu and N.E states.

Distinct advantages of NEIST Technology:

- Eco-friendly
- Low capital intensive
- Lesser gestation period
- Utilization of small limestone deposits
- Decentralization of the industry

Housing, a basic need

There is a tremendous pressure on our society for food, clothing and shelter due to ever increasing population. Rapid industrialization and urbanization combined with population explosion accompanied by associated evils like poverty are creating almost unbearable burden and need for housing. Conventional building materials and techniques are cost intensive and are almost out of reach of the economically weaker sections of our society. Therefore, there is an urgent need to look for affordable, low cost houses using locally available construction materials and suitable techniques. This problem, which stares at the face of the nation caught the undivided attention of CSIR-NEIST. It took up work to develop suitable technique for construction of ***Low-Cost-Houses*** using locally available materials like bamboo and timber as the main structural elements. This innovative technique was termed as ***Bamboocrete Housing Technique.*** Bamboo had been chosen because of its tensile strength, resistance to damping and high strength-weight ratio.

Technique:

Bamboo- split walling and roofing structure

The bamboo split walling system of a thatched house is a normal feature in the North-East. But the roofing element incorporated in the bamboocrete technique is absolutely new. The roof constructed by this technique is made wavy in shape. Two sets of bamboo splits are used to form the structure in the shape of a shell for the roof. Two coats of cement and plaster are needed, and allowed to cure for 28 days. The size 3m × 3m is considered as a standard nodule for bamboocrete houses. The roof is supported by bamboocrete diaphragm wall. It is made water-tight by a brush-coat of bitumen on the top surface followed by a spray of coarse sand and normal tarfelt.

A bamboocrete house

Advantages:

Low cost
Technique is simple
Labour intensive
Less time-consuming
Earthquake proof, and therefore suitable for seismically sensitive North–East India
Better and neat looking compared to thatched houses
Suitable for rural housing
Construction materials are indigenously available
Structurally safe, water and fire-resistant
Durable

Safety test at NEIST

Technology transfer status:

The Know-How was released to 12 parties. Govt of Arunachal Pradesh utilized the technology in a housing scheme at Pasighat. Was in production.

THE PROJECT IS KEPT IN ABEYANCE.

Low Cost Roofing sheets

NEIST (Regional Research Laboratory), Jorhat, in collaboration with Central Building Research Institute, Roorkee developed a technology for manufacture of ***low cost roofing sheets*** from disposable wastes like used papers, paper boards, paddy straw, dry grass, sugar cane bagasse and other cellulosic wastes. The sheets thus made—which were given a corrugated shape—were light in weight, fire and water resistant, durable, and above all were remarkably cheap compared to other conventional roofing materials. Moreover, these corrugated roofing sheets reduced the cost of the sub structures. The purlings and rafters could be spaced wider apart. These would enable the builders to put the roof with minimum of skilled labour and thus economize the construction.

Technology Transfer Status:

NEIST (RRL) JORHAT SUPPLIED A ROOFING SHEET PLANT TO CENTRAL RESEARCH ORGANIZATION OF THE GOVERNMENT OF MYANMAR (BURMA). IT HAD BEEN SUCCESSFULLY COMMISSIONED IN YANGON (RANGOON) IN JANUARY 1982.

THE KNOW-HOW FOR MANUFACTURE OF LOW COST ROOFING SHEETS FROM AGRICULTURAL WASTES WAS ALSO TRANSFERRED TO A PARTY IN PHILLIPINES. ON 27TH OCTOBER, 1977. M/S BENGUET ELECTRIC CORPORATION SIGNED THE TRIPARTITE TECHNOLOGY TRANSFER AGREEMENT ON BEHALF OF THE PHILLIPINES FIRM. RRL (NEIST) WAS REPRESENTED BY SRI B.P. CHALIHA, SCIENTIST AND

Mrs Eusebio E Ferrer and Mr Lourdes S Ferrer (centre) of M/s Benguet Electric Corporation, Phillipines signed agreement with NRDC on 27 October, 1977 for taking the Know-how for manufacture of "Paper Boards" used for construction purpose developed jointly by RRL, Jorhat and CBRI-Roorkee for commercialization in Phillipines. Also seen in the photograph is Sri B P Chaliha (extreme left), Sc G, RRL and NRDC personnel.

Mr. Robert F Goheen, US ambassador to India visiting low cost corrugated roofing sheets making unit at NEIST, Jorhat.

NRDC OF INDIA WAS REPRESENTED BY DR. C.V.S RATNAM MANAGING DIRECTOR AT THE SIGNING CEREMONY IN NEW DELHI.

Another plant was installed and commissioned at Pasighat in Arunachal Pradesh on turn-key basis at the request of the Industry Dept Govt of Arunachal Pradesh.

RRL JORHAT (AT PRESENT NEIST) BAGGED THE FICCI INSTITUTIONAL AWARD FOR ITS PERFORMANCE IN THE ECONOMIC DEVELOPMENT OF THE COUNTRY (1982). SPECIAL MENTION WAS MADE BY THE FICCI COMMITTEE FOR THE DEVELOPMENT OF TECHNOLOGIES FOR MANUFACTURE OF LOW COST ROOFING SHEETS, FLOW IMPROVER AND BROAD SPECTURM PESTICIDES.

The process was kept in abeyance and hence no further licensing.

Bioremediation - an innovative way of tackling new problems

Enormous population pressure forces us to engage ourselves in brisk developmental activities in all spheres demanding enhanced production of food and fuel, housing and health care products, clothing, and more efficient means of transport and communication. Efforts directed at maximizing productions, in certain cases, result in producing wastes and left-overs that act as contaminants which alters the natural environment in the area of activities. The scope of this piece of writing is limited to only one of such emerging problems, i.e. the problem of reclamation of polluted and contaminated soil degraded by crude oil. During some operations in the oil-fields, such as drilling, gathering, transportation, tank failures, pipe ruptures oil is spilled in drill-sites and its neighbouring areas. These spills cause serious threat to the flora and fauna of the region as these change the biochemical nature of the soil. Certain portion of the crude gets leached in to the rhizosphere region of the soil causing further damage to the soil health. The soil is degraded.

Geleky drill site before treatment

Sludge at Geleky drill site

Bioremediation is an accepted process by which the environment can be restored to its original status. CSIR-NEIST developed a technology on ***Remediation of Hydrocarbon Contaminated Soil*** and has *attained spectacular success in the Laboratory as well as in field conditions*. The technology developed by NEIST to reclaim such degraded soil consists of two phases:

Bioremediation with bioformulation and

Spraying of bioformulation before plantation initiation of vegetation

Vegetation after 2 months

Vegetation after 6 months

Vegetation after 10 months

Introduction of vegetation i.e. phytoremediation.

Bioformulation applied to the degraded soil is a mixed culture of four types of bacterial strains belonging to the genus, *Thiobacillus, Bacillus, Arthobacter* and *Azotobactor* isolated from the soils of Assam. The formulation is changed depending upon the nature of the contaminated soil. The number of cycles of bioformulation required for reclamation is also dependent upon the degree of contamination. Once the land is reclaimed, fast growing non-edible plants are introduced to decontaminate the polluted soil further.

Status of the technology:

The technology on ***bioremediation of hydrocarbon contaminated soil*** has met with success in the laboratory as well as in the actual field conditions. It is a site specific technology and has been tried and implemented *in situ* on many lands degraded by crude oil contamination. It was tried on six different drill sites with varying level of contamination. The Oil Industry, the ONGC in particular, has been utilizing our expertise in the reclamation of many of their drill-sites contaminated by crude oil and oil-sludge.

The development of vegetation within 1-2 years in the degraded land where no vegetation worth the name grew, is a novelty of the NEIST work. Because of the tell-tale visual results NEIST technology and expertise have been utilized by the Oil Industry for developing a much desired green belt in the contaminated sites.

Project Economics:

Total cost of developing a site of 2000 sq. meters with 48 to 50% hydrocarbon contamination is approximately: Rs. 20 lakhs. This includes manpower, site development, consumables, travel, contingency, utilities and overhead.

Technology transfer status:

Technology transferred to ONGC on consultancy basis against an amount of Rs. 10,30,000.00 as fees (in 2 projects). This was for an area of 1500 sq. m. The land was contaminated with 50 to 55% hydrocarbon with a lot of drilling mud and other chemicals. With the funding from OIDB, New Delhi, NEIST developed another formulation to suit other drill sites like Borholla. For reclamation of three more contaminated sites, each with an area of 14,500 sq. m, an amount of Rs. Seven lakhs was offered by ONGC to NEIST as a consultancy fee.

A total amount of Rs. 65,43,600.00 has been earned as fee by NEIST for transferring this technology.

Profits/ Benefits:

Besides earning substantial amount of surplus cash the technology could generate sufficient employment opportunities particularly in the effected areas. In one of the recently completed projects involving 3 sites (Geleky Kol gaon, Geleki near Sibbari and Amguri Lahon gaon) 30 nos of unskilled workers from the neighbouring areas of the contaminated drill-sites were employed. During the process of phytoremedation, by planting economically important indigenous plants value addition to the natural resources could be achieved.

DURING 2003-2004 B.P. PODDAR MEMORIAL AWARD FOR ***ENVIRONMENT IMPROVEMENT AND PROTECTION*** INSTITUTED BY BHARAT CHAMBER OF COMMERCE WAS CONFERRED TO NEIST AS A RECOGNITION TO THS WORK.

Bacteria to the rescue

Present day agricultural practices involve large scale use of various synthetic compounds to get more and more crops. This method for maximization of the food-crop results in deterioration of the quality of the produce and degradation of the soil.

Commercial samples

These compounds also have a deleterious effect on the microbe population of the soil specially the beneficial microorganisms associated with the crop and therefore, tell upon the soil-fertility. Hence NEIST developed a ***Bacterial Formulation for Crop Enhancement and yield improvement***. This technology was developed to exploit the rich microbial diversity in order to obtain more biomass, better crop yield, control of fungal and bacterial diseases and also to improve soil fertility.

A) Paddy

B) Potato

C) Tea

Advantages of the formulation:

Based on plant growth promoting Rhizobacteria
Improves crop yield
Enhances microbial bio-diversity and soil fertility
No toxic residue, and Eco friendly

Project Economics:

Capital investment: Rs. 5,00,000.00(for 50 tonnes/year)

Profitability/benefits:

Net return: Rs. 6,00,000.00/annum

Technology transfer status:

Released to 7 parties in North-East and Maharashtra. All are in commercial production.

Training Module:

Training provided at NEIST(including Branch Laboratories and Substations). For SHGs, NGOs and SC/ST training is provided in groups as per mutual convenience.

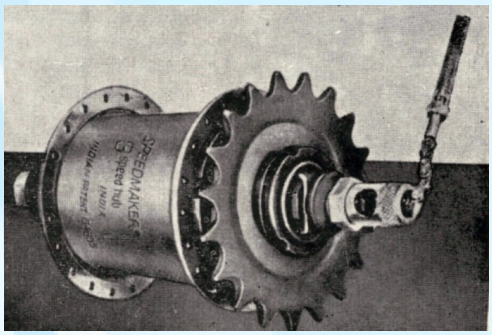
A pollution free, cheap and reliable mode of transport

Bicycle is the only low-cost, non-fuel consuming and reliable mode of transport to millions of less wealthy people from all over the world, specially of the developing countries like India, China and Brazil.

More than a billion bicycles are available in the world. India alone had 30,800,000 bicycles in 1990. The number of bicycles might have doubled by this time which criss-cross the remotest corners of our vast country not connected by motorable roads. USA had 100,000,000 (1995) bicycles, Germany 62,000,000 (1996) and Japan, a small country, had 72,540,000 (1996). The reason for using such vast numbers of bicycles in developed countries like USA, Germany and Japan is health, because cycling exercises the heart better than even that excellent aerobic exercise—brisk walking. Besides, of course, bicycle is a non polluting mode of transport which can be used irrespective of weather and road conditions.

Although the bicycle industry is several decades old, not much work was done to improve the bicycle in terms of saving human energy or attaining more speed for the same input of human energy. However in advanced countries, recently, efforts were directed to bring about innovation so that for a given input of human energy one can travel faster or move up an incline without any difficulty. Taking all these into consideration NEIST (RRL) Jorhat under-took developmental work to design ***multi-speed hubs*** (3speeds, 5 speeds). There was a time when these multispeed hubs were not manufactured in the country and there were only four manufacturers in the whole world who produced this type of multi-speed hubs to be fitted in bicycles to increase efficiency and speed.

Gear fitted wheel of a bicycle



Multispeed hubs manufactured by M/S Multispeed Hubs P Ltd, Mysore based on CSIR-NEIST technology.

Technology status:

The design of the ***multi-speed hubs*** developed by NEIST was licenced by National Research Development Corporation of India (on behalf of CSIR) to M/S Multi Speed Hubs limited, Mysore. The company had put up a factory in the Mysore-Bellagolla Industrial area for production of 1 lakh bicycle gears per annum.

Capital investment:

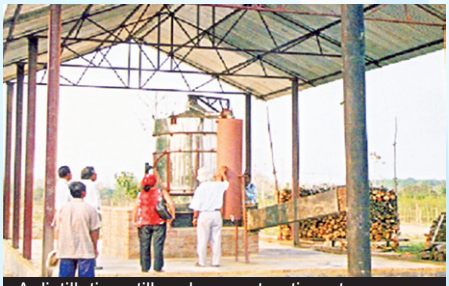
Rs. 50 lakhs for a unit of 1 lakh gears/annum was the total investment of the Mysore plant.

Technology transfer status:

No more licensing. The project has been abandoned.

The work which played a prominent supportive role in aromatic oil industry


A distillation plant for citronella/lemongrass/ patchouli set up at Dimapur, Nagaland


A distillation still under construction at Nuiland, Nagaland

North East Institute of Science & Technology (NEIST), Jorhat has been consistently working to promote essential oil industry in the North-East, in consideration of its suitable agro-climatic conditions, soil characteristics and availability of land, water and rural man-power. To a large extent it has achieved success, and the rural people in many areas of almost all the states of the region reaped considerable benefits, either direct or indirect. The organized cultivation of non traditional crops like citronella, lemongrass, patchouli etc. contributed towards establishing industries in those areas which have never seen any industry worth the name.

NEIST realized the need to work on the design and manufacture of suitable ***distillation stills for extraction of oil from essential oil bearing plants*** cultivated in a large scale in the North-Eastern region. Accordingly NEIST developed and perfected a design of distillation plants suitable for the region.

Project economics:

Cost of plant (in India):

For extraction of essential oil from Citronella, Lemongrass etc---

Rs. 5,70000.00 for 1000kg/batch (500×2) capacity for stainless steel stills.

Rs. 4,10,000.00 for 1000kg/batch (500×2) capacity for mild steel stills.

For Extraction of essential oil from leaves like Patchouli, H.aromatica etc---

Rs. 6,60,000.00 for 400kg/ batch (200×2) capacity stainless steel stills.

For extraction of essential oil from flowers like Geranium, Cinnamonum etc---

Rs. 4,50,000.00 for 800 kg/batch capacity stainless steel stills.

The costs are exclusive of land, boundary wall and office building.

Technology Transfer status:

The technology has been transferred to a large number of entrepreneurs in the North-Eastern region and in commercial production.

Profitability/benefits:

It not only brought direct economic benefits through selling of oil by the still owners but also was instrumental in providing economic benefits by creating jobs and a ready market for selling the essential oil bearing grass and leaves by the growers of the rural population.

Health care products--a major thrust area

The mosquito that spreads Malaria

Nature has made the North-East India a treasure-trove of immense varieties of flora and fauna and specially endowed it with a perennial source of high-value medicinal plants. The inhabitants of this region possess a native wisdom and a vast knowledge-base on the judicious use of ethnic drugs derived from the locally available herbs. Naturally therefore, CSIR-NEIST has been putting thrust in developing bioactive molecules and herbal preparations from medicinal plants, and launched a major programme. NEIST Jorhat sharpened its focus on effective utilization of traditional medicinal plants for the benefit of the people of the region in particular and the country in general.

It may be appropriate to mention that Assam and its neighbouring states which comprise the North-Eastern region of the country, is strategically placed and shares international borders with Myanmar, China, Bhutan and Bangladesh. The Geo-climatic conditions of the region cause excessive and prolonged rainfall promoting vector breeding and longevity due to high humidity and high temperature for most of the year. As a result, Malaria is a major public health illness in the region. Assam alone registers >5% of the total malaria cases in the country.

Considering aforesaid factors CSIR-NEIST developed several technologies on ***healthcare products*** from medicinal plants available in the region. NEIST also has been actively working on ***the CSIR co-ordinated programme on development and commercialization of bioactive molecules from medicinal plants.***

Technology development:

1. DEVELOPMENT OF KNOW-HOW FOR CHIRALLY PURE -ARTEETHER

Arteether, a new generation antimalarial drug is active against chloroquine resistant malaria strains and is produced from commercial artemisinin obtained from the Chinese medicinal plant *Artemisia annua* in three reaction steps. In the market, normally it is being sold as a mixture of two isomers. IN THE KNOW-HOW DEVELOPED BY NEIST IT IS POSSIBLE TO GET THE ACTUAL DRUG I.E. -ISOMER. In the NEIST process the yield of the drug of acceptable quality comes to more than 70% against the reported yield of 60%.

Artemisia annua,the plant that helps curing Malaria

Cost economics:

The cost of the drug is calculated at $ 5000/kg in the international market.

2. DEVELOPMENT OF KNOW-HOW FOR CHIRALLY PURE -ARETEMETHER

CSIR-NEIST developed another new generation antimalarial bulk drug, Artemether. It is active against cloroquine resistant malaria strains. Artemether is prepared from commercial artemesinin obtained from the Chinese traditional medicinal plant *Artemisia annua* in three reaction steps. THE YIELD OF

THE DRUG OF ACCEPTABLE QUALITY IS MORE THAN 80% AGAINST THE RECORDED YIELD OF 65%.

Cost economics:

The cost of the bulk drug thus obtained is calculated at approximate $5000 per kg in the international market.

3. DEVELOPMENT OF KNOW-HOW FOR CHIRALLY PURE -ARTESUNATE

Artesunate is another new generation antimalarial drug active against Chloroquine resistant malaria strains and is produced from commercial artemesinin obtained from the Chinese traditional medicinal plant *Artemisia annua* in three reaction steps. Through the process developed by NEIST one can get the actual drug i.e. the -isomer of Artesunate, and the yield is also very high i.e. more than 90%

Cost economics:

The cost of the bulk drug is estimated approximately at $5000/kg in the international market.

Technology transfer status:

ARTEETHER: **:** Released to one party for commercial implementation. Ready for further licensing.

ARETEMETHER**:** Released to one party for commercial implementation. Ready for further licensing

ARTESUNATE **:** Released to one party for commercial implementation. Ready for further licensing

These three know-hows were demonstrated and duly released to a single pharmaceutical company based at Mumbai, M/S FDC Ltd during 1998-99. Further licensing may be considered. In normal practice, these technologies are released together for commercialization as these are integrated technology.

4. DEVELOPMENT OF KNOW-HOW FOR 16-DEHYDROPREGENOLONE ACETATE(16. DPA)

NEIST developed the know-how for manufacture of 16 DPA which is a basic drug for manufacturing a number of steroidal drugs, sex hormones etc. It has substantial market demand both national and international. This is prepared by a three-step protocol from Diosgenin extracted from Dioscorea tubours. The process does not involve high boiling solvents and does not require costly and environmentally hazardous catalysts. Recovery of the solvent is also possible. The process is simple and low capital intensive. The process utilizes a low cost, non-toxic and medium boiling organic solvent under moderately high pressure.

The *Chai* that cheers but does not inebriate

A steaming cup of hot tea

A hot steaming cup of tea cheers us to no end. It uplifts the dampened spirit, brings freshness and revives your strength and stamina. The agent which contributes to the cheerfulness, freshness and revival of your flagging spirit is nothing but the bitter alkaloid, caffeine ($C_8H_{10}N_4O_2$) present in tea. Caffeine is a stimulant and a diuretic too. But it is not an intoxicant like alcohol. CSIR-NEIST (North East Institute of Science & Technology, formerly known as RRL Jorhat), while making a survey of the raw materials including agricultural and industrial wastes of the North-East region has observed that out of India's total produce of tea amounting to an average 983060 tonnes/ annum, Assam alone produces annually an average of 500475 tonnes. NEIST had noted with interest that while producing these tea the industry also produces 1.5 to 2 % of tea waste, unfit for human consumption. Interestingly these wastes contain 0.5 to 1 % caffeine which has tremendous importance in drug and beverage industries. The laboratory, after preliminary study found that this valuable caffeine which was just thrown into the gutters could be safely recovered for right and proper use by a suitable solvent extraction method. Thus a waste could be gainfully utilized and converted to a wealth. Taking a cue from above, NEIST successfully developed a technology for manufacture of 30 tonnes of caffeine per annum from tea-wastes and transferred the technology for commercial implementation. Two parties from Assam, one at Jorhat, Assam Pharma Co and the other at Nalbari, Ahinsha Chemicals Pvt.Ltd went into commercial production

A partial view of a Tea Garden

Inside view of a caffeine plant

I.P.L status:

The technology is patented in India and commercialized.

Raw materials:

Tea wastes, limestone and a solvent.

Uses:

Caffeine has a wide application in pharmaceutical and beverage industries. It is being extensively used in colas and tonics.

Project Economics:

Capital investment for a 30 TPA plant comes to about Rs: 3.5 crores. The project is economical and ensures gainful utilization of an agro-industrial waste.

Consultancy service rendered by NEIST:

- Techno-economic Feasibility Report
- Basic design
- Assistance in commissioning

Advantages:

- Eco friendly
- Organic nature of the product

The stick which keeps your enemy at bay

When swarms of mosquitoes descend upon you to suck your blood out and inject deadly germs into your blood-stream, you donot need to run out of your house nor to take shelter under the protection of a mosquito net. Nor you need to burn obnoxious-smelling mosquito-repellent coils, harmful to human-beings, to drive out the invading dreadful blood thirsty insects. Because, NEIST Jorhat has developed a simple technology and produced a **Herbal Agarbatti (incense sticks, *Dhup*) having mosquito-repellent properties.** It is manufactured using available plant-materials which, when burnt, gives off a fume which is pleasant smelling but an effective repellant against mosquitoes.

It is worth while to mention that mosquito repellents currently used for domestic purposes are mainly synthetic products with high mammalian toxicity. As in most cases these are synthetic pyrethroid, are less harmful than many insecticides, but are still not safe. The herbal agarbatti prepared by NEIST, although very much effective against mosquitoes yet it is free from toxicity and therefore most safe even for prolongrd use.

The technology is suitable for the micro-sector and can serve the society as a Cottage industry. This simple technology is low capital intensive, labour extensive and can contribute to the economic upliftment of the rural society or the impoverished urban slum area.

Capital investment:

Rs. 6242.00 for a 5000 sticks/day unit.

Profitability/benefit:

The net profit is calculated at Rs. 1260.00/ day

Besides earning attractive profits the technology ushers in industry and development to economically under-developed areas and helps in poverty alleviation

Technology transfer status:

The technology has been released so far to 2 parties in Assam and to CBTC, Guwahati for cluster promotion in the North-East. It is in production.

Safe drinking water at a low cost

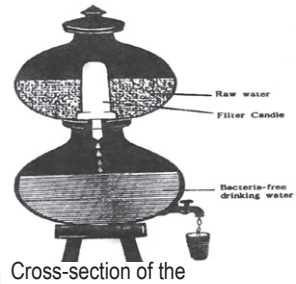

Filter- candles developed at NEIST

Drinking water, whether it is obtained from available sources or from municipal water supplies may not be completely safe to drink, because it may be contaminated with harmful bacteria capable of causing water borne diseases like cholera, typhoid or other gastrointestinal diseases. One of the conventional methods, particularly in the rural and semi-urban areas, is to filter the domestic water through a bed of sand, gravels and charcoal to remove suspended impurities followed by boiling to kill the bacteria. This method, although efficient, is cumbersome and expensive. For rural and low-income group of people in the urban areas the use of domestic water-filter candles is now a preferred choice because of its compactness, high efficiency, relative low-cost and less cumbersome character. As it was found by NEIST Jorhat that filter candles available in the market are costly and beyond the reach of the common man, the laboratory therefore undertook to develop a technology so as to obtain candles at a cheaper rate. Accordingly a process was developed using easily available raw materials to manufacture bacteria-free, cheap water-filter candles from raw materials indigenously available and at the same time relatively affordable. The processes are kept flexible in order to incorporate appropriate pores modifier (in the candles) and inhibitor to the local water conditions.

The novelty of the technology:


Candles fitted in earthen pitchers

Simple manufacturing steps involving easily available equipments and raw materials. The containers – the domestic stationary type can be made to order or the candles may even be fitted to earthen pitchers to obtain very cheap water filter system.



Cross-section of the improvised filtration system

Raw materials:

A) Candles: 1. Insulating fire-brick powder
2. China clay
3. Colloidal metallic solution
4. Charcoal or saw dust

B) Containers:
Locally available clay
or
Plastic / aluminium
or
Bamboo reinforced soil-cement mix

Return/benefits:

The project is economical
Ensures safe, bacteria-free, clear drinking water
Contributes to keeping good health, particularly of the poorer section of the society

Technology transfer status:

Transferred to 36 parties and in commercial production.

India, the first country in the world to commercialize a chemical additive for iron ore beneficiation

In the '70s NEIST (then RRL) Jorhat undertook work on problems relating to ***alumina removal from iron ore rich in alumina***. The effort had resulted in the development of a number of chemical dispersants which were specific in action on hydrous materials like clay, laterite etc. Laboratory scale investigation carried out with the developed chemicals and various iron ores of India yielded encouraging results.

It is worthwhile to mention that India, fortunately, is endowed with vast reserves of iron ore. These ores, however, contain high percentage of alumina. For achieving optimum level of productivity the blast furnace technology required iron ore having more than 60% iron. Al_2O_3 / Fe ratio should be less than 0.05 and Al_2O_3 / SiO_2 ratio must be less than 1. This required adoption of a suitable ore dressing / ***beneficiation technique*** to run of mines (R.O.M.) ores. Large scale mechanization of mining operations and subsequent ore dressing through crushing and screening liberate enormous quantity of fines (40% of R.O.M. ore) which are unsuitable for charging into the blast furnace. The fines need agglomeration through a process of sintering and / or pelletisation to process prior feeding into blast furnaces. Ore fines contain more of alumina and silica than graded ore and need upgrading for producing quality agglomerates. Besides, India have substantial deposits of lateritic iron ore, low in iron content, which cannot be put to use without beneficiation. It was therefore, felt necessary to utilize this valuable material and maximize the use of this low-grade –iron ore and fines through a suitable ***process of beneficiation of ores.***

NEIST (then RRL) Jorhat successfully developed the process know-how for the preparation of a chemical named as ***beneficiation additive*** and made the technology ready to transfer.

Technology transfer status:

Sri S.K Roy, Production Manager from ARCL receiving the know-how on beneficiation additive from Dr. G Thyagarajan, Director

NEIST Jorhat successfully demonstrated the process for production of ***Beneficiation additive*** in the production unit set-up by M/S Allied Resins & Chemicals Ltd. Calcutta. The know-how and the laboratory scale demonstration was given to the firm in the year 1979. the production of beneficiation additive by M/S ARCL using NEIST technology with full participation of NEIST scientists, R& D centre for Iron & Steel, steel Authority of India Ltd. was going ahead for sustained trial on the beneficiation of iron ore at Barsua Iron Mine of Rourkela Steel Plant.

Chrome Lignite, an additive for drilling high temperature, high pressure oil wells

As demand for petroleum products are increasing day by day, the market forces are exerting excessive pressure on the technocrats to come out with more and better technologies and products to achieve higher productivity in oil exploration and exploitation. Therefore, the Scientists and Technologists are churning out a host of specialty chemicals and additives for better and more productive exploration and exploitation of oil and gas reserves, keeping also in mind the environmental concerns. ***Chrome Lignite*** is one such chemical which is extensively used to achieve and maintain desired rheological properties of water-based drilling mud at high temperature. It is particularly used to fortify lingosulphonate treated muds when drilling temperatures above 140^{o}C are encountered. The present demand of this product in our country is estimated at more than 3000 MT per annum. However, as oil exploring organizations in our country are looking for more and more oil wells the demand of chrome lignite is bound to increase.

The CSIR-NEIST, Jorhat has developed a process at laboratory scale for manufacture of ***Chrome lignite*** from indigenously available raw materials. The process involves reacting powdered lignite with a chromium salt and alkali at elevated temperature under controlled P^{H} range. The slurry is then dried and ground to obtain free flowing powder. The product prepared by NEIST process ensures negligible amount of free chromium as compared to other products available in the country. The strict quality control measures adopted by NEIST have resulted in lesser amount of free chromium and thereby the product is found to be advantageous from environmental point of view.

The product conforms to ONGC and OIL specifications. The product supplied by the party licensed by NEIST had undergone field trials at Oil India, Duliajan and was found to perform satisfactorily. The commercial samples had also performed well at ONGC sites.

Raw materials:

- Lignite, Dichromate salt and alkalis
- Jaw crusher, grinding mill, jacketed reactor, Filter press/ Drier, Boiler.

Project economics:

Capital investment: Rs. 40.00 lakhs (including working capital for 90 days)
Annual cost of production: Rs. 42.00 lakhs
General Expenses: Rs. 6.69 lakhs

Profitability:

- Selling price : Rs. 7000.00/tonne (approximate)
- Gross annual income : Rs. 70.00 lakhs.
- Net profit : Rs. 21.14 lakhs. (before tax)

An ecofriendly oil-field chemical - Chrome Free Lignite

Although Chrome Lignite is universally used as an additive for drilling high temperature, high pressure oil wells, and which has proved to be highly efficient, yet environmentalists had been increasingly concerned, may be for the right reasons, and could prevail upon the governments concerned to tighten their restrictions for use. It has been alleged that the continued use of this additive may cause harm to the environment because of toxicity of chromium. Moreover, chromium–containing additives work efficiently up to 160°C only. The environmental and temperature constraints have, therefore, necessitated the need for a ***Chrome Free Lignite*** based drilling mud additive.

Keeping in mind the above factors CSIR-NEIST have undertaken the task to develop a process for preparing ***Chrome Free Lignite*** to take care of rheological and fluid loss characteristics of clay water based fluids. The product prepared through the process developed at NEIST could perform as a substitute of Chrome Lignite-Ferrochrome Lignosulfonate combination satisfactorily as a rheology control material and partially as a fluid loss control material. The additive could be used in the range of 160°C-180°C as a thinner (to reduce the yield point) and as a substitute of Chrome Lignite.

Raw materials:

List of raw materials	Capacity	Unit
• Lignite, Ferric chloride, Sod.hydroxide, Sod.Sulphite, phenol, formaldehyde.		
• Size reduction unit for lignite		1
• Stainless steel reactor with Jacket and agitator.	0.20 m^3	1
• Phenol dissolving tank	0.20 m^3	1
• Alkali dissolving tank	0.07 m^3	1
• Iron dissolving tank	0.02 m^3	1
• Chemical storage tanks	12.00m^3	2
• Chemical charge tanks	0.30 m^3	2
• Shells tube heat exchange	1.00 m^3	1
• Vacuums pump	--	1
• Dryer	--	1
• Pulverizer	--	1
• Pumps	various	6
• Boiler	500kg/hr	1
• Deep tube well and water Treatment tank plant	--	1 set
• Laboratory equipments	--	1 set

Project economics: (300 TPA; 3 shifts/day)

Capital investment: Rs. 89.41 lakhs

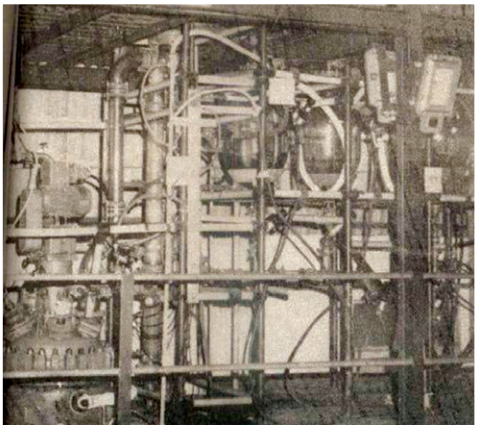
Cost of Production:

Raw materials---Rs. 96.75 lakhs
Utilities---------- Rs. 3.24 lakhs
Others----------Rs. 43.72 lakhs
Total = Rs. 144.71 lakhs

Profitability / benefits:

Estimated Profit— Rs. 35.25 lakhs (before tax)
Return on investment: Rs. 39.47%

For greater efficiency and productivity in the Oil Industry



Deoiler pilot plant at NEIST, Jorhat

Oil field (specialty) chemicals contribute significantly towards greater efficiency and productivity of the oil industry. Specialty chemicals ensure better Well and Pipeline performances.

In the production of petroleum crude, associated water exists as oil-in-water emulsion which is known as the *formation water.* Formation water may be insignificant during the initial stages of production**;** but as the well ages, water content in oil gradually increases and at one stage, it even rises to 90% of the oil produced. The associated water is separated from the crude before it is piped to the refineries. That reduces the bulk and the volume, and facilitates handling and transportation.

Oil from a gathering station is separated from the emulsified formation water by breaking the oil/water emulsion and separating the oil by using demulsifiers, and the water is then separated by thermo-mechanical and electrolytical processes. The continued production of crude oil results in accumulation of a large volume of associated water effluent. Usually, the effluent may contain 0.1 to 1% of emulsified oil. *The effluent possessing high concentration of emulsified oil cannot be disposed of as it creates pollution problems to the surrounding areas.* The *allowable limit* of oil contents in the effluent *for disposal is below 10 ppm.* On the top of it, if the oil could be recovered economically, the crude production increases, thus contributing to more profit. CSIR-North East Institute of Science & Technology, Jorhat developed a suitable polyelectrolyte called ***Deoiler*** for use on the oil-field effluent water. Deoiler is basically a cationic polyelectrolyte, and acts as a flocculent.

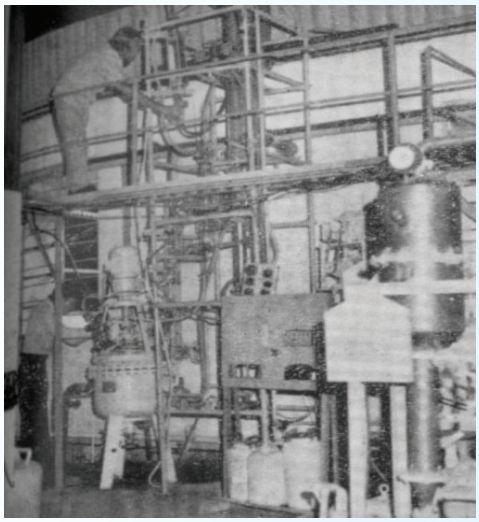
Technology status:

The process was developed in two stages, initially at the Laboratory scale and subsequently scaled up to Pilot-plant scale. The prepared product was evaluated on the effluents generated in the oil fields of Eastern region of Assam. Deoiler efficiency was found to be on an average 93.6%.

Technology transfer status:

Technology was released to M/S Poly Products Ltd, Guwahati on non exclusive basis. As Poly Products sponsored the project the first license for commercial implementation was granted to them. The process was in commercial production. The process is available for release at present at a know-how fee of Rs. 15 lakhs with a component of service tax (fixed by government) @ 10.3%. The consultancy fee for design engineering and other related services can be negotiated.

Oil Flows, the Nation grows



Flow improver pilot plant at NEIST

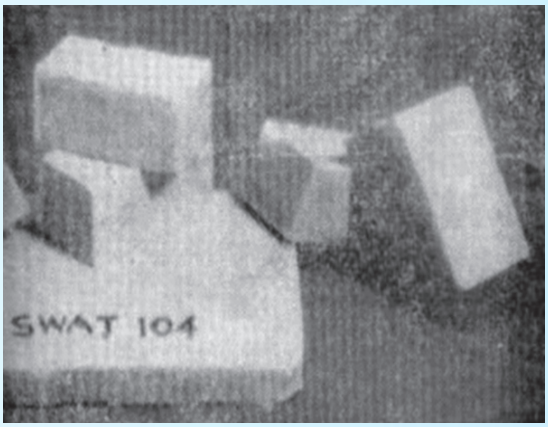
Energy is an essential element for sustenance, growth and prosperity of a nation. We may derive it as electricity either from hydroelectric or thermal or atomic sources. Other non-conventional sources may be tidal, wind, geo-thermal, solar and even biomass. Of course, one of the most commonly and easily used form of energy is by harnessing naturally available fossil fuels, i.e. coal and petroleum obtained from mining. This article, of course would be restricted to only one such fuel, namely petroleum.

Nature has been very liberal in enriching the North-Eastern region of India (where the CSIR/NEIST is situated) with abundance of petroleum crude. The area has several big oil fields located in Upper Assam which are being worked upon by giants in the Oil Industry like ONGC and Oil India.

Primarily, crude from the production-site is to be transported through pipelines to the refinery-sites. Very often pipeline transportation faces various problems which hinder smooth, regular and uninterrupted flow of the crude. Particularly, in case of Assam crude as well as the crudes obtained from Bombay High are characterized by the presence of high wax content, and therefore, are susceptible to co-agulation during extreme winter conditions. In order to avoid solidification of the wax within the pipe-line it used to require costly pretreatment in crude conditioning plants. When the economics of conditioning vis-a-vis additive treatment were compared, it was found that the additive treatment was much cheaper than that of conditioning.

The country used to import additive to the tune of 4000 TPA or even more costing Rs.15-20 crores of hard currency.

NEIST (RRL Jorhat) took up the challenging task of developing an indigenous additive, and after intense work could develop successfully several additives suited to crudes of different areas having different characteristics. Those were mainly ***SWAT 104, SWAT 106*** and *FIRJ-B*. the additives were comparable in *dose, doping temperature and efficacy with the imported additives* used in Bombay High and Eastern crudes.



Sample of flow improver SWAT-104 for tackling of problems pertaining to transportation of crude through pipe lines

Technology transfer status:

The technology had been transferred to Hico Products Ltd, Bombay and Hindustan Pesticides Ltd, New Delhi for commercialization. Hico Products Ltd, Bombay had gone into commercial production of SWAT 104.

The technologies are available for further licensing at a know how fee of Rs. 2.5 lakhs and Rs. 3.00 lakhs for SWAT 104 and SWAT 106 respectively. The technology transfer entails a royalty component of 2% for 2000 TPA for a period of 10 years.

Capital investment:

Rs. 3 crores for a plant of 200 TPA.

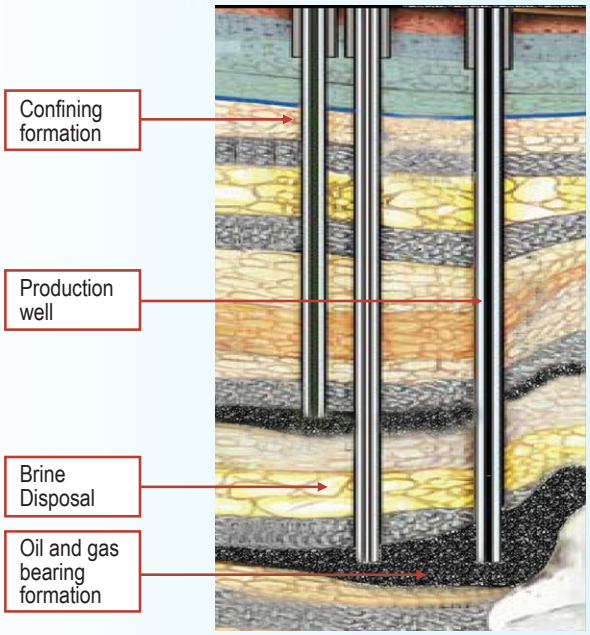
Profitability/benefits:

Substantially high profit margin. Substitutes import. Helps in self-reliance in an important industrial sector like oil.

* THE TECHNOLOGY WAS DEVELOPED AT PILOT PLANT SCALE (100 KG/BATCH). THE TECHNOLOGY PACKAGE INCLUDES PROCESS KNOW-HOW, BASIC DESIGN AND ASSISTANCE IN TRIAL RUNS IN ACTUAL FIELD CONDITIONS AND ASSISTANCE IN COMMISSIONING OF THE COMMERCIAL PLANT.

Tapping the trapped liquid gold

We are at a crucial stage where population is growing in leaps and bounds and the natural resources, once bountiful, are becoming scarcer and scarcer. Particularly, forests are dwindling and fossil-fuels including petroleum sources are depleting fast. The depletion is driving the oil industry and technologists to hunt for better and efficacious methods of oil production. Our transport system and some other sectors of the industry are guzzling up more and more petroleum products as never before. Now, the situation has come to such a pass that oil reserves are going to last for a dismally low period of several decades only and the coal reserves are going to see us through for a period of a couple of centuries or so. However, the present demand-oriented situation has forced us to find out better and more efficient technology to tap the existing reserves.

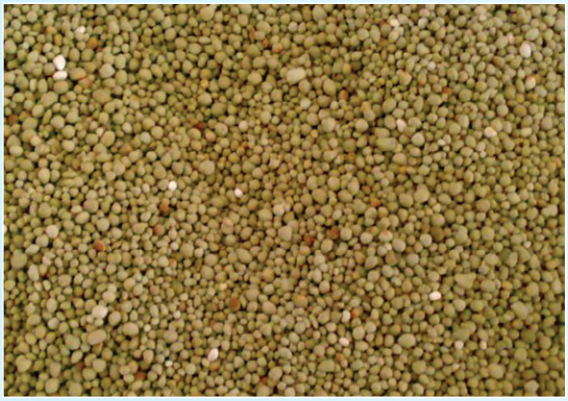


Cross section of an Oil well

Oil Well (After Fracturing Operation)

Nature traps oil (and gas) in subterranean formations which are characterised by porosity and permeability. The permeable and porous nature of the formation facilitates free flow of the oil and gas through it. These characteristics are essential to allow the oil and gas to flow to a desired location to ensure production from the oil-well. In some oil bearing formation, however, the permeability may not be sufficient for efficacious recovery of the oil. In some cases, during production from the well, the permeability gets reduced and further recovery becomes uneconomical. In such cases, to increase the production rate of the well it is essential to fracture the formation and **prop** the fracture in open condition by means of ***propping*** agents or ***proppant*** materials. Fracturing is achieved by pumping a fracturing fluid containing *proppants* at a high pressure down the well bore to overcome the tensile strength of the formation and the weight of the overburden to rupture the formation and create fractures. The proppants are deposited in the fractures and prevent closing when the pressure on the fracturing liquid is released. Thus, the proppants when properly placed provide high permeability in the fractures. Although other

particulates like sand, which may be cheaper and easily available, are used, these have certain inherent short-comings like having less crush-resistant properties. Sand, therefore cannot be used successfully in deep formations. Therefore it has become imperative to look for alternative proppant material which materialized as high strength proppants. At present, the demand of high strength-proppants in India is met through imports at a considerable cost. For the first time in our country, CSIR-NEIST Jorhat in collaboration with Keshava Deva Malaviya Institute of Petroleum Exploration (KDMIPE) ONGC, Dehradun *developed several processes at Laboratory scale* (500gm/batch) for making ***Intermediate*** and ***High Strength Proppants*** conforming to American Petroleum Institute (API) specifications. *The process was subsequently scaled up to 50kg/batch.*



High Strength Proppant - normal view

High Strength Proppants - enlarged view

Advantages (and the positive points):

The process is innovative and not available in the country.
The product can be made from indigenously available raw material, i.e. Bauxite.
The raw materials are abundantly available in the country.
User organization like ONGC is involved as collaborator which ensures a captive market for the product.
The product conforms to American Petroleum Institute (API) recommendation.
The cost of production is low.
The same process know-How may be utilized for producing ***Intermediate*** or ***Low Strength Proppants.***
India can be a leader in manufacture of High Strength Proppants.

Project Economics/Profitability/benefits: Being revised and updated.

Technology Transfer Status:

Memorandum of Understanding (MoU) was signed with a party at Surat on transfer of technology. As a part of the transfer package 3 nos of sample of bauxite were supplied by the party for evaluation regarding its suitability for making high-strength proppants. The results are very encouraging. Another party from Ahmedabad are showing active interest and negotiations are in progress.

Terms for release:

To be negotiated.

Consultancy Services:

Besides process know, CSIR-NEIST offers consultancy services during setting –up of commercial plant which by and large includes advice regarding material and equipment selection, raw material and product evaluation, back-up services etc. The consultancy fee is negotiable.

AWARD:

CSIR TECHNOLOGY AWARDS—2010 HAVE BEEN AWARDED TO NORTH EAST INSTITUTE OF SCIENCE & TECHNOLOGY FOR ***DEVELOPMENT OF HIGH STRENGTH PROPPANTS.*** IT IS SELECTED FOR THE ***INNOVATION*** CATEGORY. THE AWARD CARRIES A CASH PRIZE OF RS. 2.00 LAKH, PLAQUE AND CITATION.

CSIR-NEIST team receiving the CSIR Technology Award-2010 for 'Innovation' from Shri Prithviraj Chavan, Union Minister for Science & Technology at CSIR Foundation Day function held at Vigyan Bhavan, New Delhi on 26 September, 2010. From left to right; Dr. A. Garg, Dr P Sengupta, Dr. D K Dutta. Also seen in the picture Prof. S K Brahmachari. Director General, CSIR

The tree, capable of producing an acid useful to the pharmaceuticals and food industries

Tamarind tree

Long ago, in 1979, M/S Karnataka State Forest Industries Corporation (KSFIC), Bangalore signed an agreement with CSIR-NEIST (RRL Jorhat) for preparation of a design engineering package for production of ***Tartaric acid from tamarind leaves*** based on know-how already developed by NEIST, Jorhat. Meanwhile the process know-how was successfully demonstrated to the parties concerned.

Tartaric acid was found to have a wide application in pharmaceuticals and food industries. It was also used in textile industry and photographic jobs. The complex forming ability of tartaric acid and its salts were used in metal cleaning and polishing. The most common salt of tartaric acid known as 'Rochella salt' was widely used in electro-plating of many metals, e.g. gold, silver, copper, zinc and tin etc. The salt was also an important analytical reagent. In the year 1975-76 over 500 tonnes of tartaric acid was imported. Tartaric acid was imported to our country every year costing a huge amount of (then) scarce foreign exchange. Conventionally tartaric acid was obtained as a by-product from wine industry. As very little wines were produced (then) in the country, it was not possible to meet the demand from that source. NEIST (RRL) Jorhat innovated a process to obtain tartaric acid from an easily available alternative source i.e. leaves of tamarind abundantly available in India, specially in the South and North East. The tamarind leaves contain 4 to 10% tartaric acid depending on the quality of leaves and seasonal variations.

Close view of tamarind leaves

The Technology Status:

The process had been covered under Indian patent no 126391. The process developed by NEIST consisted of digestion of the leaves, the precipitation, (as Calcium tartarate) neutralization, decolorization, and crystallization. All the equipments required for the plant were indigenously available.

Technology Transfer Status:

The technology was released to 3 parties and were in production.

The project has since been abandoned and no further licensing.

Triphenyl and Tricresyl Phosphate

During the '70s, M/S Hindustan Photo Films approached NEIST (then RRL) for a technology to manufacture ***Triphenyl Phospphate (T.P.P) and Tricresyl Phosphate (T.C.P)*** which are plasticizers required in photo film industry. The demand of TPP alone, by M/S Hindustan Photo Films, was estimated at about 200 tonnes/annum. In addition, M/S Mysore Acetate required about 100 tonnes/annum of TPP.

Tricresyl Phosphate which is an important plasticizer is a constituent of various lacquer films and coatings. It also finds its use as an important ingredient of hydraulic fluids and lubricants. TCC is a valuable plasticizer for nitrocellulose, cellulose acetate, ethyl cellulose and vinyl plastics. Tricresyl Phosphate was not manufactured in the country ('70s) and the entire stock was imported. In the 1970s the demand of T.C.P was estimated at about 150 tonnes/annum.

Technology Status:

RRL (now NEIST) took up the challenge and successfully developed the technology for manufacture of Triphenyl and Tricresyl Phosphates. M/S Hindustan Photo Films confirmed the conformity of the product obtained at NEIST, as per the desired specifications.

Raw Materials:

1. For triphenyl phosphate—Phenol and Phosphorous Oxychloride.
2. For tricresyl phosphate—Cresol mixture and Phosphorous Oxychloride.

Project Economics: (as on 1973)

For triphenyl phosphate : (30 tonnes/annum)
Capital investment : Rs. 5 lakhs.
For tricresyl phosphate : (100kg / day)
Capital investment : Rs. 7.5 lakhs.

Technology Transfer Status:

The technology on the aryl phosphates were transferred to 6 parties from Andhra Pradesh, Madhya Pradesh, New Delhi, Karnataka and West Bengal. Two parties went into commercial production.

The technology is being kept in abeyance and hence no more licensing

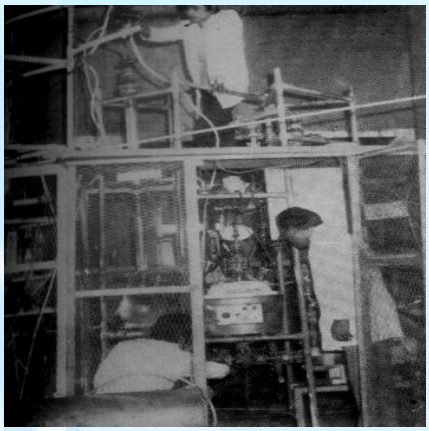
Pesticides - to grow more food to feed the teeming millions

In order to meet the demand of food for the exploding population of the world, pesticides, fertilizers and improved varieties of seeds—along with modern agricultural practices—are widely used to increase the agricultural output. From the middle of the last century upto the '70s, organochlorine and organophosphorous compounds were used in the farms most extensively. However, since late '70s and '80s most of the countries in the world either banned or restricted the use of these compounds. Although residue of organophosphorous compounds do not build up in the body-fat of humans and other animals but its regular presence in human bodies signals danger. Therefore O.P pesticides were also banned since late '70s / '80s.

However, as per demand of the day, those pesticides were abundantly made and used during the last century. The NEIST Jorhat (RRL Jorhat) developed technologies for production of ***Phosphamidon, Quinalphos*** and ***Chlorfenvinphos*** as a group of organophosphorous pesticides which occupied a unique position owing to their high systemic action combined with easy degradability and reduced residual effects to chlorinated hydrocarbons.

The Planning Commission Task Force and NCST Planning Group on Pesticides recommended the development of indigenous technologies to meet the requirements of the country. Accordingly, among other Chemical Group of Laboratories of CSIR, NEIST (RRL Jorhat) undertook the work and developed the technologies.

PHOSPHAMIDON:-



Phosphamidon, an organophosphorus pesticide was developed and Pilot plant installed.

An important organo-phosphorous synthetic insecticide extensively used in various crops. It is specially effective against aphids, stem borer, leaf hoppers, mite thrip, grass hoppers, ball worms, white flies etc.

Project economics:

Estimated cost for a battery limit plant of 300 TPA around Rs. 2.5 crores.

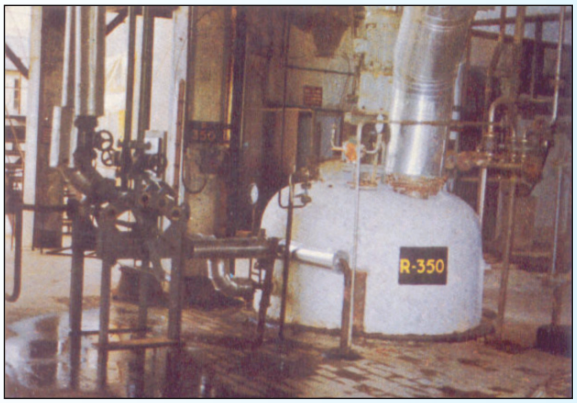
Technology package:

Process know-how, basic design package, quality assurance method, process demonstration, data on effluents, assistance in implementation and commissioning.

Technology transfer status:

Released to 4 parties. Was in production.
* SINCE THE PRODUCT IS BANNED / RESTRICTED NO MORE TRANSFER CAN BE EFFECTED. PROJECT IS ABANDONED.

QUINALPHOS:



Quinalphos pilot plant developed at NEIST

Quinalphos is one of the most commonly and effectively used insecticides of which process know-how was developed in India by NEIST Jorhat. It is effective against biting and sucking insects as well as mites and plant hoppers. This broad-spectrum organophosphorous insecticide was used for control of pests in cotton, paddy, groundnut, tobacco, vegetables and fruit crops. It had the unique property of being an insecticide as well as an acaricide.

Major raw materials and equipments:

O-phenylene diamine (OPDA), Sodium monochloroacetate, Diethyl thiophosphoryl chloride (DETC), Xylene, Potassium carbonate**;** SS and MS glass-lined reactors, heat exchangers (SS), storage vessels and boiler.

Project Economics:

Estimated investment for a battery limit plant of 1 TPA= Rs. 7 crores.

Technology status:

The technology was developed at pilot plant level. The technology package contains process know-how, basic engineering for 200/300 TPA plant, performance guarantees, C/B registration data, data on effluents, assistance in implementation and commissioning.

Technology transfer status:

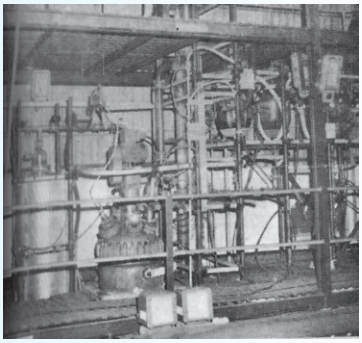
Released to 3 parties. Were in production.

* THE PROJECT IS ABANDONED. NO MORE RELEASE.
THE PRODUCT WAS BANNED/RESTRICTED AS FOUND TO BE HARMFUL TO ANIMALS AND HUMAN BEINGS.

CHLORFENVINPHOS:

◂ Dr.G Thyagarajan, former Director, RRL-Jorhat transferring the Chlorfenvinphos technology to Mr. A Van der Giessen, the then chief Technologist of NOCIL plant. At the centre is Mr. S G Krishnan, Senior Executive of NOCIL, Bombay.

Prof. Hasan, Vice President, CSIR switching on the CFVP pilot Plant



Integrated semi-commercial chlorfenvinphos pilot plant at NEIST

NEIST Jorhat (RRL JT.) successfully developed know-how for manufacture of technical Chlorfenvinphos which was most effective against soil insects for the control of root flies, root worms and cut worms. As a foliage insecticides it was recommended for the control of Colorado beetle on rice crop and stem borers on maize, sugar cane, rice, potato hoppers, leaf hoppers on rice and sugar cane. Extensive bench scale and pilot plant investigations were carried on to develop a commercially viable technology. Critical design data were marshalled.

Project economics:

For 300 TPA capacity plant = Rs. 3.5 crores (1981)

Profitability:

% return on fixed capital (including depreciation) = Rs. 14.0 million

Technology transfer status:

Technology transferred to M/S National Organic Chemical Industries (NOCIL) Mumbai. The Laboratory provided process know-how and engineering consultancy including basic design engineering.

* THE TECHNOLOGY IS ABANDONED AS THE PRODUCT IS BANNED.

Microcrystalline wax

Most of the crude oils produced in our country, particularly the Assam Crudes are highly waxy. Due to the high pour point a portion of the wax gets deposited on the pipe-walls during production and transportation and as tank-bottom sludge in the storage tanks. The waxy contents thus deposited contains high melting microcrystalline wax besides asphaltics. Regional Research Laboratory (now CSIR-NEIST) Jorhat successfully developed a process know-how for manufacture of ***Microcrystalline Wax from tank-bottom sludge and wax scrappings.***

The Technology:

The process consists of the following steps:

1. Settling to remove the sediments
2. Dehydration
3. Distillation
4. Acid treatment
5. Clay treatment
6. Filtration

Uses:

Microcrystalline wax is widely used in the manufacture of petroleum jelly, carbon paper coatings, crayon and coloured pencil leads, as extrusion lubricant, in packaging and wrapping industries, in adhesives for shoe production, in printing and engraving etc. petroleum jelly is extensively used in pharmaceuticals, textile and paper industry and shoe polishes etc.

The Demand:

The microcrystalline wax was in high demand. In 1994-95 more than 6000 tonnes were imported from abroad. During that time the wax was priced within the range of Rs. 75/kg depending upon the type of wax.

Raw Materials:

It was estimated that about 12-15 thousand tonnes of raw materials would be available in our country. In the North-Eastern region raw materials were available to produce at least 450-500 tonnes of micro-wax per annum.

Technology Transfer Status:

The technology was transferred to 3 parties out of which one, M/S Dhanuka Industries Pvt. Ltd. Calcutta, (factory located at Namrup, Assam) went into commercial production.

The technology is being kept in abeyance and hence no more licensing.

An alternative writing material: cheap but attractive

Plastic slates

As technologies like paper slate and chalk pencil could cater to the needs of the children of the weaker sections of the society, the rural and urban poor and reach the unreached to provide low cost writing materials in order to facilitate education at a cheaper cost, NEIST Jorhat had also worked to meet the needs of the middle-income segment of the society which is albeit not an insignificant part of the population.

NEIST developed a process for the production of ***Plastic slates*** using indigenously available raw materials and easily procurable equipments and chemicals. The process basically consists of pressing plastic sheets of desired size and shape in a hot press, pretreated with chemicals.

Advantages:

Unlike conventional wooden or clay slates plastic slates are not breakable

Lighter in weight and therefore easy to carry by children

Bright, and can have different colours, and therefore attractive to children

Ultimately cheaper than clay slates because of unbreakability

Project economics:

Around Rs. 10 lakh for 200 slates/day capacity unit .

Major raw materials and equipment:

Plastic sheets, chemicals, hot press and cutters.

Profitability/benefits:

Low capital intensive, having high profit margin. Beneficial to the society in the "education for all" campaign.

Technology transfer status:

Released to 22 parties from all over India. 10 were in production.

A basic material which took the human civilization forward

Printing ink-commercial sample

To record events, thoughts, impressions, accounts, estimates, ideas,-- anything which crosses one's mind needs to be recorded so that these do not fade away from the memory. So, man discovered pen, paper and ink to facilitate recording and preservation for the present as well as the future. Writing and printing ink were such items which contributed a great deal towards our present day human civilization. This piece of writing is directed towards one of such items, i.e. the ***printing ink*** which was and still is in great demand all over the world. As this item was monopolized by a few big houses, NEIST (then RRL Jorhat) developed a formulation, with indigenously available raw material, for different shades of letter-press and offset printing ink so as to make the product in the market competitive, relatively cheap and the technology to be available to small and medium scale sectors of industry.

Major raw materials and equipments:

Chemicals; multiple roller mills, mixing machine.

Project economics:

A unit of 100kg/day capacity plant is around Rs. 10 lakhs (subject to locational variations)

Profitability/benefits:

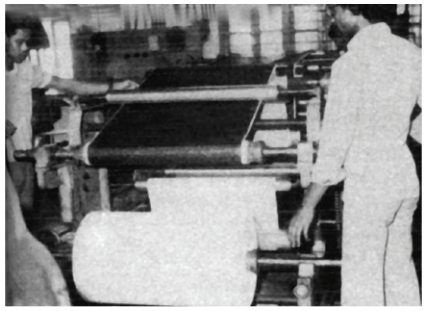
- High profitability
- Employment generation, can benefit small scale sectors of industry

Technology transfer status:

Released to 2 parties. In production.

An important office stationery item of the twentieth century

Carbon paper was an important office stationery item during the major part of the twentieth century. It was an easy method to obtain copy or copies of type-written pages by inserting carbon copies, and therefore, the stationery item was in great demand. In India the item was monopolized by a few big houses like Kores, and the technology, although simple, was not available to small or medium scale investors.



A sectional view of the carbon paper plant of M/S Poly Products, Guwahati

Commercial samples of carbon paper

NEIST Jorhat (then RRL) developed a simple, low capital intensive process-know-how to produce ***carbon paper*** from indigenously available raw materials. It developed two coating formulations for application on the carbonizing tissue to produce carbon paper.

Raw materials and major equipments:

Paper sheets, chemicals, Ball mill, carbon coating unit, boiler, cooling unit, gravure printing unit.

Project economics/capital investment:

Capital investment for 500 boxes/day capacity unit: around Rs. 30 lakhs.

Profitability/benefits:

Very high profit margin. Entrepreneurs with low capital, low skill can start an industry.

Technology package:

Process know-how, technical assistance, assistance in commissioning.

Technology transfer status:

Released to one party. In production. The know-how is protected by a patent.

A stick of coloured wax for writing or drawing

As the inclusivity of education widenes up, there is more and pressing need of writing or drawing materials. Particularly in the elementary level the demand of basic stationery material like crayons grows exponentially. Besides chalk pencil, NEIST also developed a simple technology to manufacture ***coloured wax crayons*** to meet various segments of our society. The technology is suitable for micro-sector industry.

Uses:

Mostly used in arts and drawing. Extensively used by children at elementary level, particularly in the urban sector.

Advantages:

1. Law capital intensive
2. Suitable for a cottage/ micro industry
3. Minimum power requirement
4. Eco friendly
5. Non requirement of skilled labour
6. No major or sophisticated equipments
7. Suitable for rural as well as urban areas
8. Utilization of indigenously available raw-materials

Demonstration of wax crayon making

Capital investment:

Rs. 25,000.00 (for 500 packets/day)

Training Module:

Training provided at NEIST (including Branch Laboratories and Substations). For SHGs, NGOs and SC/ST training is provided in groups as per mutual convenience.

Chalking out a grandiose plan

A sprightly young man, Pratim Jyoti Baruah, just graduating in Economics from Symbiosis College, Pune started looking for a job without wasting much time. Son of a School Teacher from Sivasagar, Assam he wanted to stand by his father and be an active earning member of his family. Pratim was very much aware of the pressing needs of the middle class families of our society. To avoid the turmoil and bickerings arising out of cut-throat competition, and evils of nepotism, favouritism and all kinds of isms he looked only for private-jobs and not the few government services. His smartness and visible persuasive nature could land him a job of stationery marketing.

He was given the task of selling Rotomac and Laxi pens. Like ducks taking to water he plunged head-long into the dynamic market of stationery items like Rotomac pen. And he did a grand job! He recorded the highest sales of Rotomac and Laxi in Assam, Meghalaya, Nagaland and all the other states of the North Eastern region. But he did not remain satisfied with his success, because he thought it might be a `flash in the frying pan'. Because market is volatile, uncertain and unpredictable, specially of stationery items in the North-Eastern region. Then again, another thought flashed through his mind. Instead of selling company products, WHY NOT SELL HIS OWN PRODUCT? Absurd! Day dreaming! What to produce? How to produce? But his better part of mind said, "Why not? you can do it. Concentrate. Open your vistas." Like a streak of lightining, the word `Chalk' came to his mind. Why not Chalk-pencil? Meanwhile, while selling pens, he observed the market demand of dust free chalk-pencil, because people are becoming aware of the hazards of chalk-dust in class-rooms of schools and colleges. There is a demand for coloured crayons too. Astute Salesman's instinctive mind could tell him that because of too much breakage of chalk-pencils on transit while transporting from far away places like Agra and Rajasthan, chalk-pencils are costlier in the North East than those of the other parts of the country. So, if it is made in Assam, naturally one should be able to sell it at a competitive price and even could beat the giants in the field like Kores. It is interesting to note that chalk-pencils are brought to the North-East not only from U.P, Bihar, Rajasthan or Mumbai, these are also imported from Korea and China. So, Pratim Jyoti Baruah thought of converting the disadvantage of breakages of the fragile chalk-pencils to his advantage. Then again, he could derive another advantage. While working for Rotomac he got the feel and the pulse of the market. He can sell.

He had been hearing about the North-East Institute of Science and Technology, situtated nearby at Jorhat. He was aware that this Research Institute is working for the welfare of the North Eastern region. It is also developing appropriate technologies for the micro-scale sector of the industry.

Baruah approached NEIST, Jorhat (then known as RRL Jorhat) and enquired whether they could provide a technology for manufacture of Dust Free Chalk Pencil. And hey presto! the technology was ready right there on the shelf! To be transferred! To an appropriate entrepreneur!

In June, 2003 the Dust Free Chalk Pencil technology was transferred to Shri Pratim Jyoti Baruah,

Inside view of the factory

Proprietor, Penguin Distributor. The technology was properly transferred and demonstrated to his satisfaction. Basically intelligent and inquisitive, Barua could master the nitty-gritties and the intricacies of the process, and returned home, a satisfied and accomplished man, full of hopes and aspirations.

Pratim Jyoti took a loan from his father, a measly sum (for establishing an industry) of Rs. 35,000/- only. Rs. 35,000/- + blessings from his father + zeal + business acumen, was his capital!

After a lot of huffing and puffing and shedding copious sweat of his brow, Pratim could set-up the Dust Free Chalk manufacturing industry on the backyard of his parental house at Sivasagar Town in Upper Assam. Initially he was producing 600 pieces of Chalk pencil per day. As a reward to his perseverance, industriousness and the efforts of NEIST Scientists, the technology had proven and Baruah could produce quality products. The product received immediate acceptance by the market. Demands came pouring in. Convinced about the marketability of the products within three months he increased the capacity of the plant to 1000 pencils per day. But he could not satiate the market demand! He received lot of orders from all over Assam, But could not produce that much and therefore could not supply. He was sad! But not disheartened. He started thinking how to achieve

Commercial products manufactured using NEIST technology

the desired results. Baruah brought in a piece of drama into the scene. He closed down the factory, took a holiday for six months and left Assam. Not in search of pleasure or recreation but in search of improved, high capacity machinery.

He met with immediate success. After traveling a lot in U.P, Bihar, Rajasthan and Mumbai, he came across his `dream machinery' which is capable of producing larger number of chalk-pencils per day. After six months from the `Shut-down', enriched by experience and fortified with much improved machinery, he started producing 50,000/- pieces of Chalk-pencils per day. After a few months, production went up to 1,00,000 (one lakh) per day. Baruah captured the entire market in Assam and could spread his tentacles to all the states of North-East including Tripura. He went on capturing market in Siliguri and Kochbehar in North Bengal. It is worthwhile to mention that Baruah's Dust Free Chalk Pencil goes to Bangladesh through Agartala and to Bhutan through Kochbehar. Now he produces 1,50,000 (one lakh fifty thousand) pencils per day. As on today his total turnover comes to about Rs. 6 lakh per month. Quality and price-wise he can out-class, hands down, products from Mumbai, Korea and even China. Of late, he has also started producing and marketing coloured crayons which he produces in four different colours. Wonder of wonders! Baruah's coloured Chalk pencils are much lower in price than those of other Indian, Korean or even Chinese products. No doubt, Shri Pratim Jyoti Baruah's eventful journey through the path of progress armed with the technology of NEIST, and a meagre capital of Rs. 35,000/- to start with, to a sumptuous amount of Rs. 6 lakh per month turnover, is indeed a glorious one and an eye-opener to thousands of unemployed youths of the country.

Done away with carbon

The society always crave for a better product. To obtain duplicate or triplicate copies of a type-written piece, one was required to insert carbon papers in between the paper-sheets. That was cumbersome and likely to leave smudges. NEIST (then RRL Jorhat) developed a ***Carbonless Copy Paper*** (CCP) or No Carbon Required Paper (NCR paper) for making multiple copies without the use of carbon inserts. The system of producing CCP depends on two coated surfaces, one as a donor or transfer surface and the other as a receiver or acceptor surface. The transfer surface is covered by a coating of microencapsulated colourles dye intermediate, while the receptor surface contains clay- like material, which developed the colour of the colourless intermediates on rupturing. The process consists of encapsulation of colourless intermediate, selection of clay-like materials for the receptor sheet and finding out suitable base paper NCR coatings. NEIST developed a process based on microencapsulation technique for no-carbon-required paper.

Commercial samples of specialty papers developed at NEIST

Advantages:

Removes the disadvantages and limitations of the conventional carbon papers like smudging, cumbersomeness, wastage of time etc.
Suitable for use in electronic data processing equipments, computer, teletype and others.

Major raw materials and equipments:

Microencapsulated colourless dye-intermediates, gums and gelatin, cellulose powder and base paper. Mixing tanks, filtration unit/centrifuge, microencapsulation unit, reaction vessels, boiler, homogenizer, emulsifier, ball-mill, attritor mill, storage vessels, coating machine, rewinding and cutting unit.

**Project economics:*

Rs. 80 lakhs for 150 tonnes/year plant

Profitability:

The product has high profit margin.
*On as is where is basis

Technology package:

The process know-how, demonstration, trial run and assistance in commissioning.

Technology transfer status:

Released to 3 parties. In production.

Paper not for writing

Sounds strange but true. Gradually and significantly there is a shift in products based on paper; and newer and newer grades and types are evolved and produced in this segment of the industry. We are talking of specialty paper industry which at present shares a sizable segment of industrial products. United States of America alone occupies an astounding $ 8.0 billion market. India's market is expanding at a phenomenal rate. The speciality paper industry comprises broadly

- consumer packaging
- food processing
- printing
- food service
- industrial packaging
- labelling
- sanitary/hygiene
- tape and so on.

Keeping pace with time and market demand NEIST (RRL), Jorhat developed several specialty papers, out of which this piece of article deals with Thermographic Paper (Heat Sensitive Paper), Correction Paper and Direct Copy Paper (DCP)

Technology development:

1. DEVELOPMENT OF KNOW-HOW FOR THERMOGRAPHIC PAPER

Thermographic papers or heat sensitive papers are normal tissue paper with a coating of special type of azodyes on its surface to make the papers sensitive to thermal impulses and record the same graphically. These specialty papers are used in Elecro-Cardiographmachines to record even the minutest movement of the rollers in the machines actuated due to the force of blood movement in the arteries of human heart. NEIST Jorhat developed a technology to manufacture this important speciality paper, i.e. Thermographic Paper.

Commercial products made based on NEIST Technology

Commercial products made by Strobel Industry based on NEIST Technology

Uses:

In ECG machines and G.L.C, G.P.C machines.

Major raw materials, equipments:

Indigenously available chemicals, base paper; mixing mill, coating unit, rewinding, cutting and slitting machines, storage tanks etc.

Project economics:

Rs. 50 lakhs for 500 kg/day capacity plant. (depending on locational variations)

Profitability:

High profit margin.

Technology package:

Process know-how, lab-scale demonstration, and assistance in commissioning.

Technology Transfer Status:

In 1984 Strobel Industries, Nizamabad, Andhra Pradesh successfully commercialized NEIST (RRL) technology on Thermographic Paper.

Chiragdeep Paper Innovators, Bhopal and Eastern Paper Industry had gone into commercial production in the year 1988 and Hi Tech Paper Co., Karukutty, Kerala started commercial production in the year 1991. The Technology on Thermographic Paper was transferred to 11 parties out of which 5 parties were in production.

2. DEVELOPMENT OF KNOW-HOW FOR CORRECTION PAPER

Commercial sample of correction papers

NEIST Jorhat developed a formulation based on indigenously available raw materials for making Correction Paper for correcting type-written errors.

Technology transfer status:

Released to 5 parties. In production.
THE TECHNOLOGY IS KEPT IN ABEYANCE. THE PRODUCT IS OBSOLESCENT.

3. DEVELOPMENT OF KNOW-HOW FOR DIRECT COPY PAPER (D.C.P):

D.C Paper manufactured by M/S Strobel Industries, Nizamabad (Andhra Pradesh) based on NEIST Technology

Direct Copy Paper is a pressure sensitive copying paper which eliminates the use of conventional carbon paper for making copies of a typed paper. The transfer material, which is coloured, is coated on the under-side of the paper. Copies are made by applying pressure on the coloured surface placed over a specially coated receptor surface. The NEIST process involves preparations of coating mixtures for both transfer and receptor coatings. The front face of the base paper is coated with the transfer coating and the rear face with the receptor (receiver) coating.

Uses:

D.C paper finds use in forms, air tickets, shipping documents, computers and other electronic data processing machines.

Technology transfer status:

Released to 10 parties. 3 in production.

THE TECHNOLOGY IS KEPT IN ABEYANCE. THE PRODUCT IS OBSOLESCENT.

Packaging stationery - an important component in marketing

Commercial sample

It is imperative for us to 'Produce more and market more'. In order to keep our economy going strong and dynamic, production must be able to keep pace with marketing and vice versa. Both are complementary to each other, and two sides of the same coin, i.e. development.

To enable proper marketing of a product, proper packaging is absolutely necessary. Packaging not only makes the product attractive, presentable and convenient to carry, it also provides physical protection which is essential for its durability, preservation and transportation. It also acts as a barrier against shocks, temperature variations, water, dust and dirt. NEIST Jorhat developed a simple technology of ***Gummed paper tape*** which is an essential component suited for sealing of soft packaging materials. Gummed paper tapes are manufactured by uniformly coating one side of the base paper with a water soluble adhesive composition. The paper tapes are used for sealing corrugated and solid fibre containers, paper bags etc.

Uses:

Extensively used in

- Paper mills
- Plywood
- Pharmaceutical and other industries.

Major raw materials/equipments:

Chemicals, paper strips; paper coating machine, slitting machine, reel making unit.

Project economics:

Around Rs. 10 lakhs/ 500 rolls/day capacity

Profitability/benefits:

Highly profitable. Suitable as a small scale project with relatively low capital investment. Does not require high skilled manpower. Easy to operate industry.

Productive utilization of a hugely available cellulosic waste

Blessed with copious rainfall and plenty of sunlight, all the states in the North-Eastern region of India are abundant with banana plants. After harvesting of the fruit the remains of the plant, stem and leaves simply go waste—decomposed and integrated with the soil. Therefore, a huge amount of this valuable cellulosic material just wait to be utilized for an appropriate and remunerative use.

North East Institute of Science & Technology, Jorhat worked on ***Production of Banana Fibres*** in order to economic utilization of this vast amount of wastes available in the N.E region.

Banana Fibre after extraction

Twines from banana fibre

NEIST developed a Know-How for extraction of fibres from banana pseudo stem for various uses. One of the major utilization is production of ropes and twines from banana fibres. Twines are described as "strong, coarse string of twisted strands of fibre" (IS : 1912-1984) which are used for binding purposes. Single ply twines are used for making coarse, woven fabrics like hessian and sackings required for container to store or transport a large variety of commodities.

Various uses :

- Twines and ropes
- Kitbags, toolbags and luggage covers
- Doormats and coarse carpets
- Decorative items
- Hessian and sackings
- Brushes and straps
- Fabrics
- Handmade papers

Project Economics (cost):

Rs. 2600.00 per tonne of banana fibre per day
Rs. 11,000.00 per tonne of 3-ply twines for a 300 tonne/year

The cost of raw materials, equipments and chemicals are taken at Jorhat situation. The cost may vary as per location.

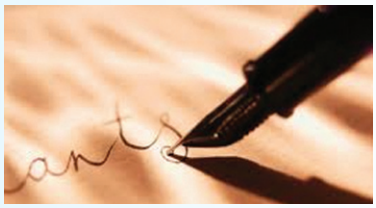
Advantages:

- Low capital intensive
- Quick return on investment
- No sophisticated machinery
- Eco friendly
- Short gestation period
- Utilization of locally available biowaste
- No high-skilled man power

Three R's - Reading, 'riting and 'rithmetic

Reading, writing and arithmetic are the fundamentals learnt in elementary schools. These three R's are the base line of our civilized society. In this article we would be dealing with only one of those--the writing. At an elementary stage our children obviously need the writing material, say paper, pen and ink or a pencil. In poverty-stricken rural and semi urban areas the poor people find it extremely difficult to use paper and pen, specially at the elementary level, because of the cost involved in it. Therefore, they prefer to use slates and pencils made from clay. In the North-East these clay slates are not manufactured and therefore these are brought from out side the state. As clay slates are fragile in nature these are highly breakable and in the long-run becomes costly. Keeping in mind all these factors, NEIST, Jorhat developed a low cost technology to manufacture **slates from paper** material during 1972-1973. At that time writing slates were in high demand all over India and therefore this technology developed by NEIST met with an instant success. The paper slate technology was received very well by the entrepreneurs, and was transferred to 83 parties from Assam, Madhya Pradesh, Tamil Nadu, Uttar Pradesh, Maharashtra, Orissa, Bihar, Rajasthan, West Bengal, Nagaland, Haryana, New Delhi, Gujarat, Karnataka, Tripura, Andhra Pradesh, Kerala and Himachal Pradesh.

Writing materials-- quill and ink- pot



Writing materials— pen and paper

Low cost paper -slates developed at NEIST

Raw materials:

Paper boards, chemicals, wooden or bamboo frames.

Project Economics:

Capital investments for a 200 slates/day unit: Rs. 2,00000/-

Technology transfer status:

Transferred to 83 parties and in commercial production. It was one of the most licensed technologies transferred by CSIR through National Research Development Corporation of India.

Advantages of the NEIST Technology:

The product is:

- Non breakable
- Inexpensive
- Light in weight
- Durable

The technology is:

- Eco friendly
- Low capital intensive
- Labour intensive and hence provider of employment to both unskilled and semiskilled.

Training Module:

Training provided to the entrepreneurs at NEIST (including Branch Laboratories and substations) or onsite as per the convenience of the entrepreneurs.

For SHGs, NGOs and Backward class (SC/ST) beneficiaries the training provided in groups at their suitability.

The Story of Sagacious Singhs

An Engineering graduate and a post-graduate diploma holder in Business Administration from Bangalore, Rajkumar Birendra Singh hails from Manipur, a small state tucked away in a corner of the north-eastern part of the country. Its remoteness and geographical isolation can be gauged by the fact that it is bounded by the Indian states of Nagaland to the North, Assam to the west, Mizoram to the South-west and by Myanmar (Burma), a foreign land to the South and East. Completely land-locked, Manipuri life entirely depends upon the supply of essential commodities like, medicine, fuel and food items transported through roads passing through its neighboring states. Vagaries of nature and political disturbances often play havoc with the life of the inhabitants of Manipur, as it lacks a rail link with the rest of the country.

Shri Rajkumar Birendra Singh

Shri Maibam Dhanbir Singh

Rajkumar Birendra Singh is from this background. He however inherited the valiant and indomitable martial spirit of his ancestors who in earlier times had to face attacks of marauding hordes from Burma (at present known as Myanmar). Birendra Singh had been nurturing a dream from his very childhood to be independent ("I always had a dream of doing something of my own", he said to us, when interviewed – Editors) and therefore, he did not run after cushy government jobs, instead he took up the challenging task for setting up an industry in Manipur, the least industrially developed state within North East which chronically suffers from communication bottlenecks and other hazards arising out of its geographical isolation and geopolitical situation.

Rajkumar Birendra Singh, surveyed the Imphal (the capital city of Manipur) market and noted down a few products, other than food items, which are brought from outside the state.

Being an educated and informed man, naturally he visited NEIST at Jorhat in search of technologies which can be commercialized without investing a heavy amount. In fact he wanted a technology suitable for a micro scale sector which should be low capital intensive having no scarcity for raw materials. His searching mind chose a technology developed at NEIST to manufacture "liquid deodorant cleaner", which is widely used for a variety of purposes viz. cleaning of floors and tiles, bathrooms and toilets, polishing glass and ceramic articles etc. Now-a-days these are widely used in hospitals and nursing homes, homes and hotels, seminar halls and auditorium and such other public places for keeping the places clean, odour-free and in an antiseptic condition. On the top of it NEIST product is ecofriendly, basically organic, safe and free from harmful chemicals.

Inside view of the factory

Rajkumar Birendra Singh wanted to capitalize on these strong points of this eco-friendly product and thought of projecting these features as selling points. As contemplated he acquired the technology from NEIST and got himself trained.

At last his dream came true and joining hands with another young, educated entrepreneur Shri Maibam Dhanbir Singh, set-up the Industry at the Industrial Estate, Imphal, Manipur. Initially they started with a production capacity of 200 litres per day. Now, after capturing 40% of the market demand, they are gaining confidence and hope to capture more market share. At present their total turn-over is worth Rs. 26 lakhs per annum which has a potential to go up to 80 lakhs or even 1 crore per annum. M/s Aroma Healthcare of the Singhs are leaving no stone unturned to popularize their product trade-named BIOKLEEN throughout the North-Eastern states. Very soon they are contemplating to increase the capacity of their unit to 600 litres per day.

Commercial product manufactured using NEIST technology

By setting up an eco-friendly chemical industry in a state like Manipur of the North-East and successful marketing of the product and also providing employment to 15 people is really commendable and an eye-opener to the Manipur youths.

Waste not, want not

If we know the art of looking, we can see that nature does not allow anything in this bio-sphere to go waste. We all are very much aware that wastes from animals are used up by the plants as supplier of nutrients. Wastes from plants are used by the animal kingdom directly or indirectly. There is a natural recycling of wastes in our ecosphere.

The process being demonstrated

North East Institute of Science and Technology, Jorhat has focused on utilization of wastes to convert those into wealth so as to increase productivity on one hand and control of the wastes on the other. Caffeine from tea wastes, Boards and Paper from recycled fibre, fibre from banana stem, Mushroom cultivation using agricultural wastes, Micro crystalline wax from sucker-rod-wax, a waste from oil industry , furfural from agro-industrial wastes are a few among many to name. Recently, NEIST developed a technology for manufacture of ***Hand Made Paper and Boards from Recycled fibre.*** The strength of the technology is the use of various types of raw materials (wastes).

Uses:

Hand made paper and board have manifold uses in office stationery as file-covers, file boards, in printing and packaging industries, invitation and visiting cards, lamp-shades, carry-bags and a wide range of decorative items.

Raw materials:

Conventional raw materials like rags and waste papers, water hyacinth, banana fibres etc. can be utilized depending upon the availability of the raw-material in a particular locality.

Capital investment:

Rs. 14.40 lakhs for production of 200kg of hand made paper and board/day. The cost includes the plant and equipments and factory-shed.

Profitability/benefits:

Monthly profit: Rs. 55,563.00/ month
% of profit by sales: 31.75%
% of profit on capital investment: 46.29%

Employment generation:	Skilled	9
	Unskilled	11
	Others	4
	Total =	24

Technology status: Released to 3 parties. In production.

Advantages:

Quality product
Eco friendly
Waste utilization
Export potential
Increasing internal market demand

Hon'ble Prime Minister of India

Dr Manmohan Singh

declared the decade 2011-21 as the decade of innovation in the 97th Indian Science Congress held at Thiruvananthapuram. CSIR-NEIST holds the promises for future innovations that can rid the society of the drudgery, unemployment and economic backwardness