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# NEWSLETTER



ON  
ENVIRONMENTAL BIOTECHNOLOGY

*Department of Environmental Science*

**University of Kalyani**

**EMCB-ENVIS**

WORLD BANK ASSISTED ENVIRONMENTAL MANAGEMENT CAPACITY BUILDING TECHNICAL MANAGEMENT PROJECT(ENVIS -EMCBTAP)

## EDITORIAL

*Environmental Pollution abatement is the primary task of the present century to save the vanishing biosphere on earth. The new era of Environmental Biotechnology puts forward enormous opportunities towards a solution of this problem. This EMCB-ENVIS node for Environmental Biotechnology attempted to collect all information relating to research publications and activities of various organizations currently under operation. All the information is then disseminated through newsletters, reports and also a dedicated website of the node([www.kuenvbiotech.org](http://www.kuenvbiotech.org)).*

*S.C.Santra*

*Envis InCharge*

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## **PROFILE OF EMCB-ENVIS NODE # 27**

Environmental Information system (ENVIS) was established in 1984 as a network of Information Centres. It was planned by the Ministry of Environmental and Forest. The aim of this centre is to provide descriptive data and environmental subject related numerical data. At present a total of 35 centres are working under the network on various subject areas of the country. The focal point of this network is at the Ministry of Environment and Forest, Government of India, New Delhi.

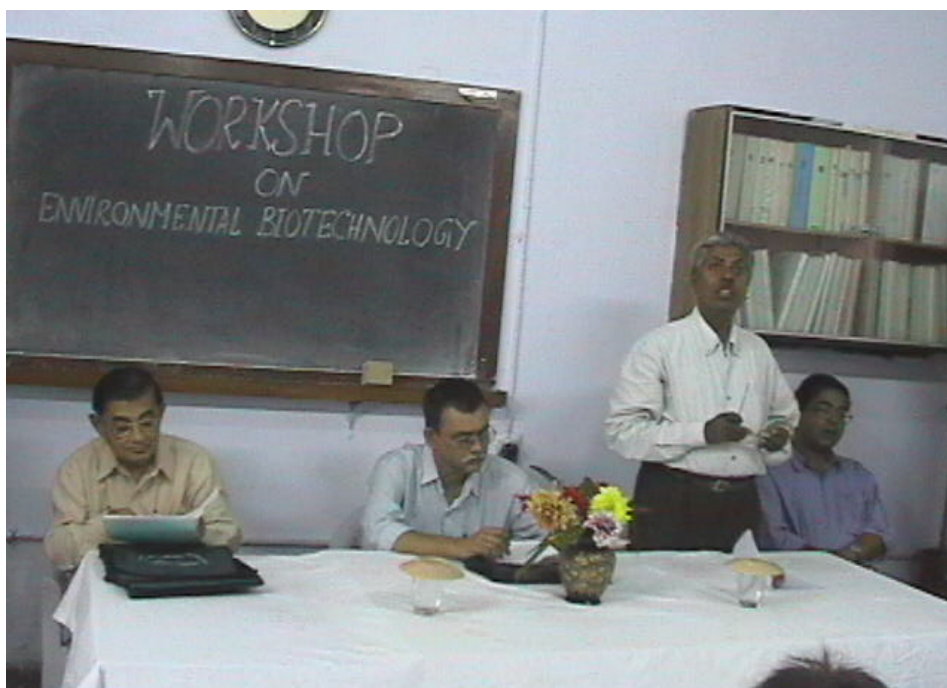
EMCB-ENVIS Centre # 2) was established in June, 2002 for studies on Environmental Biotechnology at the University of Kalyani, Department of Environmental Science, Nadia-741235, West Bengal.

The objective of this Centre is to collect data, related to the above mentioned subject, from different journals, Annual Reviews, Internet and to generate a database and to create and maintain a web-site with this database. The aim of creating the compilation of the reports/abstracts is to help the interested research workers, scientists, administrators and the interested public for better planning of environmental issues in future. The current newsletter is the second publication of this EMCB-ENVIS Node.

## **CAMPUS NEWS**

### Training workshop on environmental Biotechnology

21st March, 2003



*view of the workshop*

The Centre organized a training workshop on Environmental Biotechnology in March 2003; a total of 21 participants took part in the workshop. Dr. A. K. Sanyal, on behalf of the ENVIS Centre, Zoological Survey of India, Kolkata also attended as an observer. Lectures were delivered by different resource persons from different Universities and Research Institutions of West Bengal; some of the lectures were as follows:

- ✍✍ Environmental Biotechnology: Progress & Constraints- Prof. K.R.Samaddar
- ✍✍ Biotransformation: A Useful tool for design & detoxification of organic molecules by microbes- Prof. Timir B Samanta
- ✍✍ Bioremediation of Chromium Pollutants- Prof. A. K.Paul
- ✍✍ An investigation on the effect of some heavy metals in *Pisum sativum* in *invitro* condition.- Prof. P.D. Ghosh
- ✍✍ A novel technology of composting of rural and urban wastes by two step fermentation system - Prof. N.B.Sinha



*A view of workshop*

*Photos: courtesy of Punarbasu Choudhury*

All the participants and resource persons made an interactive seminar for better linkages of research in Environmental Biotechnology.

The Department is going to organize a national conference with active participation of the ENVIS node. The details are given below:

NATIONAL CONFERENCE ON  
**RECENT ENVIRONMENTAL CHANGES -  
ITS IMPACT ON HEALTH, AGRICULTURE AND  
ECOSYSTEM**



**Organised by**  
Department of Environmental Science  
University of Kalyani, Kalyani - 741 235  
Nadia, West Bengal

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NATIONAL CONFERENCE  
ON

RECENT ENVIRONMENTAL CHANGES – ITS IMPACT ON HEALTH,  
AGRICULTURE AND ECOSYSTEM

6-7<sup>TH</sup> August, 2003

Organized by  
Department of Environmental Science  
University of Kalyani  
Kalyani, Nadia, West Bengal  
*In Collaboration with*  
Loyola Aquatic Insect Biodiversity Society  
Loyola College, Chennai, India

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An early action in this matter is highly appreciated.

With regards  
Yours sincerely

Prof. S. C. Santra  
Organizing Secretary

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# BIOTECHNOLOGY IN WESTBENGAL- Vision 2002

The mission of the Department of Science & Technology , Government of West Bengal is to ensure scientific and technological empowerment of West Bengal's human resources. The aim is to create a strong infrastructure both for research and commercialization . The intention is to launch a major well directed effort for generation of products, processes and technologies to enhance the cost effectiveness and productivity of agriculture, modern medicine, pollution control, bio-diversity conservation and bio-industrial development .

In a nutshell , we aim to

1. Generate skilled manpower;
2. Enhance the knowledge base;
3. Strengthen the existing infrastructure and create a new infrastructure;
4. Map the bio-resources of west Bengal ;
5. Develop entrepreneurship programmes in the rural sector, special programmes for women's development, SC/ST and enhance industrialization at the cutting edge of science.

The salient features of Biotechnology in West Bengal are as follows:

- 1) Induction of Biotechnology at the grass root level .
- 2) Mapping of Bio-resources of West Bengal .
- 3) Development of Infrastructure
- 4) Human Resource Development
- 5) Regulatory policies
- 6) Specific incentives like Sales Tax, Land for Biotech Park/ Companies

Power supply- exemption from power cuts, labour concessions, grants for training institutes using their existing infrastructure.

**The immediate future:** Development and implementation of vision 2010 in West Bengal are focused on:

- 1) Agriculture
- 2) Bio-fertilizers and bio-pesticides
- 3) Animal Biotechnology
- 4) Fisheries
- 5) Bio-prospecting and bio-resource mapping
- 6) Environment protection and ecosphere management
- 7) Alternative energy resources
- 8) Biomass development
- 9) Medical Biot echnology
- 10) Industry
- 11) Manpower Development
- 12) Development of Infrastructure

**Agriculture:-**a) Transgenics of cereal crops like rice, Brassica, chickpea, potato, tomato, other vegetables. Large scale seed production. Development of hybrid seeds, nutritionally enhanced vegetables (more protein content, higher lysine content) with higher yields.

b) Development of edible vaccines in plants and fruits such as banana .

c) Improving Jute and Tea cultivation.

d) Planting trees of economic importance, development of agro-forestry development

e) Development of horticulture plants according to economic importance.

f) Enhancement of floriculture using tissue culture, micropropagation and macropropagation.

g) Agriculture in the Himalayan and Sub-Himalayan regions

h) Medicinal and aromatic plants in high altitudes and plains.

i) Establishment of gene bank, germplasm for maintenance and propagation of superior quality crops and plants of special value.

**2) Bio-fertilizers and bio-pesticides:**

a) Developments of bio-fertilizers such as blue green algae to enhance the soil fertility and decrease dependence on chemical fertilizers.

b) Identification of indigenous micro-flora for the development of bacterial consortium useful as bio-fertilizers, bio-pesticides.

c) Development of bio-pesticides and bio-control agents specific indigenous targets in rural areas in the plains and mountainous agricultural lands.

**3) Animal Biotechnology:**

a) To develop / apply methods for enhancing milk yields in cattle.

- b) To develop transgenic cattle.
- c) Use of biotechnology for diagnostics and vaccines for major live stock disease such as foot and mouth disease, rabies, hemorrhage, septicemia etc
- d) Use of transgenic animals as bio-factories
- e) Use of transgenic animals as living models for the study of human diseases.

#### **4) Fisheries**

- a) Develop better methods for pisciculture
- b) Scientific methods of cultivation of freshwater and sea water Prawn culture
- c) Diagnostics for bacterial and viral diseases affecting local edible fishes and prawns.

#### **5) Bio-prospecting and bio-resource mapping**

- a) Development of a database documenting economically and ecologically important such as Sundarban regions (mangrove), Himalayan and sub-Himalayan regions, plains of Purulia, Birbhum, Bankura and Midnapore.
- b) Inventory of microbial biodiversity in wetland areas, coastal areas, forests, hilly and teral areas.
- c) Inventory of ethnobotanical flora and fauna of different areas of West Bengal.
- d) Developing agro-forestry database and prediction of natural disasters using remote sensing methods.
- e) Development of genetic markers for plant and animal breeding programmes.

#### **6) Environmental protection and ecosphere management:**

- a) Bioremediation and waste recycling in specific location by new microbial consortia.
- b) Development of bioindicators and biosensors for pollution control.
- c) Biotechnological interventions for pollution and waste management for specific ecosystem.
- d) Development of efficient waste disposal strategies using biotechnological methods.

#### **7) Alternative energy resources**

- a) Identification and development of crops for bio-engineering, biofuels and bioenergy.
- b) Use of extremophiles as a source for bioenergy.

#### **8) Biomass development**

- a) Use of lingo-cellulosic material for development of economically viable animal feed.
- b) Conversion of waste materials for the development of biomass
- c) Cultivation of Spirulina as a high value low cost nutrient for rural and tribal areas.

#### **9) Medical biotechnology**

- a) Development of diagnostic kits for major infectious and tropical disease, genetically inherited disorders
- b) Development strategies for prevention and cure of disease induced by faulty diet and lifestyle like diabetes, heart disease etc.

#### **10) Industry**

- a) Development of joint R & D programmes between basic research scientists and private industries for commercially viable projects.
- b) Setting up production units for commercially used biotechnological and biomedical instruments.
- c) Production and commercialization recombinant biologicals and related materials like disposable plastic wares, modernization of industries using fermentation technology etc.
- d) Production of value added by-products from microbial sources.
- e) Use of Recombinant DNA technology to upgrade and modernize industrial products currently in the market.
- f) To setup biotech product development fund and technology platforms.
- g) To replace synthetic products by developing new technology based on biological materials.
- h) Development of small scale industrial sector for bio-pesticide, bio-fertilizers, food processing and packaging industries.

**Biosafety, ethical, Proprietary regulations** are based on establishment of transparency in scientific techniques and results obtained by implementing ethical and bio-safety regulations will be necessary. Protection of proprietary rights will have to be undertaken to maintain the individual's discoveries and for proper commercialization. Rigorous implementation of bio-safety guidelines will be essential. In Biotechnology and societal development issue, it is essential here to lay emphasis on the rural sector. The concept of Bio-village should be spread through out the state. Location & natural resource specific projects to be developed. Involvement of women and SC/ST should be emphasized in rural development programmes. Genetic counselling centers to be setup with diagnostic centers for genetic disorders for helping the needy. Keeping in view that Biotechnology has a pervasive role in agriculture and Industry, Food and medicine, Environment and Ecology, Plant and Animal cloning and also the fact that Biotechnology is a knowledge based industry and intellectual, rather than financial capital, our approach to the question of intellectual property protection in this area should be positive, rather than defensive. However, in view of the complexities involved in patenting Biotechnological inventions, they need to build up our knowledge and expertise in this area and evolve an IPR system over a period of time in the light of the experience and after the amendment of the patents Act 1970, passing of Biodiversity bill 1999 and Protection of Plant Varieties and Farmers' Rights Bill 1999 which are being considered by the 30 member Joint Parliamentary Committee for their recommendation.

## WORK ON ENVIRONMENTAL BIOTECHNOLOGY IN WEST BENGAL

### ***Biotransformation by microbes ( Prof. Timir B. Samanta)***

The purified penicillin amidase of *Alcaligenes* sp. was found to be a heterodimer. The 22 N-terminal residues of  $\alpha$ - (23 k Da) and  $\beta$ - (63kDa) subunits determined by automated Edman degradation were aligned with previously reported sequences and some positions were found to be conserved.

### ***Biotechnologically improved biohydrometallurgy (Dr. Prodosh Roy)***

With an aim to develop genetically engineered bacteria, suitable for application in extraction of metals from sulfidic ores, a novel sox ( sulphur oxidation) operon identified in a newly isolated lithotrophic bacterium was further characterized by genome walking .

### ***Biodegradation of phthalates ( Dr. Tapan k. Dutta)***

Phthalates are environmental chemicals in commercial products with detrimental effects on endocrine, reproductive and immune systems in human, wildlife and fish. To counter the phthalate associated environmental problems by microbial management , a number of soil isolates were found to be capable of using di-butylphthalate and butyl benzyl phthalate individually as carbon and energy sources. Hydrolysis of the diesters and further degradation of the phthalic acid and alcohols were ascertained from the products formed in spent media and resting cell transformation. Moreover, hydroxylation of the diesters is another side reaction in the degradation process.

### ***Cyanide degradation by cyanobacteria and green algae isolated from steel plant wastewater***

***S. Das and S. C. Santra,***

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Kalyani-741235*

The industry activities are such as metal mining processes, organic chemical industries, iron and steel works, and public wastewater treatment works. Cyanide salt and hydrogen cyanide are used in electroplating, metallurgy, production of organic chemicals, photographic developing, in making plastics, fumigating ships, and some mining processes (Knowles, 1976; Patterson, 1985). Cyanide is a powerful and rapid-acting poison. Hydrogen cyanide has been used in gas-chamber executions and as a war gas. Exposure to high level of cyanide might harm brain and heart leading to coma and death (Knowles, 1976).

Cyanide is chemically treated by oxidation. Oxidation is generally done with chlorine. There are some drawbacks of such processes. For instance, alkaline chlorination needs careful control of chlorine concentration and may give rise to uncontrolled formation of toxic and biologically persistent organochlorine compounds (Patterson, 1985). Previously biological methods were considered impractical or impossible because of the general belief that toxic cyanide compounds would inhibit enzymatic activities and thus any organism would be killed. But later on several organisms, which can tolerate or detoxify cyanide, are found (Adams *et al.*, 2002, Akcil *et al.*, 2002; Pablo *et al.*, 1999). Since application of biological systems is safer, effective and highly economical, many scientists made various approaches in past few decades (Akcil, 2001; Young, 2001).

A mixed consortium of microorganisms was able to remove cyanide from Food-industry wastewater under optimal pH of 6.0-7.5 and temperature of 25-37°C. The study was done by Siller and Winter (1998). The cyanide degrading bacteria like *Pseudomonas putida*, *Pseudomonas pickettii*, *Pseudomonas paucimobilis*, *Klebsiella pneumoniae*, bioremediation studies tolerant microbial strains were selected from wastewater.

The selected strains were aseptically inoculated (1 ml. of 5 days' fresh culture grown in respective media) in 100 ml. Chu-IO (algal) and BG-1 I (cyanobacterial) media spiked with potassium cyanide of 15 mg/l. concentrations in 250 ml glass flasks. The experimental sets were kept under incubation for a week at 30°C and 2000 lux illumination for 16hrs. light and 8 hrs. dark phases along with aeration. Control sets without inoculation were also run. Cyanide removal efficiency of the strains was calculated against the control set. Final cyanide estimation was done with filtrate after harvesting cell-masses by centrifugation at 11000 rpm for 15 minutes. Out of 3 cyanobacteria of BSP only one and the green alga from BSP were also found to be tolerant to cyanide up to 40 mg/l. In 15 mg/l cyanide concentration, *Oscillatoria* sp. ESBSpc-2 removed 79.3% cyanide in a week, while the unicellular green alga removed 96.5%. The rate of cyanide removal or degradation was higher upto third day, thereafter the rate slowed down but maintained a overall steady level in both cases. For both the strains, pH 7.0 was most favorable for cyanide removal

(Figure 3). *Oscillatoria* sp. ESBSPc-2 and *Chlorella* sp. ESBSPA-5 removed about 65 % and 78% in 5 days in pH 7. For both the strains, pH 7.0 was most favorable for cyanide removal. Specially acidic media hampered with cyanide removal as even at pH 6.0 cyanide removal was greatly reduced.

In comparison to glucose, sucrose as sugar source was more preferred by

strains. In case of sucrose, removal of about 73 and 81 % was seen respectively in strains *Oscillatoria* sp. ESBSPc-2 and *Chlorella* sp. ESBSPA-5. Presence of phenol reduced the removal percentage in both cases due to its toxic effect. In 50 ppm phenol cyanide removal was 53.6 and 60.9%; in 100 ppm phenol cyanide removal was 43.4 and 53.9 % respectively in strains *Oscillatoria* sp. ESBSPc-2 and *Chlorella* sp. ESBSPA-5.

By free biomass of *Oscillatoria* sp. ESBSPc-2 cyanide removal was 60.2 % three days incubation without sucrose as additional sugar. With sucrose free biomass removed 62.4 % cyanide in 3 days. Phenol removal also gradually increased to 61.7 and 64.8 % respectively in sucrose-free and sucrose-supplemented wastewater. Immobilized biomass of the said strain showed almost similar rate of cyanide and phenol degradation.

Free biomass of *Chlorella* sp. ESBSPA-5 cyanide removed 62.6 % and 66% in 3 days incubation without or with sucrose as additional sugar respectively.

Phenol removal was about 72.8 % and 59.4% in 3 days respectively in sucrose-free and sucrose-supplemented wastewater. Immobilized biomass of the green algal strain showed almost similar rate of phenol degradation but cyanide degradation decreased to some extent. Immobilization of biomass had increased cyanide or phenol removal in case of *Oscillatoria* sp. ESBSPc-2. But in case of *Chlorella* sp. ESBSPA-5 immobilization of biomass had reduced cyanide removal. Probable explanation might be that in case of *Chlorella* sp., the cells were embedded and trapped within the meshwork of PVF cubes, thus reducing the cyanide removal or degradation rate. While in case of *Oscillatoria* sp. ESBSPc-2, the filaments of the strain were mostly on external sides of the cubes and quite free along with a firm grip to the cubes. These strains could be used in removing cyanide in immobilized systems for removing cyanide. Of course some *in situ* study and up-scaling augmentation are necessary.

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## Focus on current Problems

### Arsenic Bio-accumulation in Rice Field Ecosystem

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A large area of Gangetic basin in West Bengal is contaminated by groundwater arsenic. As the ground water is the main source of water for irrigation in agricultural field during post monsoon period., arsenic comes to the surface soil and gets accumulated in the crops via soil water flow system and ultimately enters into the ecosystem through water-soil-crop-animal and ultimately enters into the human body through food chain. People even of arsenic free areas are not safe from this threat because the arsenic may enter into their bodies through ingestion crops and vegetable growing in arsenic containing irrigated water and their subsequent consumption. It was calculated that in arsenic affected areas over thousand tons of arsenic (through ground water irrigation) is deposited on agricultural land every year. Due to continued accumulation of arsenic in irrigated soil, arsenic concentration increases in vegetables and crops of that area simultaneously. Extensive survey on arsenic contamination in irrigation by arsenic containing ground water and consequent flow of the element through ecosystem (water-soil-crop- animal) is needed. In this context we have been studying on some rice field ecosystem irrigated shallow pumps along soil, crop and vegetables in some arsenic contaminated. The study areas are located in villages of Nadia and 24 Parganas(N) districts of West Bengal . It was observed that significant bioaccumulation of arsenic in crops and vegetables took place with time. Some of the findings of our study are given in the below table:-I , It is also known that rice field is used for multiple crops in kharif and rabi seasons. So that bioaccumulation of arsenic in major crops are considered here.

**Table I Bioaccumulation status of arsenic in water-soil-crops.**

Sampling location	Concentration of Arsenic in water, soil, rice & vegetables					
	Shallow – tubewell water (irrigation) (mg/l)	Soil (? g/gm)	Rice (Boro) (? g/gm)	Brinjal (Fruit) (? g/gm)	Spinach (Leafy vegetable) (? g/gm)	Arum (Underground vegetable) (? g/gm)
Sendanga, 24Pgs(N)	0.101	27.304	0.424	0.192	0.449	0.452
Sendanga, 24Pgs(N)	0.05	22.23	0.218	0.169	-	0.295
Gobardanga 24Pgs(N)	0.112	85.34	0.648	-	-	0.637
Gobardanga 24Pgs(N)	0.06	14.335	0.382	0.394	0.463	0.548
Haringhata Nadia	0.02	18.9	0.357	-	0.124	-
Haringhata Nadia	0.093	19.8	0.393	0.208	0.268	0.644

\* “-” sample not available

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