



ENVIS CENTER

on

ENVIRONMENTAL BIOTECHNOLOGY

Abstract, Vol. VIII



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ENVIS CENTRE

on

ENVIRONMENTAL BIOTECHNOLOGY

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BACKGROUND

Environmental Information System (ENVIS) is established in the year 1984 as a network of Information Centre. It is planned by the Ministry of Environment and Forest. Aim of this centre is to provide descriptive data and environmental subject related numerical data. Now 78 centres are working under this network on various subject areas in the country. The focal point of this network is at the Ministry of Environment and Forest, Government of India, New Delhi.

This ENVIS Centre is established 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 major libraries mainly in West Bengal and also from other states in India, consult with different journals, Annual reviews, Internet and to generate a database and create a website with this informations. Viewpoint of this journal abstract is to help the interested research workers, scientist, administrator and the public.

This is the 8th publication of this ENVIS Centre. This contains the abstract of research papers collected in the area of Environmental Biotechnology from various journals published during December 2005 onwards. Here various topics like Bioengineering, Bio-degradation, Bio-remediation, Bio-transformation etc. are covered. We are grateful to the various libraries and their staff for their extended cooperation in the collection of the articles.

Abstract Format

The format of the abstract is as follows:

Abstract : The abstracts were arranged in different subheads.

Author: Name of the authors are given in the order in which they appear in the original document. These names are given in succession.

Address of Authors: Address of the author is given in parenthesis at the end of the author name. When the address of any other author is found, it is written after wards delimited by stop(.).

Locus: The name of the journal are followed by the volume number, the issue number, the year of publication and the page no.

GENERAL INFORMATION

Abstract have been taken directly from source document like research report, journals, Internet, seminars, proceedings, standards and patents. All the resources published within the year 2006.

Abstract are broadly classified and arranged under the following 14 heads:

Bioaccumulation: It studies address the buildup of bioaccumulative compounds through biomagnification and/or bioconcentration. Bioaccumulation means an increase in the concentration of a chemical in a biological organism over time, compared to the chemical's concentration in the environment. Compounds accumulate in living things any time they are taken up and stored faster than they are broken down (metabolized) or excreted. Understanding the dynamic process of bioaccumulation is very important in protecting human beings and other organisms from the adverse effects of chemical exposure, and it has become a critical consideration in the regulation of chemicals.

Bioremediation: It is a clean-up technology that uses naturally occurring microorganisms to degrade hazardous substances into less toxic or nontoxic compounds. These microorganisms may:

1. Ingest and degrade organic substances as their food and energy source,
2. Degrade organic substances, such as chlorinated solvents or petroleum products, that are hazardous to living organisms, including humans, and degrade the organic contaminants into inert products.

Because the microorganisms already occur naturally in the environment they pose no contamination risk.

Bio-Transformation: This is a process of Biological changes of complex compound to simpler toxic to non-toxic or vice-versa. Several microorganism are capable of transforming a variety of compound founding nature but generally with respect to synthetic compound they are unable to show any appropriate action. Biotransfer appears to be one of the major detoxication method known so far.

Biomarker: It is a biological response to a chemical that gives a measure of exposure and, sometimes, of toxic effect. Biological markers found in crude oils and source rock extracts can provide molecular evidence of the correlation among oils and their sources.

Biofertilizer: To reduce the impact of excess chemical fertilizers in the field of agriculture the biofertilizer is a potential tool; biologically fixed nitrogen is such a source which can supply an adequate amount of Nitrogen to plants and other nutrients to some extent. Many free living and symbiotic bacteria which fix atmospheric

Nitrogen were used as biofertiliser material as a substitute for Nitrogen fertilizer. In general two types of biofertiliser are used

1. Bacterial Biofertilizer
2. Algal Biofertilizer

Biocomposting: It involves combining organic materials under conditions that enables them to decompose more quickly than they would in nature. Think about logs and leaves on the ground in a forest. The leaves will break down and disappear within a year. Logs of course will take much longer to crumble away. Composting involves combining organic materials under conditions that enables them to decompose more quickly than they would in nature.

Biopesticide: pest control by biological antagonism appears to be very useful tool in recent years. Bacterial pesticides are being developed. *Heliothis* complex, which lives in close association with plant roots, consists of two major crop pests budworm and ball worm. Biological insecticides against both these insects are being prepared by transfer of a gene from *Bacillus thuringiensis*

Biodegradation: It is nature's way of recycling wastes, breaking down organic matter into nutrients that can be used by other organisms. "Degradation" means decay, and the "bio-" prefix means that the decay is carried out by a huge assortment of bacteria, fungi, maggots, worms, and other organisms that eat dead material and recycle it into new forms.

In nature, there is no waste because everything gets recycled. The waste products from one organism become the food for others, providing nutrients and energy while breaking down the waste organic matter. Some organic materials will break down much faster than others, but all will eventually decay.

By harnessing these natural forces of biodegradation, people can reduce wastes and clean up some types of environmental contaminants. Through **composting**, we accelerate natural biodegradation and convert organic wastes to a valuable resource.

Biosensor: Biosensor represents biophysical devices which will detect the presence and measure the quantities of specific substances in a variety of environments. These specific substances may include sugars, proteins, or humas and variety of toxins in the industrial effluents. In designing a biosensor an enzyme or an antibody or even microbial cells are associated with microchip devices which are used for quantitative estimate of a substance.

Bioengineering: It is a developing speciality featuring a multidisciplinary approach to the solution of problems in medicine and biology, based on the application of advances in science, engineering and technology. A major focus for bioengineering is to improve the quality of life of people with medical conditions that restrict independent living and integration within the community.

Pollen-Biotechnology: This is a new field of science dealing with the pollen chemistry allergenicity of aerospora. This subject also covers genetic manipulation of pollen development of haploid culture. Such haploid plants have remained valuable in genetic research.

Biotechnology Policy Issue: Biotechnology appears to be an emerging science in present decades. Genetic manipulation and development of genetically modified organisms in human welfare is now showing a potential prospect and risk. Thus researches and application of Biotechnology in diverse fields is a major policy issue in the present decades.

Agricultural Biotechnology: Over the years tremendous success was made in diverse fields of agriculture by applying Biotechnology. It includes development of genetically modified crops, genetic improvement in sericulture practices, improvement in Biofertilizer development and similar other aspects. Crop production against pest and disease stress resistance of crops is also considered to be an emerging area of Agricultural Biotechnology.

Bioenergy: In recent decades, efforts were made for evolving non-polluting bioenergy sources or energy generation from organic waste or biomass. These are all ecofriendly solutions. Biomass energy supply demand balances have become a component of energy sector analysis and planning and assumed greater importance in countries. These are various biological energy sources. Biomass, Biogas, Hydrogen are examples of Bioenergy.

ABBREVIATIONS USED IN ADDRESSES AND CITED JOURNALS

Acad	Academy	Chem	Chemistry
Adm	Administration	Chemi	Chemical
Admn	Administrative	Clini	Clinical
Adv	Advance	Co	Company
Agric	Agriculture	Coil	College
Agrici	Agricultural	Comm	Committee
Amer,	American	Commn	Commission
An	Annual	Comp	Comparative
Analyt	Analytical	Conf	Conference
Anat	Anatomy	Conv	Convention
Anim	Animal	Conserv	Conservation
Ann	Annals	Conti	Control
Appt	Applied	Contam	Contamination
Arch	Archives	Corp	Corporation
Archaeo	Archaeology	Coun	Council
Archaeol	Archaeological	Cult	Culture
Architect	Architecture	Cultl	Cultural
Assoc	Association	Curr	Current
Asst	Assistant	Dept	Department
Atom	Atomic	Dev	Development
Bacterio	Bacteriology	Develop	Developmental
Bacteriol	Bacteriological	Dig	Digest
Bd	Board	Div	Division
Bio	Biology	Divl	Divisional
Biochem	Biochemistry	Dte	Directorate
Biochemi	Biochemical	Dy	Deputy
Bioengng	Bioengineering	Eco	Ecology
Biol	Biological	Ecol	Ecological
Biometeo	Biometeorology	Econ	Economics
Biophys	Biophysics	Ecosys	Ecosystem
Biometeol	Biometeorological	Exotoxico	Ecotoxicology
Biotech	Biotechnology(s)	Endocrinol	Endocrinological
Biotechno	Biotechnology	Engng	Engineering
Biotechnol	Biotechnological	Engrs	Engineers
Bidg	Building	Env	Environment
Bot	Botany	Environ	Environmental
Boti	Botanical	Epidemic	Epidemiology
Br	Branch	Epidemiol	Epidemiological
Bull	Bulletin	Estb	Establishment
Cent	Centre	Ethnopharmaco	Ethnopharmacology
Centl	Central	Exot	Experiment

Expti	Experimental	Microbiol	Microbiological
Fac	Faculty	Min	Ministry
Fd	Food	Monit	Monitoring
Fedn	Federation	Myco	Mycology
Fert	Fertiliser	Mycol	Mycological
Fmg	Farming	Nat	Natural
Gaz	Gazette	Natl	National
Genet	Genetics	N-E	North Eastern
Geo	Geology	Nut	Nutrition
Geogr	Geography	No	Number
Geogr	Geographical	Occ	Occasional
Geol	Geological	Occupl	Occupational
Geosci	Geoscience	Oceanogr	Oceanography
Govt	Government	Org	Organic
Hist	History	Orgn	Organisation
Hlth	Health	Pharmaco	Pharmacology
Hort	Horticulture	Pharmacol	Pharmacological
Hosp	Hospital	Phyl	Physical
Hydro	Hydrology	Patho	Pathology
Hydrol	Hydrological	Pathol	Pathological
Immuno	Immunology	Petrochemi	Petrochemical
Immunol	Immunological	Petro	Petrology
Ind	Industry	PG	Post Graduate
Inf	Information	Phys	Physics
Inst	Institute	Physio	Physiology
Instn	Institution	Phytopath	Phytopathology
Int	International	Phytopathol	Phytopathological
Irrig	Irrigation	Plang	Planning
J	Journal	Polln	Pollution
Lab	Laboratory	Proc	Proceedings
Lett	Letter(s)	Prot	Protection
Ltd	Limited	Pub	Publication
Malario	Malariology	Pvt	Private
Malariol	Malariological	Qlty	Quality
Manag	Management	Qr	Quarter
Med	Medicine	Rad	Radiation
Medl	Medical	Radio	Radiology
Metab	Metabolism	Radiol	Radiological
Metall	Metallurgy	Rd	Road
Metallurg	Metallurgical	Recd	Received
Meteo	Meteorology	Reg	Region
Meteol	Meteorological	Regl	Regional
Microbio	Microbiology		

Rep	Report	Stud	Studies
Reptr	Reporter	Surv	Survey
Res	Research	Syst	System
Rev	Review	Tax	Taxonomy
Sch	School(s)	Techi	Technical
Sci	Sciences(s)	Techno	Technology
Scient	Scientific	Technol	Technological
S-E	South East	Toxico	Toxicology
Sec	Section	Toxicol	Toxicological
Sect	Sector	Trans	Transcations
Semin	Seminar	Trans	Transportation
Ser	Services	Tmg	Training
Soc	Society	Trop	Tropical
Sod	Social	Univ	University
Stat	Statistics	Util	Utilisation
Stati	Statistical	Vet	Veterinary
Stand	Standard(s)	Zoo	Zoology
Std	Study	Zool	Zoological

Bioaccumulation

J.K. Wieczorek^a and Z.J. Wieczorek^b (^aInstitute of Commodities Science and Quality Management, University of Warmia and Mazury in Olsztyn, Plac Cieszyński 1, 10-726 Olsztyn, Poland, ^bDepartment of Physics and Biophysics, University of Warmia and Mazury in Olsztyn, Oczapowskiego 4, 10-719 Olsztyn, Poland). **Phytotoxicity and accumulation of anthracene applied to the foliage and sandy substrate in lettuce and radish plants. *Ecotoxicology and Environmental Safety*. Article in Press**

The effects of anthracene (ANT) on the growth of two species of vegetable plants (*Lactuca sativa* L. and *Raphanus sativus* L.), which play an important role in the human diet, were studied. ANT was applied to the leaves of these plants by foliar deposition, in aerosol form, and to the sandy substrate in which the plants were grown in a greenhouse. It was found that ANT affected plant biomass, especially root biomass, in the case of both foliar and soil application. Under conditions of induced chemical stress, the dry matter of aboveground parts and roots was lower than that in control plants. The rate of photosynthesis decreased by about 20% in both plant species following foliar ANT application. A lower rate of transpiration was also observed in lettuce plants. After the foliar application of ANT, small quantities of the compound were found in the leaves only (0.06–0.18% of the total dose). ANT translocation to other parts of the plants was not observed. This compound underwent rapid chemical changes on the leaf surface under greenhouse conditions. After the application of ANT to a sandy substrate, this compound was detected in the roots and aboveground parts of plants, which indicates that it was transported throughout the plant. In a sandy substrate, the process of ANT decomposition was much slower—60–70% of the administered dose was measured in the soil after the completion of the experiment.

Keywords: Anthracene; Lettuce; Radish; Accumulation; Phytotoxicity.

S. Tao^a, X.C. Jiao^a, S.H. Chen^a, F.L. Xu^a, Y.J. Li^b and F.Z. Liu^b. (^aLaboratory for Earth Surface Processes, College of Environmental Sciences, Peking University, Beijing 100871, China, ^bAgro-Environmental Monitoring Center, MOA, Tianjin 300191, China. Corresponding author. Tel./fax: +86 10 62751938). **Uptake of vapor and particulate polycyclic aromatic hydrocarbons by cabbage. *Environmental Pollution*, Volume 140(1)(2006): 13-15**

Polycyclic aromatic hydrocarbons (PAHs) in cabbage (aerial part), air (gas and particles) and soil samples collected from two sites in Tianjin, China were measured. Although the levels of PAHs in all samples from the heavily contaminated site B were higher than those from the less contaminated site A, the PAH profiles were similar, suggesting the similarity in source type. PAH concentrations in cabbages were positively correlated to either gas or particle-bound PAHs in air. A multivariate linear regression with cabbage PAH as a function of both gas and particle-bound PAHs in air was established to quantitatively characterize the relationship between them. Inclusion of soil PAH concentrations would not improve the model, indicating that the contribution of soil PAHs to cabbage (aerial part) accumulation was insignificant.

A multivariate linear regression model was developed for predicting vegetable uptake of PAHs based on both gas and particle phases PAH concentrations.

Keywords: PAHs; Cabbage; Air; Particle phase; Gaseous phase; Soil

Hans Wolkers^a, Mike O. Hammill^b and Bert van Bavel^c. (^aNorwegian Polar Institute, Polar Environmental Centre, N-9296 Tromsø, Norway, ^bMaurice Lamontagne Institute, Department of Fisheries and Oceans, P.O. Box 1000, Mont Joli, QC, Canada G5H 3Z4, ^cMTM Research Center, Örebro University, 701 82 Örebro, Sweden. Corresponding author. Tel.: +47 7775 0521; fax: +47

7775 0501). Tissue-specific accumulation and lactational transfer of polychlorinated biphenyls, chlorinated pesticides, and brominated flame retardants in hooded seals (*Cistophora cristata*) from the Gulf of St. Lawrence: Applications for monitoring. Environmental Pollution, Article in Press

Accumulation and mother–pup transfer of halogenated organic contaminants was studied in hooded seal tissues from eastern Canada. Blubber polychlorinated biphenyl (PCB) and total pesticide concentrations were relatively high, possibly due to their high trophic level and demersal feeding habits. Blood plasma showed the lowest contaminant concentrations compared to blubber and liver, possibly due to a lower affinity of these compounds to lipoproteins in blood plasma. Total contaminant body burden correlated well with blubber, liver, and milk contaminants, but not with blood plasma contaminants, indicating that blood plasma might be less suitable to monitor contaminants in hooded seals. Lactational transfer favored less lipophilic contaminants and was associated with relatively high blood plasma PCB and polybrominated diphenyl ether concentrations in females. Despite lactational transfer, females did not show significantly lower blubber contaminant concentrations or burdens than males. This might be caused by their low blubber, and thus contaminant, loss during lactation compared to other species.

Blood plasma contaminant concentrations differ from those in other tissues and might therefore be unsuitable for contaminant monitoring in hooded seals.

Keywords: Hooded seal; Lactational transfer; Contaminants; Polybrominated diphenyl ether; Monitoring

Marie-Elène Y. Boivin^{a, b}, Boris Massieux^c, Anton M. Breure^a, Gerdit D. Greve^{a, b}, Michiel Rutgers^a and Wim Admiraal^d. (^aNational Institute for Public Health and the Environment, P.O. Box 1, 3720 BA Bilthoven, The Netherlands, ^bVrije Universiteit, Department of Animal Ecology, De Boelelaan 1085, 1081 HV Amsterdam, The Netherlands, ^cNetherlands Institutes of Ecology, Centre for Limnology, Rijkstraatweg 6, 3631 AC Nieuwersluis, The Netherlands, ^dUniversity of Amsterdam, Department of Aquatic Ecology and Ecotoxicology, Kruislaan 320, 1098 SM Amsterdam, The Netherlands. Corresponding author. National Institute for Public Health and the Environment, P.O. Box 1, 3720 BA Bilthoven, The Netherlands. Tel.: +31 03 274 4109; fax: +31 03 274 4401). **Functional recovery of biofilm bacterial communities after copper exposure. Environmental Pollution, Volume 140(2)(2006): 239-246**

Potential of bacterial communities in biofilms to recover after copper exposure was investigated. Biofilms grown outdoor in shallow water on glass dishes were exposed in the laboratory to 0.6, 2.1, 6.8 $\mu\text{mol/l}$ copper amended surface water and a reference and subsequently to un-amended surface water. Transitions of bacterial communities were characterised with denaturing gradient gel electrophoresis (DGGE) and community-level physiological profiles (CLPP). Exposure to 6.8 $\mu\text{mol/l}$ copper provoked distinct changes in DGGE profiles of bacterial consortia, which did not reverse upon copper depuration. Exposure to 2.1 and 6.8 $\mu\text{mol/l}$ copper was found to induce marked changes in CLPP of bacterial communities that proved to be reversible during copper depuration. Furthermore, copper exposure induced the development of copper-tolerance, which was partially lost during depuration. It is concluded that bacterial communities exposed to copper contaminated water for a period of 26 days are capable to restore their metabolic attributes after introduction of unpolluted water in aquaria for 28 days.

Genetically different bacterial communities can have similar functions and tolerance to copper.

Keywords: Pollution-induced community tolerance (PICT); Community-level physiological profiling (CLPP); Denaturing gradient gel electrophoresis (DGGE); Bacterial communities; Recovery

Yu-Hong Su^{a, b} and Yong-Guan Zhu^a. (^aResearch Center for Eco-environmental Sciences, Chinese Academy of Sciences, 18 Shuangqing Road, Beijing 100085, China, ^bChemistry Department, Xinjiang University, Urumqi 830046, China. Corresponding author. Tel.: +86 10 6293 6940; fax:

+86 10 6292 3563). Bioconcentration of atrazine and chlorophenols into roots and shoots of rice seedlings. Environmental Pollution, Volume 139(1)(2006): 32-39

Accumulation of *o*-chlorophenol (CP), 2,4-dichlorophenol (DCP), and atrazine (ATR), as single and mixed contaminants, from hydroponic solutions into roots and shoots of rice seedlings was studied following 48-h exposure of the plant roots. As single contaminants at low levels, the observed bioconcentration factors (BCFs) of CP and DCP with roots approximated the equilibrium values according to the partition-limited model. The BCF of atrazine with roots was about half the partition limit for unknown reasons. The BCFs of CP and ATR with shoots also approximated the partition limits, while the BCF for more lipophilic DCP with shoots was about half the estimated limit, due to insufficient water transport into plants for DCP. As mixed contaminants at low levels, the BCFs with both roots and shoots were comparable with those for the single contaminants; at high levels, the BCFs generally decreased because of the enhanced mixed-contaminant phytotoxicity, as manifested by the greatly reduced plant transpiration rate.

Uptakes of *o*-chlorophenol, 2,4-dichlorophenol, and atrazine at various levels from nutrient solution by roots and shoots of rice seedlings were investigated using a partition-limited model.

Keywords: atrazine; partition-limited model; uptake; rice; *oryza stiva*

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^aDepartment of Food Sciences, Medical University of Gdansk, Al. Gen. J. Hallera 107, PL 80-416 Gdansk, Poland, ^bIAEA Marine Environment Laboratory, 4 Quai Antoine 1^{er}, MC-98000, Monaco, ^cLaboratory of Aquatic Environment and Ecology, Department of Fisheries, Faculty of Agriculture, Miyazaki University, 889-21 Miyazaki, Japan, ^dInstitute of Marine Sciences and Limnology, Mazatlan Station, National Autonomous University of Mexico, Mazatlan 82000, Sinaloa, Mexico, ^eFaculty of Science, Arts and Education, University of Aden, PO Box 6014, Khormaksar, Aden, Yemen, ^fSchool of Earth and Environmental Science, Seoul National University, 56-1 Shillimdong, South Korea 151-742, ^gInstituto de Radioprotecao e Dosimetria, Cz. Postal 37 750 - CEP: 22642-970, Rio de Janeiro, Brazil, ^hInstituto Tecnológico Pesquero y Alimentario, Dpto de Oceanografía y Medio Ambiente Marino, Herrera Kaia, Portualdea z/g, 20110 Pasaia (Gipuzkoa), Spain, ⁱStensund Ecological Center, 61991 Trosa, Sweden and Global Water Partnership Secretariat, Hantverkargatan 5, SE-112 21 Stockholm, Sweden, ^jGamma Dating Center (GDC), Institute of Geography, University of Copenhagen, Øster Voldgade 10 DK-1350 Copenhagen K, Denmark, ^kLaboratory of Estuarine Ecology, Institute of Oceanography, University of Gdansk, Al. Pilsudskiego 46, 81-378, Gdynia, Poland, ^lCentre for Estuarine and Marine Ecology, Netherlands Institute of Ecology, Korringaweg 7, 4401 NT Yerseke, The Netherlands, ^mIFREMER, Unite Ecologie Conchylicole, 1, rue Jean Vilar, 34200 Sete, France. Corresponding author. Fax: +48 58 349 3110). A comparative assessment of heavy metal accumulation in soft parts and byssus of mussels from subarctic, temperate, subtropical and tropical marine environments. *Environmental Pollution*, Volume 139(1)(2006): 70-78

Existing data on metal concentrations in mussels from subarctic, temperate, subtropical and tropical waters were analyzed using multivariate statistics in order to assess regional variations in metal contamination. Potential errors were reduced by only analyzing data from surveys that employed the same protocols, analytical methodologies and analysts. Factor analysis demonstrated that mussels inhabiting extremely contaminated areas (e.g. from Japanese and Swedish metallurgy sources) could be separated from mussels from other contaminated areas, and that metals such as Cd, Pb, Cu and Zn could be used to identify heavily contaminated samples while Co, Fe, Cr and Ni concentrations were good markers for exposure to inputs from different industrial sources. Furthermore byssus, like soft tissue, selectively and sensitively reflects variations of certain metal concentrations in ambient waters and thus serves as a reliable biomonitor for these contaminants in a variety of coastal and estuarine areas.

Byssus of mytilids, like soft tissues can be used as efficient biomonitor for heavy metals in the marine environment.

Keywords: Mussel; Trace metals; Soft tissue; Byssus; Temperate; Subtropical and tropical marine regions

Junta Yanai^{a, b}, Fang-Jie Zhao^b, Steve P. McGrath^b and Takashi Kosaki^a. (^aGraduate School of Global Environmental Studies, Kyoto University, Kyoto 606-8501, Japan, ^bAgriculture and the Environment Division, Rothamsted Research, Harpenden, Hertfordshire AL5 2JQ, UK. Corresponding author. Present address: Graduate School of Agriculture, Kyoto Prefectural University, Shimogamo Hangi-cho, Sakyo, Kyoto 606-8522, Japan. Tel./fax: +81 75 703 5649). **Effect of soil characteristics on Cd uptake by the hyperaccumulator *Thlaspi caerulescens*. Environmental Pollution, Volume 139(1)(2006): 167-175.**

The influence of soil characteristics on the phytoremediation potential of *Thlaspi caerulescens* is not well understood. We investigated the effect of soil pH and Cd concentration on plant Cd uptake on one soil type, and the variation in Cd uptake using a range of field contaminated soils. On soils with total Cd concentrations of 0.6–3.7 mg kg⁻¹, *T. caerulescens* (the Ganges ecotype) produced greater biomass in the pH range 5.1–7.6 than at pH 4.4. The highest plant Cd concentration (236 mg kg⁻¹) and Cd uptake (228 µg pot⁻¹) were observed at pH 5.1. On soils with total Cd concentrations of 2.6–314.8 mg kg⁻¹, shoot Cd concentrations were 10.9–1196 mg kg⁻¹. Multiple regression analysis indicated that higher Cd in soil, low pH (within the range of >5) and coarser texture were associated with higher Cd concentration and Cd uptake by *T. caerulescens*.

Higher total/extractable Cd in soil, lower pH and coarser texture were associated with higher Cd concentration by *Thlaspi caerulescens*.

Keywords: Cadmium; Hyperaccumulator; Phytoremediation; Contaminated soil; *Thlaspi caerulescens*

W.P. Norwood^{a, b}, U. Borgmann^b and D.G. Dixon^a. (^aDepartment of Biology, University of Waterloo, Waterloo, ON N2L 3G1, Canada, ^bAquatic Ecosystems Protection Research Branch, National Water Research Institute, Environment Canada, P.O. Box 5050, Burlington, ON L7R 4A6, Canada. Corresponding author. Aquatic Ecosystems Protection Research Branch, National Water Research Institute, Environment Canada, P.O. Box 5050, Burlington, ON L7R 4A6, Canada. Tel.: +1 905 336 4694; fax: +1 905 336 6430). **Saturation models of arsenic, cobalt, chromium and manganese bioaccumulation by *Hyalella azteca*. Environmental Pollution, Article in Press**

Bioaccumulation of As, Co, Cr and Mn by the benthic amphipod *Hyalella azteca* in Burlington City tap (Lake Ontario) water was measured in 4-week tests. Bioaccumulation increased with exposure concentration and demonstrated an excellent fit to a saturation model (r^2 : 0.819, 0.838, 0.895 and 0.964 for As, Co, Cr and Mn, respectively). The proportion of total body Mn eliminated during a 24-h depuration period decreased as Mn body concentration increased, apparently due to a saturation of the elimination rate. The high maximum body concentration of 116,000 nmol g⁻¹ appears to result from the saturation of the Mn excretion which is slightly greater than the maximum Mn uptake rate. Elimination rates for As, Co and Cr were not dependent on body concentration. The four elements were not physiologically regulated in *Hyalella*. Their body concentrations should be good indicators of bioavailability and useful for environmental assessment.

Bioaccumulation of As, Co, Cr and Mn follow a saturation model in *Hyalella azteca* and can be useful for environmental assessment.

Keywords: *Hyalella*; Saturation model; Bioaccumulation; Arsenic; Cobalt; Chromium; Manganese; Biotic ligand model

Daniel Hammer^a, Catherine Keller^{a, 1}, Michael J. McLaughlin^b and Rebecca E. Hamon^b. (^aSwiss Federal Institute of Technology, ENAC-ISTE-Laboratory of Soil Science, GR B1 423, Station no. 2, Ecublens, 1015 Lausanne, Switzerland, ^bCSIRO Land and Water, Adelaide Laboratory, PMB 2, Glen Osmond, SA 5064, Australia. Corresponding authors. Tel.: +33 4 42 97 15 17; fax: +33 4 42 97 15 40 (C.K.). Tel.: +61 8 8303 8489; fax: 61 8 8303 8565 (R.H.). ¹ CEREGE, Université Paul Cézanne – Aix-Marseille III, Europôle Méditerranéen de l'Arbois, BP 80, 13545 Aix-en-Provence, Cedex 4, France). **Fixation of metals in soil constituents and potential remobilization by hyperaccumulating and non-hyperaccumulating plants: Results from an isotopic dilution study. Environmental Pollution, Article in Press**

In this study isotopic dilution methods were used to investigate the hypothesis that access to metals associated with specific chemical components in the soil that are not available to non-accumulator species could be involved in hyperaccumulation. The hyperaccumulator *Thlaspi caerulescens* and a non-accumulator species, *Brassica napus*, were grown in Cd and Zn enriched soil components calcite, goethite, charcoal and cryptomelane. The metal enriched components were aged to allow transformation of a proportion of added metals to non-labile forms. Results from the isotopic dilution *L* value method showed that despite taking up more metals, *T. caerulescens* accessed the same pool of metals as *B. napus*. Hence differential access to different solid-phase pools of metals appears to be an unlikely mechanism underlying metal hyperaccumulation. For all components except charcoal, *L* values for Cd and Zn were greater than the corresponding *E* values suggesting that *E* values may tend to underestimate the bioavailable fraction of metals in soils.

Thlaspi caerulescens takes up more Cd and Zn than *Brassica napus* but from the same pools.

Keywords: *E* value; *L* value; *Thlaspi caerulescens*; *Brassica napus*; Soil components

N. L. M. Budambula¹ and E. C. Mwachiro¹. (Department of Botany, Jomo Kenyatta University of Agriculture and Technology, P.O Box 62000, 00200 Nairobi, Kenya. N. L. M. Budambula, Email: nbudambula@yahoo.com, Phone: 254-67-52511, URL: nbudambula@jkuat.ac.ke). **Metal Status of Nairobi River Waters and Their Bioaccumulation in *Labeo Cylindricus*. Water, Air, & Soil Pollution, Volume 169(1-4)(2006): 275 - 291**

This study focused on the analysis of metals in water and fish from Nairobi River. Water from Kikuyu, Kawangware, Chiromo, Eastleigh, Njiru and Fourteen Falls along the Nairobi River was analyzed for the presence of metals. Most of the metal levels in water were below the critical limit of World Health Organization and Kenya Bureau of Standards except for lead, chromium, iron and manganese. Isolated cases of mercury and aluminium pollution were recorded. Except for iron, sodium and potassium, there was no significant difference in the concentration of metals at different sites. This study also analyzed metal levels in fish organs and tissues of fish caught from downstream (Fourteen Falls). The highest zinc concentration (360 µg/g) was in the scales, copper recorded the highest concentration in the kidney (45 µg/g), while cadmium recorded high values (167 µg/g) in the heart. Lead recorded high values (178 µg/g) in the heart and mercury recorded high values also in the heart (1000 ng/g). Most of these organs, are however, not eaten by man as food. Although metal levels were within normal levels in the water at Fourteen Falls, mercury, copper, lead and iron recorded higher than accepted levels in some fish organs. This calls for caution in the consumption of fish from Fourteen Falls.

Keywords bioaccumulation - fish - Fourteen Falls - metal - Nairobi River - pollution

Anthony George Kachenko¹ and Balwant Singh¹. (Faculty of Agriculture, Food and Natural Resources, The University of Sydney, Ross Street Building A03, New South Wales, 2006, Australia. Anthony George Kachenko, Email: akac1808@mail.usyd.edu.au, Phone: +61-2-9351-2917, Fax: +61-2-9351-5108). **Heavy Metals Contamination in Vegetables Grown in Urban and Metal Smelter Contaminated Sites in Australia. Water, Air, & Soil Pollution, Volume 169(1-4)(2006): 101 - 123**

Dietary exposure to heavy metals, namely cadmium (Cd), lead (Pb), zinc (Zn) and copper (Cu), has been identified as a risk to human health through the consumption of vegetable crops. This study investigates the source and magnitude of heavy metal contamination in soil and vegetable samples at 46 sites across four vegetable growing regions in New South Wales, Australia. The four regions Boolaroo, Port Kembla, Cowra and the Sydney Basin were a mix of commercial and residential vegetable growing areas. The extent of metal contamination in soils sampled was greatest in regions located in the vicinity of smelters, such as in Boolaroo and Port Kembla. Soil metal concentrations decreased with depth at these two sites, suggesting contamination due to anthropogenic activities. Cadmium, Pb and Zn contamination was greatest in vegetables from Boolaroo, and Cu concentrations were greatest in vegetables sampled from Port Kembla. At Boolaroo, nearly all the samples exceeded the Australian Food Standards maximum level (ML) (0.01 mg kg^{-1} fresh weight) of Cd and Pb in vegetables. Over 63% of samples exceeded international food standard guidelines set by the Commission of the European Communities and the Codex Alimentarius Commission. All vegetables sampled from Cowra, which is a relatively pristine site had Cd and Pb levels below the Australian and international food standards guideline values. This study suggests that the Australian guideline values are more conservative in defining the ML for Cd and Pb in vegetable crops. This investigation highlights the increased danger of growing vegetables in the vicinity of smelters.

Keywords contamination - transfer coefficients - guidelines - heavy metals – uptake

Wei Li *, Cheng-Zhi Wu, Yao Shi. (Department of Environmental Engineering, Zhejiang University (Yuquan Campus), Hangzhou 310027, China, email: Wei Li (w_li@zju.edu.cn). *Correspondence to Wei Li, Department of Environmental Engineering, Zhejiang, University (Yuquan Campus), Hangzhou 310027, China). Metal chelate absorption coupled with microbial reduction for the removal of NO_x from flue gas. *Journal of Chemical Technology & Biotechnology*, Volume 81(3)(2006): 306 – 311

A novel process for the removal of NO_x from flue gas by a combined Fe(II)EDTA absorption and microbial reduction has been demonstrated. Fe(II)EDTA-NO and Fe(III)EDTA (EDTA: ethylenediaminetetraacetate) can be effectively reduced to the active Fe(II)EDTA in the reactor containing microorganisms. In a steady-state absorption and regeneration process, the final removal efficiency of NO is up to 88%. The effects of four main parameters (i.e. NO, O₂ and SO₂ concentrations, and the amount of cyclic solution) on NO_x removal efficiency were experimentally investigated at 50 °C. The results provide some insight into conditions required for the successful removal of NO_x from flue gas using the approach of Fe(II)EDTA absorption combined with microbial reduction.

Keywords: NO_x removal • Fe(II)EDTA • microorganisms • absorption • flue gas

Yuanyuan Suna, b, Hongxia Yua, Jingfei Zhanga, Ying Yina, Hua Shena, Hongling Liua and Xiaorong Wang. (aDepartment of Environment Science, School of Environment, State Key Laboratory of Pollution Control and Resources Reuse, Nanjing University, Hankou Road 22, Nanjing 210093, People's Republic of China, bSchool of Chemistry and Environmental Science, Nanjing Normal University, Nanjing 210097, People's Republic of China, cDepartment of Earth Sciences, Nanjing University, Nanjing 210093, People's Republic of China. Corresponding author. Department of Environment Science, School of Environment, State Key Laboratory of Pollution Control and Resources Reuse, Nanjing University, Hankou Road 22, Nanjing 210093, People's Republic of China. Fax: +86 25 83595222). Bioaccumulation and antioxidant responses in goldfish *Carassius auratus* under HC Orange No. 1 exposure. *Ecotoxicology and Environmental Safety*, Volume 63(3) (2006): 430-437.

HC Orange No. 1 is used as a color additive in hair dyes and colors. In this study, laboratory experiments were carried out to determine the accumulation of HC Orange No. 1 in goldfish and the biochemical responses in liver of freshwater goldfish *Carassius auratus*. Goldfish were exposed to 1.0 mg/L HC

Orange No. 1 for 6, 12, 24, 36, 48, 60, 72, and 96 h. Results showed that the concentrations of HC Orange No. 1 in water decreased rapidly in the first 24 h, and then maintained equilibrium, while the concentrations of HC Orange No. 1 in goldfish reached a maximum level at 24 h, and then descended appreciably. For the total loss of HC Orange No. 1 in water 16.4% was due to the accumulation by goldfish, and approximately 57.6% resulted from metabolism by goldfish. After calculation, lgBCF is equal to 2.11. Hence, HC Orange bioaccumulation is significantly affected by a fast metabolic clearance in goldfish. Next, we investigated the biochemical responses in liver of freshwater goldfish *C. auratus*. It was shown that the hepatic antioxidant defense parameters of goldfish, including the contents of reduced glutathione (GSH) and activities of superoxide dismutase (SOD), catalase (CAT), glutathione S-transferase (GST), were highly sensitive to HC Orange No. 1 exposure, accompanied by changes of HC Orange No. 1 accumulation in liver tissue. Changes of these parameters indicated that there was an increase in the production of oxyradicals by goldfish and the presence of oxidative stress. These findings also implied that glutathione as well as other antioxidant enzymes function in the protection against HC Orange No. 1 toxicity and that these antioxidants provide a first line of defense against HC Orange No. 1, before the induction of any other detoxification mechanism.

Keywords: HC Orange No. 1; Exposure; *Carassius auratus*; Antioxidant defenses; Oxidative stress; Bioaccumulation

Anju Arora¹, Sudhir Saxena¹ and Dinesh Kumar Sharma². (¹Centre for Conservation and Utilization of Blue Green algae, Indian Agricultural Research Institute, 110012 New Delhi, India, ²Division of Environmental Sciences, Indian Agricultural Research Institute, 110012 New Delhi, India, Anju Arora, Email: anjudev@yahoo.com, Phone: +91-11-25848431, Fax: +91-11-25741648). **Tolerance and phytoaccumulation of Chromium by three *Azolla* species. World Journal of Microbiology and Biotechnology, Volume 22(2) (2006): 97 – 100.**

Azolla, an aquatic fern is ideal candidate for exploitation in constructed wetlands for treating metal-contaminated wastewaters. This study demonstrates the potential of *Azolla* spp. namely *A. microphylla*, *A. pinnata* and *A. filiculoides* to tolerate Cr ions in the growth environment and bioconcentrate them. These species could grow in presence of up to 10 µg ml⁻¹ Cr and showed biomass production 30–70% as compared to controls. Nitrogenase activity was not affected at 1–5 µg ml⁻¹ but at higher concentrations it diminished. There was no growth at higher concentrations of chromium. However, the necrosed biomass harvested from treatments containing higher concentrations of chromium, accumulated Cr to the levels 5000–15,000 µg g⁻¹. At increased levels of Cr, the metal was accumulated in higher amount in dry biomass. Bioconcentration Factor (BCF) ranged between 243 and 4617 for the three species. *A. microphylla* showed highest bioconcentration potential. Thus, these *Azolla* spp. can be exploited for treatment of tannery and other Cr contaminated wastewaters.

Key words: *Azolla* species - bioremediation - chromium - heavy metal - phytosorption - wastewaters

Dennis T. Burton¹, Steven D. Turley¹, Daniel J. Fisher¹, Donald J. Green² and Tommy R. Shedd³. (¹Wye Research and Education Center, University of Maryland, P.O. Box 169, Queenstown, MD, 21658, ²U.S. Army Garrison, Directorate of Safety, Health and Environment, Building E5771, Aberdeen Proving Ground, MD, 21010, ³U.S. Army Center for Environmental Health Research, 568 Doughten Drive, Fort Detrick, MD, 21702, Dennis T. Burton, Email: dburton@umd.edu). **Bioaccumulation of Total Mercury and Monomethylmercury in the Earthworm *Eisenia Fetida*. Water, Air, & Soil Pollution, Issue: Online First (2006).**

Bioaccumulation factors (BAFs) for inorganic mercury in earthworms are usually < 1; however, factors up to 10 have been reported. Little information is available concerning the bioaccumulation of organic mercury in earthworms from actual contaminated soils and thus there has been uncertainty in the risk characterization phase of ecological risk assessments of mercury-contaminated sites. This study was initiated to determine the rate of uptake and bioaccumulation of total mercury (T-Hg) and

monomethylmercury (MMHg) in *Eisenia fetida* from soils which have been contaminated with mercury for approximately 30 years. The study consisted of a 28-day uptake phase in three mercury-contaminated soils and one soil with background concentrations of mercury followed by a 14-day depuration phase in background soil only. Total mercury concentrations in the study soils ranged from 85 to 11,542 $\mu\text{g kg}^{-1}$ dry weight soil; MMHg concentrations ranged from 1.12 to 7.35 $\mu\text{g kg}^{-1}$ dry weight soil. Time to 90% steady states for T-Hg ranged from 36 to 42 days. A steady state did not occur for any of the MMHg exposures during the 42-day study; estimated time to 90% steady state varied from 97 to 192 days. BAFs for T-Hg ranged from 0.6 to 3.3. BAFs for MMHg ranged from 175 to 249. The BAFs for T-Hg and MMHg were larger in earthworms exposed to the lower contaminated soils and smaller in the higher mercury-contaminated soils. The absolute concentrations of T-Hg and MMHg bioaccumulated in *E. fetida*, however, were higher in the earthworms exposed to the higher mercury soils and lower in the less mercury-contaminated soils.

Keywords BAF - bioaccumulation - bioaccumulation factor - earthworm - ecological risk assessment - *Eisenia fetida* - mercury - monomethylmercury - soil

Iqbal Ahmad, Shaheen Zafar; Farah Ahmad. Heavy Metal Biosorption potential of *Aspergillus* sp and *Rhizopus* sp. isolated from Wastewater treated soil. Journal of Applied Sciences and Environmental Management, Vol. 9(1) (2005): 123-126.

Two isolates belonging to the predominant genera *Aspergillus* sp. and *Rhizopus* sp isolated from agricultural field treated with sewage/ industrial effluents were selected for the biosorption potential evaluation of Cr and Cd. Pretreated, dead biomass of above fungi was used for bioadsorption experiment at pH value 4.5 with the biomass, 1-5 mg in a 100 ml metal solution of different concentration (2, 4, 6 and 8 mM) with a contact time of 18 hrs and agitation, 120 rpm. Bioadsorption of Cr ranged from 6.20- 9.5 mg/g of dry mass at one or other initial metal concentrations by *Aspergillus* and *Rhizopus* sp. The bioadsorption of Cd was ranged from 2.3-8.21 mg/g. On the comparative basis *Rhizopus* sp. could bioadsorbed higher concentration of both metals as compared to *Aspergillus* sp. Bioadsorption of Cd and Cr was influenced by initial metal concentration and nature of organism. The findings revealed that fungi of metal polluted sites showed higher metal tolerance and bioadsorption capacity of chromium and cadmium.

Michael Horsfall Jnr and Ayebaemi I. Spiff. Effect of metal ion concentration on the biosorption of Pb^{2+} and Cd^{2+} by *Caladium bicolor* (wild cocoyam) African Journal of Biotechnology, Vol. 4(02) (2005): 191-196

The influence of initial metal ion concentration of the batch sorption of Pb^{2+} and Cd^{2+} onto a low-cost biosorbent was investigated. The experimental results were analysed in terms of Langmuir and Freundlich isotherms. According to the evaluation using Langmuir equation, the monolayer sorption capacity obtained were 49.53 and 65.50 mM/g for Pb^{2+} and Cd^{2+} , respectively The data further showed that, sorption of the two divalent metals onto the biomass increased with increase in initial metal ion concentration until monolayer coverage is attained. The thermodynamic assessment of the metal ion - *Caladium bicolor* biomass system indicates the feasibility and spontaneous nature of the process and ΔGo was evaluated as ranging from -4.55 to -6.63 KJ mol^{-1} and -4.02 to -6.09 KJ mol^{-1} for Pb^{2+} and Cd^{2+} sorption, respectively. The order of magnitude of the ΔGo values indicates an ion-exchange physisorption process.

Keywords: Phytoremediation, cocoyam, adsorption, water treatment, heavy metals removal.

J. Hernández-Allica¹, J. M. Becerril², O. Zárate¹ and C. Garbisu¹ (¹NEIKER-Basque Institute of Agricultural Research and Development, c/ Berreaga 1, E-48160 Derio, Spain, ²Department of Plant Biology and Ecology, University of the Basque Country, 644, E-48080 Bilbao, Spain).

,Assessment of the Efficiency of a Metal Phytoextraction Process with Biological Indicators of Soil Health. Plant and Soil, Volume 281 (1-2) (2006): 147 – 158

The ultimate goal of any soil remediation process should be not only to remove the contaminant(s) from the polluted site but to restore soil health as well. In consequence, reliable indicators of soil health are needed if we are to properly evaluate the efficiency of a soil remediation process. The aim of the current work was to determine the effect of metal phytoextraction, through the utilization of the Zn hyperaccumulator *T. caerulescens*, on biological parameters of soil health, on the assumption that biological indicators of soil health might be valid monitoring tools to assess the efficiency of a metal phytoextraction process. To this end, a short-term microcosm phytoextraction study was carried out, with two heavy metal polluted soils collected from an abandoned mine, to determine the effect of metal phytoextraction on soil biological parameters. Higher values of biomass C, basal respiration, substrate induced respiration, and β -glucosidase activity were observed in the presence of *T. caerulescens* plants, as compared to unplanted pots. Our data confirm the great capacity of *T. caerulescens* to phytoextract Zn from polluted soils and, interestingly, suggest that metal phytoextraction has indeed a beneficial effect on soil biological activity. It was concluded that the revegetation of these metal polluted soils with *T. caerulescens* could help activate their biochemical and microbial functionality.

Keywords bioindicators - heavy metals - hyperaccumulating plants - phytoextraction - soil health - *Thlaspi*

Erema R. Daka^{1,4} and Stephen J. Hawkins^{2,3} (¹Port Erin Marine Laboratory, School of Biological Sciences, University of Liverpool, Port Erin, Isle of Man, IM9 6JA, UK, ² Division of Biodiversity and Ecology, School of Biological Sciences, University of Southampton, Southampton, SO17 1BJ, UK, ³ The Laboratory, Marine Biological Association of the United Kingdom, Citadel Hill, Plymouth, PL1 2PB, UK, ⁴ *Present address:* Department of Applied and Environmental Biology, Rivers State University of Science and Technology, PMB 5080, Port Harcourt, Nigeria). **Interactive Effects of Copper, Cadmium and Lead on Zinc Accumulation in the Gastropod Mollusc *Littorina Saxatilis*. Water, Air, & Soil Pollution, Volume 171 (1-4) (2006): 19 – 28**

The effects of copper, cadmium and lead on the bioaccumulation of zinc were studied in populations of the gastropod mollusc *Littorina saxatilis* from sites in the Isle of Man subjected to varying degrees of mine-related metal contamination. Exposures to 2 mg/L Zn alone and in combinations with 0.01 mg/L, 0.1 mg/L and 1 mg/L of the respective metals were conducted at 10°C in semi-static assays. Copper had a significant antagonistic effect on Zn accumulation at 1 mg/L Cu, but was not antagonistic at 0.01 and 0.1 mg/L Cu. Prior exposure to metals in the field did not appear to affect the interactive effect of copper as all populations showed similar patterns. Combinations of Zn with Cd or Pb at the above concentrations did not show any significant effects on Zn accumulation. On the other hand, Zn had an antagonistic effect on Cd and Pb accumulation but showed inconsistent effects on Cu accumulation. Interactions of Cu and Zn in particular may have repercussions for interpretation of biomonitoring data in *L. saxatilis*.

Keywords bioaccumulation - gastropod mollusc - heavy metals - interaction – littorinid

S. Paramasivam¹, K. S. Sajwan¹ and A. K. Alva². (¹ Center for Marine Environmental Sciences and Biotechnology Research, Department of Natural Sciences and Mathematics, Savannah State University, P.O. Box 20600, Savannah, GA 31404, USA, ² USDA-ARS Pacific West Area, Vegetable and Forage Crops Research Unit, 24106 N Bunn Rd., Prosser, WA 99350, USA). **Incinerated Sewage Sludge Products as Amendments for Agricultural Soils: Leaching and Plant Uptake of Trace Elements Water, Air, & Soil Pollution, Volume 171 (1-4) (2006):273-290**

Preliminary leaching column and greenhouse plant uptake studies were conducted in two soils with contrasting characteristics amended with varying rates (0 to 148.3 Mg ha⁻¹) of incinerated sewage sludge

(ISS) and weathered sewage sludge (WISS) to estimate the leaching losses of trace elements from the soils amended with incinerated sewage sludge by products and to evaluate the uptake and accumulation of these elements in various parts of *Sorghum vulgare* var. *sudanense* Hitchc. ("Sorghum"), a Sorghum-Sudan grass hybrid. Results of this study indicated that leaching of Cr, Cd, Zn, Cu, Ni, Fe and Mn from soils amended with ISS and WISS increased with increasing rates of amendment. Results of the leaching column study further revealed greater leaching losses from coarse-textured soil compared to medium-textured soil and also from ISS amended soils than with WISS amended soils. Results further suggested that the type of element and the interaction between the element and soil properties affected the leachability of various trace elements. The uptake study indicated uptake and accumulation of trace elements by plant parts increased with increasing rates of amendments. Greater plant uptake and accumulation of trace elements were observed in plant parts grown in soils amended with ISS compared to that of WISS. Results also indicated a greater accumulation of trace elements in below ground part of the plants (roots) compared to that was observed in above ground parts (shoots). Limited data obtained from this one season preliminary studies demonstrated that incinerated sewage sludge products from wastewater treatment plants could be used as soil amendments at low application (no more than 24.7 Mg ha⁻¹) for optimum plant growth, and dry matter yield without resulting in substantial accumulation of metals in plant parts at concentrations above the recommended critical limits and without causing significant leaching losses of various trace elements. It is imperative that long-term field studies are necessary to evaluate the long-term impact of using these new products in leaching and accumulation of various trace elements in plants and soils.

Keywords incinerated sewage sludge - leaching - sewage sludge - trace elements - weathered incinerated sewage sludge

Bioremediation

Erik J. Joner^a, Corinne Leyval^a and Jan V. Colpaert^b. ^aLaboratoire des Interactions Microorganismes-Minéraux-Matière Organique dans les Sols (LIMOS), Université H. Poincaré Nancy 1, P.O. Box 239, F-54506 Vandoeuvre-les-Nancy, France, ^bCentre for Environmental Sciences, Environmental Biology Group, Hasselt University, Agoralaan, Gebouw D, B-3590 Diepenbeek, Belgium. Corresponding author at: Norwegian Centre for Soil and Environmental Research (Jordforsk), Fredrik A Dahls vei 20, N-1432 Ås, Norway. Tel.: +47 6494 8199; fax: +47 6494 7367). Ectomycorrhizas impede phytoremediation of polycyclic aromatic hydrocarbons (PAHs) both within and beyond the rhizosphere. *Environmental Pollution*, Article in Press

Exploitation of mycorrhizas to enhance phytoremediation of organic pollutants has received attention recently due to their positive effects on establishment of plants in polluted soils. Some evidence exist that ectomycorrhizas enhance the degradation of pollutants of low recalcitrance, while less easily degradable polyaromatic molecules have been degraded only by some of these fungi in vitro. Natural polyaromatic (humic) substances are degraded more slowly in soil where ectomycorrhizal fungi are present, thus phytoremediation of recalcitrant pollutants may not benefit from the presence of these fungi. Using a soil spiked with three polycyclic aromatic hydrocarbons (PAHs) and an industrially polluted soil (1 g kg⁻¹ of Σ 12 PAHs), we show that the ectomycorrhizal fungus *Suillus bovinus*, forming hydrophobic mycelium in soil that would easily enter into contact with hydrophobic pollutants, impedes rather than promotes PAH degradation. This result is likely to be a nutrient depletion effect caused by fungal scavenging of mineral nutrients.

The ectomycorrhizal fungus *S. bovinus* impeded degradation of PAHs in soil, probably due to its negative effect on the availability of mineral nutrients of more potent PAH degraders.

Keywords: Bioremediation; Mycorrhiza; Persistent organic pollutants; Phytoremediation; Soil

Rosalind F. King^a, Anna Royle^b, Philip D. Putwain^c and Nicholas M. Dickinson^b. (^aSchool of Biological Sciences, Jones Building, Liverpool University, Liverpool L69 3GS, UK, ^bBiological and Earth Sciences, John Moores University, Byrom Street, Liverpool L17 3AF, UK, ^cEcological Restoration Consultants, 4 Bendee Road, Neston, Cheshire CH64 9QE, UK. Corresponding author. Tel.: +44 151 231 2190; fax: +44 151 207 3224). **Changing contaminant mobility in a dredged canal sediment during a three-year phytoremediation trial. Environmental Pollution, Article in Press**

Metal mobility and degradation of organic pollutants were investigated in a contaminated canal sediment in NW England. Sediment was dredged and exposed above the water surface, planted with multiple taxa of *Salix*, *Populus* and *Alnus* and monitored over 32 months. Short-term metal fractionation and phytotoxicity during sediment oxidation were also evaluated in separate laboratory studies. Zinc and Pb redistributed into more mobile fractions, which increased toxicity of the sediment to plants in the laboratory. In contrast, at the canal site, mobility of most elements decreased and total concentrations of Zn, Pb, Cu and Cd fell. Petroleum hydrocarbon concentrations decreased, but the tree-planted treatments appeared less effective at reducing PAH concentrations than treatments colonised by invasive plants. Tree survivorship decreased over time, suggesting increasing phytotoxicity of the exposed sediment in the longer term. Trees provided little benefit in terms of sediment remediation. Options for future management of the sediment are evaluated.

Highly mobilised and toxic metals in a dredged canal sediment provided unexpected responses in a phytoremediation trial.

Keywords: Phytoremediation; Short rotation coppice (SRC); Heavy metals; Hydrocarbons; Sediment

P. Lodeiro, J.L. Barriada, R. Herrero and M.E. Sastre de Vicente. (Departamento de Química Física e Enxeñaría Química I, Universidade da Coruña, Alejandro de la Sota 1, 15071 A Coruña, Spain. Corresponding author. Tel.: +34 981 167000x2126; fax: +34 981 167065). **The marine macroalga *Cystoseira baccata* as biosorbent for cadmium(II) and lead(II) removal: Kinetic and equilibrium studies. Environmental Pollution, Article in Press**

This work reports kinetic and equilibrium studies of cadmium(II) and lead(II) adsorption by the brown seaweed *Cystoseira baccata*. Kinetic experiments demonstrated rapid metal uptake. Kinetic data were satisfactorily described by a pseudo-second order chemical sorption process. Temperature change from 15 to 45 °C showed small variation on kinetic parameters. Langmuir–Freundlich equation was selected to describe the metal isotherms and the proton binding in acid–base titrations. The maximum metal uptake values were around 0.9 mmol g⁻¹ (101 and 186 mg g⁻¹ for cadmium(II) and lead(II), respectively) at pH 4.5 (raw biomass), while the number of weak acid groups were 2.2 mmol g⁻¹ and their proton binding constant, K_H , 10^{3.67} (protonated biomass). FTIR analysis confirmed the participation of carboxyl groups in metal uptake. The metal sorption was found to increase with the solution pH reaching a plateau above pH 4. Calcium and sodium nitrate salts in solution were found to affect considerably the metal biosorption.

Marine macroalgae show promise for biosorption of lead and cadmium.

Keywords: Biosorption; Marine macroalgae; Cadmium(II); Lead(II); Potentiometric titration

D.K. Bakshi¹, S. Saha², I. Sindhu³ and P. Sharma³. (¹Department of Experimental Medicine, PGIMER, Chandigarh, India, ²Institute of Microbial Technology, Chandigarh, India, ³Department of Microbiology, Panjab University, 160014 Chandigarh, India. P. Sharma, Email: princess@pu.ac.in, Phone: +91-172-2541770, Fax: +91-172-2545425). **Use of *Phanerochaete chrysosporium* biomass for the removal of textile dyes from a synthetic effluent. World Journal of Microbiology and Biotechnology, ISSN: 0959-3993 (Paper) 1573-0972 (Online First)**

The use of *Phanerochaete chrysosporium* biomass for the removal of Reactofix Golden Yellow from aqueous solution and eight textile dyes (four azo and four anthraquinone) from a synthetic effluent (0.6 g/l) at different pH, temperature and biomass concentrations was studied. Adsorption was maximum at pH 2.0 and 40 °C using 2.45 g mycelial biomass. The rate constant of adsorption was $1.95 \times 10^{-1}/\text{min}$ for Reactofix Golden Yellow and $1.64 \times 10^{-1}/\text{min}$ for synthetic effluent. In both cases, the equilibrium data fitted well in the Langmuir but not the Freundlich model of adsorption, and the adsorption was biphasic. Adsorption decreased the COD of Reactofix Golden Yellow and synthetic effluent by 54 and 57%, respectively. Desorption (80–84%) of dyes from *P. chrysosporium* mycelial surface occurred as the pH increased from 2 to 10.

Keywords Adsorption dynamics - isotherms - *Phanerochaete chrysosporium* - textile dye effluent

Rafael Clemente^a, Concepción Almela^b and M. Pilar Bernal^a. (^aDepartment of Soil and Water Conservation and Organic Waste Management, Centro de Edafología y Biología Aplicada del Segura, CSIC, Campus Universitario de Espinardo, Apartado 164, 30100 Espinardo, Murcia, Spain, ^bInstituto de Agroquímica y Tecnología de Alimentos, CSIC, Apartado 73, 46100 Burjassot, Valencia, Spain. Corresponding author. Tel.: +34 968 396 260; fax: +34 968 396 213). **A remediation strategy based on active phytoremediation followed by natural attenuation in a soil contaminated by pyrite waste. Environmental Pollution, Article in Press**

Phytoremediation of metal-polluted soils can be promoted by the proper use of soil amendments and agricultural practices. A 4-year phytoremediation programme was applied to a site affected by the toxic spill of pyrite residue at Aznalcóllar (Spain) in 1998, contaminated with heavy metals (Zn, Cu, Pb, Cd) and arsenic. This consisted of active phytoremediation, using organic amendments (cow manure and compost) and lime and growing two successive crops of *Brassica juncea* (L.) Czern., followed by natural attenuation without further intervention. Changes in soil pH, extractable metal and As concentrations, organic carbon content and microbial biomass was evaluated. The initial oxidation of metal sulphides from pyrite residues released soluble metals and reduced soil pH to extremely acidic values (mean 4.1, range 2.0–7.0). The addition of lime (up to 64 t ha⁻¹) increased soil pH to adequate values for plant growth, resulting in a significant decrease in DTPA-extractable metal concentrations in all plots. The natural attenuation phase showed also a decrease in extractable metals. Organic treatments increased the soil total organic carbon, which led to higher values of microbial biomass (11.6, 15.2 and 14.9 g kg⁻¹ TOC and 123, 170 and 275 µg g⁻¹ biomass-C in control, compost and manure plots, respectively). Active phytoremediation followed by natural attenuation, was effective for remediation of this pyrite-polluted soil.

The addition of lime and organic amendments decreased heavy metal solubility and promoted the natural attenuation of a recently-contaminated soil.

Keywords: Heavy metals; Microbial biomass; Natural attenuation; Phytoremediation; Soil contamination

Paul M. White Jr.¹, Duane C. Wolf², Gregory J. Thoma³ and Charles M. Reynolds⁴. (¹Department of Agronomy, Kansas State University, Manhattan, KS, 66506 ²Department of Crop, Soil, & Environmental Sciences, University of Arkansas, Fayetteville, AR, 72701, ³Department of Chemical Engineering, University of Arkansas, Fayetteville, AR, 72701, ⁴ Cold Regions Research and Engineering Laboratory, 72 Lyme Road, Hanover, NH, 03755. Duane C. Wolf, Email: dwolf@uark.edu, Phone: 479-575-5739, Fax: 479-575-7465). **Phytoremediation of Alkylated Polycyclic Aromatic Hydrocarbons in a Crude Oil-Contaminated Soil. Water, Air, & Soil Pollution, Volume 169(1-4) (2006): 207 – 220**

Phytoremediation uses plants and their associated microorganisms in conjunction with agronomic techniques to remove or degrade environmental contaminants. The objective of the field study was to evaluate the effect of vegetation establishment plus fertilizer addition on the biodegradation of alkylated

polycyclic aromatic hydrocarbons in a crude oil-contaminated soil. Four replications of the following treatments were used: non-vegetated non-fertilized control; fescue (*Lolium arundinaceum* Schreb.) – ryegrass (*Lolium multiflorum* L.) mixture + fertilizer; or bermudagrass (*Cynodon dactylon* (L.) Pers.) – fescue mixture + fertilizer. Vegetation was successfully established at the site that had an initial total petroleum hydrocarbon (TPH) concentration of 9,175 mg/kg. While alkylated two-ring naphthalenes were degraded in all treatments equally, there was greater degradation of the larger three-ring alkylated phenanthrenes-anthracenes and dibenzothiophenes in the vegetated fertilized plots compared to the non-vegetated non-fertilized plots. In this field study, an increase in rhizosphere soil volume associated with increased root length along with nutrient additions resulted in increased total bacterial, fungal, and polycyclic aromatic hydrocarbon (PAH) degrader numbers that most likely resulted in increased biodegradation of the more recalcitrant alkylated polycyclic aromatic hydrocarbon compounds in the crude oil-contaminated soil.

Keywords biodegradation - natural attenuation - phytotransformation - rhizosphere enhanced remediation - total petroleum hydrocarbons

James T. Hollibaugh,* Charles Budinoff, Ryan A. Hollibaugh, Briana Ransom, and Nasreen Bano. (Department of Marine Sciences, University of Georgia, Athens, Georgia 30602. * Corresponding author. Mailing address: Department of Marine Sciences, University of Georgia, Athens, GA 30602. Phone: (706) 542-5868. Fax: (706) 542-5888. E-mail: aquadoc@uga.edu). Sulfide Oxidation Coupled to Arsenate Reduction by a Diverse Microbial Community in a Soda Lake. *Applied and Environmental Microbiology*, Vol. 72 (3) (2006): 2043-2049

We characterized the arsenate-reducing, sulfide-oxidizing population of Mono Lake, California, by analyzing the distribution and diversity of *rnmA*, *cbblL*, and dissimilatory arsenate reductase (*arrA*) genes in environmental DNA, arsenate-plus sulfide-amended lake water, mixed cultures, and isolates. The arsenate-reducing community was diverse. An organism represented by an *rnmA* sequence previously retrieved from Mono Lake and affiliated with the *Desulfobulbaceae* (*Deltaproteobacteria*) appears to be an important member of the arsenate-reducing, sulfide-oxidizing community. Sulfide oxidation coupled with arsenate reduction appears to proceed via a two-electron transfer, resulting in the production of arsenite and an intermediate S compound that is subsequently disproportionated. A realgar-like As/S mineral was formed in some experiments.

Theresa M Phillips¹, Hung Lee¹, Jack T Trevors^{1*}, Alan G Seech². (¹Department of Environmental Biology, University of Guelph, Guelph, ON, Canada N1G 2W1, ²Adventus Remediation Technologies Inc., 1345 Fewster Drive, Mississauga, ON, Canada L4W 2A5. *Correspondence to Jack T Trevors, Department of Environmental Biology, University of Guelph, Guelph, ON, Canada N1G 2W1, email: Jack T Trevors (jtrevors@uoguelph.ca)). Full-scale *in situ* bioremediation of hexachlorocyclohexane-contaminated soil. *Journal of Chemical Technology & Biotechnology*. Volume 81 (3) (2006): 289 – 298

Daramend bioremediation technology was used to treat 1100 tonnes of hexachlorocyclohexane (HCH)-contaminated soil at a former lindane manufacturing plant. Half of the site (area A) was treated using a cycled anoxic/oxic treatment, and the other half (area B) was treated under oxic conditions. Each area was divided east to west into five zones. A control area (area C) consisted of strips of soil along the north and east edges of the site. Total HCH concentrations along a west to east gradient ranged from 22 430 to 1069 mg kg⁻¹ in area A and from 21 100 to 730 mg kg⁻¹ in area B. Concentrations in area C ranged from 52 to 1427 mg kg⁻¹. The soil was treated for 371 days, during which time seven anoxic/oxic cycles were completed in area A and regular tillage was performed on area B. Soil samples (one per zone) were collected after 154 and 371 days of treatment. After 371 days, total HCH concentrations were reduced in the most highly contaminated zones of areas A and B by 60% (from 22 430 to 8910 mg kg⁻¹) and 75% (from 21 100 to 5120 mg kg⁻¹), respectively. The average HCH reductions for all five zones of areas A and B were 40 and 47%, respectively, with the data indicating decreased concentrations of selected

isomers in certain zones of both areas. Less substantial changes in HCH concentrations were observed in control area C. Elevated chloride ion concentrations were observed in zones that had demonstrated HCH removal. This full scale project demonstrated the potential for solid phase bioremediation treatment of soil containing high HCH concentrations. Copyright © 2005 Society of Chemical Industry

Keywords: bioremediation • field scale • hexachlorocyclohexane • lindane • microbiology • organochlorine pesticides • soil amendments

C.A. Prochaska and A.I. Zouboulis. (Division of Chemical Technology, Department of Chemistry, Aristotle University of Thessaloniki, 54124 Thessaloniki, Greece). Removal of phosphates by pilot vertical-flow constructed wetlands using a mixture of sand and dolomite as substrate. Ecological Engineering, Volume 26 (3) (2006): 293-303

This study evaluates the performance of a mixture of river sand and dolomite (10:1, w/w) used as substrate in vertical-flow constructed wetlands in removal of phosphates. Two duplicate pilot-scale artificial wetlands (total 4 units) were set up outdoors, planted with *Phragmites australis* and fed with a synthetic sewage solution, corresponding to medium strength municipal wastewater. The wetlands were fed with two batch (intermittent) operational modes and their effluent was monitored for the presence of soluble phosphates over a period of 3 months. Laboratory (batch) incubation experiments were also carried out separately to ascertain the phosphate adsorption capacity of the two materials (i.e. sand and dolomite). The wetlands were capable to remove more than 45% of initially applied phosphates. Phosphorus accumulation in the wetlands body at the end of the operation period was in the range of 6.5–18%, as compared with the unused media. The Ca Mehlich-III extractable content was also increased, indicating that the removal of phosphates would be mainly attributed to the sorption of orthophosphate ions onto calcium carbonates and/or to the precipitation of orthophosphate ions with calcium ions as the respective insoluble calcium phosphates.

Keywords: Constructed wetlands; Vertical flow; Dolomite; Sand; Phosphorus removal; Sorption

M. Ahmadi¹, F. Vahabzadeh¹, B. Bonakdarpour¹, M. Mehranian¹ and E. Mofarrah¹. (¹ Food Process Engineering and Biotechnology Research Center, Department of Chemical Engineering, Amirkabir University of Technology (Tehran Polytechnic), Tehran, Iran, F. Vahabzadeh, Email: far@aut.ac.ir). Phenolic removal in olive oil mill wastewater using loofah-immobilized *Phanerochaete chrysosporium*. World Journal of Microbiology and Biotechnology, Volume 22 (2) (2006): 119 - 127

Olive oil mill wastewater (OMW) has a high organic load, and this is a serious concern of the olive industry. Conventional biological wastewater treatments, despite their simplicity and suitable performance are ineffective for OMW treatment since phenolics possess antimicrobial activity. In order to carry out a proper treatment of OMW, use of a microorganism able to degrade the phenolics is thus necessary. In this study the ability of *Phanerochaete chrysosporium* to degrade the phenolic compounds of OMW and to decrease the chemical oxygen demand (COD) using cells immobilized on loofah was examined. The basal mineral salt solution along with glucose, ammonium sulfate and yeast extract was used to dilute the OMW appropriately. The fungus did not grow on the concentrated OMW. The extent of removal in this bio-treatment, of total phenols (TP) and the COD were 90 and 50%, respectively, while the color and aromaticity decreased by 60 and 95%, respectively. The kinetic behavior of the loofah-immobilized fungus was found to follow the Monod equation. The maximum growth rate μ_{max} was 0.045 h^{-1} while the Monod constant based on the consumed TP and COD were (mg/l) 370 and 6900, respectively.

Keywords COD - decolorization - fungal cell immobilization - loofah sponge - olive oil mill wastewater - *Phanerochaete chrysosporium* - phenolic removal

B. H. Shomar¹, G. Müller¹ and A. Yahya¹. (¹ Institute of Environmental Geochemistry, University of Heidelberg, Im Neuenheimer Feld 236, 69120 Heidelberg, Germany. Corresponding to B. H. Shomar, Email: bshomar@ugc.uni-heidelberg.de). Occurrence of Pesticides in Groundwater and Topsoil of the Gaza Strip. Water, Air, & Soil Pollution, (2006): Online First

Agricultural activities in the Gaza Strip have been associated with excessive and uncontrolled use of dozens of pesticides. Accordingly, groundwater and soil are potentially contaminated causing severe threat to the crowded population. The present study describes a 3-year program to monitor types and levels of contamination by 52 pesticides in 94 groundwater wells in Gaza. Two analytical techniques (GC/MS and HPLC/MS) were applied to achieve this objective.

Water from 63 wells showed no detectable levels of pesticides or levels that were much lower than the allowable limit (0.5 µg/L) of the German and the European Commission (EC) standards for groundwater. Municipal groundwater wells located in residential areas showed better quality than private wells in agricultural regions. Atrazine, atrazine-desisopropyl, propazine, simazine were detected in 18, 15, 8 and 5 wells with average concentrations of 3.5, 1.2, 1.5 and 2.3 µg/L, respectively. A linear correlation was found between the chloride concentrations in groundwater and atrazine for the same private wells.

Generally speaking, shallow aquifers in sandy substances in areas of low annual precipitation in the southern areas of Gaza showed detectable concentrations of pesticides. Pesticides were more abundant in clay soils of the northern area. A linear regression analysis showed a correlation coefficient of $r = 0.87$ between the strawberry greenhouses and the occurrence of propazine, sebutylazine, terbutylazine, 4,4'-DDT, 4,4'-DDE, and 4,4'-DDD in soil. The averages of propazine, sebutylazine and terbutylazine were 19, 13 and 39 µg/kg, respectively. Two soil samples from greenhouses showed maximum contents of 4,4'-DDE and 4,4'-DDT up to 1150 and 823 µg/kg, respectively.

Groundwater needs to be assessed for pesticide contamination on a routine basis to protect the health of Gaza's residents. Where levels of pesticides are found to exceed levels that protect health, alternative water resources need to be found for drinking and possibly other household uses.

Keywords gaza - groundwater - pesticides - soil

Ebuehi, O. A. T.; Abibo, I. B.; Shekwolo, P. D.; 2Igimund, K. I.; 1Adoki, A.; Okoro, I. C. Remediation of Crude Oil Contaminated Soil by Enhanced Natural Attenuation Technique. Journal of Applied Sciences and Environmental Management, Vol. 9 (1) (2005): 103-106

The concentrations of nitrogen, phosphorus, total hydrocarbon utilizing bacteria (THUB), total heterotrophic bacteria (THB) and total petroleum hydrocarbon were determined using the remediation by enhanced natural attenuation (RENA) in a crude oil contaminated farmland in Rivers state, Nigeria. A TPH concentration of 1.1004×10^4 mg/kg of the sandy soil was achieved after spiking and tilling. There was a reduction in the TPH level from 300mg/kg after 8weeks, to 282mg/kg after 10weeks. No significant reduction in the TPH level was observed after the 10th week. The nitrogen and phosphorus levels of the sandy soil were 24.6 and 22.8mg/kg respectively. This suggests that the nitrogen and phosphorus levels could no longer support biodegradation at the residual TPH levels of 282mg/kg and 22.8mg/kg after spiking and tilling respectively, which further reduced to 0.12mg/kg and 1.7mg/kg respectively after 10 weeks. The total hydrocarbon utilizing bacteria (THUB) increased from 3.0×10^4 cfu/g to 8.55×10^4 cfu/g and finally reduced to 5.38×10^4 cfu/g, while the total heterotrophic bacteria (THB) reduced from 1.22×10^8 cfu/g to 5.98×10^5 cfu/g. Data of the study indicate that remediation enhanced natural attenuation technique could be employed to remediate a farm settlement contaminated by crude oil.

Ojumu T.V., Bello O.O., Sonibare J.A. and Solomon B.O. Evaluation of microbial systems for bioremediation of petroleum refinery effluents in Nigeria. African Journal of Biotechnology, Vol. 4 (01) (2005): 31-35

The potential of various organisms to catabolize and metabolize organic compounds has been recognized as potentially effective means of disposing of hazardous wastes. Phenolic compounds has long been recognized as one of the most recalcitrant and persistent substance in petroleum refinery effluents. This is a cause of some concern because of the high toxicity and of this compound. Bioremediation of phenolic compounds has been recognized as a potential solution for the disposal of phenolic compounds due to its scale ability, cost effectiveness and simplicity. The two species of *Pseudomonas* ^{sp}, *P. aeruginosa* ^{sp} and *P. fluorescense* ^{sp} were studied for their bioremediation potential on Refinery effluent with respect to phenol biodegradation in a batch reactor. Phenol was degraded completely by the two species. While *P. aeruginosa* completely mineralize phenol at the 60th hour of cultivation, only 75% (23 mg/l) of phenol was degraded by *P. fluorescense*; complete degradation was achieved at the 84th hour of fermentation. There was highly positive correlation between phenol biodegradation and the microbial growth. ($r = +0.994$ and $r = +0.980$ at $P \leq 0.05$ for *P. aeruginosa* and *P. fluorescense*, respectively). The maximum specific growth rate (μ_{max}) and inhibitory constant (K_i); $0.019(h^{-1})$ and 30.89 mg/l, and 0.011 (h^{-1}) and 33.43 mg/l were obtained from Haldane model for *P. aeruginosa* and *P. fluorescense*, respectively. The study revealed the high potency of these strains and the possibility of using them in bioremediation of petroleum refinery and petrochemical waste waters.

Keywords: Bioremediation, phenol, biodegradation, Pseudomonas, refinery effluents.

Christopher J. French^a, Nicholas M. Dickinson^a and Philip D. Putwain^b. (^aSchool of Biological and Earth Sciences, Liverpool John Moores University, Byrom Street, Liverpool L3 3AF, UK, ^bEcological Restoration Consultants (ERC), Ness Botanic Gardens, University of Liverpool, Ness, Cheshire CH64, UK. Corresponding author. Tel.: +44 151 2312190; fax: +44 151 2073224). **Woody biomass phytoremediation of contaminated brownfield land. Environmental Pollution, Volume 141 (3) (2006): 387-395**

Economic and environmental regeneration of post-industrial landscapes frequently involves some element of re-afforestation or tree planting. We report field trials that evaluate whether woody biomass production is compatible with managing residual trace element contamination in brownfield soils. Large-scale mapping of contamination showed a heterogenous dispersion of metals and arsenic, and highly localised within-site hotspots. Yields of *Salix*, *Populus* and *Alnus* were economically viable, showing that short-rotation coppice has a potentially valuable role in community forestry. Mass balance modelling demonstrated that phytoextraction potentially could reduce contamination hotspots of more mobile elements (Cd and Zn) within a 25–30-year life cycle of the crops. Cd and Zn in stems and foliage of *Salix* were 4–13 times higher than EDTA-extractable soil concentrations. Lability of other trace elements (As, Pb, Cu, Ni) was not increased 3 years after planting the coppice; woody biomass may provide an effective reduction of exposure (phytostabilisation) to these less mobile contaminants.

Field trials show short-rotation coppice provides effective risk management and remediation solutions to hotspots of residual metal and As contamination of brownfield land.

Keywords: Brownfield; Heavy metals; Trees; Coppice

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H.G. contributed equally to this work). Metal Reduction and Iron Biomineralization by a Psychrotolerant Fe(III)-Reducing Bacterium, *Shewanella* sp. Strain PV-4. Applied and Environmental Microbiology, Vol. 72 (5) (2006): 3236-3244

A marine psychrotolerant, dissimilatory Fe(III)-reducing bacterium, *Shewanella* sp. strain PV-4, from the microbial mat at a hydrothermal vent of Loihi Seamount in the Pacific Ocean has been further characterized, with emphases on metal reduction and iron biomineralization. The strain is able to reduce metals such as Fe(III), Co(III), Cr(VI), Mn(IV), and U(VI) as electron acceptors while using lactate, formate, pyruvate, or hydrogen as an electron donor. Growth during iron reduction occurred over the pH range of 7.0 to 8.9, a sodium chloride range of 0.05 to 5%, and a temperature range of 0 to 37°C, with an optimum growth temperature of 18°C. Unlike mesophilic dissimilatory Fe(III)-reducing bacteria, which produce mostly superparamagnetic magnetite (<35 nm), this psychrotolerant bacterium produces well-formed single-domain magnetite (>35 nm) at temperatures from 18 to 37°C. The genome size of this strain is about 4.5 Mb. Strain PV-4 is sensitive to a variety of commonly used antibiotics except ampicillin and can acquire exogenous DNA (plasmid pCM157) through conjugation.

Francesca Cappitelli,^{1*} Elisabetta Zanardini,² Giancarlo Ranalli,³ Emilio Mello,⁴ Daniele Daffonchio,¹ and Claudia Sorlini¹. (Dipartimento di Scienze e Tecnologie Alimentari e Microbiologiche, Università degli Studi di Milano, Milan,¹ Dipartimento di Scienze Chimiche e Ambientali, Università dell'Insubria, Como,² Dipartimento di Scienze e Tecnologie Agro-Alimentari, Ambientali e Microbiologiche, Università degli Studi del Molise, Campobasso,³ Syremon, Pavia, Italy⁴ . * Corresponding author. Mailing address: Dipartimento di Scienze e Tecnologie Alimentari e Microbiologiche, Università degli Studi di Milano, Via Celoria 2, 20133 Milano, Italy. Phone: 39-0250316721. Fax: 39-0250316694. E-mail: francesca.cappitelli@unimi.it). Improved Methodology for Bioremoval of Black Crusts on Historical Stone Artworks by Use of Sulfate-Reducing Bacteria. Applied and Environmental Microbiology, Vol. 72 (5) (2006): 3733-3737

An improved methodology to remove black crusts from stone by using *Desulfovibrio vulgaris* subsp. *vulgaris* ATCC 29579, a sulfate-reducing bacterium, is presented. The strain removed 98% of the sulfates of the crust in a 45-h treatment. Precipitation of black iron sulfide was avoided using filtration of a medium devoid of iron. Among three cell carriers, Carbogel proved to be superior to both sepiolite and Hydrobiogel-97, as it allowed an easy application of the bacteria, kept the system in a state where microbial activity was maintained, and allowed easy removal of the cells after the treatment.

R. Riffaldi¹, R. Levi-Minzi¹, R. Cardelli¹, S. Palumbo¹ and A. Saviozzi¹. (¹Dipartimento di Chimica e Biotecnologie Agrarie, Università di Pisa, via del Borghetto 80, 56124 Pisa, Italy). Soil Biological Activities in Monitoring the Bioremediation of Diesel Oil-Contaminated Soil. Water, Air, & Soil Pollution, Volume 170 (1-4) (2006): 3-15

The effects of two different biological treatments on hydrocarbon degradation and on soil biological activities were determined during a 100-d incubation period. An evaluation of soil biological activities as a monitoring instrument for the decontamination process of diesel-oil contaminated soil was made using measurements of organic carbon content, soil microbial respiration, soil ATP and dehydrogenase, β -glucosidase, lipase enzyme activities. Five samples were used: S (control, uncontaminated soil), CS (contaminated soil), SCS (sterilized contaminated soil), CFS (contaminated soil plus N and P), CCS (contaminated soil plus compost). The relationships between soil parameters and the levels of total petroleum hydrocarbons (TPH) residues were investigated.

Results showed that inorganic nutrients NP and compost stimulated hydrocarbon biodegradation but not all biological activities to a significant extent. The residual hydrocarbon trend was positively related with that of the organic C content, microbial respiration and with β -glucosidase activity, while both soil lipase and dehydrogenase activities were negatively related with the hydrocarbon trend. Lipase activity was found to be the most useful parameter for testing hydrocarbon degradation in soil.

Keywords bioremediation - diesel oil hydrocarbons - microbial respiration - β -glucosydase - lipase - dehydrogenase

Harrison Ifeanyichukwu Atagana¹, R. J. Haynes² and F. M. Wallis². (¹ School of Earth Sciences, Mangosuthu Technikon, P.O.Box 12363, Jacobs, Durban, 4026, South Africa, ² School of Applied Environmental Sciences, University of KwaZulu-Natal, Pietermaritzburg, 3209, South Africa). **Fungal Bioremediation of Creosote-Contaminated Soil: A Laboratory Scale Bioremediation Study Using Indigenous Soil Fungi. Water, Air, & Soil Pollution, Volume 172 (1-4) (2006): 201 – 219**

The aim of the study is to determine the efficacy of indigenous soil fungi in removing (PAHs) from creosote-contaminated soil with a view to developing a bioremediation strategy for creosote-contaminated soil. Five fungal isolates, *Cladosporium*, *Fusarium*, *Penicillium*, *Aspergillus* and *Pleurotus*, were separately inoculated onto sterile barley grains and incubated in the dark. The colonized barley was inoculated onto creosote-contaminated (250 000 mg kg⁻¹) soil in 18 duplicate treatments and incubated at 25 °C for seventy days. The soil was amended with nutrient supplements to give a C:N:Pratio of 25:5:1 and tilled weekly. Creosote removal was higher (between 78 and 94%) in nutrient supplemented treatments than in the un-supplemented ones (between 65 and 88%). A mixed population of fungi was more effective (94.1% in the nutrient amended treatment) in creosote removal than single populations with a maximum of 88%. Barley supported better fungal growth and PAH removal. *Pleurotus sp.* removed the creosote more than the other isolates. Two and three-ring PAHs were more susceptible to removal than the 4- and 5-ring PAHs, which continued to remain in small amounts to the end of the treatment. Reduction of creosote in the present study was higher than was observed in an earlier experiment using a consortium of microorganisms, mainly bacteria, on the same contaminated soil (Atagana, 2003).

Keywords bioremediation - creosote - fungi - nutrients - PAHs - soil

Biotransformation

Vijay Prabha¹ and Manju Ohri¹. (Department of Microbiology, Panjab University, 160014 Chandigarh, India. Vijay Prabha, Email: satishvijay11@yahoo.com, Phone: +91-172-2534147). **Review: Bacterial transformations of bile acids. World Journal of Microbiology and Biotechnology, Online First**

The microbial transformation of bile acids that takes place in the lower alimentary tract plays an important role in the *in vivo* metabolism of bile acids and also of cholesterol in general. Most of the transforming reactions involved can be reproduced in *in vitro* cultures of mixed intestinal microflora: hydrolysis of the peptide bond in the conjugated bile acids, removal of the 7 α -OH group, and dehydrogenation of the α -OH substituents at C-7, C-3 and C-12. The last reaction, which leads to the formation of an oxo group, is reversible and a stereospecific reduction of the oxo moiety into a β -OH group has been shown to be carried out.

Keywords Bile acids - deconjugation - dehydrogenation - dehydroxylation - epimerization - esterification – microorganisms

Iesce MR, della Greca M, Cermolai F, Rubino M, Isidori M, Pascarella L. (Dipartimento Chimica Organica e Biochimica, Universita Federico II di Napoli, Via Cinthia 4, 80126 Napoli, Italy. iesce@unina.it). **Transformation and ecotoxicity of carbamic pesticides in water. Environ Sci Pollut Res Int., 13(2) (2006):105-9.**

BACKGROUND: N-methylcarbamate insecticides are widely used chemicals for crop protection. This study examines the hydrolytic and photolytic cleavage of benfuracarb, carbosulfan and carbofuran under

natural conditions. Their toxicity and that of the corresponding main degradation products toward aquatic organisms were evaluated.

METHODS: Suspensions of benfuracarb, carbosulfan and carbofuran in water were exposed to sunlight, with one set of dark controls, for 6 days, and analyzed by ¹H-NMR and HPLC. Acute toxicity tests were performed on *Brachionus calyciflorus*, *Daphnia magna*, and *Thamnocephalus platyurus*. Chronic tests were performed on *Pseudokirchneriella subcapitata*, and *Ceriodaphnia dubia*.

RESULTS AND DISCUSSION: Under sunlight irradiation, benfuracarb and carbosulfan gave off carbofuran and carbofuran-phenol, while only carbofuran was detected in the dark experiments. The latter was degraded to phenol by exposure to sunlight. Effects of pH, humic acid and KNO₃ were evaluated by kinetics on dilute solutions in the dark and by UV irradiation, which evidenced the lability of the pesticide at pH 9. All three pesticides and phenol exhibited acute and higher chronic toxicity towards the aquatic organisms tested.

CONCLUSION: Investigation on the hydrolysis and photolysis of benfuracarb and carbosulfan under natural conditions provides evidence concerning the selective decay to carbofuran and/or phenol. Carbofuran is found to be more persistent and toxic.

RECOMMENDATIONS AND OUTLOOK: The decay of benfuracarb and carbosulfan to carbofuran and the relative stability of this latter pesticide account for many papers that report the detection of carbofuran in water, fruits and vegetables.

Blais JM, Charpentie S, Pick F, Kimpe LE, St Amand A, Regnault-Roger C. (Department of Biology, University of Ottawa, 30 Marie Curie, Ottawa, Ont., Canada K1N 6N5. jblais@science.uottawa.ca). Mercury, polybrominated diphenyl ether, organochlorine pesticide, and polychlorinated biphenyl concentrations in fish from lakes along an elevation transect in the French Pyrenees. *Ecotoxicol Environ Saf.*, 63(1) (2006):91-9.

Concentrations of mercury and persistent organic pollutants in fish were examined in 11 lakes of the French Pyrenees spanning an elevation range of 2 km. All lakes were confined to a relatively small area within a 50-km diameter. Most of the lakes were within the Pyrenees National Park, which is restricted to recreational hiking, angling, and seasonal grazing of livestock, and are not subject to any known point sources of contaminants. Fish collected were mainly of 1 species (*Salmo trutta fario*), which is stocked regularly in the lakes. With increasing elevation, lake temperatures declined along with electrical conductivity and planktonic chlorophyll a. In contrast, water column nutrients (total phosphorus and total nitrogen) and epilithic periphyton biomass were not correlated with lake elevation. Of the global contaminants measured in fish, mercury, dichlorodiphenyltrichloroethane and its derivatives, and polybrominated diphenyl ethers showed the strongest positive correlation with elevation. Hg levels in some fish exceeded health consumption guidelines in these mountain lakes. Variation in fish contaminant levels was not related to differences in growth rate or to fish trophic position as determined using delta¹⁵N stable isotope measurements. This implies that the delivery and/or retention of many of these contaminants increase with lake elevation.

Mazet A, Keck G, Berny P. (Department of Biology, Toxicology Laboratory ENVL, 1 av. Bourgelat F-69280 Marcy L'Etoile, France. a.mazet@vet-lyon.fr). Concentrations of PCBs, organochlorine pesticides and heavy metals (lead, cadmium, and copper) in fish from the Drome river: potential effects on otters (*Lutra lutra*). *Chemosphere*, 61(6) (2005): 810-6.

In this study samples of ten species of fish were analyzed for concentrations of organochlorine pesticides, PCBs and heavy metals (Pb, Cd, and Cu). Fish were captured using electric fishing on ten sites along the Drome river (Rhône-Alpes region). Quantitative determination of the organochlorine and PCBs compounds was performed by gas chromatography-electron-capture detection (GC-ECD). The

concentrations of heavy metals were determined by atomic absorption spectrophotometry. Samples contained detectable concentrations of lindane, PCBs, and heavy metals but at concentrations below the maximum residue limit (MRL). Non-parametric statistical analysis was performed to distinguish groups of sites with different levels of contamination. PCBs concentrations increased along the river with four groups of sites significantly different from each other. Cadmium concentrations were below the MRL. Lead contamination showed two groups significantly different and a repartition similar to PCBs. Copper contamination was correlated with the localization of vineyards. We assessed the potential effects of contamination the otter (*Lutra lutra*). The concentrations of all pollutants analyzed in fish sampled in this study are lower than the threshold values described in literature. The Drome river is relatively unpolluted river, and the establishment of otter populations should not be affected by pollution.

Piacham T, Isarankura-Na-Ayudhya C, Nantasenamat C, Yainoy S, Ye L, Bulow L, Prachayasittikul V. (Department of Clinical Microbiology, Faculty of Medical Technology, Mahidol University, Bangkok 10700, Thailand). Metalloantibiotic Mn(II)-bacitracin complex mimicking manganese superoxide dismutase. *Biochem Biophys Res Commun*, 341(4) (2006): 925-30.

Superoxide dismutase (SOD) activities of various metallobacitracin complexes were evaluated using the riboflavin-methionine-nitro blue tetrazolium assay. The radical scavenging activity of various metallobacitracin complexes was shown to be higher than those of the negative controls, e.g., free transition metal ions and metal-free bacitracin. The SOD activity of the complex was found to be in the order of Mn(II)>Cu(II)>Co(II)>Ni(II). Furthermore, the effect of bacitracin and their complexation to metals on various microorganisms was assessed by antibiotic susceptibility testing. Moreover, molecular modeling and quantum chemical calculation of the metallobacitracin complex was performed to evaluate the correlation of electrostatic charge of transition metal ions on the SOD activity.

Kourtev PS, Nakatsu CH, Konopka A. (Department of Biological Sciences, 915 W. State Street, Purdue University, West Lafayette, IN 47907-2054. pkourtev@purdue.edu). Responses of the anaerobic bacterial community to addition of organic C in chromium(VI)- and iron(III)-amended microcosms. *Appl Environ Microbiol*, 72(1) (2006): 628-37.

Chromium (VI) is toxic to microorganisms and can inhibit the biodegradation of organic pollutants in contaminated soils. We used microcosms amended with either glucose or protein (to drive bacterial community change) and Fe(III) (to stimulate iron-reducing bacteria) to study the effect of various concentrations of Cr(VI) on anaerobic bacterial communities. Microcosms were destructively sampled based on microbial activity (measured as evolution of CO₂) and analyzed for the following: (i) dominant bacterial community by PCR-denaturing gradient gel electrophoresis (DGGE) of the 16S rRNA gene; (ii) culturable Cr-resistant bacteria; and (iii) enrichment of iron-reducing bacteria of the Geobacteraceae family by real-time PCR. The addition of organic C stimulated the activities of anaerobic communities. Cr(VI) amendment resulted in lower rates of CO₂ production in glucose microcosms and a slow mineralization phase in protein-amended microcosms. Glucose and protein amendments selected for different bacterial communities. This selection was modified by the addition of Cr(VI), since some DGGE bands were intensified and new bands appeared in Cr(VI)-amended microcosms. A second dose of Cr(VI), added after the onset of activity, had a strong inhibitory effect when higher levels of Cr were added, indicating that the developing Cr-resistant communities had a relatively low tolerance threshold. Most of the isolated Cr-resistant bacteria were closely related to previously studied Cr-resistant anaerobes, such as *Pantoea*, *Pseudomonas*, and *Enterobacter* species. Geobacteraceae were not enriched during the incubation. The studied Cr(VI)-contaminated soil contained a viable anaerobic bacterial community; however, Cr(VI) altered its composition, which could affect the soil biodegradation potential.

White JC, Parrish ZD, Isleyen M, Gent MP, Iannucci-Berger W, Eitzer BD, Kelsey JW, Mattina MI. (Department of Soil and Water, Connecticut Agricultural Experiment Station (CAES), 123 Huntington Street, New Haven, CT 06504, USA. jason.white@po.state.ct.us). Influence of citric

acid amendments on the availability of weathered PCBs to plant and earthworm species. *Int J Phytoremediation*, 8(1) (2006): 63-79.

A series of small and large pot trials were conducted to assess the phytoextraction potential of several plant species for weathered polychlorinated biphenyls (PCBs) in soil (105 microg/g Arochlor 1268). In addition, the effect of citric acid on PCB bioavailability to both plants and earthworms was assessed. Under small pot conditions (one plant, 400 g soil), three cucurbits (*Cucurbita pepo* ssp *pepo* [zucchini] and ssp *ovifera* [nonzucchini summer squash], *Cucumis sativus*, cucumber) accumulated up to 270 microg PCB/g in the roots and 14 microg/g in the stems, resulting in 0.10% contaminant removal from soil. Periodic 1 mM subsurface amendments of citric acid increased the stem and leaf PCB concentration by 330 and 600%, respectively, and resulted in up to a 65% increase in the total amount of contaminant removed from soil. Although citric acid at 10 mM more than doubled the amount of PCB desorbed in abiotic batch slurries, contaminant accumulation by two earthworm species (*Eisenia foetida* and *Lumbricus terrestris*) was unaffected by citric acid at 1 and 10 mM and ranged from 11-15 microg/g. Two large pot trials were conducted in which cucurbits (*C. pepo* ssp *pepo* and ssp *ovifera*, *C. sativus*) and white lupin (*Lupinus albus*) were grown in 70 kg of PCB-contaminated soil. White lupin was the poorest accumulator of PCBs, with approximately 20 microg/g in the roots and 1 microg/g in the stems. Both *C. pepo* ssp *ovifera* (summer squash) and *C. sativus* (cucumber) accumulated approximately 65-100 microg/g in the roots and 6-10 microg/g in the stems. *C. pepo* ssp *pepo* (zucchini) accumulated significantly greater levels of PCB than all other species, with 430 microg/g in the roots and 22 microg/g in the stems. The mechanism by which *C. pepo* spp *pepo* extracts and translocates weathered PCBs is unknown, but confirms earlier findings on the phytoextraction of other weathered persistent organic pollutants such as chlordane, p,p'-DDE, and polycyclic aromatic hydrocarbons.

Lu J, Wu L, Newman J, Faber B, Gan J. (Department of Environmental Sciences, University of California-Riverside, Riverside, California 92521, USA. Jianhang@ucr.edu). Degradation of pesticides in nursery recycling pond waters. *J Agric Food Chem*. 2006 Apr 5;54(7):2658-63.

Recycling or collection ponds are often used in outdoor container nursery production to capture and recycle runoff water and fertilizers. Waters in recycling ponds generally have high concentrations of nutrients, pesticides, and dissolved organic matter, as well as elevated salinity and turbidity. Little is known about pesticide degradation behavior in the unique environment of nursery recycling ponds. In this study, degradation of four commonly used pesticides diazinon, chlorpyrifos, chlorothalonil, and pendimethalin in waters from two nursery recycling ponds was investigated at an initial pesticide concentration of 50 microg/L. Results showed that the persistence of diazinon and chlorpyrifos appeared to be prolonged in recycling pond waters as compared to surface streamwaters, possibly due to decreased contribution from biotic transformation, while degradation of chlorothalonil and pendimethalin was enhanced. Activation energies of biotic degradation of all four pesticides were lower than abiotic degradation, indicating that microbial transformation was less affected by temperature than chemical transformation. Overall, the pesticide degradation capacity of recycling ponds was better buffered against temperature changes than that of surface streamwaters.

Amatya PL, Hettiaratchi JP, Joshi RC. (Department of Civil Engineering, University of Calgary, Calgary, Alberta, Canada). Interaction effects of metals and salinity on biodegradation of a complex hydrocarbon waste. *J Air Waste Manag Assoc*, 56(2) (2006): 197-205.

The presence of high levels of salts because of produced brine water disposal at flare pits and the presence of metals at sufficient concentrations to impact microbial activity are of concern to bioremediation of flare pit waste in the upstream oil and gas industry. Two slurry-phase biotreatment experiments based on three-level factorial statistical experimental design were conducted with a flare pit waste. The experiments separately studied the primary effect of cadmium [Cd(II)] and interaction effect between Cd(II) and salinity and the primary effect of zinc [Zn(II)] and interaction effect between Zn(II) and salinity on hydrocarbon biodegradation. The results showed 42-52.5% hydrocarbon removal in

slurries spiked with Cd and 47-62.5% in the slurries spiked with Zn. The analysis of variance showed that the primary effects of Cd and Cd-salinity interaction were statistically significant on hydrocarbon degradation. The primary effects of Zn and the Zn-salinity interaction were statistically insignificant, whereas the quadratic effect of Zn was highly significant on hydrocarbon degradation. The study on effects of metallic chloro-complexes showed that the total aqueous concentration of Cd or Zn does not give a reliable indication of overall toxicity to the microbial activity in the presence of high salinity levels.

Miyamoto K, Hoshimiya T. (Research Institute of Electrical Communication, Tohoku University, Aoba-ku, Sendai, Miyagi, Japan). Measurement of the amount and number of pollen particles of *Cryptomeria japonica* (taxodiaceae) by imaging with a photoacoustic microscope. *IEEE Trans Ultrason Ferroelectr Freq Control*, 53(3) (2006): 586-91.

A photoacoustic microscope (PAM), which includes a condenser microphone and a pair of linear-motor-driven pulse stages, was specially designed for spectroscopic applications. The PAM was applied to measure the amount and number of pollen particles of *Cryptomeria japonica* (CJ), which is known for its allergic function against eyes and nose. The advantage of photoacoustic (PA) imaging is both its high sensitivity and its counting ability up to high concentrations of the specimen. The CJ pollen particles were fixed on a piece of adhesive tape or on albumen (egg white) on a glass slide set in a PA cell. The PA image showed the ability of this method to count CJ pollen from the several-hundred-milligram region to even a single particle. The PA signal obtained was integrated over the specimen surface. The dependence of the PA signal on the amount or number of the pollen particles was measured. The resulting coefficients of correlation of the calibration curves for the amount and the number of pollen particles were 0.94 and 0.97, respectively.

Matsunaga T, Shintani S, Hara A. (Laboratory of Biochemistry, Gifu Pharmaceutical University, Japan). Multiplicity of mammalian reductases for xenobiotic carbonyl compounds. *Drug Metab Pharmacokin*, 21(1) (2006): 1-18.

A variety of carbonyl compounds are present in foods, environmental pollutants, and drugs. These xenobiotic carbonyl compounds are metabolized into the corresponding alcohols by many mammalian NAD(P)H-dependent reductases, which belong to the short-chain dehydrogenase/reductase (SDR) and aldo-keto reductase superfamilies. Recent genomic analysis, cDNA isolation and characterization of the recombinant enzymes suggested that, in humans, the six members of each of the two superfamilies, i.e., total of 12 enzymes, are involved in the reductive metabolism of xenobiotic carbonyl compounds. They comprise three types of carbonyl reductase, dehydrogenase/reductase (SDR family) member 4, 11beta-hydroxysteroid dehydrogenase type 1, L-xylulose reductase, two types of aflatoxin B1 aldehyde reductase, 20alpha-hydroxysteroid dehydrogenase, and three types of 3alpha-hydroxysteroid dehydrogenase. Accumulating data on the human enzymes provide new insights into their roles in cellular and molecular reactions including xenobiotic metabolism. On the other hand, mice and rats lack the gene for a protein corresponding to human 3alpha-hydroxysteroid dehydrogenase type 3, but instead possess additional five or six genes encoding proteins that are structurally related to human hydroxysteroid dehydrogenases. Characterization of the additional enzymes suggested their involvement in species-specific biological events and species differences in the metabolism of xenobiotic carbonyl compounds.

Jadhav JP, Govindwar SP. (Department of Biochemistry, Shivaji University, Kolhapur 416 004, India) Biotransformation of malachite green by *Saccharomyces cerevisiae* MTCC 463. *Yeast*, 23(4) (2006): 315-23.

In recent years, use of microbial biomass for decolourization of textile industry wastewater is becoming a promising alternative in which some bacteria and fungi are used to replace present treatment processes. *Saccharomyces cerevisiae* MTCC 463 decolourized the triphenylmethane dyes (malachite green, cotton blue, methyl violet and crystal violet) by biosorption, showing different decolourization patterns.

However, malachite green decolourized by biosorption at the initial stage and further biodegradation occurred, about 85% in plain distilled water within 7 h, and about 95.5% in 5% glucose medium within 4 h, under aerobic conditions and at room temperature. Decolourization of malachite green depends on various conditions, such as concentration of dye, concentration of cells, composition of medium and agitation. HPLC, UV-VIS, FTIR and TLC analysis of samples extracted with ethyl acetate from decolourized culture flasks confirmed the biodegradation of malachite green into several metabolites. A study of the enzymes responsible for the biodegradation of malachite green in the control and cells obtained after decolourization showed the activities of laccase, lignin peroxidase, NADH-DCIP reductase, malachite green reductase and aminopyrine N-demethylase in control cells. A significant increase in the activities of NADH-DCIP reductase and MG reductase was observed in the cells obtained after decolourization, indicating a major involvement of reductases in malachite green degradation. Copyright 2006 John Wiley & Sons, Ltd.

Occupational Safety and Health Administration (OSHA), Department of Labor. Occupational exposure to hexavalent chromium. Final rule. Fed Regist, 71(39) (2006): 10099-385.

The Occupational Safety and Health Administration (OSHA) is amending the existing standard which limits occupational exposure to hexavalent chromium (Cr(VI)). OSHA has determined based upon the best evidence currently available that at the current permissible exposure limit (PEL) for Cr(VI), workers face a significant risk to material impairment of their health. The evidence in the record for this rulemaking indicates that workers exposed to Cr(VI) are at an increased risk of developing lung cancer. The record also indicates that occupational exposure to Cr(VI) may result in asthma, and damage to the nasal epithelia and skin. The final rule establishes an 8-hour time-weighted average (TWA) exposure limit of 5 micrograms of Cr(VI) per cubic meter of air (5 [mu]g/cu m). This is a considerable reduction from the previous PEL of 1 milligram per 10 cubic meters of air (1 mg/10 cu m, or 100 [mu]g/cu m) reported as CrO₃, which is equivalent to a limit of 52 [mu]g/cu m as Cr(VI). The final rule also contains ancillary provisions for worker protection such as requirements for exposure determination, preferred exposure control methods, including a compliance alternative for a small sector for which the new PEL is infeasible, respiratory protection, protective clothing and equipment, hygiene areas and practices, medical surveillance, recordkeeping, and start-up dates that include four years for the implementation of engineering controls to meet the PEL. The final standard separately regulates general industry, construction, and shipyards in order to tailor requirements to the unique circumstances found in each of these sectors. The PEL established by this rule reduces the significant risk posed to workers by occupational exposure to Cr(VI) to the maximum extent that is technologically and economically feasible.

La Porte PF. (Biological Sciences Division, University of Chicago, Chicago, IL, USA. laporte@uchicago.edu). Mytilus trossulus hsp70 as a biomarker for arsenic exposure in the marine environment: laboratory and real-world results. Biomarkers. 2005 Nov-Dec;10(6):417-28.

The highly conserved heat shock protein 70 (hsp70) is induced by heat and chemical toxins, particularly heavy metals such as arsenic (As). The use of *Mytilus trossulus* (bay mussel) hsp70 as a 'screening' biomarker for marine heavy metals contamination was assessed. Some studies have found high hsp70 sensitivity to heavy metals, while others have found the opposite. Few studies have realistically used low heavy metals exposures, and fewer have used real-world contamination exposures. Clean sub-tidal mussels from the Puget Sound, Washington State (WA), USA, were acclimatized for 2 weeks and exposed for 24 h to As-spiked seawater (n=9) or to contaminated seawater from an arsenical pesticide plant in Tacoma, WA (n=10) followed by a Western blot for hsp70. Hsp70 inductions were insignificant at 10 microg l(-1) As(III), but were strong at 100 microg l(-1) (p<0.05) and 1000 microg l(-1) (p<0.01), with the induction threshold estimated at 30-50 microg l(-1) As(III). Hsp70 induction roughly correlated with arsenical toxicity, with As(III) > As(V) > (CH₃)₂As(V). Altogether, the inter-individual variability of hsp70 levels tends to mask inductions at low As concentrations, making it a crude toxicity biomarker. In addressing this problem, the following options could prove promising: (1) pre- or post-

stressing specimens for greater hsp70 sensitivity, (2) use of internal protein controls such as actin, (3) use of hsp70-reporter gene constructs, and (4) detection with hsp60, heme oxygenase-1, metallothionein, CYP450, MXR or GPx.

Biomarker

S.A. Reinecke and A.J. Reinecke. (Department of Botany and Zoology, University of Stellenbosch, Private Bag X1, Matieland 7602, South Africa, Corresponding author. Fax: +27 21 808 3405). Biomarker response and biomass change of earthworms exposed to chlorpyrifos in microcosms, Ecotoxicology and Environmental Safety, Article in Press

Background levels of chlorpyrifos and earthworm abundance were determined in an orchard and adjacent areas on a farm in the Western Cape, South Africa before these areas were again sprayed with this organophosphate. The background concentrations ranged from 0.2 µg/kg dm in the spray drift area adjacent to the orchard to 10.18 µg/kg dm on the slope in the run off area. In the target area the chlorpyrifos concentrations varied from a mean of 15.25±10.0 µg/kg directly after spraying to a mean of 7.0±0.9 µg/kg 6 months later and in the nontarget area they varied from a mean of 55.0±35 µg/kg to 12.0±5 µg/kg after 6 months. Chlorpyrifos was therefore still present in the field soils, but at lower concentrations, up to 6 months after the last spraying event. Earthworm abundance and population densities were very low. Only *Aporrectodea caliginosa* was found and the densities were much lower in the orchards (22 per m²) than in the nontarget areas (98.3 per m²). Microcosm studies were undertaken to relate biomarker responses to chlorpyrifos with biomass changes. Microcosms were filled with soil from the same areas and earthworms of the species *A. caliginosa* were introduced. The microcosms were treated with a series of concentrations of chlorpyrifos in the laboratory under controlled conditions. These concentrations were chosen to fall within the background ranges found in the soils. The biomass of the worms was determined regularly for a period of 5 weeks and worms in a state of estivation were noted. Earthworms were removed from the microcosms for biomarker tests: for cholinesterase (ChE) inhibition assays every week and for a neutral red retention determination 2 weeks after the exposures started. The most prominent biomass loss was noted in earthworms exposed to the highest pesticide concentration of 8.0 µg/kg. Estivation was higher among earthworms exposed to higher exposure concentrations. Inhibition of ChE increased with higher exposure concentrations and with time but there was no clear dose-related response. A clear dose-related response with exposure concentration was established for the neutral red retention assay. A correlation between ChE inhibition and biomass change existed directly after the second application of chlorpyrifos.

Keywords: Chlorpyrifos; Earthworms; Microcosms; ChE; Neutral red retention times

Wu Jifa^{a, b}, Zhiming Yu^a, Song Xiuxian^a and Wang You^a (^aKey Laboratory of Marine Ecology and Environmental Science, Institute of Oceanology, Chinese Academy of Sciences, Qingdao 266071, China, ^bGraduate School of the Chinese Academy of Science, Beijing 100039, China, Corresponding author. Fax: +86 532 2898581). Response of integrated biomarkers of fish (*Lateolabrax japonicus*) exposed to benzo[a]pyrene and sodium dodecylbenzene sulfonate. Ecotoxicology and Environmental Safety, Article in Press

Fish *Lateolabrax japonicus* were exposed to 0.1 and 1 mg/L of anion surfactant sodium dodecylbenzene sulfonate (SDBS) and to 2 and 20 µg/L of benzo[a]pyrene (B[a]P) for 6, 12, and 18 days, with control and solvent control groups. Liver antioxidant enzymes, including superoxide dismutase (SOD), catalase (CAT), glutathione peroxidase (GPx), reduced glutathione (GSH), and glutathione S-transferase (GST), were determined; brain acetylcholinesterase (AChE) and liver inducible nitric oxide synthase (iNOS) activities were also measured. The results indicated that (1) *L. japonicus* avoided oxidative damage through antioxidant systems; (2) SOD, GPx, and GSH were induced, and GST was inhibited and then

induced by B[a]P exposure; and (3) CAT, GPx, and AChE were induced while iNOS was inhibited, and GST was induced and then inhibited by SDBS stress in experimental period.

Keywords: *Lateolabrax japonicus*; Antioxidant system; B[a]P; SDBS; SOD; CAT; GPx; GST; GSH; AChE; iNOS

Anita J. Kirkpatrick^a, Almut Gerhardt^b, Jaimie T.A. Dick^a, Maria McKenna^a and John A. Berges^{a,1}
(^aMedical Biology Centre, Queen's University Belfast, 97 Lisburn Road, Belfast BT9 7BL, Northern Ireland, ^bLimCo International, An der Aa 5, D-49477 Ibbenbüren, Germany, ¹ Current address: University of Wisconsin-Milwaukee, 3209 N. Maryland Ave., Milwaukee, WI 53211, USA). Use of the multispecies freshwater biomonitor to assess behavioral changes of *Corophium volutator* (Pallas, 1766) (Crustacea, Amphipoda) in response to toxicant exposure in sediment. *Ecotoxicology and Environmental Safety*, Article in Press

Automated sediment toxicity testing and biomonitoring has grown rapidly. This study tested the suitability of the marine amphipod *Corophium volutator* (Pallas, 1766) for sediment biomonitoring using the Multispecies Freshwater Biomonitor (MFB). Two experiments were undertaken to (1) characterize individual behaviors of *C. volutator* using the MFB and (2) examine behavioral changes in response to sediment spiked with the pesticide Bioban. Four behaviors were visually identified (walking, swimming, grooming and falling) and characterized in the MFB as different patterns of locomotor activity (0–2 Hz range). Ventilation was not visually observed but was detected by the MFB (2–8 Hz). No clear diel activity patterns were detected. The MFB detected an overall increase in *C. volutator* locomotor activity after Bioban addition to the sediments (56, 100, 121 mg kg⁻¹). *C. volutator* was more active (both locomotion and ventilation) in the water column than the spiked sediment. *C. volutator* appears a sensitive and appropriate species for behavioral sediment toxicity assessment and biomonitoring.

Keywords: *Corophium volutator*; Bioban; Behavior; Sediment toxicity testing; Multispecies Freshwater Biomonitor

Francis L. Martin^a, Trevor G. Pearce^a, Alan Hewer^b, David H. Phillips^b and Kirk T. Semple^c.
(^aDepartment of Biological Sciences, Institute of Environmental and Natural Sciences, Lancaster University, Lancaster LA1 4YQ, UK, ^bInstitute of Cancer Research, Brookes Lawley Building, Cotswold Road, Sutton, Surrey SM2 5NG, UK, ^cDepartment of Environmental Science, Institute of Environmental and Natural Sciences, Lancaster University, Lancaster LA1 4YQ, UK. Corresponding author. Tel.: +44 1524 594505; fax: +44 1524 843854). A biomarker model of sublethal genotoxicity (DNA single-strand breaks and adducts) using the sentinel organism *Aporrectodea longa* in spiked soil. *Environmental Pollution*, Volume 138(2) (2005): 307-315

There is a need to develop risk biomarkers during the remediation of contaminated land. We employed the earthworm, *Aporrectodea longa* (Ude), to determine whether genotoxicity measures could be applied to this organism's intestinal tissues. Earthworms were added, for 24 h or 7 days, to soil samples spiked with benzo[a]pyrene (B[a]P) and/or lindane. After exposure, intestinal tissues (crop/gizzard or intestine) were removed prior to the measurement in disaggregated cells of DNA single-strand breaks (SSBs) by the alkaline comet assay. Damage was quantified by comet tail length (CTL, μm). B[a]P 24-h exposure induced dose-related increases ($P < 0.0001$) in SSBs. Earthworm intestine was significantly ($P < 0.0001$) more susceptible than crop/gizzard to B[a]P and/or lindane. However, both tissues appeared to acquire resistance following 7-day exposure. B[a]P-DNA adducts, measured by ³²P-postlabelling, showed a two-adduct-spot pattern. This preliminary investigation suggests that earthworm tissues may be incorporated into genotoxicity assays to facilitate hazard identification within terrestrial ecosystems.

Sublethal genotoxicity in the sentinel organism *A. longa* can be used to monitor the effects of contaminants in soil.

Sublethal genotoxicity in the sentinel organism *A. longa* can be used to monitor the effects of contaminants in soil.

Keywords: Adducts; Benzo[*a*]pyrene; Contaminated soil; Comet assay; DNA single-strand breaks; Earthworms

Angela Zaccaron da Silva^a, Juliano Zanette^a, Jaime Fernando Ferreira^b, João Guzenski^c, Maria Risoleta Freire Marques^a and Afonso Celso Dias Bainy^a. (^aLaboratório de Biomarcadores de Contaminação Aquática e Imunoquímica, Departamento de Bioquímica, CCB, Universidade Federal de Santa Catarina, 88040-900, Florianópolis, SC, Brazil, ^bLaboratório de Moluscos Marinhos, Departamento de Aquicultura, CCA, Universidade Federal de Santa Catarina, 88040-900, Florianópolis, SC, Brazil, ^cEmpresa de Pesquisa Agropecuária e Extensão Rural de Santa Catarina, 88034-901, Florianópolis, SC, Brazil. Corresponding author. Fax: +55 48 331 9672). **Effects of salinity on biomarker responses in *Crassostrea rhizophorae* (Mollusca, Bivalvia) exposed to diesel oil, *Ecotoxicology and Environmental Safety*, Volume 62(3) (2005):376-382**

Crassostrea rhizophorae is a euryhaline oyster that inhabits mangrove areas, which are widely distributed along the Brazilian coast. The aim of this study was to investigate the effects of salinity (9, 15, 25, and 35 ppt) on the activities of glutathione *S*-transferase (GST), glucose 6-phosphate dehydrogenase (G6PDH), catalase (CAT), and acetylcholinesterase (AChE) in the digestive gland of this species after exposure to diesel oil for 7 days at nominal concentrations of 0.01, 0.1, and 1 ml L⁻¹ and after depuration for 24 h and 7 days. GST activity increased in a diesel oil concentration-dependent manner at salinities 25 and 15 ppt and remained slightly elevated even after depuration periods of 24 h and 7 days. No changes were observed in the activities of G6PDH, CAT, and AChE in the oysters exposed to diesel and depurated. Based on these results, GST activity in the digestive gland of *C. rhizophorae* might be used as a biomarker of exposure to diesel oil in sites where the salinity is between 15 and 25 ppt, values usually observed in mangrove ecosystems.

Keywords: Mangrove oyster; *Crassostrea rhizophorae*; Diesel; Salinity; Glutathione *S*-transferase; Biomarkers

Biofertilizer

M. N. Jha¹ and A. N. Prasad¹. (¹ Department of Microbiology, Faculty of Basic Sciences & Humanities, Rajendra Agricultural University, Pusa, Samastipur, 848125, Bihar. M. N. Jha, Email: mani_raksha@yahoo.com, Phone: +91-6274-240412, Fax: +91-6274-240266). **Efficacy of New Inexpensive Cyanobacterial Biofertilizer Including its Shelf-life. *World Journal of Microbiology and Biotechnology*, Volume 22(1) (2006): 73 - 79**

Four cyanobacterial inoculants all significantly increased grain and straw yield of rice either alone or in combination with chemical fertilizer. A saving of 25 kg N ha⁻¹ can be attained through cyanobacterial fertilization. Tobacco waste-based cyanobacterial biofertilizer was best in performance. Cyanobacterial acetylene reducing activity *in vivo* varied from 144 to 255 μmol C₂H₄ m⁻² h⁻¹ in different treatments, being highest for tobacco-based cyanobacterial biofertilizer integrated with 50% chemical N. The nutrient balance for total N, available N, total P and available P was found positive in biofertilizer- and chemical fertilizer-treated plots. The total and available K showed negative balance in all the treatments. The shelf-life of cyanobacterial biofertilizer can be augmented by selecting translucent packing material, dry mixing and paddy straw as a carrier. Dry mixing and a mixing ratio of 50:50 (carrier:cyanobacteria) gave better inoculum loading and shelf-life. Decrease in cyanobacterial population was least in dried

cyanobacterial flacks, indicating a possibility of developing cyanobacterial biofertilizer without carrier mixing at the time of production.

Keywords Cyanobacteria - inoculant - nutrient balance - paddy yield - shelf-life

Silva PG, Silva HJ. Laboratorio de Alimentos, Area de Microbiologia, Facultad de Quimica, Bioquimica y Farmacia, Universidad Nacional de San Luis, Chacabuco y Pedernera, 5700 San Luis, Argentina.) Effect of mineral nutrients on cell growth and self-flocculation of *Tolypothrix tenuis* for the production of a biofertilizer. Bioresour Technol. 2006 Apr 16; [Epub ahead of print]

The influence of mineral nutrients on the growth and self-flocculation of *Tolypothrix tenuis* was studied. The identification of possible limiting nutrients in the culture medium was performed by the biomass elemental composition approach. A factorial experimental design was used in order to estimate the contribution of macronutrients and micronutrients, as well as their interactions. Iron was identified to be limiting in the culture medium. The micronutrients influenced mainly cellular growth without effects on self-flocculation. Conversely, the self-flocculation capacity of the biomass increased at higher concentrations of macronutrients. The optimization of mineral nutrition of *T. tenuis* allowed a 73% increase in the final biomass level and 3.5 times higher flocculation rates.

Ram LC, Srivastava NK, Tripathi RC, Jha SK, Sinha AK, Singh G, Manoharan V (Central Fuel Research Institute, PO-FRI, 828108 Dhanbad, Jharkhand, India. lcramcfri@rediffmail.com) Management of mine spoil for crop productivity with lignite fly ash and biological amendments. J Environ Manage. 2006 Apr;79(2):173-87. Epub 2005 Oct 26

Long-term field trials using lignite fly ash (LFA) were carried out in rice crops during the period 1996-2000 at Mine I, Neyveli Lignite Corporation, Tamil Nadu. LFA, being alkaline and endowed with an excellent pozzolanic nature, silt loam texture, and plant nutrients, has the potential to improve the texture, fertility, and crop productivity of mine spoil. The rice crops were the first, third, fifth, and sixth crops in rotation. The other crops, such as green gram (second) and sun hemp (fourth), were grown as green manure. For experimental trials, LFA was applied at various dosages (0, 5, 10, 20, 50, 100, and 200 t/ha), with and without press mud (10 t/ha), before cultivation of the first crop. Repeat applications of LFA were made at the same dosages in treatments of up to 50 t/ha (with and without press mud) before cultivation of the third and fifth crops. Press mud, a lightweight organic waste product from the sugar industry, was used as an organic amendment and source of plant nutrients. Also, a recommended dosage of chemical fertilizer, along with gypsum, humic acid, and biofertilizer as supplementing agents, was applied in all the treatments, including control. With one-time and repeat applications of LFA, from 5 to 20 t/ha (with and without press mud), the crop yield (grain and straw) increased significantly ($p < 0.05$), in the range from 3.0 to 42.0% over the corresponding control. The maximum yield was obtained with repeat applications of 20 t/ha of LFA with press mud in the third crop. The press mud enhanced the yield in the range of 1.5-10.2% with various dosages of LFA. The optimum dosage of LFA was 20 t/ha for both one-time and repeat applications. Repeat applications of LFA at lower dosages of up to 20 t/ha were more effective in increasing the yield than the corresponding one-time applications of up to 20 t/ha and repeat applications at 50 t/ha. One-time and repeat applications of LFA of up to 20 t/ha (with and without press mud), apart from increasing the yield, evinced improvement in the texture and fertility of mine spoil and the

nutrient content of crop produce. Furthermore, some increase in the content of trace and heavy metals and the level of gamma-emitters in the mine spoil and crop produce was observed, but well within the permissible limits. The residual effect of LFA on succeeding crops was also encouraging in terms of eco-friendliness. Beyond 20 t/ha of LFA, the crop yield decreased significantly ($p < 0.05$), as a result of the formation of hardpan in the mine spoil and possibly the higher concentration of soluble salts in the LFA. However, the adverse effects of soluble salts were annulled progressively during the cultivation of succeeding crops. A plausible mechanism for the improved fertility of mine spoil and the carryover or uptake of toxic trace and heavy metals and gamma-emitters in mine spoil and crop produce is also discussed.

Son HJ, Park GT, Cha MS Heo MS. (Department of Biotechnology, Miryang National University, Miryang 627-706, Republic of Korea. shjoo@mnu.ac.kr) Solubilization of insoluble inorganic phosphates by a novel salt- and pH-tolerant *Pantoea agglomerans* R-42 isolated from soybean rhizosphere. *Bioresour Technol.* 2006 Jan;97(2):204-10. Epub 2005

To develop environment-friendly biofertilizer solubilizing insoluble phosphates, salt- and pH-tolerant, insoluble inorganic phosphate-solubilizing bacterium was isolated from soybean rhizosphere. On the basis of its physiological characteristics and Vitek analysis, this bacterium was identified as *Pantoea agglomerans*. The optimal medium composition and cultural conditions for the solubilization of insoluble phosphate by *P. agglomerans* R-42 were 3% (w/v) of glucose, 0.1% (w/v) of NH_4NO_3 , 0.02% (w/v) of $\text{MgSO}_4 \times 7\text{H}_2\text{O}$, and 0.06% (w/v) of $\text{CaCl}_2 \times 2\text{H}_2\text{O}$ along with initial pH 7.5 at 30 degree C. The soluble phosphate production under optimal condition was around 900 mg/l, which was approximately 4.6-fold higher than the yield in the MPVK medium. The solubilization of insoluble phosphate was associated with a drop in the pH of the culture medium. *P. agglomerans* R-42 showed resistance against different environmental stresses like 5-45 degrees C temperature, 1-5% salt concentration and 3-11 pH range. Insoluble phosphate solubilization was highest from CaHPO_4 (1367 mg/l), hydroxyapatite (1357 mg/l) and $\text{Ca}_3(\text{PO}_4)_2$ (1312 mg/l). However, the strain produced soluble phosphate to the culture broth with the concentrations of 28 mg/l against FePO_4 , and 19 mg/l against AlPO_4 , respectively.

Biocomposting

C. P. Jordão¹, L. L. Fialho², P. R. Cecon³, A. T. Matos⁴, J. C. L. Neves¹, E. S. Mendonça¹ and R. L. F. Fontes¹. (¹Departamento de Solos, Universidade Federal de Viçosa, 36570-000 Viçosa, Minas Gerais, Brasil, ² Departamento de Química, Universidade Federal de Viçosa, 36570-000 Viçosa, Minas Gerais, Brasil, ³ Departamento de Informática, Universidade Federal de Viçosa, 36570-000 Viçosa, Minas Gerais, Brasil, ⁴ Departamento de Engenharia Agrícola, Universidade Federal de Viçosa, 36570-000 Viçosa, Minas Gerais, Brasil). Effects of Cu, Ni and Zn on Lettuce Grown in Metal-Enriched Vermicompost Amended Soil. *Water, Air, & Soil Pollution, Volume 172 (1-4) (2006): 21 - 38*

A greenhouse experiment was conducted to test the effectiveness of cattle manure vermicompost enriched with Cu, Ni or Zn to increase plant yield. An oxisol amended with the metal-enriched vermicompost at the doses 0, 25, 50, 65, and 80 t ha⁻¹ was used to grow lettuce (*Lactuca sativa* L). After 39 days of growth, the plants were weighed for fresh and dry matter weight determinations. The soil amended with the vermicompost was analyzed for determination of DTPA (diethylenetriaminepentaacetic acid)-extractable Cu, Ni and Zn. The distribution of the metals in the plants was determined and the metal concentrations compared with the levels commonly found in plants, as well as with the range of the

critical levels of toxicity to plants. Within each dose of 50, 65 and 80 t ha⁻¹ of the metal-enriched vermicomposts applied there was a decrease in lettuce yield as compared to the correspondent 50, 65 and 80 t ha⁻¹ doses of the natural vermicompost applied. The Cu concentrations in the lettuce leaves from the pots with vermicompost enriched with this element were in the range commonly found in plants (from 5.9 to 13.9 mg kg⁻¹), although in the roots they were relatively high (from 76.25 to 244.56 mg kg⁻¹). The Ni concentrations in the leaves from the pots with the vermicompost contaminated with this element were within the range of critical levels of toxicity to plants, i.e., from 10 to 50 mg kg⁻¹. In the case of Zn, its concentrations in the leaves from the pots with vermicompost enriched with this element were, in general, above the range of critical levels of toxicity to plants, i.e., from 200 to 500 mg kg⁻¹. The plants grown in soil amended with vermicomposts enriched with Cu and Ni showed high Cu and Ni concentrations in the roots, while the plants grown in soil amended with vermicompost enriched with Zn showed high Zn concentrations in the leaves. The correlation coefficients between the DTPA-extractable Cu, Ni and Zn and their concentrations in the plants varied from 0.835 to 0.950.

Keywords heavy metal - lettuce - soil - vermicompost - DTPA extraction - electroplating waste

Srivastava R, Kumar D, Gupta SK. (Industrial Toxicology Research Centre, P.O. Box 80, M.G. Marg, Lucknow 226 001, India). Bioremediation of municipal sludge by vermitechology and toxicity assessment by *Allium cepa*. Bioresour Technol.,96(17) (2005): 1867-71.

The aim of this study was to evaluate municipal sludge (MS) for its toxic potential by *Allium cepa* and also to understand the effect of vermicomposting on the reduction of toxicity, if any. Municipal sludge (MS) and vermicomposted sludge (VS) were evaluated. Elemental analysis of MS showed the presence of heavy metals. Morphological studies of *A. cepa* roots indicated coiled and wavy roots on exposure to MS but no root abnormality was reported in VS. Under genotoxic studies, inhibition in mitotic index was concentration dependent and the control values of 11.76 gradually reduced to 5.40 at 10% MS leachate whereas mitotic index was increased to 9.48 at 10% VS leachate. Exposure of leachate induced chromosomal aberrations, micronucleus formation and binucleate cells in a dose dependent manner. However, mitotic aberrations were observed significant at 10% MS leachate but they were insignificant at 10% VS leachate. The wet and dry weight of roots, root elongation and chlorophyll contents were reduced as the concentration of leachate increased but VS leachate did not produce considerable reduction. The wet and dry weight of *A. cepa* roots were 20.312 g and 3.250 g respectively and they were reduced to 10.82 g and 1.68 g respectively at 10% MS leachate but VS leachate showed an increase to 18.127 g and 2.53 g respectively. Total chlorophyll in control, 10% MS leachate and 10% VS leachate were 0.245 g, 0.162 g and 0.214 g respectively. It could be concluded that the MS was toxic to a remarkable extent but vermicomposting of sludge might be beneficial for bioremediation and recommended before land filling.

Garg P, Gupta A, Satya S. (Department of Environmental Science and Engineering, Guru Jambheshwar University, Hisar (Haryana) 125 001, India). Vermicomposting of different types of waste using *Eisenia foetida*: a comparative study. Bioresour Technol.,97(3) (2006): 391-5.

A study (100 days duration) was conducted to evaluate the efficiency of an exotic earthworm species (epigeic-*Eisenia foetida*) for decomposition of different types of organic substrates (kitchen waste, agro-residues, institutional and industrial wastes including textile industry sludge and fibres) into valuable vermicompost. The percentage of, nitrogen, phosphorous and potassium in vermicompost was found to increase while pH and total organic carbon declined as a function of the vermicomposting period. 4.4-5.8-fold increases in TKN was observed in different feed mixtures at the end of vermicomposting period. The increase in TKN for different feed substrates was found in the order: textile sludge>textile fibre=institutional waste>agro-residues>kitchen waste. Available Phosphorus increased 1.4 to 6.5-fold in different feed mixtures in comparison to control. Reduction in TOC was highest in agro-residues (3-fold) followed by kitchen waste (2.2-fold), institutional waste (1.7-fold) and textile industrial wastes (sludge, 1.5-fold and fibre, 1.68-fold) in earthworm-inoculated pots than control. The data reveals that

vermicomposting (using *E. foetida*) is a suitable technology for the decomposition of different types of organic wastes (domestic as well as industrial) into value-added material.

Banu JR, Esakkiraj S, Nagendran R, Logakanthi S. (Centre for Environmental studies, Anna University, Chennai-600 025, India). Biomanagement of petrochemical sludge using an exotic earthworm *Eudrilus eugineae*. J Environ Biol., 26(1) (2005): 43-7.

Petrochemical industry have severe problem in disposing effluent and semisolid sludge despite repeated recycling. It requires further treatment prior to disposal of sludge. In recent years biological treatment methods received much attention and considered as an efficient low-cost treatment. One such method is vermiculture treatment. The end product of vermicompost is rich in essential micro and macronutrients along with microorganisms in a very simple form. Adding cast, not only improves the soil structure and fertility but also leads to improvement in overall plant growth and thus increase their yield. The present study was carried out to dispose the petrochemical sludge biologically using an exotic earthworm *Eudrilus eugineae*. The petrochemical sludge at various concentrations 25, 50 and 75% were subjected to vermicomposting treatment for a period of 60 days. During the period of study, data were collected on life form of earthworm and chemical analysis of the sludge before and after treatment. The microbial analysis was carried out fortnightly. The results indicate that 25 and 50% concentration of sludge was ideal for the vermicomposting, whereas the higher concentration inhibits the vermicomposting.

Kristiana R, Nair J, Anda M, Mathew K. (Environmental Technology Centre, Murdoch University, Murdoch, WA 6150, Australia). Monitoring of the process of composting of kitchen waste in an institutional scale worm farm. Water Sci Technol., 51(10) (2005):171-7.

Vermicomposting provides an alternative method of managing waste that is ecofriendly and cost-effective. The Environmental Technology Centre (ETC) at Murdoch University and St. John of God Hospital (SJOG) signed a Memorandum of Understanding (MOU) to install a vermiculture system in SJOG to treat some of the organic waste generated by the on site kitchen facility. This is an effort made by SJOG to reduce the amount of organic waste sent to landfill each year and to treat the waste on site as part of a recycling/reuse program. The study is aimed at scientifically monitoring vermicomposting process and to understand the optimum management requirements to improve the operation of an institutional scale worm farm. In addition, an experiment was conducted to investigate the suitability of bedding materials: horse manure, cow manure, peat coir, and natural bedding (vermicast). The species of earthworms used in this experiment were Red (*Lumbricus rubellus*), Tiger (*Eisenia fetida*), and Blue (*Lumbricus excavatus*). The pH, temperature, worm population and quality of castings were tested in different beds. Results indicated that vermicast was the best bedding for vermicomposting, and there were no significant difference between the performances of the other three beds. However, it can be concluded that the bedding material of horse manure, cow manure, and peat coir were successfully established well within the experimental period of eight weeks, and cow manure with the lowest C:N ratio produced the best quality bedding. As using vermicast for the initial bedding creates a very high capital cost these organic substrates provide cost-effective alternative. Therefore they would be quite appropriate to initiate an institutional scale worm farm.

Kurien J, Ramasamy EV. (School of Environmental Sciences, Mahatma Gandhi University, Kottayam, Kerala 686 560, India). Vermicomposting of Taro (*Colocasia esculenta*) with two epigeic earthworm species. Bioresour Technol., 97(11) (2006): 1324-8.

The bioconversion potential of two epigeic species (*Eisenia foetida* Sav. and *Eudrilus eugeniae* Kinberg) of earthworms was assessed in terms of efficiency and sustainability of vermicomposting of Taro (*Colocasia esculenta* (Linn) Schott in Schott and Endl). In different vermireactors, each run in triplicates with one of the two species of earthworms, and 60g of 6:1 *Colocasia*:cowdung as feed, vermicasts were produced with steadily increasing output in all the reactors. *E. eugeniae* was found to be more efficient

producer of vermicasts than *E. foetida*. In all reactors, the earthworms grew well, increasing their weights and number.

Majumdar D, Patel J, Bhatt N, Desai P. (Department of Environmental Science, Institute of Science and Technology for Advanced Studies and Research, Vallabh Vidyanagar, Gujarat 388 120, India. joy_ensc@yahoo.com). Emission of methane and carbon dioxide and earthworm survival during composting of pharmaceutical sludge and spent mycelia. Bioresour Technol., 97(4) (2006): 648-58.

Emissions of methane (CH₄) and carbon dioxide (CO₂) from spent mycelia of the mold *Penicillium notatum* and sludge from the effluent treatment facility (ETPS) of a pharmaceutical industry were estimated twice during a two-week composting before vermicomposting. These wastes are dumped in landfills or sometimes used in agricultural fields and no reports are available on their greenhouse gas producing potentials. The solid wastes contained appreciable organic carbon and nitrogen while very high Fe, Mn and Zn were found in ETPS only. Pure wastes did not support germination of *Vigna radiata* L. while mixing soil with ETPS and spent mycelia at the ratios of 12:1 and 14:1 led to 80% and 50% germination, respectively. The wastes were mixed with cowdung at the ratios of 1:1, 1:3 and 3:1 for composting. Carbon dioxide emissions were always significantly higher than CH₄ emissions from all the treatments due to prevalence of aerobic condition during composting. From some treatments, CH₄ emissions increased with time, indicating increasing activity of anaerobic bacteria in the waste mixtures. Methane emissions ranged from 21.6 to 231.7 microg m⁽⁻²⁾ day⁽⁻¹⁾ while CO₂ emissions were greater than thousand times at 39.8-894.8 mg m⁽⁻²⁾ day⁽⁻¹⁾. The amount of C emitted as CH₄-C and CO₂-C from ranged from 0.007% to 0.081% of total C composted. Cowdung emitted highest CH₄ followed by spent mycelia and ETPS while ETPS emitted more CO₂ than spent mycelia but lesser than cowdung. Global warming potential of emitted CH₄ was found to be in the range of 10.6-27.7 mg-CO₂-equivalent on a 20-year time horizon. The results suggest that pharmaceutical wastes can be an important source of CH₄ and CO₂ during composting or any other stockpiling under suitable moisture conditions. The waste mixtures were found not suitable for vermicomposting after two weeks composting and earthworms did not survive long in the mixtures.

Garg VK, Kaushik P, Dilbaghi N. (Department of Environmental Science and Engineering, Guru Jambheshwar University, Hisar 125001, India). Vermiconversion of wastewater sludge from textile mill mixed with anaerobically digested biogas plant slurry employing *Eisenia foetida*. Ecotoxicol Environ Saf., 2006 Jan 10; [Epub ahead of print]

Vermicomposting is commonly used for the management of organic wastes. We have investigated the potential of an epigeic earthworm, *Eisenia foetida*, to transform solid textile mill sludge (STMS) spiked with anaerobically digested biogas plant slurry (BPS) into vermicompost to evaluate the feasibility of vermicomposting in industries for waste management. The growth and reproduction of *E. foetida* was monitored in a range of different feed mixtures for 15 weeks in laboratory under controlled experimental conditions. *E. foetida* did not survive in fresh STMS. But worms grew and reproduced in STMS spiked with BPS feed mixtures. A greater percentage of STMS in feed mixture affected biomass gain and cocoon production by earthworms. The maximum growth was recorded in 100% BPS. The net weight gain by *E. foetida* in 100% BPS was two-four-fold higher than STMS-containing feed mixtures. After 15 weeks, maximum cocoons (78) were counted in 100% BPS and minimum (26) in 60% BPS+40% STMS feed. Vermicomposting resulted in pH shift toward acidic, significant reduction in C:N ratio, and increase in nitrogen, phosphorus, and potassium contents. Microbial activity measured as dehydrogenase activity increased with time up to day 75 but decreased on day 90, indicating the exhaustion of feed and decrease in microbial activity. These experiments demonstrate that vermicomposting can be an alternate technology for the recycling and environmentally safe disposal/management of textile mill sludge using an epigeic earthworm, *E. foetida*, if mixed with anaerobically digested BPS in appropriate ratios.

Deolalikar AV, Mitra A, Bhattacharyee S, Chakraborty S. (Aquaculture Department, College of Fisheries, Ratnagiri, Maharashtra). Effect of vermicomposting process on metal content of paper mill solid waste. J Environ Sci Eng., 47(2) (2005): 81-4.

In the present study the change in metal content on vermicomposting of paper mill solid waste was studied. On vermicomposting, quantity of iron, zinc and chromium found to be increased whereas quantity of aluminium, copper, manganese, nickel and lead found comparatively low. The bioaccumulation of any metal was not observed in the body of the earthworm, hence after vermicomposting, there is no harm to fishes to utilize earthworm biomass as their food. The metal content in the vermicompost prepared from the paper mill solid waste was well within the permissive limits and can therefore be safely applied in an aquaculture, agriculture and other food production systems.

Biopesticides

Sengottayan Senthil Nathan^{a, b}, Kandaswamy Kalaivani^b and Kadarkarai Murugan^b. (^aDepartment of Environmental Engineering, Chonbuk National University, Jeonju City, Chonbuk 561 756, South Korea, ^bDepartment of Zoology, Bharathiar University, Coimbatore, Tamil Nadu 641 046, India, Corresponding author. Fax: +82 63 270 2449.). Effect of biopesticides on the lactate dehydrogenase (LDH) of the rice leaffolder, *Cnaphalocrocis medinalis* (Guenée) (Insecta: Lepidoptera: Pyralidae). Ecotoxicology and Environmental Safety, Article in Press.

The effects of bacterial toxins (*Bacillus thuringiensis*) and botanical insecticides (*Azadirachta indica* and *Vitex negundo*) on lactate dehydrogenase (LDH) activity in *Cnaphalocrocis medinalis* (Guenée) (the rice leaffolder) were evaluated. Bacterial toxins and botanical insecticides affected the LDH activity individually and in combination. When they were combined, the effect was more severe at low concentration. There was a decrease in enzyme activity over controls at all concentrations tested. The combined effect of the three biopesticides resulted in a considerable decrease in enzyme activity, indicating strong enzyme inhibition. Clear dose–response relationships were established with respect to enzyme activity.

Keywords: Biopesticides; Botanical insecticide; Neem; *Vitex*; *Btk*; Bioassay; Toxicity; Enzyme; LDH; Metabolism

Abbreviations: RLF, rice leaffolder; LDH, lactate dehydrogenase; *Btk*, *Bacillus thuringiensis* Berliner sub sp. *kurstaki*; NSKE, neem seed kernel extract; VNLE, *Vitex negundo* leaf extract; SE, standard error

P. Melin, S. Håkansson, T.H. Eberhard and J. Schnürer. Survival of the biocontrol yeast *Pichia anomala* after long-term storage in liquid formulations at different temperatures, assessed by flow cytometry. Journal of Applied Microbiology, Volume 100(2)(2006):264

Aims: Investigate the survival of liquid formulations of the biocontrol yeast *Pichia anomala* J121 at different temperatures, and develop a system for comparative studies of different storage conditions and formulations.

Methods and Results: The survival of *P. anomala* in liquid formulations with lactose, starch and trehalose amendments was measured during prolonged storage at temperatures ranging from –20 to +30°C. The relative survival of the stored cells was rapidly estimated by flow cytometry. After 4 weeks incubation at 4 and 10°C, 75–90% of the cells were viable, with no significant differences between the various formulations. Supplementing the storage buffer with lactose or trehalose increased the survival after longer incubations (8 and 12 weeks) at all temperatures (–20 to 30°C). Trehalose was the most effective protectant at 20 and 30°C (>20% viable cells after 12 weeks at 20°C). The biocontrol activity was maintained after formulation and prolonged storage of *P. anomala*.

Conclusions: The storage potential of liquid formulated *P. anomala* cells can be increased by supplementation with lactose or trehalose. The combination of a custom made incubation chamber and flow cytometry was suitable to evaluate stability of *P. anomala* formulations.

Significance and Impact of the Study: Liquid formulated *P. anomala* have a long shelf life. The developed test system can be used to study different formulations of other biocontrol agents.

O.E. Fagade, S.A. Balogun and C.J. Lomer .Microbial control of caged population of *Zonocerus variegatus* using *Beauveria bassiana* and *Metarhizium* sp. African Journal of Biotechnology, Vol. 4 (01) (2005): 113-116

Microbial control of caged populations of *Zonocerus variegatus* was carried out using indigenous fungal entomopathogens isolated from the grasshopper's cadaver. Bioassay response indicated a dose-dependent mortality coupled with drastic reduction in food consumption among spores infected grasshoppers. Lethal time (LT₅₀) of 4.6 days for 10³ spores/ml and 3.8 days for 10⁷ spores/ml of oil formulation of *Beauveria bassiana* were observed. While *Metarhizium* sp recorded LT₅₀ of 9.0 days and 2.8 days for 10³ and 10⁷ spores/ml, respectively. The results obtained were discussed in relation to use of the isolates in the control *Z. variegatus* infestation in forest agro-ecosystem of south west, Nigeria.

Kristine Frederiksen,¹ Hanne Rosenquist,¹ Kirsten Jørgensen,² and Andrea Wilcks^{1*}. (Department of Microbiology and Risk Assessment, Danish Institute for Food and Veterinary Research, 2860 Søborg, Denmark,¹ Department of Veterinary Pathobiology, The Royal Veterinary and Agricultural University, 1870 Frederiksberg C, Denmark² . * Corresponding author. Mailing address: Department of Microbiological Food Safety, Danish Institute for Food and Veterinary Research, Mørkhøj Bygade 19, DK-2860 Søborg, Denmark. Phone: 45 7234 7185. Fax: 45 7234 7698. E-mail: anw@dfvf.dk). Occurrence of Natural *Bacillus thuringiensis* Contaminants and Residues of *Bacillus thuringiensis*-Based Insecticides on Fresh Fruits and Vegetables. Applied and Environmental Microbiology, Vol. 72 (5) (2006): 3435-3440.

A total of 128 *Bacillus cereus*-like strains isolated from fresh fruits and vegetables for sale in retail shops in Denmark were characterized. Of these strains, 39% (50/128) were classified as *Bacillus thuringiensis* on the basis of their content of *cry* genes determined by PCR or crystal proteins visualized by microscopy. Random amplified polymorphic DNA analysis and plasmid profiling indicated that 23 of the 50 *B. thuringiensis* strains were of the same subtype as *B. thuringiensis* strains used as commercial bioinsecticides. Fourteen isolates were indistinguishable from *B. thuringiensis* subsp. *kurstaki* HD1 present in the products Dipel, Biobit, and Foray, and nine isolates grouped with *B. thuringiensis* subsp. *aizawai* present in Turex. The commercial strains were primarily isolated from samples of tomatoes, cucumbers, and peppers. A multiplex PCR method was developed to simultaneously detect all three genes in the enterotoxin hemolysin BL (HBL) and the nonhemolytic enterotoxin (NHE), respectively. This revealed that the frequency of these enterotoxin genes was higher among the strains indistinguishable from the commercial strains than among the other *B. thuringiensis* and *B. cereus*-like strains isolated from fruits and vegetables. The same was seen for a third enterotoxin, CytK. In conclusion, the present study strongly indicates that residues of *B. thuringiensis*-based insecticides can be found on fresh fruits and vegetables and that these are potentially enterotoxigenic.

Biodegradation

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^cChemistry Department, University of Florida, Gainesville, FL, USA, Corresponding author. Fax: +1 904 461 4008. Degradation and effects of the potential mosquito larvicides methazolamide and acetazolamide in sheepshead minnow (*Cyprinodon variegatus*). *Ecotoxicology and Environmental Safety*, Article in Press

To test for environmental persistence in order to determine the potential of carbonic anhydrase inhibitors as larvicides, the decomposition and degradation of samples containing methazolamide (MTZ) and acetazolamide (ACZ) in aqueous solution were monitored under different conditions. Additionally, nontarget species impact was assessed in an acute toxicity test using sheepshead minnow (*Cyprinodon variegatus*). The fish were exposed for 120 h to 10^{-3} and 10^{-4} M each compound in replicate seawater tanks. In the high-MTZ treatment, all fish died within 48 h, while mortality in the low-MTZ treatment was 27% at 120 h. In the high-ACZ treatment mortality reached 83% at 120 h. We observed no mortality for the lowest dose of ACZ. Tissue samples were collected from the fish to investigate absorption of the compounds. In the gills, MTZ concentrations were around $40 \mu\text{g g}^{-1}$ and ACZ reached concentrations up to $80 \mu\text{g g}^{-1}$. Liver concentrations were low for MTZ probably due to metabolism.

Keywords: Methazolamide; Acetazolamide; Fish; Mosquito larvae; Carbonic anhydrase inhibitors

K. Verma, N. Agrawal, M. Farooq, R.B. Misra and R.K. Hans. (Photobiology Division, Industrial Toxicology Research Center, P.O. Box No. 80, Mahatma Gandhi Marg, Lucknow 226001, India, Corresponding author. Fax: +91 522 2228227). Endosulfan degradation by a *Rhodococcus* strain isolated from earthworm gut. *Ecotoxicology and Environmental Safety*, Article in Press

A *Rhodococcus* MTCC 6716 bacterial strain was isolated apparently for the first time from the gut microflora of an Indian earthworm (*Metaphire posthuma*). Endosulfan was used as a carbon source by the strain and degraded it up to 92.58% within 15 days. Furthermore, the isolated strain of the bacterium did not produce the persistent form of the toxic metabolite endosulfan sulfate. This strain exhibits luxury growth in minimal medium with high concentrations of endosulfan ($80 \mu\text{g mL}^{-1}$). Degradation of the endosulfan occurred simultaneously with bacterial growth and an increase in chloride ion (87.1%) in the growth medium, suggesting nearly complete degradation of the insecticide. This strain is able to tolerate 45°C and retain its degradation potential even under sunlight exposure. Since endosulfan is used worldwide for pest control and its residues have been retained for long periods in soil, water, and agricultural products, the strain isolated by us is valuable for bioremediation of endosulfan-contaminated soil and water.

Keywords: Earthworm; Endosulfan; Bioremediation; Gut microflora; *Rhodococcus* MTCC 6716

Idil Arslan-Alaton and Ali Efe Caglayan. (Department of Environmental Engineering, Faculty of Civil Engineering, Istanbul Technical University, 34469 Maslak, Istanbul, Turkey). Toxicity and biodegradability assessment of raw and ozonated procaine penicillin G formulation effluent. *Ecotoxicology and Environmental Safety*, Volume 63(1) (2006): 131-140

The effect of O_3 (applied dose= 1440 mg h^{-1} ; pH 7 and pH 12) and $\text{H}_2\text{O}_2/\text{O}_3$ (applied dose= 1440 mg h^{-1} ; pH 7; $10 \text{ mM H}_2\text{O}_2$) pretreatment of procaine penicillin G (PPG) formulation effluent on its biodegradability and acute toxicity was investigated. For that purpose ISO 8192 activated sludge inhibition and *Daphnia magna* acute toxicity tests were conducted. BOD_5 measurements that were carried out to preevaluate the biocompatibility of untreated, ozonated, and perozonated PPG effluent have shown that BOD_5 alone was not a very correct or useful tool to predict the actual biodegradability of PPG effluent. No significant correlation existed between the BOD_5 and the toxicity test results. Acute toxicity studies carried out with *D. magna* and synthetic municipal sewage sludge have demonstrated the inhibitory effect of $\text{H}_2\text{O}_2/\text{O}_3$ oxidation. COD removal of pharmaceutical wastewater containing PPG effluent with acclimated sewage sludge decreased from 79% to 50% after $\text{H}_2\text{O}_2/\text{O}_3$ pretreatment.

Keywords: Activated sludge inhibition; Advanced oxidation processes (AOPs); Antibiotic formulation effluent; Pharmaceutical wastewater; Procaine penicillin G; Ozonation; Acute toxicity; Biodegradability

M. Lee^{1,2}, M.K. Kim^{1,3}, I. Singleton³, M. Goodfellow³ and S.-T. Lee¹. Enhanced biodegradation of diesel oil by a newly identified *Rhodococcus baikonurensis* EN3 in the presence of mycolic acid. Journal of Applied Microbiology, Volume 100 (2) (2006): 325

Aims: The aim of the present study was to isolate and characterize a bacterium, strain EN3, capable of using diesel oil as a major carbon and energy source, and to analyse the enhancement of diesel oil degradation by this organism using synthetic mycolic acid (2-hexyl-3-hydroxydecanoic acid).

Method and Results: An actinomycete with the ability to degrade diesel oil was isolated from oil contaminated soil and characterized. The strain had phenotypic properties consistent with its classification in the genus *Rhodococcus* showing a 16S rRNA gene similarity of 99.7% with *Rhodococcus baikonurensis* DSM 44587^T. The ability of the characterized strain to degrade diesel oil at various concentrations (1000, 5000, 10 000 and 20 000 mg l⁻¹) was determined. The effect of synthetic mycolic acid on the biodegradation of diesel oil was investigated at the 20 000 mg l⁻¹ concentration; the surfactant was added to the flask cultures at three different concentrations (10, 50 and 100 mg l⁻¹) and degradation followed over 7 days. Enhanced degradation was found at all three concentrations of the surfactant. In addition, the enhancement of diesel oil degradation by other surfactants was observed.

Conclusions: The synthetic mycolic acid has potential for the remediation of petroleum-contaminated sites from both an economic and applied perspective as it can stimulate biodegradation at low concentrations.

Significance and Impact of the Study: This study showed that the synthesized mycolic acid can be used for potential applications in the bioremediation industries, for example, in oil spill clean-up, diesel fuel remediation and biostimulation.

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Disperse Orange 3, 4-(4-nitrophenylazo)aniline, was chosen as a model to study biodegradation of azo dyes by the white-rot fungus *Pleurotus ostreatus* (strain Florida) which was grown in submerged culture under controlled conditions. Degradation was investigated using a commercial preparation of Disperse Orange 3 that contained 20% dye plus dispersing agents, and an high-performance liquid chromatography purified preparation of the dye. The metabolites generated by *Pleurotus ostreatus* were identified as 4-nitroaniline, 4-nitrobenzene, 4-nitrophenol, and 4-nitroanisole. Veratryl alcohol, a redox mediator for lignin peroxidase of white-rot fungi, and its oxidant veratraldehyde were also detected in cultures grown in the presence of Disperse Orange 3. 4-Nitroanisole was the major metabolite when 4-nitrophenol was incubated with *Pleurotus ostreatus*. Kinetic profiles of these degradation products were determined and a partial degradation pathway is proposed.

Keywords: Azo dye; Biodegradation; Products; White rot fungi

Claudio Milanese^a, Franco Baldi^b, Rita Vignani^a, Fabrizio Ciampolini^a, Claudia Faleri^a and Mauro Cresti^a. (^aDepartment of Environmental Science 'G.Sarfatti' University of Siena, P.A. Mattioli 4, 53100 Siena, Italy, ^bDepartment of Environmental Science Cà Foscari University of Venezia, Calle Larga S. Marta, 30121 Venezia, Italy). Fungal deterioration of medieval wall fresco determined by

analysing small fragments containing copper. *International Biodeterioration & Biodegradation*, Volume 57(1) (2006): 7-13

A medieval fresco at the Chapel of the Holy nail, Siena was analysed to determine microbiological causes of deterioration of the painted surface or fresco micro-layer. Fragments of fresco a few mm wide were sampled under sterile conditions and some were incubated in mineral medium to isolate microbial species growing on endogenous carbon sources. Quiescent spores of fungi were detected. After 18 h fungal hyphae grew from turgid spores and pH dropped from 5.5 to 5.0, suggesting organic acid production during growth. Light microscopy (LM) and transmission electron microscopy (TEM) were used to study the ultrastructure of the fungi. Molecular studies involving sequencing 18S rDNA led to identification of *Penicillium crysogenum*. Element concentrations in the painted layer were analysed by scanning electron microscopy (SEM) with energy dispersive X-ray microanalysis of the fresco micro-layer before and after incubation of fragments. The main finding was that total carbon decreased from 26% to 13% while copper increased from 5% to 28%. The high concentration of copper and the acid pH inhibiting bacterial proliferation, indicated *P. crysogenum* as the main agent of deterioration. Hypotheses are formulated with regard to the high concentrations of copper useful for conservation of fresco substrates.

Keywords: Biodeterioration; Copper; Hypha; Light and electron microscopy; Microanalysis; Molecular biology; *Penicillium crysogenum*; Spores

María José Lopez, María del Carmen Vargas-García, Francisca Suárez-Estrella and Joaquín Moreno. (Area de Microbiología, Departamento de Biología Aplicada, CITE II-B, Universidad de Almería, La Cañada de San Urbano, 04120 Almería, Spain). Biodelignification and humification of horticultural plant residues by fungi. *International Biodeterioration & Biodegradation*, Volume 57(1) (2006): 24-30

The degradation of lignin in mixtures of horticultural plant residues with different C/N ratios by lignocellulolytic fungi was evaluated. Sterile sun-dried horticultural wastes were inoculated with *Coriolus versicolor*, *Phanerochaete flavid-alba* and *Trichoderma koningii* under controlled laboratory conditions and the fungal ligninolytic abilities compared and correlated with the humification process. The three fungi enhanced the formation of polymerized molecules, showing a trend similar to that commonly observed in soil humification processes. Lignin was degraded by all three, but to different degrees dependent on fungus and substrate composition. *P. flavid-alba* was the most active degrader, with a maximum lignin degradation rate of 46%. The efficiency of degradation was affected by the C/N ratio of the substrate, which was adjusted between 21 and 35 by addition of sawdust. Data showed that the tested fungi were effectively involved in humification and lignin degradation of horticultural wastes and might be used as inocula in a pre-treatment process before composting in order to reduce the resistance of the substrate to biodegradation.

Keywords: Humification; Lignin; *Coriolus*; *Phanerochaete*; *Trichoderma*

Leela Edwin and P. Muhamed Ashraf. (Central Institute of Fisheries Technology, Cochin 682029, India). Assessment of biodeterioration of rubber wood exposed to field conditions. *International Biodeterioration & Biodegradation*, Volume 57(1) (2006): 31-36

Rubber wood (*Hevea brasiliensis*) can be used commercially for the construction of fishing boats, which are subjected to biodegradation in the water, and on land both with and without soil contact. In order to obtain data on the natural durability of this wood, the extent of biodeterioration was assessed through visual observation, changes in the specific gravity of the wood and loss in the compressive strength of wood panels after 90 and 150 days in field tests. Changes in wood chemistry due to biodeterioration under field conditions were also characterized through Fourier transform infrared (FTIR) spectroscopy. Test samples in soil burial tests (graveyard tests) were more severely damaged than panels exposed to

atmospheric weathering or immersed in sea water below the low tide mark. Strength losses in panels exposed to the marine and atmospheric conditions were not commensurate with the weight losses.

Keywords: *Hevea*; Rubber wood; Field studies; Compressive stress; Specific gravity; FTIR spectroscopy

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Dihydroxybenzenes reduce Fe(III) to Fe(II), which react with H₂O₂ driving a Fenton reaction. This non-enzymic mechanism operates in wood degradation by brown-rot fungi, which mainly degrade wood carbohydrates and, to a lesser extent, lignin. Consequently, less attention has been focussed on lignin transformation by these organisms. In this work, the degradation of veratryl alcohol (VA), the simplest lignin model compound, via a Fenton reaction driven by 1,2-dihydroxybenzene (catechol, CAT) was studied. Multivariate analysis performed in order to determine the relationship between pH and concentrations of CAT, FeCl₃ and H₂O₂ showed that the highest VA degradation, 1 mol base, was obtained at the CAT:FeCl₃:H₂O₂ ratio of 0.375:0.375:5.0 at pH 3.4. Under these reaction conditions, VA degradation and mineralisation were, respectively, 3.8 and almost 40 times greater than for a Fe(II)-Fenton reaction.

Keywords: Veratryl alcohol; Fenton reaction; Catechol; Brown-rot fungi

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The *tfDA* gene is known to be involved in the first step of the degradation of the phenoxy acid herbicide 4-chloro-2-methylphenoxyacetic acid (MCPA) in several soil bacteria, but bacteria containing other *tfDA*-like genes have been isolated as well. A quantitative real-time PCR method was used to monitor the increase in the concentration of *tfDA* genes during degradation of MCPA in sandy topsoil and subsoil over a period of 115 days. Quantitative PCR revealed growth in the *tfDA*-containing bacterial community, from 500 genes g⁻¹ soil to approximately 3 x 10⁴ genes g⁻¹ soil and to 7 x 10⁵ genes g⁻¹ soil for topsoil initially added to 2.3 mg MCPA kg⁻¹ (dry weight) soil and 20 mg MCPA kg⁻¹ (dry weight) soil, respectively. We analyzed the diversity of the *tfDA* gene during the degradation experiment. Analyses of melting curves of real-time PCR amplification products showed that a shift in the dominant *tfDA* population structure occurred during the degradation period. Further denaturing gradient gel electrophoresis and sequence analysis revealed that the *tfDA* genes responsible for the degradation of MCPA belonged to the class III *tfDA* genes, while the *tfDA* genes present in the soil before the occurrence of degradation belonged to the class I *tfDA* genes. The implications of these results is that the initial assessment of functional genes in soils does not necessarily reflect the organisms or genes that would carry out the degradation of the compounds in question.

Xavier Capilla^a, Christophe Schwartz^b, Jean-Philippe Bedell^a, Thibault Sterckeman^b, Yves Perrodin^a and Jean-Louis Morel^b. (^aLaboratoire des Sciences de l'Environnement à l'ENTPE, Rue Maurice Audin, 69 518 Vaulx-en-Velin Cedex, France, ^bLaboratoire Sols et Environnement, INPL (ENSAIA)/INRA UMR 1120, 2 avenue de la forêt de Haye, BP 172, 54 505 Vandoeuvre les Nancy, France. Corresponding author. Tel.: +33 4 7204 7081; fax: +33 4 7204 7743). **Physicochemical and biological characterisation of different dredged sediment deposit sites in France. Environmental Pollution, Article in Press**

The aim of this work is to determine sediment properties, metal contents and transfers of Cd and Zn from dredged sediments to plants. To this end 10 deposit sites with different contexts were visited in France. The main agronomic characteristics and metal contents for surface soil layers were measured, the plant species present at the sites, such as Brassicaceae and Fabaceae, were listed, and the distribution of their root systems described. Soil characteristics such as available P (Olsen) varied between sites, with values ranging from 0.01 to 0.49 g kg⁻¹. Total contents and enrichment factors were studied, highlighting metal contamination in most of the sites. Despite carrying out principal component analyses, it was not possible to group deposits by age or geographical localisation. However, deposits could be distinguished as a function of proximity of industrial facilities, sediment grain size and carbonate content. Associations between metals were also highlighted: (1) Cd, Pb and Zn, and (2) Al, Cr, Cu and Fe. Consequently, we propose classifying them as technogenic anthrosols.

The term technogenic arthrosols is suggested.

Keywords: Anthrosol; Deposit; Trace elements; Sediment; Typology; Vegetation

José-Luis Niqui-Arroyo, Marisa Bueno-Montes, Rosa Posada-Baquero and José-Julio Ortega-Calvo. (Instituto de Recursos Naturales y Agrobiología, C.S.I.C., Apartado 1052, E-41080-Seville, Spain. Corresponding author. Tel.: +34 95 462 4711; fax: +34 95 462 4002). **Electrokinetic enhancement of phenanthrene biodegradation in creosote-polluted clay soil. Environmental Pollution, Article in Press**

Given the difficulties caused by low-permeable soils in bioremediation, a new electrokinetic technology is proposed, based on laboratory results with phenanthrene, to afford bioremediation of polycyclic aromatic hydrocarbons (PAH) in clay soils. Microbial activity in a clay soil historically polluted with creosote was promoted using a specially designed electrokinetic cell with a permanent anode-to-cathode flow and controlled pH. The rates of phenanthrene losses during treatment were tenfold higher in soil treated with an electric field than in the control cells without current or microbial activity. Results from experiments with Tenax-assisted desorption and mineralization of ¹⁴C-labeled phenanthrene indicated that phenanthrene biodegradation was limited by mass-transfer of the chemical. We suggest that the enhancement effect of the applied electric field on phenanthrene biodegradation resulted from mobilization of the PAH and nutrients dissolved in the soil fluids.

Electrokinetic bioremediation is a potentially effective technology to treat PAH-polluted, clay-rich soils.

Keywords: Polycyclic aromatic hydrocarbons; Bioremediation; Electrokinetics; Electro-osmosis; Desorption

Asta Lapinskienė, Povilas Martinkus and Vilija Rėbždaitė. (Klaipėda University, School of Maritime Technology, Department of Technological Processes, Bijūnų St. 17, Klaipėda LT-91225, Lithuania. Corresponding author. Taikos pr. 119, Klaipėda LT-94231, Lithuania. Tel.: +370 46 430463; fax: +370 46 430469) **Eco-toxicological studies of diesel and biodiesel fuels in aerated soil. Environmental Pollution, Article in Press**

The goal of this study was to compare diesel fuel to biodiesel fuel by determining the toxicity of analyzed materials and by quantitatively evaluating the microbial transformation of these materials in non-adapted aerated soil. The toxicity levels were determined by measuring the respiration of soil microorganisms as well as the activity of soil dehydrogenases. The quantitative evaluation of biotransformation of analyzed materials was based on the principle of balancing carbon in the following final products: (a) carbon dioxide; (b) humus compounds; (c) the remainder of non-biodegraded analyzed material; and (d) intermediate biodegradation products and the biomass of microorganisms. The results of these studies indicate that diesel fuel has toxic properties at concentrations above 3% (w/w), while biodiesel fuel has none up to a concentration of 12% (w/w). The diesel fuel is more resistant to biodegradation and produces more humus products. The biodiesel is easily biotransformed.

The comparison of diesel and biodiesel fuels' eco-toxicological parameters in non-adapted aerated soil is relevant when considering the effects of these substances on the environment in cases of accidental spills.

Keywords: Soil; Toxicology; Biotransformation; Diesel fuel; Biodiesel fuel

L.N. Muñoz-Castellanos¹, J.V. Torres-Muñoz², A. Keer-Rendón¹, L.I. Manzaneres-Papayanopoulos¹ and G.V. Nevárez-Moorillón². (¹Centro de Investigación en Materiales Avanzados, S.C., Miguel de Cervantes No. 120. Complejo Industrial Chihuahua, C.P. 31109 Chihuahua, Chih, Mexico, ² Facultad de Ciencias Químicas, Universidad Autónoma de Chihuahua, 1542-C, Chihuahua, Chih. G.V. Nevárez-Moorillón, Email: vnevare@uach.mx, Phone: +52-614-414-4492 Mexico). **Aerobic biodegradation of methyl *tert*-butyl ether (MTBE) by pure bacterial cultures isolated from contaminated soil. World Journal of Microbiology and Biotechnology, Online First**

Methyl *tert*-Butyl Ether (MTBE) has been used in gasoline as a substitute for lead-based additives, which have been demonstrated to be toxic. MTBE however, is persistent in soil and water, showing high affinity for water and low affinity for soil, and has become an important contaminant. Therefore, the aim of this work was to isolate and identify soil microorganisms capable of degrading MTBE. Two samples were taken from a gasoline-contaminated soil at a service station and 59 different bacterial strains were isolated by enrichment culture with three consecutive selective transfers. Biochemical and morphological characterization of the bacterial isolates classified them into the following groups: *Bacillus*, *Rhodococcus*, *Micrococcus*, *Aureobacterium* and *Proteus*. Twelve strains were selected for evaluation of MTBE biodegradation depending on visual growth and biomass production of the isolates in minimal salt broth. Six strains significantly reduced MTBE concentration (22–37%) compared to an abiotic control after 5 days of incubation. Although it has been considered that MTBE is degraded mainly by cometabolism, our results demonstrate that these microorganisms are able to reduce MTBE concentration when MTBE is the sole source of carbon.

Keywords Aerobic biodegradation - MTBE - soil contamination - bacterial soil isolates

Madjid Mohseni*, Joy Lan Zhao. (Department of Chemical and Biological Engineering, University of British Columbia, 2216 Main Mall, Vancouver, BC V6T 1Z4, Canada. *Correspondence to Madjid Mohseni, Department of Chemical and Biological Engineering, University of British Columbia, 2216 Main Mall, Vancouver, BC V6T 1Z4, Canada, email: Madjid.Mohseni@chml.ubc.ca).. **Coupling ultraviolet photolysis and biofiltration for enhanced degradation of aromatic air pollutants. Journal of Chemical Technology & Biotechnology, Volume 81(2) (2005): 146 – 151**

Coupling UV photolysis and biofiltration was evaluated as an effective treatment strategy for the enhanced degradation of hardly biodegradable aromatic volatile organic compounds (VOCs). *o*-Xylene, a recalcitrant and poorly water-soluble VOC, was used as a model compound and treated in two parallel treatment systems with and without UV pretreatment. Contaminated streams with flow rates of 0.186-

0.384 m³ h⁻¹ and inlet *o*-xylene concentrations of up to 0.22 g m⁻³ were passed through the treatment system. About 20% (between 10 and 35%) of *o*-xylene was converted into water-soluble intermediates during the UV photolysis stage, which partially oxidized *o*-xylene to more water-soluble and biodegradable byproducts. The untreated contaminant along with the byproducts of UV photolysis was then removed effectively in the biofiltration stage, with improvements of up to 100% compared with the control biofiltration process. The results suggested that combined UV photolysis-biofiltration is promising as an effective technique to eliminate hydrophobic and recalcitrant organic compounds from contaminated air streams. Copyright © 2005 Society of Chemical Industry

Keywords: volatile organic compound • VOC • *o*-xylene • UV • photolysis • photooxidation • air treatment • biofiltration

Bo Yu,¹ Ping Xu,^{1*} Shanshan Zhu,¹ Xiaofeng Cai,¹ Ying Wang,¹ Li Li,^{1,2} Fuli Li,¹ Xiaoyong Liu,¹ and Cuiqing Ma¹ (State Key Laboratory of Microbial Technology,¹ School of Environmental Science and Engineering, Shandong University, Jinan 250100, People's Republic of China². * Corresponding author. Mailing address: State Key Laboratory of Microbial Technology, Shandong University, Jinan 250100, People's Republic of China. Phone: 86-531-88564003. Fax: 86-531-88567250. E-mail: pingxu@sdu.edu.cn). Selective Biodegradation of S and N Heterocycles by a Recombinant *Rhodococcus erythropolis* Strain Containing Carbazole Dioxygenase. *Applied and Environmental Microbiology*, Vol. 72 (3) (2006): 2235-2238

The carbazole dioxygenase genes were introduced into a dibenzothiophene degrader. The recombinant *Rhodococcus erythropolis* SN8 was capable of efficiently degrading dibenzothiophene and carbazole simultaneously. SN8 could also degrade various alkylated derivatives of carbazole and dibenzothiophene in FS4800 crude oil by just a one-step bioprocess.

Marta Eiroa, Almudena Vilar, Christian Kennes, María C Veiga * (Chemical Engineering Laboratory, Faculty of Sciences, University of A Coruña, Alejandro de la Sota No. 1, 15008-A Coruña, Spain email: María C Veiga (veiga@udc.es) *Correspondence to María C Veiga, Chemical Engineering Laboratory, Faculty of Sciences, University of A Coruña, Alejandro de la Sota No. 1, 15008 A Coruña, Spain). Formaldehyde biodegradation in the presence of methanol under denitrifying conditions. *Journal of Chemical Technology & Biotechnology*, Volume 81 (3) (2006): Pages 312 - 317

Simultaneous formaldehyde and methanol biodegradation and also denitrification were studied in batch assays and in a continuous laboratory-scale reactor. In batch assays, high formaldehyde concentrations (up to 1360 mg dm⁻³) were removed under anoxic conditions in the presence of methanol. It was found that formaldehyde biodegradation produced methanol and formic acid as products. The denitrification process was affected by the initial formaldehyde concentration. In the continuous reactor, the biodegradation of different concentrations of formaldehyde (1500-275 mg dm⁻³) and methanol (153-871 mg dm⁻³) took place, maintaining the organic loading rate at 0.84 g COD dm⁻³ d⁻¹ (COD/N 4). However, each increase in the methanol concentration in the influent caused a decrease in the denitrification level. An adaptation period to methanol was necessary before the denitrification percentage could be recovered. In contrast with batch assays, in the continuous reactor methanol and formic acid were not detected in the effluent. Moreover, in the continuous reactor the denitrification percentages were higher and the nitrite accumulation was lower.

Keywords: formaldehyde • methanol • biodegradation • denitrification

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Technology, Matunga, Mumbai-400 019, India). Photocatalytic degradation of 3-nitrobenzenesulfonic acid in aqueous TiO₂ suspensions. *Journal of Chemical Technology & Biotechnology*, Volume 81 (3) (2006): 359 – 364

The photocatalytic degradation of 3-nitrobenzenesulfonic acid in the presence of solar radiation and artificial UV radiation with suspended TiO₂ was studied in a batch and continuous annular reactor, respectively. The effects of catalyst loading, pH, presence of anions and cations and initial concentration on the rate of photocatalytic degradation were investigated. Concentration-time data were correlated with the rate equation $d[C_{t=0}]/dt = k_r K [C_{t=0}] / (1 + K [C_{t=0}])$. Studies were carried out to compare the photolytic, photochemical and photocatalytic methods of degradation. Copyright © 2005 Society of Chemical Industry

Keywords: nitrobenzenesulfonic acid • photocatalysis • titanium dioxide • chemical kinetics **Sanjay P Kamble, Sudhir B Sawant, Vishwas G Pangarkar*** (Chemical Engineering Department, University of Mumbai, Institute of Chemical Technology Matunga, Mumbai-400 019, India email: Vishwas G Pangarkar (vgp@udct.org) *Correspondence to Vishwas G Pangarkar, Chemical Engineering Department, University of Mumbai, Institute of Chemical Technology Matunga, Mumbai-400 019, India). Photocatalytic degradation of *m*-dinitrobenzene by illuminated TiO₂ in a slurry photoreactor. *Journal of Chemical Technology & Biotechnology*, Volume 81 (3) (2006): 365 – 373

1,3-dinitrobenzene (*m*-DNB) is one of the compounds released to water in discharges during the manufacture of explosives. Its widespread distribution as an environmental contaminant is a potential threat to wildlife and other ecological receptors. Therefore, removal of *m*-DNB from aqueous solution is very important. In this work, which is a continuation of our ongoing investigation of the effect of various functional groups in aromatic derivatives, a study of the destruction of *m*-DNB in aqueous solution, was carried out using both concentrated solar radiation and artificial UV radiation. It was found that a variety of phenolic intermediates are formed via hydroxyl radicals attacking the parent compound. The effects of the various parameters such as adsorption, initial concentration, catalyst loading, pH and anions on the photocatalytic degradation of *m*-DNB was studied. The kinetics of the photocatalytic reaction were also studied. The effect of the second nitro group in *m*-DNB was elucidated by comparison with our earlier work on PCD of nitrobenzene.

Keywords: *m*-dinitrobenzene • photocatalytic degradation • slurry photocatalytic reactor • annular stainless-steel slurry reactor • solar radiation • artificial radiation

Wael S. El-Sayed^a, Ashraf F. El-Baz^b and A.M. Othman^c. (^aMicrobiology Department, Faculty of Science, Ain Shams University, Cairo, Egypt, ^bDepartment of Industrial Biotechnology, Genetic Engineering and Biotechnology Research Institute (GEBRI), University of Menoufiya, Sadaat City, Egypt, ^cDepartment of Environmental Biotechnology, Genetic Engineering and Biotechnology Research Institute (GEBRI), University of Menoufiya, Sadaat City, Egypt. Corresponding author. Central Research Institute of Electric Power Industry, Biotechnology Sector, Environmental Science Research Laboratory, 1646 Abiko, Abiko-shi, Chiba-ken 270-1194, Japan. Tel.: +81 70 5008 7926; fax: +81 4 7183 3347). Biodegradation of melamine formaldehyde by *Micrococcus* sp. strain MF-1 isolated from aminoplastic wastewater effluent *International Biodeterioration & Biodegradation*, Volume 57 (2) (2006): 75-81

Novel bacterial strain MF-1, able to grow using melamine formaldehyde (MF) resin as main carbon and nitrogen source, is described and characterized. Strain MF-1 was isolated from wastewater effluent of an aminoplastic industrial plant. Growth rate kinetics of the strain on MF showed a maximum specific growth rate (μ_{max}) of 0.83 cells ml⁻¹ h⁻¹ and K_s of 7.18 cells ml⁻¹. Mineralization of MF by strain MF-1 was confirmed by the decrease in dissolved oxygen (DO), release of ammonia, and detection of intermediate metabolites during biodegradation. Melamine, cyanuric acid, and biuret were detected as intermediate metabolites in the culture filtrate, suggesting that biodegradation of MF by strain MF-1

proceeds via successive deamination reactions of melamine to cyanuric acid, which is hydrolyzed to biuret and finally to NH₃ and CO₂. Based on 16S-rDNA sequence analysis, strain MF-1 had a similarity of 97% to *Micrococcus* sp. MN 8.1d. However, the high bootstrap value obtained in the phylogenetic analyses suggests that this is a novel strain.

Keywords: Melamine formaldehyde; *Micrococcus* sp.; Kinetics; Biodegradation; Metabolites

Neelakanteshwar K. Patil, Y. Veeranagouda, M.H. Vijaykumar, S. Anand Nayak and T.B. Karegoudar. (Department of Biochemistry, Gulbarga University, Gulbarga 585 106, Karnataka, India). Enhanced and potential degradation of *o*-phthalate by *Bacillus* sp. immobilized cells in alginate and polyurethane. International Biodeterioration & Biodegradation, Volume 57 (2) (2006): 82-87

Phthalate is a key metabolite during the degradative pathways of various aromatic compounds, which are generally recognized as pollutants. *Bacillus* sp. (NCIM 5220), a soil microbe, is capable of utilizing *o*-phthalate as the sole carbon and energy source. This bacterium was immobilized in alginate and polyurethane foam (PUF). The degradation of phthalate by free cells was compared with the degradation by alginate- and PUF-immobilized cells in shaken batch, repeated batch, and continuous degradation in a packed bed reactor. The immobilized cells in alginate and PUF showed higher degradation of phthalate than free cells and could be used for repeated cycles for more than 12 and 24 cycles, respectively. Further the immobilized cells could be operated for the degradation of phthalate in a packed-bed reactor with much higher dilution rates. Thus, more efficient degradation of phthalate was achieved by immobilizing the *Bacillus* sp. in alginate and polyurethane foam.

Keywords: Alginate; *Bacillus* sp.; Biodegradation; Immobilization; *o*-Phthalate; Polyurethane

Pankaj Chaudhary, Manish Kumar, Bhom S. Khangarot and Ashwani Kumar. (Industrial Toxicology Research Centre, Post Box No 80, Mahatma Gandhi Marg, Lucknow 226 001, India). Degradation and detoxification of hexachlorocyclohexane isomers by *Pseudomonas aeruginosa* ITRC-5. International Biodeterioration & Biodegradation, Volume 57(2) (2006): 107-113

Technical-hexachlorocyclohexane (t-HCH) consists of four major isomers i.e. α -, β -, γ - and δ -HCH. The insecticidal γ -HCH is separated from it by solvent extraction, and the remaining 'muck' is discarded. HCH-isomers from the 'muck' can potentially enter the environment and impart toxicity. For its biological treatment, biodegradation of HCH-isomers by the isolated bacterium *Pseudomonas aeruginosa* ITRC-5 was evaluated. In its presence, from 1.7 mM 'muck', >98% α - and >80% β -, γ - and δ -HCH were degraded after 24 days of incubation. The degradation was optimal at 1.7 mM input concentration of 'muck', pH 9.0, and temperature 20–30 °C. Under these conditions, from 2 g 'muck', >90% Σ -HCH, i.e. the sum of α -, β -, γ -, and δ -HCH, were degraded in a 1.0-liter batch-reactor after incubation for 4 cycles of 5 weeks each. The degradation was accompanied with 90% reduction in the toxicity of 'muck' to the aquatic test organism *Daphnia magna*. The isolated bacterium ITRC-5 can therefore be used for the degradation and detoxification of HCH-wastes, prior to their disposal.

Keywords: Hexachlorocyclohexane; *Pseudomonas aeruginosa*; Degradation; Detoxification

Rómulo Osés^a, Sofía Valenzuela^a, Juanita Freer^b, Jaime Baeza^b and Jaime Rodríguez^a. (^aRenewable Resources Laboratory, Forest Science Faculty, Biotechnology Center, Universidad de Concepción, Casilla 160-C., Concepción, Chile, ^bRenewable Resources Laboratory, Chemistry Science Faculty, Biotechnology Center, Universidad de Concepción, Casilla 160-C., Concepción, Chile). Evaluation of fungal endophytes for lignocellulolytic enzyme production and wood biodegradation. International Biodeterioration & Biodegradation, Volume 57 (2) (2006): 129-135

Wood-inhabiting fungal endophytes of Chilean tree species *Drimys winteri* and *Prumnopitys andina* were isolated and assayed for lignocellulolytic enzymes production and wood biodegradation. Using an increment wood borer, four endophyte fungi were isolated: in *D. winteri* a basidiomycete identified as *Bjerkandera* sp., and a Deuteromycete classified as *Mycelia sterilia* (Dw-2), whilst in *P. andina* an unidentified Basidiomycete (Pa-1) and also a *M. sterilia*(Pa-2) were found. In agar solid media, the Basidiomycetes displayed positive reaction to phenoloxidase (PO) and cellulase, and did not show iron-reducing activity. A weak reaction to the cellulase and iron-reducing assay but not for PO activity was detected in both *M. sterilia* isolates. PO activity was detected in liquid cultures of both basidiomycetes. After treating *D. winteri* wood chips with *Bjerkandera* sp. presented the following weight and component losses: weight of 13.3±1.5%, total lignin of 13.2±1.2%, glucan 16.9±4.4%, polyoses 22.6±3.8% and extractives 16.0±1.7%. For Pa-1, weight and component losses were: weight of 5.6±0.0%, total lignin of 8.0±0.6%, glucan 7.0±0.3%, polyoses 9.0±0.5% and extractives 7.7±0.1% in 45 days were detected. These results indicate that isolated fungal basidiomycete endophytes are able to develop a non-selective white-rot wood decay pattern.

Keywords: Wood endophytes; *Bjerkandera* sp.; *Mycelia sterilia*; Rhizoctonia; Wood decay; Cellulase; Phenoloxidase

Byoung-In Sang¹, Won-Kwon Lee¹, Katsutoshi Hori² and Hajime Unno². (¹ Water Environment and Remediation Research Center, Korea Institute of Science and Technology, 39-1 Hawolgok-Dong, 136-791, Seongbuk-Ku, Seoul, Korea, ² Department of Biotechnology, Graduate School of Bioscience and Biotechnology, Tokyo Institute of Technology, 4259 Nagatsuta, 226-8501, Midori, Yokohama, Japan. Byoung-In Sang, Email: biosang@kist.re.kr Phone: +82-2-958-6751, Fax: +82-2-958-5839). Purification and Characterization of Fungal Poly(3-hydroxybutyrate) Depolymerase from *Paecilomyces lilacinus* F4-5 and Enzymatic Degradation of Poly(3-hydroxybutyrate-co-3-hydroxyvalerate) Film World Journal of Microbiology and Biotechnology, Volume 22 (1) (2006) : 51 - 57

Poly(3-hydroxybutyrate) [P(3HB)] depolymerase was purified from a poly(3-hydroxybutyrate-co-3-hydroxyvalerate) [P(3HB-co-3HV)]-degrading fungus, *Paecilomyces lilacinus* F4-5 by hydrophobic and ion exchange column chromatography, and showed a molecular mass of 45 kDa. The optimum temperature and pH of the P(3HB) depolymerase were 50 °C and 7.0, respectively. The enzyme was stable for at least 30 min at temperatures below 40 °C, while the activity abruptly decreased over 55 °C. Enzymatic P(3HB-co-3HV) degradation showed a similar degradation pattern to that of film overlaid by fungal hyphae. It reflects that the fungal degradation of P(3HB-co-3HV) in soil is mainly caused by extracellular depolymerases.

Keywords biodegradation - fungi - P(3HB) depolymerase - P(3HB-co-3HV)-degrading enzyme

Oloke J. K. and Glick B. R. Production of bioemulsifier by an unusual isolate of salmon/red melanin containing *Rhodotorula glutinis* African Journal of Biotechnology, Vol. 4 (02) (2005): 164-171

An unusual isolate of *Rhodotorula glutinis* was obtained. The yeast produces a spore and a crystalliferous protein per cell. Sodium dodecyl sulfate polyacrylamide gel electrophoresis revealed that the parasporal crystals contained polypeptides with a molecular mass of approximately 55, 47, 40, 36 32.5, 30 and 25 kD. The yeast also produces a salmon/red pigment at late stage of exponential growth, which has physical and chemical properties that are consistent with it being a form of melanin. The organism has been used to produce bioemulsifier with emulsion index of 80% when tested against kerosene and crude oil. The bioemulsifier has been shown to be capable of eliminating about 76% of crude oil pollutant. The colonial and mycelia forms of *Rhodospiridium toruloides* and *Rhodospiridium sphaerocarum* have been successfully isolated from the unusual organism.

Keywords: Bioemulsifier, *rhodotorula glutinis*, teleomorph, *Rhodosporidium toruloides*.

Emtiazi, G., Shakarami, H., Nahvi, I. and Mirdamadian, S. H. Utilization of petroleum hydrocarbons by *Pseudomonas* sp. and transformed *Escherichia coli*. African Journal of Biotechnology, Vol. 4 (02) (2005): 172-176

Our previous studies showed that the biodegradation of petroleum oil by a *pseudomonas* isolated from a petroleum-contaminated soil was instable. In this work, it is shown that when the isolates are immobilized on Perlite, they are more stable for oil degradation. Although the isolate did not have any chemotaxis to octadecane, dodecane and octane but utilize octadecane and dodecane better than octane and it did not utilize hexane, benzene, kerosene, pentane, heptane or thiophenol. The generation time for degradation of petroleum oil, dodecane and octadecane was 20, 22, and 25 h respectively. This phenotype was not transformed to *Pseudomonas* by conjugation even with lysozyme treatment, however the petroleum oil and octadecane utilization were transformed to *Escherichia coli* by lysozyme treatment. The transformed *E. coli* lost the ability to use octadecane after three subcultures on nutrient broth and 34 generations.

Keywords: Petroleum, transformation, chemotaxis, biodegradation, immobilization.

Blanca Antizar-Ladislao, Joe Lopez-Real and Angus James Beck. (Imperial College London, Wye Campus, Department of Agricultural Science, Wye, Ashford, Kent TN25 5AH, UK. Corresponding author. Tel.: +44 20 759 42779; fax: +44 20 759 42640). Degradation of polycyclic aromatic hydrocarbons (PAHs) in an aged coal tar contaminated soil under in-vessel composting conditions. Environmental Pollution, Volume 141 (3) (2006):459-468

In-vessel composting of polycyclic aromatic hydrocarbons (PAHs) present in contaminated soil from a manufactured gas plant site was investigated over 98 days using laboratory-scale in-vessel composting reactors. The composting reactors were operated at 18 different operational conditions using a 3-factor factorial design with three temperatures (T , 38 °C, 55 °C and 70 °C), four soil to green waste ratios (S:GW, 0.6:1, 0.7:1, 0.8:1 and 0.9:1 on a dry weight basis) and three moisture contents (MC, 40%, 60% and 80%). PAH losses followed first order kinetics reaching 0.015 day^{-1} at optimal operational conditions. A factor analysis of the 18 different operational conditions under investigation indicated that the optimal operational conditions for degradation of PAHs occurred at MC 60%, S:GW 0.8:1 and T 38 °C. Thus, it is recommended to maintain operational conditions during in-vessel composting of PAH-solid waste close to these values.

Maximum degradation of PAHs in an aged coal tar contaminated soil can be achieved using optimal operational conditions during composting.

Keywords: Composting; Kinetics; Polycyclic aromatic hydrocarbons

Zhenyu Wang^{1, 2}, Jing Zhang¹, Yu Zhang¹, Abdel Latif Hesham¹ and Min Yang¹ (¹State Key Laboratory of Environmental Aquatic Chemistry, Research Center for Eco-Environmental Sciences, Chinese Academy of Sciences, P.O. Box 2871, 100085 Beijing, P.R. China, ²College of Life Science, Henan Normal University, 453007 Xinxiang Henan, P.R. China, Min Yang, Email: yangmin@rcees.ac.cn, Fax: +86-10-62923475). Molecular Characterization of a Bacterial Consortium Enriched from an Oilfield that Degrades Phenanthrene. Biotechnology Letters, Volume 28 (9) (2006): 617 – 621

Characterization of functional and phylogenetic genes was carried out on a bacterial consortium, enriched from a water treatment system of an oilfield, that could use phenanthrene as the sole carbon source. The mixed culture degraded 130 mg phenanthrene l^{-1} in 16 days, which is significantly faster than previously reported pure cultures. The existence of catabolic genes (*nahAc*, *C23O*) in the mixed culture was quantitated by most probable number PCR. The plasmid encoding phenanthrene catabolic genes

increased relative to the chromosome genes. Heterogeneous bacteria were present according to both PCR denaturing gradient gel electrophoresis and cloning methods, suggesting the possible existence of cooperation between different biochemical PAH-transforming pathways.

Keywords biodegradation - catabolic gene - cloning – phenanthrene

Mary Beth Leigh,^{1*} Petra Prouzová,² Martina Macková,² Tomáš Macek,³ David P. Nagle,¹ and John S. Fletcher¹. (Department of Botany and Microbiology, University of Oklahoma, 770 Van Vleet Oval, Norman, Oklahoma 73019,¹ Department of Biochemistry and Microbiology, Faculty of Food and Biochemical Technology, Institute for Chemical Technology, Prague, Technická 3, 16628 Prague, Czech Republic,² Department of Natural Products, Institute of Organic Chemistry and Biochemistry, Academy of Sciences of the Czech Republic, Flemingovo n. 2, 16610 Prague, Czech Republic³, * Corresponding author. Present address: Center for Microbial Ecology, Michigan State University, 540 Plant and Soil Sciences Building, East Lansing, MI 48824. Phone: (517) 355-0271, ext. 1283. Fax: (517) 353-2917. E-mail: leigh@msu.edu). **Polychlorinated Biphenyl (PCB)-Degrading Bacteria Associated with Trees in a PCB-Contaminated Site. Applied and Environmental Microbiology, Vol. 72 (4) (2006): 2331-2342**

The abundance, identities, and degradation abilities of indigenous polychlorinated biphenyl (PCB)-degrading bacteria associated with five species of mature trees growing naturally in a contaminated site were investigated to identify plants that enhance the microbial PCB degradation potential in soil. Culturable PCB degraders were associated with every plant species examined in both the rhizosphere and root zone, which was defined as the bulk soil in which the plant was rooted. Significantly higher numbers of PCB degraders (2.7- to 56.7-fold-higher means) were detected in the root zones of Austrian pine (*Pinus nigra*) and goat willow (*Salix caprea*) than in the root zones of other plants or non-root-containing soil in certain seasons and at certain soil depths. The majority of culturable PCB degraders throughout the site and the majority of culturable PCB degraders associated with plants were identified as members of the genus *Rhodococcus* by 16S rRNA gene sequence analysis. Other taxa of PCB-degrading bacteria included members of the genera *Luteibacter* and *Williamsia*, which have not previously been shown to include PCB degraders. PCB degradation assays revealed that some isolates from the site have broad congener specificities; these isolates included one *Rhodococcus* strain that exhibited degradation abilities similar to those of *Burkholderia xenovorans* LB400. Isolates with broad congener specificity were widespread at the site, including in the biostimulated root zone of willow. The apparent association of certain plant species with increased abundance of indigenous PCB degraders, including organisms with outstanding degradation abilities, throughout the root zone supports the notion that biostimulation through rhizoremediation is a promising strategy for enhancing PCB degradation in situ.

Patthra Pason, Khin Lay Kyu,* and Khanok Ratanakhanokchai . (School of Bioresources and Technology, King Mongkut's University of Technology Thonburi, Bangkok, Thailand. * Corresponding author. Mailing address: School of Bioresources and Technology, King Mongkut's University of Technology Thonburi, Bangkok 10140, Thailand. Phone: 662 470 7753. Fax: 662 452 3479. E-mail: khin.kyu@kmutt.ac.th). **Paenibacillus curdolanolyticus Strain B-6 Xylanolytic-Cellulolytic Enzyme System That Degrades Insoluble Polysaccharides. Applied and Environmental Microbiology, Vol. 72 (4) (2006): 2483-2490**

A facultatively anaerobic bacterium, *Paenibacillus curdolanolyticus* B-6, isolated from an anaerobic digester produces an extracellular xylanolytic-cellulolytic enzyme system containing xylanase, β -xylosidase, arabinofuranosidase, acetyl esterase, mannanase, carboxymethyl cellulase (CMCase), avicelase, cellobiohydrolase, β -glucosidase, amylase, and chitinase when grown on xylan under aerobic conditions. During growth on xylan, the bacterial cells were found to adhere to xylan from the early exponential growth phase to the late stationary growth phase. Scanning electron microscopic analysis revealed the adhesion of cells to xylan. The crude enzyme preparation was found to be capable of binding to insoluble xylan and Avicel. The xylanolytic-cellulolytic enzyme system efficiently hydrolyzed

insoluble xylan, Avicel, and corn hulls to soluble sugars that were exclusively xylose and glucose. Sodium dodecyl sulfate-polyacrylamide gel electrophoresis (SDS-PAGE) of a crude enzyme preparation exhibited at least 17 proteins, and zymograms revealed multiple xylanases and cellulases containing 12 xylanases and 9 CMCase. The cellulose-binding proteins, which are mainly in a multienzyme complex, were isolated from the crude enzyme preparation by affinity purification on cellulose. This showed nine proteins by SDS-PAGE and eight xylanases and six CMCase on zymograms. Sephacryl S-300 gel filtration showed that the cellulose-binding proteins consisted of two multienzyme complexes with molecular masses of 1,450 and 400 kDa. The results indicated that the xylanolytic-cellulolytic enzyme system of this bacterium exists as multienzyme complexes.

Anthony S. Danko,¹ Christopher A. Sasaki,² Jeffrey P. Tomkins,² and David L. Freedman^{3*} (Centro de Engenharia Biológica, Universidade do Minho, Campus Gualtar, Braga 4710-057, Portugal,¹ Clemson University Genomics Institute, 100 Jordan Hall, Clemson University, Clemson, South Carolina 29634,² Department of Environmental Engineering and Science, Clemson University, Clemson, South Carolina 29634³, * Corresponding author. Mailing address: Department of Environmental Engineering & Science, Box 340919, Clemson University, Clemson, SC 29634-0919. Phone: (864) 656-5566. Fax: (864) 656-0672. E-mail: dfreedm@clemson.edu). Involvement of Coenzyme M during Aerobic Biodegradation of Vinyl Chloride and Ethene by *Pseudomonas putida* Strain AJ and *Ochrobactrum* sp. Strain TD. *Applied and Environmental Microbiology*, Vol. 72 (5) (2006): 756-3758

The involvement of coenzyme M in aerobic biodegradation of vinyl chloride and ethene in *Pseudomonas putida* strain AJ and *Ochrobactrum* sp. strain TD was demonstrated using PCR, hybridization, and enzyme assays. The results of this study extend the range of eubacteria known to use epoxyalkane:coenzyme M transferase.

Qingzhong Wu,¹ Robert A. Sanford,³ and Frank E. Löffler^{1,2*} (School of Civil and Environmental Engineering,¹ School of Biology, Georgia Institute of Technology, Atlanta, Georgia 30332-0512,² Department of Geology, University of Illinois, Urbana, Illinois 61801-2352³, * Corresponding author. Mailing address: Georgia Institute of Technology, School of Civil and Environmental Engineering, 311 Ferst Drive, 3228 ES&T Building, Atlanta, GA 30332-0512. Phone: (404) 894-0279. Fax: (404) 894-8266. E-mail: frank.loeffler@ce.gatech.edu). Uranium(VI) Reduction by *Anaeromyxobacter dehalogenans* Strain 2CP-C. *Applied and Environmental Microbiology*, Vol. 72 (5) (2006): 3608-3614

Previous studies demonstrated growth of *Anaeromyxobacter dehalogenans* strain 2CP-C with acetate or hydrogen as the electron donor and Fe(III), nitrate, nitrite, fumarate, oxygen, or *ortho*-substituted halophenols as electron acceptors. In this study, we explored and characterized U(VI) reduction by strain 2CP-C. Cell suspensions of fumarate-grown 2CP-C cells reduced U(VI) to U(IV). More-detailed growth studies demonstrated that hydrogen was the required electron donor for U(VI) reduction and could not be replaced by acetate. The addition of nitrate to U(VI)-reducing cultures resulted in a transitory increase in U(VI) concentration, apparently caused by the reoxidation of reduced U(IV), but U(VI) reduction resumed following the consumption of N-oxyanions. Inhibition of U(VI) reduction occurred in cultures amended with Fe(III) citrate, or citrate. In the presence of amorphous Fe(III) oxide, U(VI) reduction proceeded to completion but the U(VI) reduction rates decreased threefold compared to control cultures. Fumarate and 2-chlorophenol had no inhibitory effects on U(VI) reduction, and both electron acceptors were consumed concomitantly with U(VI). Since cocontaminants (e.g., nitrate, halogenated compounds) and bioavailable ferric iron are often encountered at uranium-impacted sites, the metabolic versatility makes *Anaeromyxobacter dehalogenans* a promising model organism for studying the complex interaction of multiple electron acceptors in U(VI) reduction and immobilization.

Anna H. Kaksonen,^{1*} Jason J. Plumb,² Wendy J. Robertson,² Stefan Spring,³ Peter Schumann,³ Peter D. Franzmann,² and Jaakko A. Puhakka¹ (Institute of Environmental Engineering and

Biotechnology, Tampere University of Technology, Tampere, Finland,¹ CSIRO Land and Water, Floreat, Western Australia, Australia,² DSMZ—German Collection of Microorganisms and Cell Cultures, Braunschweig, Germany³ * Corresponding author. Mailing address: Institute of Environmental Engineering and Biotechnology, Tampere University of Technology, P.O. Box 541, FIN-33101 Tampere, Finland. Phone: 358-(0)3-3115 3523. Fax: 358-(0)3-3115 2869. E-mail: anna.kaksonen@tut.fi). Novel Thermophilic Sulfate-Reducing Bacteria from a Geothermally Active Underground Mine in Japan. *Applied and Environmental Microbiology*, Vol. 72 (5) (2006): 3759-3762

Thermophilic sulfate-reducing bacteria were enriched from samples obtained from a geothermal underground mine in Japan. The enrichment cultures contained bacteria affiliated with the genera *Desulfotomaculum*, *Thermanaeromonas*, *Thermincola*, *Thermovenabulum*, *Moorella*, "*Natronoanaerobium*," and *Clostridium*. Two novel thermophilic sulfate-reducing strains, RL50JIII and RL80JIV, affiliated with the genera *Desulfotomaculum* and *Thermanaeromonas*, respectively, were isolated.

Biosensor

Avraham Rasooly^{a, b}, and James Jacobson^a (^aCancer Diagnosis Program (CDP) of the National Cancer Institute, United States, ^bDivision of Biological Sciences, Office of Science and Engineering Laboratories, FDA Center for Devices and Radiological Health, United States, Corresponding author. Present address: NIH/NCI, 6130 Executive Blvd. EPN, Room 6035A, Rockville, MD 20852, United States. Tel.: +1 301 402 4185; fax: +1 301 402 7819.). Development of biosensors for cancer clinical testing. *Biosensors and Bioelectronics*, Article in Press.

Biosensors are devices that combine a biochemical recognition/binding element (ligand) with a signal conversion unit (transducer). Biosensors are already used for several clinical applications, for example for electrochemical measurement of blood glucose concentrations. Application of biosensors in cancer clinical testing has several potential advantages over other clinical analysis methods including increased assay speed and flexibility, capability for multi-target analyses, automation, reduced costs of diagnostic testing and a potential to bring molecular diagnostic assays to community health care systems and to underserved populations. They have the potential for facilitating Point of Care Testing (POCT), where state-of-the-art molecular analysis is carried out without requiring a state-of-the-art laboratory. However, not many biosensors have been developed for cancer-related testing. One major challenge in harnessing the potential of biosensors is that cancer is a very complex set of diseases. Tumors vary widely in etiology and pathogenesis. Oncologists rely heavily on histological characterization of tumors and a few biomarkers that have demonstrated clinical utility to aid in patient management decisions. New genomic and proteomic molecular tools are being used to profile tumors and produce "molecular signatures." These signatures include genetic and epigenetic signatures, changes in gene expression, protein profiles and post-translational modifications of proteins. These molecular signatures provide new opportunities for utilizing biosensors. Biosensors have enormous potential to deliver the promise of new molecular diagnostic strategies to patients. This article describes some of the basic elements of cancer biology and cancer biomarkers relevant for the development of biosensors for cancer clinical testing, along with the challenges in using this approach.

Keywords: Cancer diagnostics; Biosensors; Point of Care Testing; Molecular signatures; Ligands

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Bulgaria, Corresponding author. Tel.: +359 29627220x518; fax: +359 2624240.). Bacterial sensors based on *Acidithiobacillus ferrooxidans* Part I. Fe²⁺ and S₂O₃²⁻ determination. Biosensors and Bioelectronics, Volume 21(8)(2006): 1493-1500

An amperometric bacterial sensor with current response to Fe²⁺ and S₂O₃²⁻ ions has been designed by immobilizing an acidophilic biomass of *Acidithiobacillus ferrooxidans* on a multi disk flat-front oxygen probe. The bacterial layer was located between the oxygen probe and a membrane of cellulose. A filtration technique was used to yield the bacterial membranes having reproducible activity.

The decrease of O₂ flow across the bacterial layer is proportional to the concentration of the dosed species.

The dynamic range appeared to be linear for the Fe²⁺ ions up to 2.5 mmol L⁻¹ with a detection limit of 9 × 10⁻⁷ mol L⁻¹ and a sensitivity of 0.25 A L mol⁻¹. The response of the biosensor is 84 s for a determination of 2 × 10⁻⁴ mol L⁻¹ Fe²⁺. Optimizing the Fe²⁺ determination by *A. ferrooxidans* sensor was carried out owing to Design of Experiments (DOE) methodology and empirical modelling. The optimal response was thus obtained for a pH of 3.4, at 35 °C under 290 rpm solution stirring.

S₂O₃²⁻ concentration was determined at pH 4.7, so avoiding its decomposition. The concentration range was linear up to 0.6 mmol L⁻¹. Sensitivity was 0.20 A L mol⁻¹ with a response time of 207 s for a 2 × 10⁻⁴ mol L⁻¹ S₂O₃²⁻ concentration.

Keywords: Bacterial sensor; *Acidithiobacillus ferrooxidans*; Ferrous ions; Thiosulfate

Roumen Zlatev^a, Jean-Pierre Magnin^b, Patrick Ozil^b and Margarita Stoytcheva^c. (^aAutonomous University of Baja California, Institute of Engineering, Blvd. Benito Juarez S/N 21280 Mexicali, Baja California, Mexico, ^bLaboratoire d'Electrochimie et de Physico-chimie des Matériaux et Interfaces (LEPMI), UMR 5631, CNRS/UJF/INPG, BP75, 38402 St. Martin d'Hères, France, ^cUniversity of Mining and Geology, Department of Chemistry, Studentski grad, 1700 Sofia, Bulgaria, Corresponding author. Tel.: +359 296 27220x518; fax: +359 262 4240.). Bacterial sensors based on *Acidithiobacillus ferrooxidans*. Part II. Cr(VI) determination. Biosensors and Bioelectronics, Volume 21(8)(2006):1501-1506

The aerobic acidophilic bacterium *Acidithiobacillus ferrooxidans* oxidizes Fe²⁺ and S₂O₃²⁻ ions by consuming oxygen. An amperometric biosensor was designed including an oxygen probe as transducer and a recognition element immobilized by a suitable home-made membrane. This biosensor was used for the indirect amperometric determination of Cr₂O₇²⁻ ions owing to methods based on a mediator (Fe²⁺) or titration.

Using the mediator, the biosensor response versus Cr₂O₇²⁻ was linear up to 0.4 mmol L⁻¹, with a response time of, respectively, 51 s (2 × 10⁻⁵ mol L⁻¹ Cr₂O₇²⁻) and 61 s (6 × 10⁻⁵ mol L⁻¹ Cr₂O₇²⁻). The method sensitivity was 816 μA L mol⁻¹. Response time and measurement sensitivity depended on membrane material and technique for biomass immobilization. For example, their values were 90 s—200 μA L mol⁻¹ when using a glass-felt membrane and 540 s—4.95 μA L mol⁻¹ with a carbon felt one to determine a concentration of 2 × 10⁻⁵ mol L⁻¹ Cr₂O₇²⁻.

For the titration method, the biosensor is used to determine the equivalence point. The relative error of quantitative analysis was lower than 5%.

Keywords: Biosensor; *Acidithiobacillus ferrooxidans*; Cr(VI) determination

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700032, India, Corresponding author. Tel.: +91 32 16233638; fax: +91 33 24137121). A biosensor based on co-immobilized L-glutamate oxidase and L-glutamate dehydrogenase for analysis of monosodium glutamate in food. Biosensors and Bioelectronics, Article in Press

A monosodium glutamate (MSG) biosensor made by co-immobilized L-glutamate oxidase (L-GLOD) and L-glutamate dehydrogenase (L-GLDH) as the bio-component based on substrate recycling for highly sensitive MSG or L-glutamate determination, has been developed. Regeneration of MSG by substrate recycling provided an amplification of the sensor response. Higher signal amplification was found in the presence of ammonium ion. The sensor was standardized to determine MSG in the range of 0.02–3.0 mg/L. Linearity was obtained from 0.02 to 1.2 mg/L in presence of ammonium ion (10 mM) and NADPH (reduced nicotinamide adenine dinucleotide phosphate) (2 mM), but in absence of L-GLDH, the detection limit of MSG is confined to 0.1 mg/L. The apparent K_m for MSG with L-GLOD–L-GLDH coupled reaction was 0.4451 mM but 1.9222 mM when only L-GLOD was immobilized. Cross linking with glutaraldehyde in the presence of bovine serum albumin (BSA) as a spacer molecule has been used for the method of immobilization. The response time of the sensor was 2 min. The optimum pH and temperature of the biosensor has been determined as 7 ± 2 and 25 ± 2 °C, respectively. The enzyme immobilized on the membrane was used for over 50 measurements. The standard error of the sample measurement was 4–5%. The activity of the enzyme-immobilized membrane was tested over a period of 60 days.

Keywords: MSG biosensor; Substrate recycling; L-GLOD–L-GLDH co-immobilization; pH and temperature optimization; Signal amplification

Scott R. Horner^{b, d}, Charles R. Mace^{b, d}, Lewis J. Rothberg^{c, d} and Benjamin L. Miller^{a, b, d} (^aDepartment of Dermatology, University of Rochester, 601 Elmwood Avenue, Box 697, Rochester, NY 14642, USA, ^bDepartment of Biochemistry and Biophysics, University of Rochester, Rochester, NY 14642, USA, ^cDepartment of Chemistry, University of Rochester, Rochester, NY 14642, USA, ^dThe Center for Future Health, University of Rochester, Rochester, NY 14642, USA, Corresponding author. Tel.: +1 5852759805; fax: +1 5851731346). A proteomic biosensor for enteropathogenic *E. coli*, Biosensors and Bioelectronics, Volume 21(8)(2006):1659-1663

The study of proteins and the molecules with which they interact on an organismwide scale is critical to understanding basic biology, and understanding and improving human health. New platform technologies allowing label-free, quantitative array-based analysis of proteins are particularly desirable. We have developed an analytical technology, reflective interferometry (RI), which provides specific, rapid, and label-free optical detection of biomolecules in complex mixtures. In order to evaluate the suitability of RI for proteomics, we have prepared a series of arrays bearing the extracellular domain of the secreted enteropathogenic *Escherichia coli* (EPEC) protein Translocated Intimin Receptor (Tir). These arrays are able to selectively detect the extracellular domain of the protein Intimin, Tir's natural binding partner. Furthermore, we demonstrate the use of RI and Tir-functionalized arrays for the selective detection of EPEC directly from culture.

Keywords: Interferometry; Biosensor; Proteomics; EPEC

J.J.C. Dawson^a, C.D. Campbell^b, W. Towers^b, C.M. Cameron^b and G.I. Paton^a . (^aSchool of Biological Sciences, University of Aberdeen, Cruickshank Building, St. Machar Drive, Aberdeen AB24 3UU, UK, ^bThe Macaulay Institute, Craigiebuckler, Aberdeen AB15 8QH, UK. Corresponding author. Tel.: +44 1224 272259; fax: +44 1224 272703). Linking biosensor responses to Cd, Cu and Zn partitioning in soils. Environmental Pollution, Article in Press

Soils bind heavy metals according to fundamental physico-chemical parameters. Bioassays, using bacterial biosensors, were performed in pore waters extracted from 19 contrasting soils individually amended with Cd, Cu and Zn concentrations related to the EU Sewage Sludge Directive. The biosensors

were responsive to pore waters extracted from Zn amended soils but less so to those of Cu and showed no toxicity to pore water Cd at these environmentally relevant amended concentrations. Across the range of soils, the solid-solution heavy metal partitioning coefficient (K_d) decreased ($p < 0.01$) with increasing amendments of Cu and Zn; Cu exhibited the highest K_d values. Gompertz functions of Cu and Zn, K_d values against luminescence explained the relationship between heavy metals and biosensors. Consequently, biosensors provide a link between biologically defined hazard assessments of metals and standard soil-metal physico-chemical parameters for determining critical metal loadings in soils.

Biosensors link biological hazard assessments of metals in soils with physico-chemical partitioning.

Keywords: Heavy metals; Partitioning coefficient; K_d ; Biosensors; pH; Organic matter

Jens Tschmelak, Guenther Proll and Guenter Gauglitz. (Eberhard-Karls-University of Tuebingen, Institute of Physical and Theoretical Chemistry (IPTC), Auf der Morgenstelle 8, 72076 Tuebingen, Germany. Corresponding author. Tel.: +49 7071 29 74668; fax: +49 7071 29 5490). Improved strategy for biosensor-based monitoring of water bodies with diverse organic carbon levels. Biosensors and Bioelectronics, Volume 21(6) (2005): 979-983

To protect water resources and to control the water quality it is necessary to develop fast, sensitive, cost-effective, and easy-to-use analytical systems, which are able to measure a variety of contaminants in water. Monitoring water bodies with various matrices can be very difficult. The diverse organic carbon level in water samples (e.g. river water or seawater) causes problems at common analysis and in particular at immunological methods. Here, we demonstrate a new method to overcome the partly occurring matrix problems at quasi-continuous real-world biosensor monitoring. Therefore, we developed an easy matrix referencing method for our fully automated immunoassays that could be adapted to other applications depending on a similar test-format. The method was developed using a synthetic organic carbon standard, and validated using a diluted turf extract. Results for the ultra-sensitive immunoassay for estrone quantification are shown as example. The developed method was verified using immunoassays for testosterone, progesterone, ethinylestradiol, estradiol, and estriol.

Keywords: Organic carbon level; Matrix effects; Biosensors; River Analyser (RIANA); Environmental analysis; Immunoassays

Gyeong Sook Bang, Suhyeong Cho and Byung-Gee Kim. (School of Chemical and Biological Engineering and Institute of Molecular Biology and Genetics, Seoul National University, Kwanak-ku, Seoul 151-742, South Korea. Corresponding author. Tel.: +82 2 880 6774; fax: +82 2 883 6020). A novel electrochemical detection method for aptamer biosensors. Biosensors and Bioelectronics, Volume 21(6) (2005): 863-870

A beacon aptamer-based biosensor for the detection of thrombin was developed using electrochemical transduction method. Gold surface was modified with a beacon aptamer covalently linked at 5'-terminus with a linker containing a primary aliphatic amine. Methylene blue (MB) was intercalated into the beacon sequence, and used as an electrochemical marker. When the beacon aptamer immobilized on gold surface encounters thrombin, the hairpin forming beacon aptamer is conformationally changed to release the intercalated MB, resulting a decrease in electrical current intensity in voltamogram. The peak signal of the MB is clearly decreased by the binding of thrombin onto the beacon aptamer. The linear range of the signal was observed between 0 and 50.8 nM of thrombin with 0.999 correlation factor. This method was able to linearly and selectively detect thrombin with a detection limit of 11 nM.

Keywords: Beacon aptamer; Biosensor; Self-assembled monolayer; Methylene blue; Electrochemistry

Jin Hyung Lee^a, Robert J. Mitchell^a, Byoung Chan Kim^a, David C. Cullen^b and Man Bock Gu^a. (^aNational Research Laboratory on Environmental Biotechnology, Gwangju Institute of Science

and Technology (GIST), 1 Oryong-dong, Buk-gu, Gwangju 500-712, Republic of Korea, ^bCranfield Biotechnology Centre, Institute of Bioscience and Technology, Cranfield University, Silsoe, Bedfordshire MK45 4DT, UK. Corresponding author. Tel.: +82 62 970 2440; fax: +82 62 970 2434). A cell array biosensor for environmental toxicity analysis. *Biosensors and Bioelectronics*, Volume 21(3) (2005): 500-507

In this study, a cell-based array technology that uses recombinant bioluminescent bacteria to detect and classify environmental toxicity has been implemented to develop two biosensor arrays, i.e., a chip and a plate array. Twenty recombinant bioluminescent bacteria, having different promoters fused with the bacterial *lux* genes, were immobilized within LB-agar. About 2 μ l of the cell-agar mixture was deposited into the wells of either a cell chip or a 384-well plate. The bioluminescence (BL) from the cell arrays was measured with the use of highly sensitive cooled CCD camera that measured the bioluminescent signal from the immobilized cells and then quantified the pixel density using image analysis software. The responses from the cell arrays were characterized using three chemicals that cause either superoxide damage (paraquat), DNA damage (mitomycin C) or protein/membrane damage (salicylic acid). The responses were found to be dependent upon the promoter fused upstream of the *lux* operon within each strain. Therefore, a sample's toxicity can be analyzed and classified through the changes in the BL expression from each well. Moreover, a time of only 2 h was needed for analysis, making either of these arrays a fast, portable and economical high-throughput biosensor system for detecting environmental toxicities.

Keywords: Cell array chip; Bioluminescent bacteria; Environmental biosensor; Toxicity analysis

Young-Soo Sohn^a, Adrian Goodey^b, Eric V. Anslyn^b, John T. McDevitt^b, Jason B. Shear^b and Dean P. Neikirk^a. (^aThe University of Texas at Austin, Department of Electrical and Computer Engineering, Austin, TX 78712, USA, ^bThe University of Texas at Austin, Department of Chemistry and Biochemistry, Austin, TX 78712, USA. Corresponding author. Present address: The University of Texas at Austin, J.J. Pickle Research Campus, 10100 Burnet Road, Bldg. #160, MER 1.604A, R9900, Austin, TX 78758, USA. Tel.: +1 512 471 6707 (O)/+1 512 791 1896 (M); fax: +1 512 471 8575). A microbead array chemical sensor using capillary-based sample introduction: toward the development of an "electronic tongue". *Biosensors and Bioelectronics*. Volume 21(2) (2005): 303-312

The development of a micromachined fluidic structure for the introduction of liquid samples into a chip-based sensor array composed of individually addressable polymeric microbeads is presented. The micromachined structure consists of micromachined storage cavities combined with a covering glass layer that confines the microbeads and fluidic channels. In our sensor array transduction occurs via optical (colorimetric and fluorescence) changes to receptors and indicator molecules that are covalently attached to termination sites on the polymeric microbeads. Spectral data are acquired for each of the individual microbeads using a charged-coupled device (CCD) allowing for the near-real-time analysis of liquid sample. Hence the micromachined fluidic structure must allow for both optical access to the microbeads and fluid flow through the micromachined cavities that serve as the microreactors/analysis chambers. One of the key parts of the structure is a passive fluid introduction system driven only by capillary force. This simple means of fluid introduction realizes a compact device. The capillary flow on the inlet channel has been studied, and the responses of the microbeads (alizarin complexone) to a liquid sample have been characterized. The test results show that this system is useful in a micro-total-analysis-system (μ -TAS) and biomedical applications.

Keywords: Chemical sensor array; Microbeads; Microfluidic; Capillary; Micromachine

Francesco Ricciardi, Andrea Binelli and Alfredo Provini. (Department of Biology, University of Milan, via Celoria 26, 20133 Milan, Italy). Use of two biomarkers (CYP450 and

acetylcholinesterase) in zebra mussel for the biomonitoring of Lake Maggiore (northern Italy). *Ecotoxicology and Environmental Safety*, Volume 63 (3) (2006): 406-412

The use of zebra mussel *Dreissena polymorpha* as a bioaccumulator for lipophilic compounds is nowadays standardized, but its employment in early warning systems by the biomarker approach is much less frequent. One of the main problems with the biomarker approach is due to natural variation of abiotic factors such as temperature that influence the activity of several enzymes. In this study, we investigated the influence of this environmental parameter on the activities of two different biomarkers: acetylcholinesterase (AChE) (inhibited by organophosphorus compounds) and CYP450 (inversely influenced by planar compounds and heavy metals). We used these two biomarkers to evaluate the environmental pollution of Lake Maggiore (northern Italy). Results showed a strong AChE inhibition in mussel specimens collected in some sampling sites of the lake, indicating heavy pollution by neurotoxic compounds. We also found a twofold effect on CYP450 activity, probably due to the activating effect of planar compounds and the inhibiting effect of trace metals.

Keywords: Biomarkers; Zebra mussel; *Dreissena polymorpha*; AChE; EROD; Lake Maggiore; Biomonitoring

Ling Lin^a, Lai-Long Xiao^a, Sha Huang^a, Li Zhao^a, Jian-Shen Cui^c, Xiao-Hui Wang^c and Xi Chen^{a,b}. (^aDepartment of Chemistry and Key Laboratory of Analytical Sciences of the Ministry of Education, College of Chemistry and Chemical Engineering, Xiamen University, Xiamen 361005, China, ^bState Key Laboratory of Marine Environmental Science, Xiamen University, Xiamen 361005, China, ^cDepartment of Environmental Science, Hebei University of Science and Technology, Shijiazhuang 050000, China). **Novel BOD optical fiber biosensor based on co-immobilized microorganisms in ormosils matrix. *Biosensors and Bioelectronics*, Volume 21 (9) (2006): 1703-1709**

A biochemical oxygen demand (BOD) sensor has been developed, which is based on an immobilized mixed culture of microorganisms combined with a dissolved oxygen (DO) optical fiber. The sensing film for BOD measurement consists of an organically-modified silicate (ORMOSIL) film embedded with tri(4,7-diphenyl-1,10-phenanthroline) ruthenium(II) perchlorate and three kinds of seawater microorganisms immobilized on a polyvinyl alcohol sol-gel matrix. The BOD measurements were carried out in the kinetic mode inside a light-proof cell and with constant temperature. Measurements were taken for 3 min followed by 10 min recovery time in 10 mg/L glucose/glutamate (GGA) BOD standard solution, and the range of determination was from 0.2 to 40 mg/L GGA. The effects of temperature, pH and sodium chloride concentration on the BOD sensing films were studied. BOD values estimated by this optical BOD sensing film correlate well with those determined by the conventional BOD₅ method for seawater samples.

Keywords: Biochemical oxygen demand; BOD optical biosensor; Sol-gel; Ormosils

Hui Peng, Christian Soeller, Mark B. Cannell, Graham A. Bowmaker, Ralph P. Cooney and Jadranka Travas-Sejdic. (Polymer Electronics Research Centre, The University of Auckland, 23 Symonds Street, Private Bag 92019, Auckland 1001, New Zealand). **Electrochemical detection of DNA hybridization amplified by nanoparticles. *Biosensors and Bioelectronics*, Volume 21 (9) (2006): 1727-1736**

Detection of specific oligonucleotide (ODN) fragments has become an important field in many areas of biomedicine. We describe a novel ODN sensor based on electropolymerization of a conducting polymer (polypyrrole) in the presence of a sample containing ODN(s). The resulting trapped ODN(s) are then probed by addition of complimentary sequence ODN. By incorporating CdS nanoparticles with the probe, a significant improvement in sensor sensitivity was observed. Impedance spectroscopy suggested that optimal detection of hybridization occurred at frequencies ≥ 3000 Hz (for a 0.07 cm² 85 nm thick film). At

these frequencies, the impedance signal was almost linear with the logarithm of ODN concentration in the range 3.7–370 nM with a detection limit of ≈ 1 nM ODN (for the sensor fabricated). Importantly, the sensor could be regenerated by removing hybridized ODN with NaOH suggesting possibility of the sensor re-use.

Keywords: DNA sensor; Nanoparticles; Polypyrrole; Electrochemical impedance spectroscopy

J. Quincy Brown and Michael J. McShane. (Biomedical Engineering and the Institute for Micromanufacturing, Louisiana Tech University, 911 Hergot Ave., PO Box 10137, Ruston, LA 71272, USA). Modeling of spherical fluorescent glucose microsensor systems: Design of enzymatic smart tattoos. *Biosensors and Bioelectronics*, Volume 21 (9) (2006): 1760-1769

A two-substrate mathematical model of microspherical optical enzymatic glucose sensors is presented. The sensors are based on the well-known oxidation of glucose by glucose oxidase, and are constructed by the encapsulation of glucose oxidase within hydrogel microspheres coated with ultrathin polyelectrolyte multilayer films. In order to measure glucose via changes in oxygen concentration, a fluorescent oxygen indicator is co-encapsulated with the enzyme. The model was used to predict the temporal and spatial distributions of glucose and oxygen within the sphere for step increases in bulk glucose concentration. In addition, the model was used to observe the effect of varying sensor parameters, namely sphere size, film thickness, enzyme concentration, and mass transport of substrate and co-substrate within the sphere and film coatings, on the response of the sensors. A major finding was that the application of {PSS/PAH} films as thin as 12 nm can drastically improve the sensor performance over uncoated sensors based on calcium alginate microspheres. The model is proposed as an important tool for a priori design of these complex sensor structures.

Keywords: Glucose sensors; Fluorescent sensors; Mathematical modeling; Layer-by-layer

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Double stranded calf thymus deoxyribonucleic acid (DNA) was physisorbed onto polypyrrole–polyvinyl sulphonate (PPY–PVS) films electrochemically deposited onto indium–tin–oxide (ITO) coated glass plates. These DNA immobilized PPY–PVS films optimized for various conditions, such as polymerization potential, pH of buffer, DNA concentration and scan rate were characterized using Fourier-transform infrared (FT-IR) spectroscopy, atomic force microscopy (AFM) and cyclic voltammetry (CV) techniques, respectively. The amperometric response studies of these DNA/PPY–PVS electrodes were carried out as a function of 2-aminoanthracene (2-AA, 0.01–20 ppm) and *o*-chlorophenol (OCP, 0.1–30 ppm) concentration, respectively at 25 °C. The observed amperometric current arising due to oxidation of guanine in the DNA/PPY–PVS films decreased linearly with the increase in the concentration of 2-AA and OCP. It has been revealed that 10 ppm of 2-AA is sufficient to reduce the observed guanine oxidation peak current by approximately $-95 \pm 10\%$ as compared to the reported values. A 25 ppm of OCP was capable enough to reduce the guanine oxidation current to zero. These DNA/PPY–PVS electrodes were found to have a shelf life of about 4 months when stored at 25 °C.

Keywords: Polypyrrole; DNA; Toxicants; *o*-Chlorophenol; 2-Aminoanthracene; Biosensor

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Renmin Street, Changchun, Jilin 130022, Graduate School of the Chinese Academy of Sciences, Beijing 100039, China. Corresponding author. Tel.: +86 431 5262101; fax: +86 431 5689711.). Facile preparation of amperometric laccase biosensor with multifunction based on the matrix of carbon nanotubes–chitosan composite. *Biosensors and Bioelectronics*, Volume 21 (12) (2006): 2195-2201

The carbon nanotubes–chitosan (CNTs–CS) composite provides a suitable biosensing matrix due to its good conductivity, high stability, and good biocompatibility. Enzymes can be firmly incorporated into the matrix without the aid of other cross-linking reagents. The composite is easy to form insoluble film in solution above pH 6.3. Based on this, a facilely fabricated amperometric biosensor by entrapping laccase into the CNTs–CS composite film has been developed. At pH 6.0, the fungi laccase incorporated into the composite film remains better catalytic activity than that dissolved in solution. The system is in favor of the accessibility of substrate to the active site of laccase, thus the affinity to substrates is improved greatly, such as 2,2'-azino-bis-(3-ethylbenzthiazoline-6-sulfonic acid) diammonium salt (ABTS), catechol, and O₂ with *K_m* values of 19.86 μM, 9.43 μM, and 3.22 mM, respectively. The major advantages of the as-prepared biosensor are: detecting different substrates (ABTS, catechol, and O₂), possessing high affinity and sensitivity, durable long-term stability, and facile preparation procedure. On the other hand, the system can be applied in fabrication of biofuel cells as the cathodic catalysts based on its good electrocatalysis for oxygen reduction. It can be extended to immobilize other enzymes and biomolecules, which will greatly facilitate the development of biosensors, biofuel cells, and other bioelectrochemical devices.

Keywords: Carbon nanotubes; Chitosan; Laccase; Biosensor

Fabiana S. Felix, Miyuki Yamashita and Lúcio Angnes. (Departamento de Química Fundamental, Instituto de Química, Universidade de São Paulo, Av. Prof. Lineu Prestes, 748, 05508-900 São Paulo, SP, Brazil. ✉ Resume presented in the XVIII International Symposium on Electrochemistry and Bioenergetics (Coimbra, 19–24 June, 2005). Corresponding author. Tel.: +55 11 3091 3828; fax: +55 11 3818 5579). Epinephrine quantification in pharmaceutical formulations utilizing plant tissue biosensors ✉. *Biosensors and Bioelectronics*, Volume 21(12) (2006): 2283-2289

A plant tissue biosensor associated with flow injection analysis is proposed to determine epinephrine in pharmaceutical samples. The *polyphenol oxidase* enzymes present in the fibers of a palm tree fruits (*Livistona chinensis*), catalyses the oxidation of epinephrine to epinephrinequinone as a primary product. This product is then electrochemically reduced (at -0.10 V versus Ag/AgCl_{sat}) on the biosensor surface and the resulting current is used for the quantification of epinephrine. The biosensor provides a linear response for epinephrine in the concentration range from 5.0×10^{-5} to 3.5×10^{-4} mol l⁻¹. The limit of detection estimated for this interval was 1.5×10^{-5} mol l⁻¹ and the correlation coefficient of 0.998, working under a flow rate of 2.0 ml min⁻¹ and using a sample loop of 100 μl. The repeatability (R.S.D. for 10 consecutive determinations of a 3.0×10^{-4} mol l⁻¹ epinephrine solution) was 3.1%. The results obtained by the method here proposed were compared with the official UV spectrophotometric procedure and also using a plant tissue reactor. The responses obtained with the proposed strategies were in good agreement with both ways of analyses, whereas the values obtained by the official spectrophotometric method was strongly affected by benzoic acid, present in the formulation of pharmaceutical product utilized for inhalation. Such favorable results obtained with the carbon paste biosensor or utilizing the bioreactor, joined with the simplicity of its preparation turns these procedures very attractive for epinephrine quantification in pharmaceutical products.

Keywords: Epinephrine; Biosensor; Polyphenol oxidase; Pharmaceutical products; Amperometric detection; Tissue biosensors

Søren J Sørensen, Mette Burmølle and Lars H Hansen. (Department of Microbiology, University of Copenhagen, Sølvgade 83H, 1307 Copenhagen K, Denmark). Making bio-sense of toxicity: new

developments in whole-cell biosensors. Current Opinion in Biotechnology , Volume 17 (1) (2006): 11-16

Bacterial whole-cell biosensors are very useful for toxicity measurements of various samples. Semi-specific biosensors, containing fusions of stress-regulated promoters and reporter genes, have several advantages over the traditional, general biosensors that are based on constitutively expressed reporter genes. Furthermore, semi-specific

Bioengineering

Angela L. Batt^a , Ian B. Bruce^b and Diana S. Aga^a . (^aDepartment of Chemistry, The State University of New York at Buffalo, 608 Natural Sciences Complex, Buffalo, NY 14260-3000, USA, ^bDepartment of Geography, Buffalo State College, Buffalo, NY, USA, Corresponding author. Tel.: +1 716 645 6800x2226; fax: +1 716 645 6963). Evaluating the vulnerability of surface waters to antibiotic contamination from varying wastewater treatment plant discharges. Environmental Pollution, Article in Press

Effluents from three wastewater treatment plants with varying wastewater treatment technologies and design were analyzed for six antibiotics and caffeine on three sampling occasions. Sulfamethoxazole, trimethoprim, ciprofloxacin, tetracycline, and clindamycin were detected in the effluents at concentrations ranging from 0.090 to 6.0 µg/L. Caffeine was detected in all effluents at concentrations ranging from 0.19 to 9.9 µg/L. These findings indicate that several conventional wastewater management practices are not effective in the complete removal of antibiotics, and their discharges have a large potential to affect the aquatic environment. To evaluate the persistence of antibiotics coming from the wastewater discharges on the surrounding surface waters, samples were collected from the receiving streams at 10-, 20- and 100-m intervals. Ciprofloxacin, sulfamethoxazole, and clindamycin (0.043 to 0.076 µg/L) were found as far as 100 m from the discharge point, which indicates the persistence of these drugs in surface waters.

This work investigates the extent of antibiotic concentrations in receiving waters from discharges of wastewater treatment plants.

Keywords: Antibiotics; Wastewater; Surface water; Liquid chromatography/tandem mass spectrometry (LC/MS/MS)

Q. Zuo, H. Lin, X.L. Zhang, Q.L. Li, S.Z. Liu and S. Tao. (Laboratory for Earth Surface Processes, College of Environmental Sciences, Peking University, Beijing 100871, China. Corresponding author. Tel./fax: +86 10 62751938). A two-compartment exposure device for foliar uptake study. Environmental Pollution, Article in Press

An airtight two-chamber exposure device was designed for investigating foliar uptake of polycyclic aromatic hydrocarbons (PAHs) by plants. The upper and the bottom chambers of the device were airtightly separated by an aluminum foil and the plant aerial tissues and roots were exposed in the two chambers, respectively. The device was tested using maize exposed to several PAH species. Positive correlations between air and aerial tissue concentrations of the exposed PAH species were revealed. PAHs spiking in the culture solution had no influence on the leaf concentrations.

A two-compartment gastight exposure device was developed for investigation of foliar uptake of PAHs by plants.

Keywords: Exposure device; PAHs; Maize; Foliar uptake

Paula Madejón^a, Teodoro Maraño^b, José M. Murillo^b and Brett Robinson^c. (^aSchool of Biological and Earth Sciences, Liverpool John Moores University, Byrom Street, Liverpool L3 3AF, UK, ^bInstituto de Recursos Naturales y Agrobiología, CSIC, P.O. Box 1052, E-41080 Sevilla, Spain, ^cInstitut für Terrestrische Ökologie, Universitätstrasse 16, ETH Zentrum CHN F 24.1, CH-8092 Zürich, Switzerland. Corresponding author. Tel.: +34 954624711; fax: +34 954624002). In defence of plants as biomonitors of soil quality. *Environmental Pollution*, Article in Press

Biomonitors are organisms that provide quantitative information on environmental quality. There are some constraints and limitations for the use of plants as biomonitors of soil pollution, as pointed out recently by some authors in this journal. However, we defend the use of plants as biomonitors, and argue that they have important advantages over soil analyses as indicators of soil quality, particularly when investigations are made on a large scale.

The use of plants as biomonitors of soil quality has important advantages, particularly on a large scale.

Keywords: Plant biomonitoring; Plant–metal interactions; Risk-based assessment; Soil quality

Alain Dumestre^{a,1}, Matteo Spagnuolo^b, Rebecca Bladon^c, Jacques Berthelin^d and Philippe Baveye^a. (^aLaboratory of Geoenvironmental Science and Engineering, Bradfield Hall, Cornell University, Ithaca, NY 14853, United States, ^bDipartimento di Biologia e Chimica Agro-forestale ed Ambientale, Università degli Studi di Bari, via Amendola 165/a, 70126 Bari, Italy, ^c158 Kottlinger Drive, Pleasanton, CA, United States, ^dCNRS-LIMOS Laboratoire des Interactions Microorganismes-Minéraux-Matières Organiques, UMR 7137 du CNRS, Université Henri Poincaré, B.P. 239, F-54506 Vandoeuvre les Nancy, France. Corresponding author. Tel.: +1 607 255 1741; fax: +1 607 255 8615, ¹ Present address: Serpol, Parc d'activités 2, chemin du Génie – B.P. 80 – 69633 Vénissieux Cedex, France). EPR monitoring of the bioavailability of an organic xenobiotic (4-hydroxy-TEMPO) in model clay suspensions and pastes. *Environmental Pollution*, Article in Press

Electron paramagnetic resonance spectroscopy is used to monitor the bioavailability of a nitroxide spin probe, 4-hydroxy-Tempo or Tempol, in Ca-hectorite suspensions and pastes, to bacteria capable of degrading this probe co-metabolically. In nutrient solutions with an initial probe concentration of 1.2 mM and in the absence of hectorite, bacteria are able to denature Tempol and eliminate its paramagnetic signal within 48 h. In the presence of hectorite and after flocculation, the effect of bacteria is significantly delayed, but almost complete denaturation still occurs, after roughly 120 h. When hectorite is added but the bacterial/clay suspension is not centrifuged, Tempol denaturation levels off after about 24 h and reaches a plateau with approximately 45% of Tempol remaining. This plateau does not constitute evidence of limited bioavailability, as is widely assumed, since subsequent addition of nutrients causes the denaturation reaction to proceed to a second plateau, with merely 10% of Tempol remaining.

Spectroscopic data demonstrate that the bioavailability of an organic compound in clay suspensions and pastes strongly depends on conditions that affect bacterial metabolism.

Keywords: Xenobiotics; Bioaccessibility; Bacterial growth; Cometabolism

Khaled F. Nakhlé^a, Daniel Cossa^b, Ghaby Khalaf^a and Benoit Beliaeff^b. (^aNational Centre for Marine Sciences, National Council for Scientific Research, P.O. Box 534, Batroun, Lebanon, ^bInstitut français de recherche pour l'exploitation durable de la mer (Ifremer), BP 21105, F-44311 Nantes Cedex 03, France). *Brachidontes variabilis* and *Patella* sp. as quantitative biological indicators for cadmium, lead and mercury in the Lebanese coastal waters. *Environmental Pollution*, Article in Press

The mussel, *Brachidontes variabilis*, and the limpet, *Patella* sp., were used as indicators to monitor cadmium, lead and mercury concentrations along the Lebanese coast. Studies were carried out in order to define the best strategy for assessing and minimizing the effects of size and physiological condition on the metal contents of the molluscs, and corrective models were constructed. Metal concentrations in surface water were measured to estimate bioconcentration factors (BCFs). The BCFs varied from 8.3×10^3 to 3.4×10^4 , from 7.5×10^3 to 8.0×10^3 and from 3.0×10^4 to 3.2×10^4 , for Cd, Pb and Hg, respectively. For limpets, BCFs varied from 1.7×10^4 to 7.4×10^4 for Cd, from 2.5×10^3 to 6×10^3 for Pb and remained fairly constant at around 10^4 for Hg. The highest BCFs were associated with lowest contamination levels. The results of the geographical survey exhibited a similar large-scale spatial pattern for the two species and followed the metal concentration distributions measured in the waters.

Two molluscs were effective bioindicators for metal pollution in waters along the Lebanese coast.

Keywords: Trace metal; Bioindicator; *Brachidontes variabilis*; *Patella* sp.; Bioconcentration factors; Mediterranean Sea; Lebanon

Wen Jianping^{*}, Chen Yu, Jia Xiaoqiang, Mao Guozhu. (Department of Biochemical Engineering, School of Chemical Engineering and Technology, Tianjin University, Tianjin 300072, People's Republic of China. ^{*}Correspondence to Wen Jianping, Department of Biochemical Engineering, School of Chemical Engineering and Technology, Tianjin University, Tianjin 300072, People's Republic of China. email: Wen Jianping (jpwen@tju.edu.cn)). Removal of toluene from air streams using a gas-liquid-solid three-phase airlift loop bioreactor containing immobilized cells. *Journal of Chemical Technology & Biotechnology*, Volume 81(1)(2005):17-22

Toluene, a kind of volatile organic compound (VOC), is widely used as a solvent (paints and coatings, gums, resins, rubber) as well as a reagent (medicines, dyes, perfumes) and is one of the components of gasoline. Over the more recent decades, many studies have led to the development of biological methods to treat toluene. This paper presents the results of a study on the treatment of airborne toluene using a laboratory-scale gas-liquid-solid three-phase airlift loop bioreactor containing immobilized cells. Based on the optimum operating conditions such as the temperature of 28-30 °C, pH of 7.0-7.2, and an empty bed residence time (EBRT) of 39.6 s, a continuous bioprocess showed that this immobilized airlift loop bioreactor had a steady-state performance within 15 days, the outlet concentrations of toluene were lower than the national emission standard in China (GB 16297-1996), and the chemical oxygen demand and $\text{NH}_4^+\text{-N}$ of the effluent also satisfied the primary discharge standard in China (GB 8978-1996). In addition, this immobilized airlift loop bioreactor had a good ability to tolerate shock loads, while the maximum elimination capacity of toluene was $168 \text{ g m}^{-3} \text{ h}^{-1}$ which was higher than those not only in biofilters and biotrickling filters but also in the airlift bioreactor with free microorganisms. Copyright © 2005 Society of Chemical Industry

Keywords: gas-liquid-solid three-phase flow • airlift loop bioreactor • toluene • volatile organic compounds (VOCs)

Musisi Nkambwe¹ and Mogodisheng B. M. Sekhwela². (¹Department of Environmental Science, University of Botswana, Private Bag 0022, Gaborone, Botswana, ² Harry Oppenheimer Okavango Research Center, University of Botswana, Private Bag 285, Maun, Botswana. Musisi Nkambwe, Email: musisin@mopipi.ub.bw). Utilization Characteristics and Importance of Woody Biomass Resources on the Rural-Urban Fringe in Botswana. *Environmental Management*, Volume 37(2)(2006): 281 - 296

This article examines the utilization characteristics and importance of woody biomass resources in the rural-urban fringe zones of Botswana. In the literature for Africa, attention has been given to the availability and utilization of biomass in either urban or rural environments, but the rural-urban fringe has been neglected. Within southern Africa, this neglect is not justified; the rural-urban fringe, not getting the

full benefits available in urban environments in Botswana, has developed problems in woody biomass availability and utilization that require close attention. In this article, socioeconomic data on the importance of woody biomass in the Batlokwa Tribal Territory, on the rural-urban fringe of Gaborone, Botswana, were collected together with ecologic data that reveal the utilization characteristics and potential for regrowth of woody biomass. The analysis of these results show that local woody biomass is very important in the daily lives of communities in the rural-urban fringe zones and that there is a high level of harvesting. However, there is no effort in planning land use in the tribal territory to either conserve this resource or provide alternatives to its utilization. The future of woody biomass resources in Botswana's rural-urban fringe is uncertain. The investigators recommend that a comprehensive policy for the development of the rural-urban fringe consider the importance of this resource. The neglect of this resource will have far-reaching implications on the livelihoods of residents as well as the environment in this zone.

Keywords Botswana - Land use competition - Plant density - Rural urban fringe - Woody biomass

M. Asgher^{1,2}, M.J. Asad¹ and R.L. Legge². (¹Department of Chemistry, University of Agriculture, Faisalabad, Pakistan, ²Department of Chemical Engineering, University of Waterloo, Ontario, Canada. M. Asgher, Email: mabajwapk@yahoo.com, Fax: +92-41-9200764). Enhanced lignin peroxidase synthesis by *Phanerochaete Chrysosporium* in solid state bioprocessing of a lignocellulosic substrate. World Journal of Microbiology and Biotechnology, Online First

A solid state fermentation (SSF) process for the production of lignin peroxidase was optimized to enhance enzyme production by *Phanerochaete chrysosporium*. Optimization of the corncob SSF medium caused a significant reduction in fermentation time to give maximum lignin peroxidase yield. Supplementation of the SSF medium by low concentrations of peptone, yeast extract and Tween-80 enhanced lignin peroxidase production. Maximum yield of lignin peroxidase was 13.7 U/gds (units per gram dry substrate) noted after 5 days of SSF with 70% moisture and 20% (v/w) inoculum.

Keywords Enhanced production, *Phanerochaete chrysosporium*, Lignin peroxidase, Optimization, Solid state fermentation

G. La Rosa^a, E. De Carolis^a, M. Sali^a, M. Papacchini^b, C. Riccardi^b, A. Mansi^c, E. Paba^c, C. Alquati^d, G. Bestetti^d and M. Muscillo^a. (^aEnvironmental and Primary Prevention Department, Istituto Superiore di Sanità, Viale Regina Elena 299, 00161 Rome, Italy, ^bDepartment for Productions Premises and Interaction with the Environment, I.S.P.E.S.L.-National Institute for Occupational Safety and Prevention, Italy, ^cDepartment of Hygiene, I.S.P.E.S.L.-National Institute for Occupational Safety and Prevention, Italy, ^dDepartment of Environmental Sciences, University of Milano-Bicocca, Italy). Genetic diversity of bacterial strains isolated from soils, contaminated with polycyclic aromatic hydrocarbons, by 16S rRNA gene sequencing and amplified fragment length polymorphism fingerprinting. Microbiological Research, Volume 161(2) (2006): 150-157

In order to study microbial diversity in a polycyclic aromatic hydrocarbon-impacted soil, 14 bacterial strains were analyzed by 16S rRNA gene sequencing and amplified fragment length polymorphism (AFLP) analysis.

Bacterial strains isolated from two different hydrocarbon-polluted sites were identified to the species level by 16S rRNA full-gene sequencing using MicroSeq 16S rRNA gene sequencing. Their genome was subsequently analyzed by high-resolution genotyping with AFLP analysis, in order to monitor species variability and to differentiate closely related strains. Cluster analysis based on AFLP fingerprinting showed intra-specific polymorphism, even among strains with 100% 16S rRNA gene sequence identity.

The results show that AFLP is a powerful, highly reproducible and discriminatory tool for revealing genetic relationships in bacterial populations. The ability to differentiate and track related closely

microbes is fundamental for studying structure and dynamics of microbial communities in contaminated ecosystems.

Keywords: PAH degrading bacteria; AFLP; PCR; 16S rRNA; Bacterial diversity

Xiaoping Li^a, Liqun Zhang^b and Zheng Zhang^c. (^aShanghai Academy of Environmental Sciences, 508 Qinzhou Road, Shanghai 200233, China, ^bState Key Laboratory of Estuarine and Coastal Research, East China Normal University, Shanghai 200062, China, ^cPudong Water Authority, Shanghai 200135, China). **Soil bioengineering and the ecological restoration of riverbanks at the Airport Town, Shanghai, China. Ecological Engineering, Volume 26 (3) (2006): 304-314**

Ecological, soil bioengineering, and traditional techniques were integrated to obtain a structurally sound, ecologically sustainable and socio-economically beneficial method for restoring the riverbanks at the Airport Town, Shanghai, which was the first project applying soil bioengineering to riverbank restoration in China. Soil bioengineering is the use of living plant materials to construct structures that perform some engineering and ecological functions and can provide an effective means for slope stabilization and site restoration of riverbanks. The restoration and management strategy was based on a plan to integrate the natural landscape using live staking, live fascines, brush layer, vegetated geo-grids and geo-gabions, along with native vegetation for riverbank preservation. Ecological parameters including root characteristics and their biomass, species and habitat diversity, and soil moisture and shear stress were measured for site characterization and evaluation of a demonstration project. The riverbank erosion was reduced significantly, along with an increase in species and habitat diversity, and improvement in aesthetics and water quality after a ten-month project implementation period, when compared to the control site. Our project of ecological restoration of riverbanks can be viewed through the perspective of the 19 principles presented by Mitsch and Jorgensen, which shows also how the principles and methods of soil bioengineering, and the concepts of ecological engineering that have recently been much developed in the West have been absorbed into Chinese practices of ecological engineering and can be applied to ecological restoration of riverbanks in China.

Keywords: Soil bioengineering; Ecological restoration; Riverbanks; Demonstration project; Pudong Airport Town

A. Rasheed Khan, Hajira Tahir, Fahim Uddin; Uzma Hameed. Adsorption of Methylene Blue from aqueous Solution on the Surface of Wool Fiber and Cotton Fiber. Journal of Applied Sciences and Environmental Management, Vol. 9(2) (2005): 29-35

Adsorption of dye methylene blue from aqueous solution on the surface of sheep wool and cotton fibers was accomplished under the optimized conditions of temperature, concentration, pH, stay time duration and quantity of adsorbent. Spectrometric technique was used for the measurements of concentration of dye before and after adsorption. The percentage removal and distribution constant (K_D) values for the removal of methylene blue were also calculated. The values of % adsorption data for methylene blue - sheep wool system show better adsorption capacity as compared to methylene blue - cotton fiber system. The applicability of Langmuir and Freundlich adsorption isotherm equations for the present system was also tested. The experimental data are fitted to the Langmuir and Freundlich isotherm equations. The values of their corresponding constants were determined from the slope and intercepts of their respective plots. Thermodynamic parameters like ΔDG° , ΔDH° and ΔDS° were calculated on the basis of Langmuir constant K. The methylene blue - sheep wool system show non spontaneous and exothermic behavior, while methylene blue - cotton fiber system show spontaneous and endothermic behavior. The results of these investigations suggested that natural adsorbents can be utilized as adsorbent materials, because of their selectivities for the removal of dyes.

R.J. Crookes. (Queen Mary, University of London, London, UK. Corresponding author: Tel.: +44 020 7882 5270; fax: +44 020 8983 1007). Comparative bio-fuel performance in internal combustion engines. Biomass and Bioenergy, Volume 30(5) (2006): 461-468

An experimental programme examining performance and emissions from spark- and compression-ignition engines, running on a variety of bio-fuels, including simulated bio-gas and commercial seed oil is presented. Both engines were single-cylinder laboratory-type engines of comparable power output having variable speed and load capability, the spark-ignition engine additionally having variable compression ratio. For bio-gas, containing carbon dioxide, emissions of oxides of nitrogen were reduced relative to natural gas, while unburnt hydrocarbons were increased. Brake power and specific fuel consumption changed little and carbon monoxide was predominantly affected by air:fuel ratio. Equivalent effects were demonstrated with nitrogen replacing carbon dioxide in the simulated bio-gas and similar trends were evident as compression ratio was increased. Seed-oil bio-fuel gave similar performance to diesel fuel without major disadvantages, other than an increased specific fuel consumption. Tests with cetane and rape-seed methyl ester bio-diesel are also presented for comparison. Specific fuel consumption was about the same and specific NO_x emissions were lower with bio-fuel than results from the spark-ignition engine tests running on biogas.

Keywords: Bio-fuels; Biogas; Gasoline engine; Diesel engine; Performance; Emissions

Yao-Ting Fan^a, Gao-Sheng Zhang^a, Xin-Yong Guo^b, Yan Xing^a and Mao-Hong Fan^c. (^aDepartment of Chemistry, Zhengzhou University, Zhengzhou, Henan 450052, PR China, ^bLaboratory of Special Functional Materials, Henan University, Kaifeng, Henan 475001, PR China, ^cCenter for Sustainable Environmental Technologies, Iowa State University, Ames, Iowa 50011, USA. Corresponding author. Tel./fax: +86 (0) 371 67766017). Biohydrogen-production from beer lees biomass by cow dung compost. Biomass and Bioenergy, Volume 30 (5) (2006): 493-496

Efficient conversion of beer lees wastes into biohydrogen gas by microorganisms was reported for the first time. Batch tests were carried out to analyze influences of several environmental factors on yield of H₂ from beer lees wastes. The maximum yield of H₂ 68.6 ml H₂/g TVS was observed, the value is about 10-fold as compared with that of raw beer lees wastes. The hydrogen content in the biogas was more than 45% and there was no significant methane observed in this study. In addition, biodegradation characteristics of the substrate were also discussed. The results indicated that the HCl pretreatment of the substrate plays a key role in the conversion of the beer lees wastes into biohydrogen by the cow dung composts.

Keywords: Biohydrogen gas; Beer lees wastes; Pretreatment; Natural anaerobic microorganisms

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Wastewater samples from 12 slaughterhouses located in different regions in France were tested for the presence of *stx*-positive and *eae*-positive *Escherichia coli* isolates, and characteristics of the isolates obtained were determined. A total of 224 wastewater samples were collected in wastewater treatment

plants at different stages of wastewater processing. Altogether, 5,001 *E. coli* isolates were obtained by colony counting and screened for the presence of *stx* and *eae* genes by multiplex PCR. *stx*-positive and *eae*-positive *E. coli* isolates were detected in 25% of the samples collected; they were found in 13% and 3% of the samples obtained from treated effluent and sludge, respectively, suggesting that they could be spread into the environment. Screening of the samples collected by immunomagnetic separation allowed us to isolate 31 additional *E. coli* serogroup O157 isolates. Four of these isolates harbored *stx* and *eae* genes. All *stx*-positive and *eae*-positive *E. coli* isolates were analyzed for *eae* and *stx* genetic variants, as well as for additional virulence factors and serotypes. Our results suggest that the majority of the *stx*- and *eae*-positive *E. coli* isolates from wastewater have low virulence for humans. However, the diversity of the enterohemorrhagic *E. coli*-associated virulence factors in the strains indicates that the environment may play an important role in the emergence of new pathogenic enterohemorrhagic *E. coli* strains.

Bong Hyun Sung,^{1,†} Choong Hoon Lee,^{1,†} Byung Jo Yu,¹ Jun Hyoung Lee,¹ Ju Young Lee,¹ Mi Sun Kim,² Frederick R. Blattner,³ and Sun Chang Kim^{1*} (Department of Biological Sciences, Korea Advanced Institute of Science and Technology, Daejeon 305-701, Korea,¹ Biomass Team, Korea Institute of Energy Research, Daejeon 305-343, Korea,² Department of Genetics, University of Wisconsin, Madison, Wisconsin 53706³, * Corresponding author. Mailing address: Department of Biological Sciences, Korea Advanced Institute of Science and Technology, 373-1 Guseong-dong Yuseong-gu, Daejeon, 305-701, Korea. Phone: 82-42-869-2619. Fax: 82-42-869-2610. E-mail: sunkim@kaist.ac.kr, [†]B. H. Sung and C. H. Lee contributed equally to this work). **Development of a Biofilm Production-Deficient *Escherichia coli* Strain as a Host for Biotechnological Applications. Applied and Environmental Microbiology, Vol. 72 (5) (2006) : 3336-3342**

Bacteria form biofilms by adhering to biotic or abiotic surfaces. This phenomenon causes several problems, including a reduction in the transport of mass and heat, an increase in resistance to antibiotics, and a shortening of the lifetimes of modules in bioindustrial fermentors. To overcome these difficulties, we created a biofilm production-deficient *Escherichia coli* strain, BD123, by deleting genes involved in curli biosynthesis and assembly, $\Delta(csgG-csgC)$; colanic acid biosynthesis and assembly, $\Delta(wcaL-wza)$; and type I pilus biosynthesis, $\Delta(fimB-fimH)$. *E. coli* BD123 remained mostly in the form of planktonic cells under the conditions tested and became more sensitive to the antibiotics streptomycin and rifampin than the wild-type *E. coli* MG1655: the growth of BD123 was inhibited by one-fourth of the concentrations needed to inhibit MG1655. In addition, the transformation efficiency of BD123 was about 20 times higher than that of MG1655, and the production and secretion of recombinant proteins were \approx 16% and \approx 25% greater, respectively, with BD123 than with MG1655. These results indicate that the newly created biofilm production-deficient strain of *E. coli* displays several key properties that substantially enhance its utility in the biotechnology arena.

Hideo Kawaguchi, Alain A. Vertès, Shohei Okino, Masayuki Inui, and Hideaki Yukawa * (Research Institute of Innovative Technology for the Earth, 9-2 Kizugawadai, Kizu-cho, Soraku-gun, Kyoto 619-0292, Japan, * Corresponding author. Mailing address: Research Institute of Innovative Technology for the Earth, 9-2 Kizugawadai, Kizu-cho, Soraku-gun, Kyoto 619-0292, Japan. Phone: 81-774-75-2308. Fax: 81-774-75-2321. E-mail: mmg-lab@rite.or.jp). **Engineering of a Xylose Metabolic Pathway in *Corynebacterium glutamicum*. Applied and Environmental Microbiology, Vol. 72 (5) (2006): 3418-3428**

The aerobic microorganism *Corynebacterium glutamicum* was metabolically engineered to broaden its substrate utilization range to include the pentose sugar xylose, which is commonly found in agricultural residues and other lignocellulosic biomass. We demonstrated the functionality of the corynebacterial *xylB* gene encoding xylulokinase and constructed two recombinant *C. glutamicum* strains capable of utilizing xylose by cloning the *Escherichia coli* gene *xylA* encoding xylose isomerase, either alone (strain CRX1) or in combination with the *E. coli* gene *xylB* (strain CRX2). These genes were provided on a high-copy-number plasmid and were under the control of the constitutive promoter *trc* derived from plasmid pTrc99A. Both recombinant strains were able to grow in mineral medium containing xylose as the sole

carbon source, but strain CRX2 grew faster on xylose than strain CRX1. We previously reported the use of oxygen deprivation conditions to arrest cell replication in *C. glutamicum* and divert carbon source utilization towards product production rather than towards vegetative functions (M. Inui, S. Murakami, S. Okino, H. Kawaguchi, A. A. Vertès, and H. Yukawa, J. Mol. Microbiol. Biotechnol. 7:182-196, 2004). Under these conditions, strain CRX2 efficiently consumed xylose and produced predominantly lactic and succinic acids without growth. Moreover, in mineral medium containing a sugar mixture of 5% glucose and 2.5% xylose, oxygen-deprived strain CRX2 cells simultaneously consumed both sugars, demonstrating the absence of diauxic phenomena relative to the new *xylA-xylB* construct, albeit glucose-mediated regulation still exerted a measurable influence on xylose consumption kinetics.

Hatsumi Shiratori,¹ Hironori Ikeno,¹ Shohei Ayame,² Naoaki Kataoka,² Akiko Miya,² Kuniaki Hosono,¹ Teruhiko Beppu,¹ and Kenji Ueda^{1*}. (Life Science Research Center, College of Bioresource Sciences, Nihon University, 1866 Kameino, Fujisawa 252-8510, Japan,¹ Ebara Research Co., Ltd., 4-2-1 Honfujisawa, Fujisawa 251-8502, Japan², * Corresponding author. Mailing address: Life Science Research Center, College of Bioresource Sciences, Nihon University, 1866 Kameino, Fujisawa 252-8510, Japan. Phone: 81-466-84-3937. Fax: 81-466-84-3935. E-mail: ueda@brs.nihon-u.ac.jp). Isolation and Characterization of a New *Clostridium* sp. That Performs Effective Cellulosic Waste Digestion in a Thermophilic Methanogenic Bioreactor. Applied and Environmental Microbiology, Vol. 72 (5) (2006) : 3702-3709

A methanogenic bioreactor that utilized wastepaper was developed and operated at 55°C. Microbial community structure analysis showed the presence of a group of clostridia that specifically occurred during the period of high fermentation efficiency. To isolate the effective cellulose digester, the sludge that exhibited high fermentation efficiency was inoculated into a synthetic medium that contained cellulose powder as the sole carbon source and was successively cultivated. A comprehensive 16S rRNA gene sequencing study revealed that the enriched culture contained various clostridia that had diverse phylogenetic positions. The microorganisms were further enriched by successive cultivation with filter paper as the substrate, as well as the bait carrier. A resultant isolate, strain EBR45 (= *Clostridium* sp. strain NBRC101661), was a new member of the order *Clostridiales* phylogenetically and physiologically related to *Clostridium thermocellum* and *Clostridium straminisolvens*. Specific PCR-based monitoring demonstrated that strain EBR45 specifically occurred during the high fermentation efficiency period in the original methanogenic sludge. Strain EBR45 effectively digested office paper in its pure cultivation system with a synthetic medium.

Jianping Wen^{1*}, Xianling Liu^{1,2}, Qing Yuan¹, Xueming Zhao¹. (¹Department of Biochemical Engineering, School of Chemical Engineering and Technology, Tianjin University, Tianjin 300072, People's Republic of China, ²Luoyang Petrochemical Engineering Corporation, SINOPEC, Luoyang City, Henan Province, People's Republic of China, email: Jianping Wen (jpwen@tju.edu.cn. Correspondence to Jianping Wen, Department of Biochemical Engineering, School of Chemical Engineering and Technology, Tianjin University, Tianjin 300072, People's Republic of China). A pilot study for nitrifying treatment of wastewater from fertilizer production using a gas-liquid-solid three-phase flow airlift loop bioreactor. Journal of Chemical Technology & Biotechnology, Volume 81 (5) (2006): 817 - 822

An 80 m³ pilot-scale gas-liquid-solid three-phase flow airlift loop bioreactor (ALR) with a low ratio of height to diameter, in which a biological membrane replaced the activated sludge, was used in the nitrifying treatment of a real effluent from a fertilizer plant. The influences of pH value, air influx (Q_g) and hydraulic residence time (HRT) on the reductions in chemical oxygen demand (COD) and ammonia nitrogen (NH₄-N) were investigated and are discussed herein. The optimum operating conditions were obtained at a pH value of 7.0-8.0, air influx of 500 m³ h⁻¹ and an HRT of 10 h. Under these optimum conditions, the effluent COD and NH₄-N were less than 50 mg L⁻¹ and 10 mg L⁻¹ for a 40-day run, which were far below the primary discharge standard for the chemical fertilizer industry in the People's Republic of China (COD ≤100 mg L⁻¹ and NH₄-N ≤40 mg L⁻¹). Furthermore, this pilot-scale airlift loop

bioreactor generated only one-quarter of the sludge waste compared with the traditional activated sludge process. Copyright © 2006 Society of Chemical Industry

Keywords gas-liquid-solid three-phase flow • airlift loop bioreactor • pilot-scale • wastewater treatment • height to diameter ratio

Robert H. Devlin^a, L. Fredrik Sundström^a and William M. Muir^b. (^aFisheries and Oceans Canada, 4160 Marine Drive, West Vancouver, British Columbia, V7V 1N6, Canada, ^bDepartment of Animal Science, Purdue University, West Lafayette, Indiana, 47906-1151, USA). **Interface of biotechnology and ecology for environmental risk assessments of transgenic fish. Trends in Biotechnology, Volume 24 (2) (2006): 89-97**

Genetically engineered fish with enhanced phenotypic traits have yet to be implemented into commercial applications. This is partly because of the difficulties in reliably predicting the ecological risk of transgenic fish should they escape into the wild. The ecological consequences of the phenotypic differences between transgenic and wild-type fish, as determined in the laboratory, can be uncertain because of genotype-by-environment effects (GXE). Additionally, we are limited in our ability to extrapolate simple phenotypes to the complex ecological interactions that occur in nature. Genetic background can also shape the phenotypic effects of transgenes, which, over time and among different wild populations, can make risk assessments a continuously evolving target. These uncertainties suggest that assessments of transgenic fish in contained facilities need to be conducted under as wide a range of conditions as possible, and that efficacious physical and biological containment strategies remain as crucial approaches to ensure the safe application of transgenic fish technology.

Pollen Biotechnology

Erika L. Barthelmess¹, Christopher M. Richards² and David E. McCauley. (Department of Biology, Vanderbilt University, Nashville, Tennessee 37235, USA; ¹Current address: Biology Department, St Lawrence University, Canton, NY 13617, USA; ²Current address: United States Department of Agriculture, National Center for Genetic Resources Preservation, Colorado State University, 1111 South Mason Street, Fort Collins, CO 80521, USA. Author for correspondence: Erika L. Barthelmess Tel: +1 315 229 5712 Fax: +1 315 229 7429 Email: barthelmess@stlawu.edu). **Relative effects of nocturnal vs diurnal pollinators and distance on gene flow in small *Silene alba* populations. New Phytologist 169 (4) (2006): 689-698.**

Silene alba exists in natural metapopulations throughout its range and is visited by a suite of both diurnal and nocturnal pollinators. Pollen-mediated gene flow may help reduce genetic isolation of subpopulations. Here, we compared the relative effects of nocturnal vs diurnal pollinators on pollen-mediated gene flow in subpopulations separated by two distance treatments.

We established populations consisting of genetically marked individuals in an old field in Tennessee (USA). Electrophoretic examination of seedlings produced by plants exposed to nocturnal, diurnal and control pollinator treatments and separated by either 20 or 80 m allowed us to directly measure pollen-mediated gene flow.

Gene flow was more common between populations separated by only 20 m. Nocturnal pollinators were responsible for most gene flow between populations, regardless of distance. Diurnal pollinators played only a small role in pollen-mediated gene flow.

The results suggest that nocturnal pollinators are better than diurnal pollinators at moving pollen between small *S. alba* subpopulations. However, their effectiveness declines as the distance between

subpopulations increases, making them relatively ineffective at moving genes between isolated subpopulations.

Arjen Biere and Sonja C. Honders. (Department of Plant Population Biology, Netherlands Institute of Ecology (NIOO-KNAW), Centre for Terrestrial Ecology, PO Box 40, 6666 ZG Heteren, the Netherlands. Author for correspondence: *Arjen Biere* Tel: +31 26 4791212 Fax: +31 26 4723227 Email: *a.biere@nioo.knaw.nl*). **Coping with third parties in a nursery pollination mutualism: *Hadena bicruris* avoids oviposition on pathogen-infected, less rewarding *Silene latifolia*.** *New Phytologist* 169 (4) (2006): 719-727.

In nursery pollination systems, pollinator offspring usually feed on pollinated fruits or seeds. Costs and benefits of the interaction for plant and pollinator, and hence its local outcome (antagonism–mutualism), can be affected by the presence of 'third-party' species. Infection of *Silene latifolia* plants by the fungus *Microbotryum violaceum* halts the development of fruits that provide shelter and food for larvae of the pollinating moth *Hadena bicruris*. We investigated whether the moth secures its benefit by selective oviposition on uninfected flowers.

Oviposition was recorded in eight natural populations as a function of plant infection status, local neighbourhood, plant and flower characteristics.

Oviposition was six times lower on flowers from infected than on those from uninfected plants. Oviposition decreased with decreasing flower and ovary size. Moths could use the latter to discriminate against diseased flowers.

Although moths show an adaptive oviposition response, they reduce the future potential of healthy hosts because they still visit infected plants for nectar, vectoring the disease, and they reduce any fitness advantage gained by disease-resistant plants through selective predation of those plants.

Biotechnology Policy Issue

Robert J. Brulle¹ and David N. Pellow². (¹Department of Culture and Communication, School of Public Health, Drexel University, Philadelphia, Pennsylvania 19104; email: *brullerj@drexel.edu*, ²Department of Ethnic Studies, California Cultures in Comparative Perspective, University of California, San Diego, La Jolla, California 92093-0522; email: *dpellow@ucsd.edu*). **ENVIRONMENTAL JUSTICE: Human Health and Environmental Inequalities.** *Annual Review of Public Health*, Vol. 27 (2006): 103-124

In this review, we provide an introduction to the topics of environmental justice and environmental inequality. We provide an overview of the dimensions of unequal exposures to environmental pollution (environmental inequality), followed by a discussion of the theoretical literature that seeks to explain the origins of this phenomenon. We also consider the impact of the environmental justice movement in the United States and the role that federal and state governments have developed to address environmental inequalities. We conclude that more research is needed that links environmental inequalities with public health outcomes.

Hoare M, Levy MS, Bracewell DG, Doig SD, Kong S, Titchener-Hooker N, Ward JM, Dunnill P. (The Advanced Centre for Biochemical Engineering, Department of Biochemical Engineering, University College London, Torrington Place, UK.). **Bioprocess engineering issues that would be faced in producing a DNA vaccine at up to 100 m³ fermentation scale for an influenza pandemic.** *Biotechnol Prog.*, 21(6) (2005):1577-92.

The risk of a pandemic with a virulent form of influenza is acknowledged by the World Health Organization (WHO) and other agencies. Current vaccine production facilities would be unable to meet the global requirement for vaccine. As a possible supplement a DNA vaccine may be appropriate, and bioprocess engineering factors bearing on the use of existing biopharmaceutical and antibiotics plants to produce it are described. This approach addresses the uncertainty of timing of a pandemic that precludes purpose-built facilities. The strengths and weaknesses of alternative downstream processing routes are analyzed, and several gaps in public domain information are addressed. The conclusion is that such processing would be challenging but feasible.

Rahardjo YS, Tramper J, Rinzema A. (Wageningen Centre for Food Sciences, P.O. Box 557, 6700 AN Wageningen, The Netherlands. Yovita.Rahardjo@wur.nl). Modeling conversion and transport phenomena in solid-state fermentation: a review and perspectives. Biotechnol Adv., 24(2) (2006): 161-79.

Solid-state fermentation (SSF) is accompanied inevitably by development of concentration and temperature gradients within the substrate particles and microbial biofilms. These gradients are needed for driving the transport of substrates and products. In addition, concentration gradients have been suggested to be crucial for obtaining the characteristics that define the products of SSF; nevertheless, gradients are also known to result in reduced productivity and unwanted side reactions. Solid-state fermentations are generally batch processes and this further complicates their understanding as conditions change with time. Mathematical models are therefore needed for improving the understanding of SSF processes and allowing their manipulation to achieve the desired outcomes. Existing models of SSF processes describe coupled substrate conversion and diffusion and the consequent microbial growth. Existing models disregard many of the significant phenomena that are known to influence SSF. As a result, available models cannot explain the generation of the numerous products that form during any SSF process and the outcome of the process in terms of the characteristics of the final product. This review critically evaluates the proposed models and their experimental validation. In addition, important issues that need to be resolved for improved modeling of SSF are discussed.

Snodin DJ, Ryle PR. (PAREXEL Drug Development Consulting, Uxbridge, Middlesex, UK. david.snodin@parexel.com). Understanding and applying regulatory guidance on the nonclinical development of biotechnology-derived pharmaceuticals. BioDrugs. 2006;20(1):25-52.

Biotechnology-derived pharmaceuticals are a well established and growing part of the therapeutic armamentarium. Beginning with recombinant versions of products such as insulin that were previously manufactured by extraction from animal and human sources, licensed biotechnology drugs and those in development now span an ever-increasing range of product types and therapeutic categories. As a consequence of this diversity, both general and product class-specific scientific guidelines have been developed on a regional (e.g. EU/US) or international (e.g. ICH - International Conference on Harmonization) basis. The current portfolio of nonclinical guidelines, particularly ICH S6, emphasizes flexibility and adaptability to the specific circumstances of the individual biotechnology product and its intended indication, taking into account factors not generally applicable to small-molecule drugs, such as pharmacodynamic responsiveness of safety and efficacy models, species specificity, and antibody formation. Guidelines developed principally with small-molecule drugs in mind may, nevertheless, have some applicability to biotechnology drugs on issues such as safety pharmacology, as well as on regulatory, procedural and dossier submission requirements. Scientific guidelines, such as those providing nonclinical guidance, are just one, albeit important, component of an increasingly complex legal/scientific environment in drug development.

Castiel LD, Guilam MC, Vasconcellos-Silva PR, Sanz-Valero J. (Departamento de Epidemiologia e Metodos Quantitativos em Saude, Escola Nacional de Saude Publica, Fundacao Oswaldo Cruz, Rio de Janeiro (RJ), Brazil. luis.castiel@ensp.fiocruz.br). [Genomic risk and personal responsibility in health]. Rev Panam Salud Publica., 19(3) (2006):189-97.

With the advent of genomic research, a new category of risk has emerged--genetic risk--from which an individual cannot be separated. Among the outcomes of this model is a discussion on personal accountability, according to which an individual may both be exempted from events related to certain states of health ("blame it on the genes") or be blamed for those events ("transmitter of disease"). In addition, the search for genes to explain disease erases the line between what is normal and what is pathological, with a growing tendency towards considering individuals with no or very mild clinical manifestations as being "ill." The great emphasis on genomics may lead to both an exaggerated attention to genetics rather than social and environmental factors and to a reductionism that favors sociobiological explanations for human behavior. In addition, in this scenario, the right to information may paradoxically stimulate some to consume goods and services in order to prevent a hypothetical illness that could occur at some point in time as a result of genetic predisposition--goods and services that may not be available to everyone. It is essential that such issues be considered with the same urgency with which the genomic paradigm is being developed.

Agricultural Biotechnology

I. Walter^a, F. Martínez^a and V. Cala^b. (^aDepartamento de Medioambiente, INIA, Apartado de Correos 8111, 28080 Madrid, Spain, ^bDepartamento de Química Agrícola, Geología y Geoquímica, Facultad de Ciencias Universidad Autónoma de Madrid, 28049 Madrid, Spain. Corresponding author. Tel.: +34 913476738; fax: +34 913572293). Heavy metal speciation and phytotoxic effects of three representative sewage sludges for agricultural uses. *Environmental Pollution*, Volume 139(3)(2006):507-514

The environmental impact of sewage sludges depends on the availability and phytotoxicity of their heavy metal. The influence of representative sludges (dewatered anaerobic, pelletization, and composted sludge) on the availability of heavy metals, and their effects on seed germination were compared. The total heavy metal concentrations were below the maximum permitted for land-applied waste and the differences among them were small. The DTPA-extracted metal concentrations were rather different. The sequential extraction of the compost showed a slight increase in Cd and Cu availability, and a decrease in the availability of Fe, Mn, Ni and Zn. Pelletization increased the availability of Ni and slightly reduced that of Cr. The dewatering sludge led to greater availability of Cr and Mn but reduced the concentration of Cd. The three different sludges also affected seed germination and root elongation in different ways. The most serious adverse effects were caused by the dewatered sludge extract.

Different sewage sludge processing methods affected the distribution of metals and the seed germination test in different ways.

Keywords: Sewage sludge; Metals-DTPA extraction procedure; Metal speciation; Germination test; Root elongation

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Haemophilus influenzae b (Hib), an encapsulated Gram-negative cocco-bacillus, is one of the most common agents of meningitis worldwide. The capsular polysaccharide conjugated to a carrier protein is

the antigen of the vaccine against Hib. An optimized cultivation process that could lead to an increase in the polysaccharide production would be of great interest for mass vaccination programs. The aim of this work was to evaluate different culture conditions in attempt to improve the capsular polysaccharide yield. Hib was cultivated in a bioreactor with modified soy-peptone and yeast-extract (MP) medium and optimal hemin and nicotinamide adenine dinucleotide (NAD) concentration in the culture medium was established at 30 mg L⁻¹ and 15 mg L⁻¹, respectively. The batch experiments were carried out as follows: (a) overlay aeration without pH control; (b) air-sparged with dissolved oxygen tension (DOT) controlled at 10 and 30% air saturation, with and without pH control. The cultures with air-sparged aeration, without pH control, showed values for the specific production (SP_{p/x}) of 180-190 mg PRP g⁻¹ dry cell weight (DCW) and overall polysaccharide productivity of 22-29 mg L⁻¹ h⁻¹, accounting for an increase of ca 47% over the polysaccharide production with overlay aeration. Batch cultivations with air sparged aeration led to an improvement in the poly(ribosylribitol phosphate) (PRP) production for both conditions (DOT at 10 and 30% air saturation) investigated upon pH control, achieving up to 980 PRP mg L⁻¹. The SP_{p/x} and overall polysaccharide productivity were 280-300 mg PRP g⁻¹ DCW and 45-41 mg L⁻¹h⁻¹, respectively. The best production of capsular polysaccharide was obtained in the modified MP-medium, with 30 mg L⁻¹ hemin and 15 mg L⁻¹ NAD, upon sparged aeration and pH control. Copyright © 2005 Society of Chemical Industry

Keywords: *Haemophilus influenzae* b • overlay aeration • air-sparged aeration • batch cultivation • polysaccharide production

Carmen López-Berenguer¹, Cristina García-Viguera² and Micaela Carvajal¹. (¹Departamento de Nutrición Vegetal, CEBAS-CSIC, P.O. Box 164, 30100 Espinardo, Murcia, Spain, ² Departamento de Ciencia y Tecnología de los Alimentos, CEBAS-CSIC, P.O. Box 164, 30100 Espinardo, Murcia, Spain. Micaela Carvajal, Email: mcarvaja@cebas.csic.es, Fax: +34-968-39-62-13). **Are Root Hydraulic Conductivity Responses to Salinity Controlled by Aquaporins in Broccoli Plants? Plant and Soil, Volume 279(1-2)(2006): 13 - 23**

Broccoli (*Brassica oleracea* L. var. *Italica*) is a recognised health-promoting vegetable, which is moderately sensitive to salinity. In this study, the primary response of broccoli plants (cv. Marathon) to salinity has been characterised. For this, leaf water relations, nutrient composition, root hydraulic conductivity (L_0) and the effect of mercury (an aquaporin blocker) on L_0 were determined for plants grown with 0, 20, 40, 60, 80 or 100 mM NaCl for 2 weeks. During the 2 weeks of treatment, the plants showed a two-phase growth response to salinity. During the first phase (1 week), growth reduction was high, probably related to water stress as no osmotic adjustment occurred and reductions of L_0 , the mercury effect and Gs were observed. After 2 weeks, the growth reduction could have resulted from internal injury caused by Na⁺ or Cl⁻, since osmotic adjustment was achieved and water relations plus the mercury effect were re-established to a high degree, indicating high aquaporin functionality. The fact that aquaporin functionality fits well with the overall water relations response is very relevant, since the two-phase adaptation to salinity may imply two types of aquaporin regulation.

Key words: aquaporins - broccoli - leaf water relations - root hydraulic conductivity - salinity – stomatal

Linda A Castle¹, Gusui Wu¹ and David McElroy². (¹Pioneer Hi-Bred International, Inc., 700A Bay Road, Redwood City, CA 94063, USA, ²Pioneer Hi-Bred International, Inc., 7300 NW 62nd Avenue, Johnston, IA 50131, USA). **Agricultural input traits: past, present and future. Current Opinion in Biotechnology, Volume 17, Issue 2, April 2006, Pages 105-112**

For thousands of years farm practices have evolved as new innovations have become available. Farmers want more value per unit of land, clean fields, and high yields with less input. Plants with incorporated pest resistance and herbicide resistance help meet these needs through increased yield, reduced chemical use, and reduced soil impacts. Although researchers have developed useful traits for a wide variety of plant species, only a few traits are available commercially; however, global adoption of these traits

Rachel K. Thiet^{1, 2}, R. E. J. Boerner¹, Moria Nagy^{3, 5} and Richard Jardine⁴. (¹Department of Evolution, Ecology, and Organismal Biology, The Ohio State University, Columbus, OH 43210, USA, ² Department of Environmental Studies, Antioch New England Graduate School, Keene, NH 03431, USA, ³ Department of Biology, John Carroll University, University Heights, OH 44118, USA, ⁴ Department of Mathematics, Keene State College, Keene, NH 03435, USA, ⁵ Applied Nanobioscience Center, State University, Tempe, AZ 85282, USA). **The Effect of Biological Soil Crusts on Throughput of Rainwater and N into Lake Michigan Sand Dune Soils. Plant and Soil, Volume 278 (1-2) (2005) : 235 - 251**

Biological soil crusts composed of cyanobacteria, green algae, bryophytes, and lichens colonize soils in arid and semiarid ecosystems worldwide and are responsible for significant N input to the soils of these ecosystems. Soil crusts also colonize active sand dunes in more humid regions, but studies of structure and function of such sand dune crusts are lacking. We identified the cyanobacterial, algal, and bryophytic constituents and N production and leachates of biological soil crusts that colonize beach dunes at the Indiana Dunes National Lakeshore along southern Lake Michigan in Indiana, USA. To determine the role of these crusts in this system, we conducted a greenhouse experiment in which intact soil cores with biological crusts were subjected to artificial rainfall over a full growing season. The volume and N content of leachate from the cores were quantified in relation to degree of crust development, taxonomic composition, rainfall volume and intensity, light intensity, and the presence of plant litter. Net N throughput significantly exceeded N inputs to cores in rainwater. Net N outputs from crusts to subsurface soil ranged from 0.01 to 0.19 g NH₄⁺-N m⁻² yr⁻¹ and 0.01 to 0.61 g NO₃⁻-N m⁻² yr⁻¹. Thus, total inorganic N inputs associated with biological soil crusts ranged from 0.02 g N m⁻² yr⁻¹ to 0.8 g N m⁻² yr⁻¹. High volume (≥2 cm) rainfall resulted in more N leaching than low volume events, and plant litter added over the surface of crusted soil cores significantly increased the amount of N in leachate. Exploratory path analysis revealed direct and indirect linkages among environmental factors, crust development, and crust composition in regulating the throughput of H₂O and N from these intact soil cores. Biological soil crusts at this site, combined with other properties of the soil surface, substantially increase N inputs to this water- and nutrient-limited sand dune ecosystem.

Keywords biological soil crusts - cyanobacteria - ecosystem N budget - N fixation - rainwater throughput - sand dunes

K. E. Grønli¹, Å. Frostegård², L. R. Bakken³ and M. Ohlson⁴. (¹Dept. of Biology, Centre for Ecological and Evolutionary Synthesis, University of Oslo, P.O. Box 1066, 0316, Blindern, Oslo, Norway, ² Dept. of Chemistry, Norwegian University of Life Sciences, P.O. Box 5003, 1432, Ås, Norway, ³ Dept. of Plant and Environmental Sciences, Norwegian University of Life Sciences, P.O. Box 5003, 1432, Ås, Norway, ⁴ Dept. of Ecology and Natural Resource Management, Norwegian University of Life Sciences, P.O. Box 5003, 1432, Ås, Norway). **Nutrient and Carbon Additions to the Microbial Soil Community and its Impact on Tree Seedlings in a Boreal Spruce Forest. Plant and Soil, Volume 278 (1-2) (2005) : 275 – 291**

We have added glucose and nutrients to manipulate soil microbial activity and nutrient availability in a boreal spruce forest to study the performance of birch and spruce seedlings in relation to the soil microbial community. The proportion of aboveground biomass in the seedlings was largest in plots amended with extra nutrients, while ectomycorrhizal (ECM) colonisation was low in these plots. ECM appeared beneficial for growth of both species, but only at low levels of colonisation (<25% ECM colonised root-tips). The soil microbial biomass, as determined by total PLFA, was largest in plots treated with glucose and there was a significant negative relationship between birch seedling size and levels of total PLFA in soil. This could be taken to suggest that poor seedling growth was due to nutrient limitation caused by microbial assimilation. However, the treatment response of the birch seedlings was generally weak, and spruce often showed no response at all to the addition of nutrients and glucose. The most consistent parameter for the variation in plant performance, as well as for the microbial soil community,

was the block-effect. This suggests a strong spatial structure in the soil microbial community, and that this structure was robust with respect to our treatments even though they continued over a 3-year period.

Keywords *Betula pubescens* - ectomycorrhizae - growth and allocation pattern - nutrient uptake - *Picea abies* - PLFA

Bioenergy

Laureano Canoira, Ramón Alcántara, M^a Jesús García-Martínez and Jesús Carrasco. (Department of Chemical Engineering and Fuels, School of Mines, Polytechnic University of Madrid, Ríos Rosas 21, 28003-Madrid, Spain). Biodiesel from Jojoba oil-wax: Transesterification with methanol and properties as a fuel. Biomass and Bioenergy, Volume 30(1) (2006): 76-81

The Jojoba oil-wax is extracted from the seeds of the Jojoba (*Simmondsia chinensis* Link Schneider), a perennial shrub that grows in semi desert areas in some parts of the world. The main uses of Jojoba oil-wax are in the cosmetics and pharmaceutical industry, but new uses could arise related to the search of new energetic crops.

This paper summarizes a process to convert the Jojoba oil-wax to biodiesel by transesterification with methanol, catalysed with sodium methoxide (1 wt% of the oil). The transesterification reaction has been carried out in an autoclave at 60 °C, with a molar ratio methanol/oil 7.5:1, and vigorous stirring (600 rpm), reaching a quantitative conversion of the oil after 4 h. The separation of the fatty acid methyl esters (the fraction rich in FAME, 79% FAME mixture; 21% fatty alcohols; 51% of methyl *cis*-11-eicosenoate) from the fatty alcohols rich fraction (72% fatty alcohols; 28% FAME mixture; 26% of *cis*-11-eicosen-1-ol, 36% of *cis*-13-docosen-1-ol) has been accomplished in a single crystallization step at low temperature (-18 °C) from low boiling point petroleum ether.

The fraction rich in FAME has a density (at 15 °C), a kinematic viscosity (at 40 °C), a cold filter plugging point and a high calorific value in the range of the European standard for biodiesel (EN 14214).

Keywords: *Simmondsia chinensis* Link Schneider; Cryogenic crystallization; European standard EN 14214

Maite Martínez Aldaya^a, Christine Lors^b, Sandrine Salmon^c and Jean-François Ponge^c. (^aUniversidad de Navarra, Facultad de Ciencias, Departamento de Zoología y Ecología, 31080 Pamplona, Spain, ^bCentre National de Recherche sur les Sites et Sols Pollués, 930 Boulevard Lahure, BP 537, 59505 Douai Cédex, France, ^cMuseum National d'Histoire Naturelle, CNRS UMR 5176, 4 avenue du Petit-Chateau, 91800 Brunoy, France. Corresponding author. Tel.: +33 1 60479213; fax: +33 1 60465009). Avoidance bio-assays may help to test the ecological significance of soil pollution. Environmental Pollution, Volume 140(1) (2006): 173-180

We measured the short-term (100 min) avoidance of a soil heavily polluted by hydrocarbons by the soil springtail *Folsomia candida*, at six rates of dilution in a control, unpolluted soil. We compared the results with those of long-term (40-day) population tests. Five strains were compared, of varying geographical and ecological origin. When pure, the polluted soil was lethal in the long-term and avoided in the short-term by all strains. Avoidance tests, but not population tests, were able to discriminate between strains. Avoidance thresholds differed among strains. Two ecological consequences of the results were discussed: (i) toxic compounds may kill soil animals or deprive them from food, resulting in death of populations, (ii) pollution spots can be locally deprived of fauna because of escape movements of soil animals. Advantages and limitations of the method have been listed, together with proposals for their wider use in soil ecology and ecotoxicology.

Polluted soils are avoided by soil animals, a phenomenon which can be used as a cheap, sensitive tool for the early detection of environmental risk.

Keywords: Avoidance; Ecotoxicological test; *Folsomia candida*; Soil pollution; Toxicity

Adalberto Noyola¹, Juan Manuel Morgan-Sagastume¹ and Jorge E. López-Hernández². (¹Instituto de Ingeniería, UNAM, Circuito Escolar, Ciudad Universitaria, Coyoacán, 04510, México D.F., México, ²IBTech, Av. Aztecas 479, Col. Ajusco, Coyoacán, 04300, México D.F., México. Adalberto Noyola, Email: noyola@pumas.iingen.unam.mx, Phone: +52-55-56233662, Fax: +52-55-56162798). **Treatment of Biogas Produced in Anaerobic Reactors for Domestic Wastewater: Odor Control and Energy/Resource Recovery. Reviews in Environmental Science and Biotechnology, Volume 5(1): 93 – 114**

Anaerobic municipal wastewater treatment in developing countries has important potential applications considering their huge lack of sanitation infrastructure and their advantageous climatic conditions. At present, among the obstacles that this technology encounters, odor control and biogas utilization or disposal should be properly addressed. In fact, in most of small and medium size anaerobic municipal treatment plants, biogas is just vented, transferring pollution from water to the atmosphere, contributing to the greenhouse gas inventory. Anaerobic municipal sewage treatment should not be considered as an energy producer, unless a significant wastewater flow is treated. In these cases, more than half of the methane produced is dissolved and lost in the effluent so yield values will be between 0.08 and 0.18 N m³ CH₄/kg COD removed. Diverse technologies for odor control and biogas cleaning are currently available. High pollutant concentrations may be treated with physical-chemical methods, while biological processes are used mainly for odor control to prevent negative impacts on the treatment facilities or nearby areas. In general terms, biogas treatment is accomplished by physico-chemical methods, scrubbing being extensively used for H₂S and CO₂ removal. However, dilution (venting) has been an extensive disposal method in some small- and medium-size anaerobic plants treating municipal wastewaters. Simple technologies, such as biofilters, should be developed in order to avoid this practice, matching with the simplicity of anaerobic wastewater treatment processes. In any case, design and specification of biogas handling system should consider safety standards. Resource recovery can be added to anaerobic sewage treatment if methane is used as electron donor for denitrification and nitrogen control purposes. This would result in a reduction of operational cost and in an additional advantage for the application of anaerobic sewage treatment. In developing countries, biogas conversion to energy may apply for the clean development mechanism (CDM) of the Kyoto Protocol. This would increase the economic feasibility of the project through the marketing of certified emission reductions (CERs).

Keywords anaerobic sewage treatment - biogas - biogas utilization - denitrification - hydrogen sulfide - Kyoto protocol - methane - odor control

Monique Hoogwijk^{a, b}, André Faaij^a, Bas Eickhout^b, Bert de Vries^b and Wim Turkenburg^a. (^aDepartment of Science, Technology and Society, Copernicus Institute, Utrecht University, Heidelberglaan 23584 CS Utrecht, The Netherlands, ^bNetherlands Environmental Assessment Agency (MNP), Bilthoven, The Netherlands. Corresponding author. Department of Science, Technology and Society, Copernicus Institute, Utrecht University, Heidelberglaan 23584 CS Utrecht, The Netherlands. Tel.: +31 30 2537600, fax: +31 30 2537601. **Potential of biomass energy out to 2100, for four IPCC SRES land-use scenarios. Biomass and Bioenergy, Volume 29(4) (2005): 225-257**

The availability of the resources is an important factor for high shares of biomass to penetrate the electricity, heat or liquid fuel markets. We have analysed the geographical and technical potential of energy crops for the years 2050–2100 for three land-use categories: abandoned agricultural land, low-productivity land and ‘rest land’, i.e. remaining no-productive land. We envisaged development paths using four scenarios resulting from different future land-use patterns that were developed by the

Intergovernmental Panel on Climate Change in its Special Report on Emission Scenarios: A1, A2, B1 and B2. The geographical potential is defined as the product of the available area for energy crops and the corresponding productivity level for energy crops. The geographical potential of abandoned agricultural land is the largest contributor. For the year 2050 the geographical potential of abandoned land ranges from about 130 to 410 EJ yr⁻¹. For the year 2100 it ranges from 240 to 850 EJ yr⁻¹. The potential of low-productive land is negligible compared to the other categories. The rest land area is assumed to be partly available, resulting in ranges of the geographical potential from about 35 to 245 EJ yr⁻¹ for the year 2050 and from about 35 to 265 EJ yr⁻¹ in 2100. At a regional level, significant potentials are found in the Former USSR, East Asia and South America. The geographical potential can be converted to transportation fuels or electricity resulting in ranges of the technical potential for fuels in the year 2050 and 2100 equal to several times the present oil consumption.

Keywords: Potential; Global; Scenarios; Energy crops

Yukihiko Matsumura^a, Tomoaki Minowa^b, Biljana Potic^c, Sascha R.A. Kersten^c, Wolter Prins^c, Willibrordus P.M. van Swaaij^c, Bert van de Beld^d, Douglas C. Elliott^e, Gary G. Neuenschwander^e, Andrea Kruse^f and Michael Jerry Antal Jr.^g. (^aDepartment of Mechanical System Engineering, Hiroshima University, 1-4-1 Kagamiyama, Higashi-hiroshima-shi, Hiroshima 739-8527, Japan, ^bBiomass Technology Research Laboratory, National Institute of Advanced Industrial Science and Technology, 2-2-2 Hiro-Suehiro, Kure-shi, Hiroshima 737-0197, Japan, ^cTCCB Group, Faculty of Chemical Technology, University of Twente, P.O. Box 217, 7500 AE, Enschede, The Netherlands, ^dBiomass Technology Group B.V., Pantheon 12, 7521 PR, Enschede, The Netherlands, ^ePacific Northwest National Laboratory, P.O. Box 999, MSIN K2-12, Richland, Washington 99352, USA, ^fInstitut fuer Technische Chemie, Forschungszentrum Karlsruhe GmbH, Postfach 3640, D-76021 Karlsruhe, Germany, ^gHawaii Natural Energy Institute, School of Ocean and Earth Science and Technology, University of Hawaii at Manoa, Honolulu, Hawaii 96822, USA. Corresponding author. Tel./fax: +81 82 424 7561). **Biomass gasification in near- and super-critical water: Status and prospects. Biomass and Bioenergy, Volume 29(4) (2005): 269-292**

The current status of biomass gasification in near- and supercritical water (SCWG) is reviewed. There are two approaches to biomass gasification in supercritical water. The first: low-temperature catalytic gasification, employs reaction temperature ranging from 350 to 600 °C, and gasifies the feedstock with the aid of metal catalysts. The second: high-temperature supercritical water gasification, employs reaction temperatures ranging from 500 to 750 °C, without catalyst or with non-metallic catalysts. Reviews are made on reaction mechanism, catalyst, and experimental results for these two approaches. Engineering technologies for SCWG gasification, and an example of process analysis are also introduced. Finally, the authors' prognostications on the future prospects of this technology are offered.

Keywords: Reaction mechanism; Catalyst; Reactor

Edgard Gnansounou^{1,*}, and Arnaud Dauriat². (¹Laboratory of Energy Systems (LASSEN), ICARE-ENAC, Swiss Federal Institute of Technology of Lausanne (EPFL), ²ENERS Energy Concept). **Ethanol fuel from biomass: a review. Journal of Scientific & Industrial Research, Vol. 64 (2005): 809-821.**

This paper presents a general review of biomass-to-ethanol, analysis of conversion pathways from technical, economic and environmental points of view, and estimation of production cost in the Indian context. Due to learning curve and other economic reasons. Brazil and the United States are found to be more competitive worldwide and will maintain their comparative advantage in the next decade. However, the fast growth of the world demand of bio-ethanol fuel as well as the perspectives of the oil market may notably influence the international market price of bio-ethanol fuel and give windows for a wide scale production in other regions such as Europe and Asia. As one of the major producers and consumers of sugars and the second populous country, India gives a high priority to food production. However, Indian

production of bio-ethanol can be envisaged successfully and preliminary analyses exhibit a promising avenue. In long term, lignocellulose-to-ethanol is the most viable pathway from environmental point of view. However, its production cost must be reduced for giving this process a chance to drive forward the strategy of biomass-to-ethanol worldwide.

Keywords: Biomass, CO₂ emissions reduction, Ethanol, Motor fuels, Renewable energy.

Padma Vasudevan*, Satyawati Sharma and Ashwani Kumar. (Centre for Rural Development & Technology Indian Institute of Technology, Hauz Khas, New Delhi 110 016). **Liquid fuel from biomass: an overview**. *Journal of Scientific & Industrial Research*, Vol. 64 (2005): 822-831.

With depleting oil resources and negative environmental impact associated with the use of petro fuels, there is a renewed interest in biomass based fuels, which can still form the base for sustainable development in terms, of techno-economics, environmental as well as socio-cultural considerations. As it is a locally available resource, energy equity can also be achieved at global levels and developing countries would stand to gain. However, to exploit the potential of biomass. More work is needed for converting it efficiently into modern energy carriers at competitive prices, supported by relevant policies. Currently. Bioethanol and biodiesel have already reached commercial markets, especially as blends with petro fuels. This paper gives an overview on liquid biofuels covering the current and futuristic trends with respect to production and utilization of alcohols, vegetable oil based biodiesel and biocrude, emphasizing on the benefits to rural economy.

Keywords: Biodiesel, Bioethanol, Biomass, Liquid fuel, Vegetable oil.

Rajeev K Sukumaran, Reeta Rani Singhania and Ashok Pandey*. (Biotechnology Division, Regional Research Laboratory, Industrial Estate PO, Trivandrum 695 019). **Microbial cellulases – Production, applications and challenges**. *Journal of Scientific & Industrial Research*, Vol. 64 (2005): 832-844.

Microbial cellulases find applications in various industries and constitute a major group of the industrial enzymes. Recently, there is resurgence in utilization of biomass for fuel production employing cellulases and hence forth in obtaining better yields and novel activities. Improving the economics of such processes will involve cost reduction in cellulase production which may be achieved by better bioprocesses and genetic improvement of cellulase producers to yield more of the enzyme. The review discusses the current knowledge on cellulase production by microorganisms and the genetic controls exercised on it. It discusses the industrial applications of cellulases and the challenges in cellulase research especially in the direction of improving the process economics of enzyme production.

Keywords: Biofuel, Cellulase, Endoglucanase, β -Glucosidase, *Humicola*, Lignocellulose, *Trichoderma*.

V. Senthikumar and P. Gunasekaran*. (Department of Genetics, Center for Excellence in Genomic Sciences, School of Biological sciences, Madurai Kamaraj University, Madurai 625 021). **Bioethanol production from cellulosic substrates: Engineered bacteria and process integration challenges**. *Journal of Scientific & Industrial Research*, Vol. 64 (2005): 845-853.

Cellulosic biomass from agricultural and forestry residues, waste paper and industrial wastes could be used as an ideal and inexpensive source of sugar for sustainable fermentation into transportation fuel. As such, ethanol-production. However, the substrates are not cost effective, as the organisms are not able to hydrolyze complex sugars such as lignocellulose. Since last two decades, several microorganisms are manipulated for production of ethanol. Gram-negative bacteria such as *Escherichia coli*, *Klebsiella oxytoca*, *Z. mobilis*, Gram-positive bacteria such as *Clostridium cellulolyticum*. *Lactobacillus casei* and several yeast strains have been engineered for bioethanol production from cellulosic substrates. These engineered organisms are able to produce ethanol from a wide spectrum of sugars. This review is focused

on the strategies and development of processes for ethanol production by such organism from lignocellulosic substrates.

Keywords: Bioethanol, Cellulosic biomass, Ethanol producing bacteria, Metabolic engineering.

M.A.Hanna¹, Loren Isom¹ and John Campbell². (¹University of Nebraska, Industrial Agricultural products Center, 209 LW Chase Hall, Lincoln, NE 68538-0730, ² Ag Processing Inc. (AGP), 12700 West Dodge Road, Omaha, NE 68154, USA). **Biodiesel: Current perspectives and future. Journal of Scientific & Industrial Research, Vol. 64 (2005): 854-857.**

Biodiesel, a fuel comprised of mono-alkyl esters of long chain fatty acids derived from vegetable oils or animal fat (or mixtures thereof), is produced by transesterification with glycerol being produced as a co-product. Worldwide, 1 billion ton of diesel fuel are consumed annually. The total feedstocks available for biodiesel production are 115 million tons. This represents less than 12% of diesel fuel use. The opportunities for the future for biodiesel include improvements in the conversion technology which appears promising and expanding the amount of available feedstock through various plans to increase oil yields or oilseed production.

Keywords: Animal fat, Biodiesel, Transesterification, Vegetable oil.

Ayhan Demirbas*. (Department of Chemical Engineering, Selcuk University, Campus, Konya, Turkey). **Biodiesel production from vegetable oils by supercritical methanol. Journal of Scientific & Industrial Research, Vol. 64 (2005): 858-865.**

Transesterification of vegetable oils in supercritical methanol are carried out without using any catalyst. Methyl esters of vegetable oils or biodiesels have several outstanding advantages among other non-renewable and clean engine fuel alternatives and can be used in any diesel engine without modification. The most important variables affecting the methyl ester yield during the transesterification reaction are molar ratio of alcohol to vegetable oil and reaction temperature. Compared to no. 2 Diesel fuel, all vegetable oils are more viscous, while the methyl esters of vegetable oils are slightly more viscous. Biodiesel has become more attractive because of its environmental benefits. The cost of biodiesel, however, is the main obstacle to commercialization. With cooking oils as raw material, viability of a continuous transesterification process and recovery of high quality glycerol as a biodiesel by-product are primary options to be considered to lower the cost of biodiesel. Supercritical methanol has a high potential for both transesterification of triglycerids and methyl esterification of free fatty acids to methyl esters for diesel fuel substitute. In supercritical methanol transesterification method, yield of conversion rises 95% in 10 min. Viscosity of vegetable oils (27.2-53.6 mm²/s) get reduced in vegetable oil methyl esters (3.59-4.63 mm²/s). The flash point values of vegetable oil methyl esters are highly lower than those of vegetable oils. An increase in density from 860 to 885 kg/m³ for vegetable oil methyl esters increases the viscosity from 3.59 to 4.63 mm²/s.

Keywords: Alternative fuel, Biodiesel, Methanol, Transesterification, Vegetable oil.

Yi-Hsu Ju* and Shaik Ramjan Vali. (Department of Chemical Engineering, National Twiwan University of Science and Technology, 43 Sec 4, Keelung Road, Taipei 106-07). **Rice bran oil as a potential resource for biodiesel: A review. Journal of Scientific & Industrial Research, Vol. 64 (2005): 866-882.**

Biodiesel (BD) is receiving increased attention as an alternative, non-toxic, biodegradable, and renewable diesel fuel. Exploring new energy resources, such as BD fuel, is of growing importance in recent years. The main concern with BD fuel is its high price. One of the future aims in BD research is on the selection of inexpensive feedstock with high value-added byproducts. Rice bran is a by-product of rice milling that contains 15-23% lipids and a significant amount of nutraceutical compounds. Due to the presence of

active lipase in the bran and the lack of economical stabilization methods, most bran is used as livestock feed or boiler fuel and most rice bran oil (RBO) produced is not of edible grade. Thus RBO is relatively an inexpensive raw material for the production of BD. The utilization of by-product such as defatted rice bran for the production of proteins, carbohydrates, phytochemical, and the isolation and purification of value added nutraceutical generated during DB production from RBO are attractive options to lower the cost of BD. Production of BD from RBO can be carried out either *via in situ* esterification, lipase-catalyzed esterification, acid-catalyzed or base-catalyzed reactions. A single step reaction for the conversion of RBO with high free fatty acid content into BD, via acid-catalyzed, base-catalyzed or lipase-catalyzed, fails to attain high conversion in reasonably short time. Pretreatment of crude RBO such as dewaxing/degummed RBO is similar to that of other vegetable oils, which are used as BD feedstock. Various byproducts generated from the rice bran during the production of BD and their applications are also addressed.

Keywords: Defatted rice bran, Methanolysis, γ -Oryzanol, Rice bran oil, Soxhlet extraction, Wax esters.

Naveen Kumar*, and **P.B.Sharma.** (Delhi College of Engineering, Bawana Road, Delhi 110 042). **Jatropha curcus – A sustainable source for production of biodiesel. Journal of Scientific & Industrial Research, Vol. 64 (2005): 883-889.**

Non-edible oils like Jatropha, Pongamia, Argemone, Mahua, Castor, Sal etc., can be used for the production of biodiesel. *Jatropha curcus* has enormous potential for biodiesel production in India. *J. Curcus* is a multipurpose plant with many attributes and considerable potential. It is a propical plant that can be grown in low to high rainfall areas and can be used to reclaim land, as a hedge and/or as a commercial crop. Thus, growing it could provide employment, improve the environment and enhance the quality of rural life.

Keywords: Biodiesel, *Jatropha curcus*, Diesel engine, Diesel fuel, Transesterification.

Sukumar Puhan¹, N. Vedaraman^{1*}, B.V.Rambrahamam¹ and G.Nagarajan². (¹Chemical engineering Division, Central Leather Research Institute, Chennai, ²Department of Mechanical Engineering, Ana University, Chennai). **Mahua (*Madhuca indica*) seed oil: A source of renewable energy in India. Journal of Scientific & Industrial Research, Vol. 64 (2005): 890-896.**

Mahua oil methyl, ethyl and butyl esters were prepared and studied in a four stroke, direct injection diesel engine for their performance and emissions. The engine test results showed high thermal efficiency in case of methyl ester compared to all other esters and diesel fuel. Different emissions such as carbon monoxide (CO), oxides of nitrogen (NO_x), hydrocarbons (HC) is low for alkyl esters compared to diesel. Among alkyl esters except NO_x all tail pipe emission are lower in case of methyl ester compared to other esters. The ethyl ester show lower NO_x emission compared to other esters. Based on this study, mahua oil methyl ester performs well compared to other esters on the basis of performance and emissions.

Keywords: Biodiesel, Diesel engine, Emissions, Mahua oil, Renewable energy.

Carlos R. Soccol^{1*}, Luciana P.S.Vandenberghe¹, Bill Costa², Adenise Lorenci Woiciechowski¹, Julio Cesar de Carvalho¹, Adriane B.P. Medeiros¹, Antonio Maria Francisco and Luiz Jose Bonomi³. (¹Bioprocess Engineering and Biotechnology Division, Dept. of Chemical Engineering, UFPR, Federal University of Parana, PO Box 190011, CEP 81531-970 Curitiba –PR, - Brazil, ²Brazilian Reference Centre in Biofuels 0 CERBIO, parana Institute of Technology TECPAR, ³Instituto de Pesquisas Tecnologicas do Estado de Sao Paulo 0 IPT e Director de Combustiveis Automotivos e Biocombustiveis da Associacao Brasileira de Engenharia Automotiva). **Brazilian biofuel program: An overview. Journal of Scientific & Industrial Research, Vol. 64(2005): 897-904.**

Brazilian National Bio-Fuel Program comprises ProAlcool and Biodiesel: the former was initiated in 1975 to substitute gasoline for sugarcane alcohol in automobile use. ProAlcool passed through intensive changes due to fluctuant social-economics situation and public policies, which are fundamental to definitely install the use of biomass and make it competitive to face traditional fossil fuels. The production of flex fuel cars is bringing great promise for ProAlcool, not only for Brazilian market but also for rest of the world. In parallel, program of vegetable oils – OVEG, conceived in 1983, gave significant contribution to the automotive applications of vegetable oils (biodiesel) in vehicles. The fleet tested ran more than one million km at that time. The results demonstrated the technical feasibility of using vegetable oils in diesel engines.

Keywords: Biodiesel, Ethanol production, Sugarcane.

Mats Glabe, Gunnar Liden and Guido Zacchi*. (Chemical Engineering, Lund University, PO Box 124, S-221 00 Lund, Sweden). **Production of ethanol from biomass 0 Research in Sweden. Journal of Scientific & Industrial Research, Vol. 64(2005): 905-919.**

Ethanol produced from various lignocellulosic materials such as wood, agricultural and forest residues has the potential to be a valuable substitute for, or complement to, gasoline. This paper reviews the research activities in Sweden on development of the technology for ethanol production from lignocellulosics. The paper focuses on hemicellulose and cellulose hydrolysis and fermentation as well as on process integration and techno-economic evaluation of the overall process.

Keywords: Biomass, Ethanol, Fermentation, Hydrolysis, Lignocellulosic materials

M.A.Kalam* and H.M.Masjuki. (Department of Mechanical Engineering, University of Malaya, Kuala Lumpur 50603, Malaysia). **Recent developments on biodiesel in Malaysia. Journal of Scientific & Industrial Research, Vol. 64 (2005): 920-927.**

This paper presents recent developments on biodiesel production from palm oil, its properties and engine test results to evaluate its performance on diesel engine. The potential of palm diesel to be commercially used depends on its price comparison with diesel fuel and its status of reservation. Increasing cost and pollution effects of fossil diesel fuel can be resolved through producing vegetable oil based fuels such as palm diesel. This paper discusses Malaysian palm diesel as well as global biodiesel status, standardization of biodiesel and their commercial price consideration and various engine test results on aspects of brake power, combustion, emissions, engine wear and lubrication performance.

Keywords: Biodiesel, Emissions, Performance, Standardization, Wear

Stephane His*. (French Institute of Petroleum (IFP), Economic Studies Division, 1&4 Avenue de Bois-Preau, F-92 852 Rueil – Malmaison cedex, France). **Biofuels in Europe. Journal of Scientific & Industrial Research, Vol. 64 (2005): 931-935.**

Biofuels have been under industrial development for over 20 years. Still handicapped by high costs, their future once again looks promising because they might be able to help reduce oil consumption and greenhouse gas emissions in the transport sector. This is especially true in Europe. Where recently approved directives contain ambitious production volume targets encouraging member states to develop biofuels.

Keywords: Biofuels, Transport sector

Sulaiman Al-Zuhair*. (School of Chemical Engineering, Faculty of Engineering, The University of Nottingham Malaysia Campus, Semenyeh, Malaysia email: Sulaiman Al-Zuhair (alzuhair.sulaiman@nottingham.edu.my)). **The effect of substrate concentrations on the production**

of biodiesel by lipase-catalysed transesterification of vegetable oils. Journal of Chemical Technology & Biotechnology, Volume 81(3) (2006): 299 - 305

All the kinetic studies, found in the literature, on the production of biodiesel (fatty acids methyl esters) considered the esterifications of free fatty acids rather than the transesterification of the vegetable oil itself. The main industrial interest, however, is for the production of biodiesel with the triglyceride (oil) being the substrate. A mathematical model taking into account the mechanism of the methanolysis reaction starting from the vegetable oil as substrate, rather than the free fatty acids, has been developed. From the proposed model equation, the regions where the effect of alcohol inhibition fades, at different substrate concentrations, were identified. The proposed model equation can be used to predict the rate of methanolysis of vegetable oils in a batch or a continuous reactor and to determine the optimal conditions for biodiesel production.

Keywords: biodiesel • lipase • kinetics • transesterification • vegetable oils

Kenneth Iversen^{a, 1} and Richard Van Demark^b. (^aIversen Consultancy International, 141 Juniper Ridge Dr, Prescott, AZ 86301 5469, USA, ^bSouthwest Forestry, Inc., USA. Corresponding author. Tel.: +1 928 708 9909, ¹Both are members of Prescott Area Wildland/Urban Interface Commission (PAWUIC)). **Integrating fuel reduction management with local bioenergy operations and businesses—A community responsibility. Biomass and Bioenergy, Volume 30 (4) (2006): 304-307. (Proceedings of the third annual workshop of Task 31 'Sustainable production systems for bioenergy: Impacts on forest resources and utilization of wood for energy' October 2003, Flagstaff, Arizona, USA)**

In approximately 20,000 US wildfire “at-risk” communities, private citizen awareness and involvement is essential for the effective integration of sustainable fuel reduction programs with the establishment of local biomass/woody materials businesses and bioenergy facilities. The factors that influence local community bioenergy and wood products economic development are mostly social, political, and financial not biological, ecological, or technological. It is the private sector that is the driving force for creating and influencing sustainable forest resources and broadening access to public lands. The many years of no-wood harvesting policies in the United States have caused excessive overgrowth and eliminated local forest products markets. Now with the severe overgrowth, drought and beetle-infested conditions in many Southwestern forests, actions are necessary to reduce fire hazards, improve public safety, and promote forest health. It is the local communities that must take an active role in creating bioenergy facilities and wood products markets to use these fuel reduction supplies. A case in point is Prescott, Arizona, which is enclosed in the south and west by the Bradshaw Mountains and Sierra Prieta range. In 1990, under companion resolution of the Mayor of the City of Prescott and the Yavapai County Supervisors, the Prescott Area Wildland/Urban Interface Commission (PAWUIC) was formed to address the continuing growth of urban population into the wildland areas surrounding the Prescott basin. This organization of private volunteers and cooperating government agencies has the objectives to provide community fire safety education, wildland/urban fire hazard removal, and to promote the local markets for materials harvested from the wildland areas.

Keywords: Prescott, Arizona; PAWUIC; Bioenergy; Fuel reduction; Woody biomass; Wood products; Wildland/urban interface; Wildfires

L.B. Guo^a, R.E.H. Sims^a and D.J. Horne^b. (^aInstitute of Technology and Engineering, Massey University, Private Bag 11 222, Palmerston North, New Zealand, ^bInstitute of Natural Resources, Massey University, Private Bag 11 222, Palmerston North, New Zealand). **Biomass production and nutrient cycling in *Eucalyptus* short rotation energy forests in New Zealand: II. Litter fall and nutrient return. Biomass and Bioenergy, Volume 30 (5) (2006): 393-404**

Litter fall and nutrient return via the litter fall were measured during the first 3-yr rotation of three *Eucalyptus* short rotation forest species (*E. botryoides*, *E. globulus* and *E. ovata*) irrigated with meatworks effluent compared with no irrigation. Up to 13.4 oven dry t/ha/yr of annual litter fall was recorded with nutrient returns of up to 159 kg N/ha/yr, 9 kg P/ha/yr, 28 kg K/ha/yr, 125 kg Ca/ha/yr, 22 kg Mg/ha/yr, and 32 kg Mn/ha/yr. Effluent irrigation increased the litter fall and the return of some nutrients. More litter fall with higher nutrient return was found under *E. globulus* than under the other two species. However, the amounts of litter fall and nutrient return were highly dependent on the degree of biomass production and nutrient uptake. During the 3-yr period, up to 20% of the total above ground biomass produced was in the form of litter, and via the litter fall, up to 24% of the total N uptake was returned to the soil surface.

Keywords: Litter fall; Nutrient cycling; *Eucalyptus*; Short rotation forest; Effluent land treatment

Mukesh Kumar Modi¹, J. R. C. Reddy¹, B. V. S. K. Rao¹ and R. B. N. Prasad¹. (¹Division of Lipid Science and Technology, Indian Institute of Chemical Technology, 500 007 Hyderabad, India, R. B. N. Prasad, Email: rbnprasad@iict.res.in, Fax: +91-40-27193370). **Lipase-mediated Transformation of Vegetable Oils into Biodiesel using Propan-2-ol as Acyl Acceptor. Biotechnology Letters, Volume 28 (9) (2006): 637 – 640**

Propan-2-ol was used as an acyl acceptor for immobilized lipase-catalyzed preparation of biodiesel. The optimum conditions for transesterification of crude jatropha (*Jatropha curcas*), karanj (*Pongamia pinnata*) and sunflower (*Helianthus annuus*) oils were 10% Novozym-435 (immobilized *Candida antarctica* lipase B) based on oil weight, alcohol to oil molar ratio of 4:1 at 50 °C for 8 h. The maximum conversions achieved using propan-2-ol were 92.8, 91.7 and 93.4% from crude jatropha, karanj and sunflower oils, respectively. Reusability of the lipase was maintained over 12 repeated cycles with propan-2-ol while it reached to zero by 7th cycle when methanol was used as an acyl acceptor, under standard reaction conditions.

Keywords biodiesel - *Candida antarctica* - propan-2-ol - transesterification - vegetable oil

M. Jashimuddin, K.M. Masum and M.A. Salam. (Institute of Forestry and Environmental Sciences, Chittagong University, Chittagong 4331, Bangladesh. Corresponding author. Tel.: +88 0189 390676; fax: +88 031 726310). **Preference and consumption pattern of biomass fuel in some disregarded villages of Bangladesh. Biomass and Bioenergy, Volume 30 (5) (2006): 446-451**

Consumer's preference and consumption pattern of biomass fuel, fuel types and energy use category has been studied in the disregarded villages of Bangladesh. The study was conducted both in the inland and island areas. Biomass energy in the study area was used in domestic cooking, tea stalls, brickfields, bakeries, paddy parboiling and pottery. Assessment of consumption in domestic cooking was done by means of multistage random sampling and that in the tea stalls, brickfields, bakeries, paddy parboiling and pottery by means of complete enumeration of the sampling unit. Based on the homestead size respondents were categorized into small, medium and large and a total of 60 homesteads (30 from inland and another 30 from island areas), 20 from each category were selected randomly for the study. The study revealed that natural gas was quite absent and stems, branches and twigs, leaves of trees, agricultural residues, shell and coir of coconut, saw dust, brush wood, rhizomes of bamboo, and cowdung were the biomass fuel used by the respondent. Nine fuelwood species were identified as the most preferred in the study area. Consumption pattern was mostly traditional. Each year preceding the rainy season cyclonic action damages a large quantity of biomass energy sources. Though at the initial stage of rainy season (April–May) there remain a more or less good collection of fuelwood to the user as the byproduct of cyclones and storms, the last part of the rainy season (July–August) was identified as the fuel shortage period.

Name of Journals

1. Acta Biotechnologica
2. Aerobiologia
3. Annual Review-Plant Pathology
4. Annual Review- Ecology and Systematics
5. Annual Review-Biochemistry
6. Annual Review-Biomedical Engineering
7. Annual Review-Biophysics and Biomolecular Structure
8. Annual Review-Microbiology
9. Annual Review-Pharmacology and Toxicology
10. Annual Review-Phytopathology
11. Annual Review-Physiology
12. Annual Review-Plant Physiology
13. Annual Review-Public Health
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15. Applied Bacteriology
16. Applied and Environmental Microbiology
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18. Aquaculture
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71. Indian Journal of Environmental Health
72. Indian Journal of Plant Physiology
73. International Biodeterioration & Biodegradation
74. International Journal of Biotechnology
75. International Journal of Phytoremediation
76. Journal of Applied Sciences and Environmental Management
77. Journal of Agriculture and Environmental Ethics
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81. Journal of Environmental Management
82. Journal of Food Science and Technology-Mysore

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