BIOQUAL

NEWSLETTER

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Note from the Chairperson

Over the past few years, BIOQUAL has conducted its annual meeting in conjunction with other organizations. Last year, we were fortunate to be associated with the very successful GASReP Conference in Quebec City where the focus was site remediation. In previous years, we have collaborated with BIOFOR to address issues related to pulp and paper and forestry management.

This year, our meeting will take place in Windsor, Ontario, from April 17 to 19, 1994, in conjunction with the Water Environment Association of Ontario (WEA). The focus of our meeting will be municipal wastewater applications of biotechnology.

We look forward to seeing you there.

Glenn Allard

The BIOQUAL Action Plan... an Opportunity for You

The Federal Government adopted the National Biotechnology Strategy in 1983 to promote the development, commercialization, and marketing of advanced biotechnology products and processes. As part of the strategy, National Biotechnology Networks were created to facilitate communication and cooperation and technology transfer between government and university laboratories and industry. BIOQUAL is one of these networks.

The BIOQUAL Network, an acronym for BIOtechnology Network for the Preservation of Environmental QUALity, is an association of scientists, engineers, and entrepreneurs dedicated to the development and practical application of biotechnology processes and products for maintaining or improving environmental quality. Its objective is to facilitate the development, introduction, and industrial use of biotechnology for the protection, preservation, and enhancement of environmental quality.

BIOQUAL does not directly develop or market new biotechnology products or processes. Others -- government, university, and industry research establishments, technology development specialists, entrepreneurs, etc. -- develop and market the products and processes of biotechnology. What the Network does is to act

News Items Needed!

The BIOQUAL Secretariat compiles the information in this Newsletter. We will be pleased to print any items relevant to the objectives of the BIOQUAL network that you think may be of interest to members. Please send any submissions or enquiries to the Secretariat at the following address:

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as a "facilitator" in this endeavour by ensuring that the most effective communication links are in place and that those involved in the field are made aware of the opportunities available to them.

BIOQUAL's Action Plan is designed to promote membership in the Network and to improve its services to members. Among other things, these services will include:

- organizing conferences, workshops, and short courses;
- publishing a Newsletter;
- developing a comprehensive membership data base;
- identifying sources of technical expertise;
- identifying funding sources for commercialization projects;
- promoting alliances between members;
- identifying problems and opportunities; and
- promoting commercialization of environmental technologies.

Membership in BIOQUAL is open without charge to all parties who are engaged or interested in the application of bioprocess engineering, bioremediation, biodiagnosis, and/or biofouling to the treatment of wastes and the preservation and improvement of environmental quality.

Optimized Biological Treatment of Bleached Kraft Mill Effluents for the Enhanced Removal of Toxic Compounds and Mixed Function Oxygenase (MFO) Induction Response in Fish

A controlled laboratory-scale investigation was conducted at the Wastewater Technology Centre (WTC) to comparatively assess three traditional biological processes for treating modernized bleached kraft mill effluents under relatively conservative conditions (i.e., elevated solids and hydraulic retention times and moderate temperatures). Enhanced treatment performances were achieved with the optimized activated sludge (AS), facultative stabilization basin (FSB), and aerated stabilization basin (ASB) processes as indicated by consistently high removals of conventional contaminants, as well as polychlorinated phenolics (PoCP) and absorbable organic halogen (AOX).

Effluent-associated hepatic mixed function oxygenase (MFO) induction potential was also substantially reduced, often to insignificant levels as determined by fish bioassay testing at 10% (v/v). Pentachlorophenol- equivalent toxicity (TEQ-PCP) of effluent chlorophenolics residuals was consistently measured at below predicted chronic effects levels. Follow-up pilot-scale field studies on activated sludge treatment in extended-aeration mode has demonstrated relatively high reductions in whole mill effluent potency to induce MFO activity. A comprehensive characterization of various in-plant process waters indicated that the softwood-line bleach plant was a major contributor to the MFO induction potential of untreated and biologically (aerobic mode) treated bleached kraft mill effluent (BKME), for the particular mill sampled.

Much emphasis has been placed on the adverse environmental effects of wastewaters discharged by chemical pulp mills that use chlorine compound-based bleaching. Bleached chemical pulp mill effluents have been defined as toxic under the *Canadian Environmental Protection Act*. Some of the acute and chronic toxic effects have been associated with chlorinated phenolic (CP) compounds. The polychlorinated phenolics (PoCP) are of particular environmental concern because of their characteristic bioaccumulability and potential toxic effects and persistence. Reported experiences with effluent PoCP removal by ASB and AS treatment have revealed varying degrees of efficiency, ranging from modest to relatively high. These removal efficiencies were apparently strongly dependent on biological process conditions, with greatest degrees of treatment at the more conservative conditions.

Biologically treated effluent discharged from modern or modernized bleached kraft mills (BKM) using conventional secondary treatment has also been found to consistently cause

hepatic MFO induction in fish. This has been determined in both field and laboratory exposure studies. Although MFO induction, and ethoxyresorufin-o-deethylase (EROD) activity in particular, have not been directly linked to adverse effects at the higher organizational levels, the parameter has served as an indicator of chemical exposure of the organism and of **possible** effluent-associated biological effects. Also, since short-term exposures are sufficient for producing a measurable response, testing for MFO induction is a useful tool in laboratory and field experiments for evaluating the relative potency of effluents and for comparatively assessing the effectiveness of possible remedial measures.

As part of the investigation of conservative-mode biological treatment, laboratory exposure bioassays were used to evaluate the potential for reducing levels of effluent-induced MFO activity. Information on treatment effectiveness for this relatively sensitive surrogate parameter would complement the existing knowledge-base which indicates that conventionally designed and/or operated secondary treatment is insufficient for eliminating BKME induction potential. The performance assessments were also based on reductions in effluent chemical contamination, with PoCP removal having been given special consideration. The latter parameter provides a good measure of treatment process capabilities, owing to the environmental relevance of PoCP compounds, as well as their possible use as surrogate indicators of other difficult-to-degrade organic compounds, including persistent toxics.

The treatment process conditions selected for the laboratory-scale investigations were based on the findings of an optimization study conducted at the WTC. Elevated hydraulic and solids retention times (HRT and SRT), as well as favourable temperature conditions, were determined to be necessary for the maximal removal of chlorinated organics in AS, FSB, and ASB processes. The focus of the follow-up investigations was to comparatively assess the potential treatment capabilities of these three biological systems under somewhat modified process conditions that were considered conservative but also practical. Assessments with the MFO induction parameter were an added component of the follow-up work. Subsequent to these laboratory investigations, the optimized processes have also been tested at the pilot scale under dynamic mill site conditions to verify the promising laboratory study results obtained.

These collaborative investigations between the WTC and the National Water Research Institute (NWRI) support the high priority federal government initiative to identify those compounds in pulp and paper effluent discharges that are responsible for observed adverse biological effects on fish, and developing and demonstrating potentially effective remedial measures.

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Treatment of Kraft Mill Bleach Plant Effluents in an Anaerobic Membrane Bioreactor with Aerobic Polishing

A three-year laboratory-scale study has been conducted at the Wastewater Technology Centre to evaluate the capabilities of a novel anaerobic membrane bioreaction (ANMB) process for the enhanced dechlorination of kraft mill bleach plant effluents. The high rate process comprised an anaerobic reactor (15L; completely mixed mode) for energy-efficient reductive dechlorination and degradation of chlorinated organics, coupled with a tubular ultrafiltration unit (10 000 molecular weight cut-off) for the retention of reactor biomass and high molecular weight contaminants.

The treatment system was upgraded for more comprehensive

testing during the last half of the study. This included the installation of an aerobic post-treatment stage (15 L) for polishing of the ANMB permeate, and an alternative ultra high-shear membrane process in parallel with the tubular ultrafiltration unit to demonstrate the potential for improved permeate flux and membrane cleanability and reduced requirements for mixed liquor recycle flow. The treatment system influent comprised a representative blend of first chlorination-stage and extraction-stage filtrates from a modernized softwood kraft mill bleach plant ($C_{60}d_{40}E_O$ effluent during Period 1 and $D_{100}E_{OP}$ effluent during Period 2 operations of the ANMB system), supplemented with methanol co-substrate.

Long-term process performance was assessed with regard to the removal of AOX [total and <1000 apparent molecular weight (AMW)], chlorinated phenolics, and non-chlorinated dissolved organics; contaminant accumulation rates within the system; possible microbial inhibition effects associated with methane yield of accumulated substances; membrane permeate flux; membrane rejection efficiencies; and stability/ runnability of the biological and membrane processes.

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Commercial Recycling Centres for Contaminated Soils

There are several advantages to mediating contaminated soils on site, particularly when volumes are large enough to justify set-up costs. The on-site option is often not feasible, however, due to time, space, and site limitations. Even when physical conditions are favourable, property owners are often willing to pay a premium for prompt and reliable removal of a liability, especially in cases of sales or closures. These factors have created a market for centralized commercial facilities where certain types of contaminated soils are accepted at short notice and treated under enhanced conditions.

One such commercial facility was opened near Halifax, Nova Scotia in October 1992. The facility combines bioremediation and soil-venting technologies to recycle hydrocarbon-contaminated soils for quarry pit restoration. The facility was established by Envirosoil Ltd., a privately owned company, based on a remediation concept developed by Jacques Whitford Environment Limited (JWEL) of Dartmouth, Nova Scotia. JWEL was commissioned to carry out baseline environmental studies, seek approvals, and design the ten-acre facility. Construction approvals were obtained in June and operating permission granted in October 1992.

The facility has a soil storage capacity of 80 000 tonnes. Soil is treated on two parallel cells, each holding up to 10 000 tonnes. The entire facility is contructed on a clay-lined base and leachate is drained to a large reservoir before treatment. Biological treatment is enhanced by air circulation, nutrient adjustment, and moisture control. The process parameters can be monitored, controlled, and logged by computer. Environmental compliance is monitored in accordance with licence stipulation.

In the first year of operation, over 60 000 tonnes of soil were received and about 40 000 tonnes treated to the permit criteria of 400 ppm of TPH. Most of the soil originated from remedial operations at fuel service stations and bulk storage terminals, but significant amounts were from heating oil spills at public buildings and residences. Before the facility opened, a large proportion of such soils was being dumped at local landfill sites or subjected to lengthy treatment at source.

The main off-site competition to such a facility is most likely to come from treatment centres using low temperature thermal desorption technology, which may out-perform biological

methods under stricter cleanup criteria. There is a place for a wide range of treatment methods, however, and remediation options must be evaluated on a site-specific basis, in order to avoid unnecessary cost and disruption.

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BIO-REM H-10 Specializing in the Bio-remediation of Hydrocarbon Contaminants

Bioremediation usually involves bringing contaminated material to the surface of the soil or water to expose the digesting bacteria to oxygen and to add some nutrients for the bacteria to grow. Sometimes, however, it is either impractical or impossible to move dirt or bring the contaminated material to the surface. Bio-Rem Canada Co. has a better way.

H-10 is a formulation of specialized microaerophilic bacteria that depends on hydrocarbons for proper growth. These bacteria can survive on the small amount of oxygen found under the soil surface, in the water, as well as on soil and water surfaces. No digging or soil venting is necessary. When properly applied, the contaminated material is digested over a period of time until the food source is gone and the problem is solved.

As an authorized Bio-Rem distributor, TCS Management Ltd. specializes in the cleanup of wastes through the use of the microbes contained in Bio-Rem's H-10 formula. Bio-Rem H-10 can provide a guaranteed cleanup of most hydrocarbon wastes in both surface and subsurface situations. The company can provide a turn-key remediation or simply supplement a project's needs.

For further information, please contact:

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#110, 19329 Enterprise Way
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Announcements

April 17-19, 1994
Windsor, Ontario

WEAO/BIOQUAL 23rd Annual Technical Symposium and Exhibition

Topics: Emerging bio-process developments, issues for Great Lakes water quality, wastewater treatment, pollution prevention, stormwater/sewer overflow, partnerships

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April 20, 1994
Laval, Quebec

Seminar on Cleanup Using Environmental Biotechnology

This course will focus on techniques for cleanup of soils, wastewater, and air and gases. Training specifically on environmental biotechnology for cleanup; contributors from the many areas of environmental biotechnologies will participate. Written course materials will be supplied at the registration desk.

Presented by: Conseil des Bio-industries environnementales

Guest speaker: Dr. Réjean Samson, Institut de Recherche biotechnologique, Montreal, Quebec

Contact:

M. Carl Aubé
Tel: (514) 686-5590

May 10-11, 1994
Mississauga, Ontario

8th Annual Toronto Environmental Trade Show and Conference (formerly Haztech Canada)

Topics: Air pollution control, consulting, water and wastewater treatment, laboratory analysis and testing, solid and hazardous waste, transportation handling and disposal, site remediation, health, safety and protection, treatment of contaminated underground water, and other related topics

Contact:

Canadian Exhibition Management Inc.
Tel: (403) 469-2400
Fax: (403) 469-1398

May 23-27, 1994
Toronto, Ontario

8th International Biotechnology Meeting and Exhibition and 6th Annual Bio Council of Biotechnology Centres Meeting

Contact:

BIO International Biotechnology Meeting
Tel: (202) 857-0244
Fax: (202) 331-8132

June 16-17, 1994
Toronto, Ontario

14th International Symposium on Environmental Pollution and Water Quality and the 18th International Conference on Analytical Chemistry and Applied Chromatography/ Spectroscopy

Contact:

Dr. V.M. Bhatnagar
Alena Chemicals of Canada
P.O. Box 1779
Cornwall, Ontario
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Tel: (613) 932-7702

July 4-8, 1994
University of Waterloo
Waterloo, Ontario

International Symposium/ Workshop on Environmental Biotechnology

Topics: Characterization and monitoring of environmental biohazards; biotreatment methods; bio-utilization of residues; conservation/recycle strategies; bioremediation of contaminated soils/groundwater; equipment for bioprocessing of wastes; risk assessment/ regulatory guidelines; international issues; technology transfer/business opportunities

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August 8-12, 1994
Tromsø, Norway

Third International Marine Biotechnology Conference 1994

Topics: Marine microbial ecology and physiology; gene technology and marine organisms; signals and receptors in the marine environment; environmental marine biotechnology; biotechnology of marine aquaculture; diseases, immunology and vaccinology; marine biomolecules and products; biotechnology in management of marine ecosystems and resources; starvation and non-culturable marine bacteria; marine biotechnology and Third World.

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