and immobilized *Yamadazyma stipitis* simultaneously from liquefied spent grain. Both yeast cells were immobilized on the glass beads carrier. Xylose and arabinose were consumed after glucose was consumed completely during ethyl alcohol production. 5.8% (v/v) ethyl alcohol was produced from liquefied spent grain that was adjusted 17% of initial sugar concentration after 2 days.

4

Lipase catalyzed synthesis of biodiesel from castor oil in organic solvent *Fábio Fernandes Fagundes, Rosângela Balaban Garcia, Marta Costa, Mauricio Rodrigues Borges*, Chemistry Department, Federal University of Rio Grande do Norte, Postal Code 1662, Natal, Brazil

The vegetable oils constitute a resource of renewable potential for the production of fuels, becoming a viable alternative when compared to the diesel from petroleum. Among the vegetable oils, the extracted oil of the castor plant seeds is a promising alternative source because it is constituted mainly of the ricinoleic acid (12-hydroxy-9-octadecenoic) that represents 90% of the total constitution of the oil approximately. The biodiesel obtained from castor oil can be defined chemically as being a mixture of methyl esters or ethyl esters of carboxylic acids synthesized by transesterification reaction of the existent triglyceride and an alcohol of little chain through the use of alkaline or enzymatic catalysts. In this work, we described the results found in castor oil with different degrees of purity. Initially, it was made a rheological characterization followed by structural characterization (RMN 13C, RMN 1H and infrared) and thermal characterization (DTG, DTA and DSC) of the crude and refined castor oil. It has been also measured the hydroxyl tenor, acidity index, saponification index and iodine index in different oils. Later, these results were used to evaluate possible differences in the quality of the biodiesel (ethyl esters) produced in the enzymatic alcoholysis of the castor oil catalyzed by lipases (Novozym 435, Liposyme RM IM and Lipozyme TL IM). The degree of substitution of castor oil derivative was performed by titration with 0.1N HCl and confirmed by TLC analysis and the results showed conversion rates about 90%.

5

Different dephosphorylation pathways of bacterial phytate-degrading enzymes and their applications Malaysian rice bran utilization *Abd-ElAziem Farouk*[1], *Ralf Greiner*[2], *Hamzah Mohd Salleh*[1]: [1]Biomolecular Engineering Research Group, Department of Biotechnology Engineering, Kulliyyah of Engineering, International Islamic University Malaysia, Jalan Gombak, 53100 Kuala Lumpur, Malaysia; [2]Centre for Molecular Biology, Federal Research Centre for Nutrition and Foods, Haid-und-Neu-Straße 9, D-76131 Karlsruhe, Germany

myo-Inositol hexakisphosphate (IP6) has been demonstrated to have a wide range of health benefits such as prevention and therapy of various cancers, amelioration of heart disease, and prevention of renal stone formation as well as complications from diabetes. On the hand, lower phosphorylated forms of inositol, especially inositol trisphosphate (IP3) and inositol tetrakisphosphate (IP4) are important signal transduction molecules within the cells both in plants and the animal kingdom. It has been hypothesized that at least the anticancer function of IP6 is mediated via these lower inositol phosphates. The diversity and practical unavailability of the individual *myo*-inositol phosphates preclude their investigation. Phytases, which catalyze the sequential hydrolysis of phytate, render production of defined *myo*-inositol phosphates in pure form and sufficient quantities. Different phytases may result in different positional isomers of *myo*-inositol phosphates and therefore different biochemical properties. Phytases differing in pH optima, substrate specificity, and specificity of hydrolysis have been identified in plants and microorganisms. In this paper the dephosphorylation pathway of the novel PhyFAUIA1 was compared to other bacterial phytate degrading enzymes. Preliminary results have shown that PhyFAUIA1 converted IP6 into IP5 (*myo*-inositol 1,2,3,5,6-pentakisphosphates) and another isomer, which is yet to be elucidated.

4. New Trends in Bioremediation and Wastewater Treatment

1

New visions on life style and application of anammox bacteria *Boran Kartal*[1], *Wouter van der Star*[2], *Mike Jetten*[1,2], *Cristian Picioreanu*[2], *Mark van Loosdrecht*[2], *Marc Strous*[1]: [1]Institute of Water and Wetland research, Department of Microbiology, Radboud University Nijmegen, Toernooiveld 1,6525 ED Nijmegen, the Netherlands; [2]Department of Biotechnology, TU Delft, Julianalaan 67, 2628 BC Delft, the Netherlands. E-mail: M.Jetten@science.ru.nl; URL: www.anammox.com, www.iwwr.science.ru.nl; www.microbiology.science.ru.nl (M. Jetten)

In a denitrifying pilot plant reactor, a new obligately anaerobic ammonium oxidation (anammox) process with great potential for nitrogen removal for high strength wastewater was discovered. After transfer of the complex microbial community to a laboratory SBR system, a highly enriched population, dominated by a single anaerobic chemolithoautotrophic bacterium related to the Planctomycetes was obtained. The bacterium was purified via percoll centrifugation and characterized as 'Candidatus Brocadia anammoxidans'. Survey of different wastewater treatment plants using anammox specific 16S rRNA gene primers and anammox specific oligonucleotide probes revealed the presence of at least four other anammox bacteria, tentatively named 'Candidatus Kuenenia stuttgartiensis', 'Candidatus Brocadia fulgida', 'Candidatus Scalindua wagneri' and 'Candidatus Scalindua brodae'. A close relative of the two Scalindua species, 'Candidatus Scalindua sorokinii' was found to be responsible for about 50% of the nitrogen conversion in the anoxic zone of the Black Sea and in the Benguela upwelling system along the Namibian coast, making anammox an important player in the global nitrogen cycle. Electron microscopic studies of all five anammox bacteria showed that several prokaryotic membrane-bounded compartments are present inside the cytoplasm, which are surrounded by unique ladderane lipids. Hydroxylamine oxidoreductase, a key anammox enzyme, was present exclusively inside one of these compartments, named the 'anammoxosome'. Unique peptides fragments of the purified HAO were used to locate the hao gene in genome assembly of 'Candidatus Kuenenia stuttgartiensis'. The implementation of the anammox process in the treatment of wastewater with high ammonium concentrations was started at the treatment plant in Rotterdam, the Netherlands, where it is combined with the partial nitrification process SHARON. The estimated price for nitrogen removal with partial nitrification and anammox is about 0.75 euro/kg N.

Gas lift reactors could sustain the highest anammox capacity at 8.9 kg N removed/m^3 reactor per day. An alternative configuration of anammox is the oxygen-limited CANON process in which aerobic ammonium-oxidizing bacteria protect anammox bacteria from oxygen and produce the necessary nitrite. Maximum nitrogen removal with CANON in gas lift reactors was 1.5 kg N/m^3 reactor per day. Using several different conditions and parameters, the competition and co-existence of aerobic and anaerobic ammonium-oxidizing bacteria were modeled. In addition to ammonia, urea was also converted after a 2-week adaptation in the CANON system. Recently it was shown that anammox bacteria can use organic acids as additional energy source.

3

Bioreactor design strategies for bioremediation applications *Murray Moo-Young*, *WA Anderson* Department of Chemical Engineering, University of Waterloo, Waterloo, Ont., Canada N2L 3G1

Bioreactors are central to the bioremediation of contaminated environments of water, air or soil. In all three areas of application, bioreactor design is critical to the development of new or improved processes. This overview focuses on the physical limitations of bioreactors caused by biological requirements. The information is based on our own research findings. The need for more applications-oriented bioremediation research becomes apparent. For techno-economic reasons, the airlift type has often been the bioreactor of choice for most bioremediations. However, lack of adequate understanding of the quantitative effects of operating conditions on its performance has been an ongoing concern. These effects have been characterized for engineering implementation. To enhance productivity, innovative pretreatment techniques of the polluted sources have also been developed using photocatalytic and chemical oxidation methods. Case studies on petrochemical-contaminated water and soil reveal significant enhancement potentials. Other studies on microbial biofilters for air bioremediation indicate that the active mass of the biological consortia is not sufficiently understood for rational design.

4

Analysis and retrofit design of wastewater treatment facilities using process simulation tools *Demetri Petrides*, *Alexandros Koulouris*, INTELLIGEN, Inc., Scotch Plains, NJ 07076, USA. E-mail: dpetrides@intelligen.com (D. Petrides)

Process simulators have been used in the petroleum and chemical industries for over four decades to facilitate the design of new processes and optimize the performance of existing ones. Similar benefits can be derived from the use of such tools in the environmental arena, particularly in the field of physical and biological treatment of municipal and industrial wastewater. Specifically, process simulators can be used to evaluate and improve options for: (1) more efficient removal of nutrients (e.g., organic nitrogen and phosphorous) that cause eutrofication, (2) estimation and control of volatile organic compound (VOC) emissions from open tanks, and (3) more efficient removal and control of hazardous compounds. The potential benefits will be illustrated with cases studies involving both municipal and industrial wastewater facilities.

Poster Abstracts Environmental Biotechnology (EB)

EB1

Precipitation of metal by *Desulfovibrio* sp. in presence of petroleum *R. Pérez*, *J.M. Gómez*, *A. Ábalos*, *D. Cantero* Study Centre of Industrial Biotechnology, Faculty of Natural Sciences, University of East, Santiago of Cuba, CP 90500, Cuba. E-mail: rmaria@cebi.uo.edu.cu (R. Perez)

The microbial reduction of metals has showed recent interest as these transformations can play crucial roles in the cycling of both inorganic and organic species in a range of environments and, if harnessed, may offer the basis for a wide range of innovative biotechnological processes. Under certain conditions, however, microbial metal reduction can also mobilise toxic metals with potentially calamitous effects on human health. Some effluents present heavy metals as soluble compounds, several microorganisms have the capacity to precipitate these metals as insoluble compounds, and this fact allows the collection and separation of these metallic precipitates from contaminated medium. Sulfate-reducing bacteria (SRB), under anaerobic conditions, oxidize simple organic compounds (such as acetic acid and lactic acid) by utilizing sulfate as an electron acceptor and generate hydrogen sulfide. Hydrogen sulfide reacts with heavy metal ions to form insoluble metal sulfides that can be easily separated from a solution. The purpose of this work was study the capacity of *Desulfovibrio* sp. cultures to reduce mixtures of the heavy metals in presence or not of petroleum. For it the experimental design 2^k ($k = 5$) was carried out. The five studied factors were Cr, Cu, Mn, Zn and petroleum. The study was carry out with *Desulfovibrio* sp. Batch studies were performed in 50 ml sealed bottles with different concentrations (Cr(III)-10 ppm, Cu(II)-5 ppm, Mn(II)-10 ppm, Zn(II)-15 ppm) of metal sulfate and 2 g l^{-1} of petroleum. During batch incubation the dissolved concentration of metal studied in supernatant were decreased to undetectable levels for Zn (70–100%), however with Cu (40–60%), Mn (40–70%) and Cr (50–80%). The development of continuous process with sulfate-reducing bacteria seems to be a suitable alternative to reduce metals in solution from contaminated media such as industrial or mine effluents. After these preliminary results, some experiments in course are focused to study that purpose.

EB2

Reduction of odour emissions from livestock buildings using a bioscrubbing system *Morten Øgendahl*, *Nawaf Abu-Khalaf*, *Jens Jørgen Lønsmann Iversen* Department of Biochemistry and Molecular Biology, University of Southern Denmark, DK-5230 Odense M, Denmark. E-mail: tvede@bmb.sdu.dk (M. Øgendahl)

A bioscrubbing system for reducing odour emissions from livestock buildings is presented. The bioscrubbing system consists of two separate units; an absorption column and a water purification module. The absorption column is mounted in the ventilations stacks in the livestock buildings absorbing odorants in the effluent air flow. The odorants are absorbed in a spray of droplets formed by a grid of high pressure nozzles in the inlet of the absorption column. The spray of droplets is extracted from the air flow and pumped to a centrally located water purification module, an inverse three phase fluidised bed bioreactor, where the bio-degradation of the absorbed odorants occurs. The bioreactor features a split sparging system for maximum mixing and aeration. The cleaned water is recirculated