ABSTRACTS

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Dynamic model of nutrients withdrawal at the open ponds for phytoplancton biomass production

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Domestic wastewater effluent after biological treatment is usually saturated with nutrients and can be used as fertilizer. At the present time artificial ponds for phytoplankton biomass growing, used for biodiesel and other byproducts production, can be considered as new potential consumer of these kinds of effluents. Sequestration of CO_2 from atmosphere is another positive environmental effect of biodiesel production. Dynamic model of phytoplankton biomass breeding at the open pond with forced mixing is developed to study analytically the processes of nutrient consumption and transformation. The model equations are based on the principle of material balance, the law of mass action and stoichiometric relations. The necessary model parameters for unicellular green algae called *Monoraphidium minutum* are obtained by use of the published experimental data available. It enables to get assessment of annual consumption of nutrients at the pond for phytoplankton biomass breeding under different climatic conditions of illumination.

Start up of partial nitritation/anammox process from SBRs under different operation strategies

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Start-up of anammox process becomes a choke point on the application of nitrogen removal by partial nitrification/anammox process. The responsible microorganisms of nitrification/anammox process are anammox and ammonium oxidizing bacteria (AOB). The difficulties to start up anammox process is because anammox has very low bacteria growth rate (μ_{max}: 0,065 d^{-1}) and can get influence by the reactor configurations, concentrations of substrates, DO and other chemical compounds. The purpose of this study was to investigate the performances of SBR on starting up partial nitrification/anammox process under different operation strategies. Evaluation of nitrogen conversions were done by cycle measurement. FISH analysis was performed to determine the existence of anammox bacteria during the start up period. Additionally, bacterial biodiversity monitoring using polymerase chain reaction - denaturing gradient gel electrophoresis (PCR-DGGE) method was performed.

Key words: Anammox, FISH, nitrogen removal, nitrification, reject water

Minimization of sewage sludge production – legislation, new technologies, applying

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Attaching great importance to environmental issues in the European Union has resulted in the desire of maximization of the use of sewage, mainly to minimize their final disposal. Final agricultural disposal of sludge is caused mainly by stringent EU directives. Conventional storage of sludge may be applied on condition that comprehensive national strategy is issued. All these aspects led to increasing importance of minimization of dry and wet masses of sludges outgoing treatment plants. This strategy is also supported by significant economic reasons for plants' operators as in typical municipal WWTP sludge treatment and handling costs are estimated as high as up to 60% of total operational costs. Development of specific technologies resulting in significant reduction of the amount of residual substances introduced into the environment and remain in circulation has crucial importance for modern sustainable plants.

Retrofitting of municipal wastewater treatment plants has to incorporate both wastewater and sludge treatment trains. Despite sludge stabilization recently a main task of contemporary sludge processing technology is to produce an additional source of easybiodegradable carbon compounds to increase efficiency and intensification of nutrient removal from wastewater. However a conventional requirement i.e. reduction of dry mass together with an increase in biogas production in anaerobic stabilization is still valid in routine operation. Numerous improvements in sludge processing were proposed in last decade however a sludge disintegration seems to be most feasible at present. The paper describes various technologies of sludge minimization with special emphasis on proven disintegration technologies.

Disintegration breaks down solids, first of all the microbial cells, leading to release of intracellular fluid, which thus become more accessible for further biological treatment processes, wastewater and sludge. The result is intensified decomposition of organic substances contained in the sediment and accelerate the transformation into biogas, which results in the final reduction of the amount of sludge to land.

This paper presents a description of the biochemical changes occurring in the biomass in wastewater and sludge lines complemented the characteristics of new manufacturing processes used to minimize the amount of sewage sludge. Some processes have been analyzed for their advantages and drawbacks detected or predicted (for the less popular solutions) when applied in practice.

Evaluating the effectiveness of anion exchange extraction of nitrates from aqueous

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Contamination of natural waters by nitrates is one of the most major problems. In some cases, excess nitrate concentrations ten times higher than MAC (45 mg NO_3^-/dm^3), and varies in the range 80-800 mg/dm^3.

This paper presents the results of anion exchange extraction of nitrate from aqueous solutions. The studies found that strong-base anion exchanger AV-17-8 in the chloride and in sulfate forms and weak-base anion exchanger DOWEX Marathon WBA in chloride form provides an effective extraction of nitrate from water solution between concentration levels in the range 200-2400 mg/dm^3.

The degree of extraction of nitrates from municipal wastewater after biological treatment in the case of use of strong-base anion exchanger AV-17-8 and weak-base anion exchanger DOWEX Marathon WBA in the chloride form were 92 and 89 % respectively.

Also we studied the regeneration of strong-base anion exchanger AB-17-8 by solutions of sodium chloride, potassium chloride, ammonium chloride, ammonium sulfate, sodium carbonate, potassium carbonate, and alkali. The best results were obtained using sodium chloride, ammonium chlorine and ammonium sulfate. Waste solutions containing potassium nitrate and ammonium nitrate can be used to manufacture liquid fertilizers.

The best recovery of capacity of anion exchange resin DOWEX Marathon WBA in the nitrate form was obtained by using solutions of ammonia and ammonium chloride. Spent regenerant are promising in the manufacture liquid fertilizers.

Evaluating the effectiveness use of weak-acid cation exchanger DOWEX MAC-3 for cationic water softening

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One of the ways to reduce discharges of saline solution is the creation of low-waste technologies softening and desalination of water. Therefore in this study we investigated the processes of water softening using cation exchanger DOWEX MAC-3 in acid and in salt forms.

As object of this study we used the tap water.

It is shown that the effectiveness of water softeners by the weak-acid cation exchanger DOWEX MAC-3 depends on the form of resin and alkalinity of water. When using the resin in the acid form the efficiency of softening is determined by carbonate hardness. When using the resin in the Na^+-formit was observed that the hardness is decreased to 0.2-0.3 meq/dm^3 with increasing pH of soft water to 9.0 without changing the residual alkalinity of the water.

It is established that the use of cation exchanger DOWEX MAC-3 in the acid form in the first stage after the reagent water softening can not only prove to be an effective water softener, but also reduces the value of the residual alkalinity. At the same time ion exchanger provides efficient water treatment from aluminum ions, and also protects the resin from poisoning iron compounds.

The processes of water softening after the reagent softening stage was studied and it is observed that consistent use of cation exchanger DOWEX MAC-3 in the acid form in the first stage of the cation exchange, and KU-2-8 in the Na^+-form in the second stage cation exchange allows you to reach deep water softening, reduce its alkalinity and achieve pH in the range of 6.5-7.1.

Treatment of effluents from soil remediation processes

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Contamination of soil by petrochemical products and their derivatives is widespread and frequent due to their common use as e.g. fuels, heating mediums, lubricants, drawing oils, etc. One of the method of soil remediation is flushing of contaminated soil by surfactants solutions. This method can be used on the site of the oil spill or accident (*in-situ*) but also outside of the remediation site (*ex-situ*). Surfactants in soil remediation are used to improve contaminated aquifer remediation rates. Principal remediation mechanisms include micellar solubilization and mobilization of the trapped liquids by lowering of the oil/water interfacial tension. By reducing the interfacial tension surfactants can also stabilize the emulsion and decreasing the rate of coalescence.

The effluents resulting from soil remediation processes consist of high surfactant concentration solutions, mobilized oils and oil-in-water (o/w) emulsions. Such a constitution of wastewater make them difficult to treat in a standard biological methods.
In the present study wastewater from soil remediation processes were treated by means of 1-step processes like Fenton, aerobic degradation and 2-steps combined method. The effectiveness of wastewater treatment was evaluated by COD reduction and surfactant removal. The application of Fenton process alone showed around 80% of COD and surfactant removal, and in case of aerobic process only 60% of COD and 50% of surfactant removal was accomplished.

Keywords: aerobic treatment; Fenton treatment; nonionic surfactant; o/w emulsion; PAO6 oil; soil remediation;

Studying of carbonization process for adsorbent production from natural materials

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Large quantities of plant wastes and agricultural by-products, such as grape seeds, nutshells, corn waste, etc. are produced annually. Meanwhile, excellent renewable raw materials for adsorbent production can be prepared. The previous investigations have shown a potential of using walnut shell as effective adsorbent for removing oil products from sewerage water. Moreover, walnut shell can be an alternative source of production of activated carbon used as adsorbent for water treatment, medical needs, chemical processes etc. The object is to study the possibility of expanding source of raw materials via using plant wastes. Impact of carbonization principal factors on product yield, ash content and sorption activity of carbonizate obtained both from birch wood (traditional raw material) and walnut shell (alternative material) have been compared. Studies have not shown significant distinction in carbonizate yield obtained from birch wood and walnut shell. As the final temperature of carbonization increases, ash content, sorption activity and carbonizate yield of walnut are found to vary slightly. Thus, obtained results shown inexpediency of walnut shell heating to high temperatures. The relevance of further studies in the field of walnut shell carbonization for both waste utilization and adsorbent production was substantiated.

Environmental consequences of emulsifying properties of biosurfactant produced by *pseudomonas* sp.

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Biosurfactants are natural surfactants produced by variety of microorganisms. They are environmentally sustainable (green) chemicals due to low toxicity and high susceptibility to biodegradation. Thus, biosurfactants find practical applications in cosmetics and food industry, physical (flooding with surfactant solution) and biological soil remediation (enhancing biodegradation by surfactant solutions addition), removal of oil spills from water etc. One of the properties of biosurfactants that respond for their wide application is the ability to stabilize emulsions. Stable emulsions are preferable in biodegradation of oil pollutants where they increase bioavailability of oil to microorganisms. In turn, high stability of emulsions in undesirable in the case of soil remediation by flooding with surfactant solution, where used solution with solubilised and emulsified oil has to be pump out for recovering. At this point very stable and viscous emulsions can block up the soil pores hindering the solution movement and later the oil separation from used surfactant solution.

The aim of this work was to investigate the emulsifying properties of biosurfactants produced by Pseudomonas sp. The product of these bacteria is not pure rhamnolipid but its mixture or even complex with alginate. Their behaviour during emulsification process may differ substantially. According to potential applications of biosurfactants paraffin and rapeseed oils were used as oil phases. Emulsions were generated using biosurfactants (non purified), pure rhamnolipids mixture (JBR425) and alginate as emulsifiers. For comparison lecithin was also used as an emulsifier. The stability of emulsions was determined by measuring the intensity of both, the transmitted and backscattered light, in Turbiscan *Lab* apparatus.

Polybrominated flame retardants in sewage sludge. (review)

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This study complete review of literature, on the content of flame retardants in healing, effluents and sewage and fate of biodegradation. This kind of compounds are widely applied in the textile industry, electronics. This is strongly hydrophobic compounds with very low solubility in water, but are released slowly during the washing of clothing, from waste electronic products, etc. In the environment are moving very slowly. Accumulate in sediments in the wastewater in the bottom sediments of rivers and lakes and in the soil.

Total polybrominated diphenyl ethers (PBDEs) concentrations ranged from 142 to 18199 and DeBDE (BDE 209) concentrations from 0,6 to 18032 ng/g d.m. BDE 209 dominated the congener profile.

Keywords: Polibrominated flame retardants, PBDE, Wastewater treatment plant, WWTP, Sewage sludge

Ammonium removal through biological processes of partial nitrification and Anammox from wastewater with increased salinity

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This work is dedicated to treatment of wastewater with increased salinity from ammonium ions. In the work possibility of such wastewaters treatment using energy efficient process of partial nitrification/Anammox is investigated. It was shown that aerobic bacteria activity as well as activity of Anammox bacteria decreases with increase of salinity. The results of operation of two reactors working with different strategies of salinity increase are presented. It was shown that increase of salinity by 2.5 g/L every two weeks allows avoiding complete inhibition of bacteria and is acceptable for adaptation of bacteria culture to increased salinity. After salinity of wastewater was increased to 10 g/L reactor was operated during 92 days with average nitrogen removal rate of 0.39 gN/(m^2·day) and efficiency of nitrogen removal of 59 %. It was shown that conductivity can not be used for monitoring of the process when reactor is treating wastewater with increased salinity, whereas pH can be correlated to effluent ammonium concentration regardless of wastewater salinity.

Perspectives of bentonite clays application in the technology of heavy metal ions removal from industrial wastewaters

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This work is dedicated to development of technology of heavy metal ions removal from industrial wastewaters using methods of sorption of ions in static mode on bentonite clays of different layers of 2nd and 3rd horizon of Dashukiv part of Cherkasy deposit.

Concentration of metal ions was determined using iodometric and oxyquinoline methods with volumetric determination. The dependence of adsorption degree from sorbent layer thickness, concentration of initial solution (250, 500, 750 and 1000 mg/L) and temperature in time was investigated. Mineral and chemical composition of productive layers of Cherkasy deposit was determined. Results showed that sorption capacity for copper and zink ions depends on the origin of sorbent and its layer thickness. Maximum capacity for copper and zink ions in time as well as optimal temperature interval for running the process were determined.

On the use of natural sorbents for removal of microbial contaminants from water solutions

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Microorganisms with treated sewage are discharged into surface waters, compromising their sanitary state and causing need for special extensive water treatment prior to use for domestic and industrial needs. The aim of research was to explore the process of water treatment by adsorption method. Adsorption method has advantages over other methods – high treatment efficiency and high levels of disinfection. Moreover, this treatment does not remove useful minerals and salts from water.

In this investigation several kinds of sorbents were used: bentonite, zeolite and glauconite. These sorbents are characterized by sufficiently high adsorption capacity, selectivity and cation-exchange properties. Use of natural sorbents in water treatment technologies does not require their regeneration. Used sorbents can be used in chemical and construction industries or applied in agriculture. Therefore, water treatment using sorbents is a promising and relatively inexpensive method. In experiments, water, contaminated by monocultures of *Bacillus* sp. was used. Samples were analyzed for microbial number (MN) before and after application of treatment method. The results indicate high capacity of sorbents to adsorb microorganisms. This method allows removal of pathogenic microorganisms from water solutions to the required level.

Anoxic and anaerobic wastewater treatment in presence of aromatic hydrocarbons

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Advance biological wastewater treatment is performed in various ORP conditions including anaerobic, anoxic and oxic processes. For removal of specific industrial and petrochemical contaminants like aromatic hydrocarbons (BTX) the anaerobic treatment is recommended as the adequate alternative for their removal. Anaerobic treatment process is well known as an efficient method to degrade high strength wastewater. The investigations of the treatment processes were carried out in the laboratory anoxic reactor of the 5 L volume with a HRT 20 h and anaerobic reactor of the 2,5 L volume with a HRT 72 h and 144 h. The presence of aromatic hydrocarbons in municipal wastewater, in concentration from 1,0 to 12,0 mg/L a moderate negative influence these compounds on COD removal in anoxic and anaerobic processes has been shown. Decrease of COD removal in anoxic and anaerobic treatment was in the range of 15 to 40 % depending on the COD load in contrast to blank.

Keywords: aromatic hydrocarbons, BTX, biochemical treatment, anoxic conditions, anaerobic wastewater treatment

Municipal sewage treatment in upflow anaerobic filter

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In this work, an upflow anaerobic filter (UAF) for municipal sewage treatment was used. The studies ware carried out in laboratory scale. The treatment process was operated in psychrophilic conditions. The value of hydraulic retention time (HRT) in anaerobic bioreactor was 48 h and the temperature varied during the investigations from 15 to 20ºC. A real municipal sewage was taken from the treatment plant (WWTP – Tychy), operated in a full scale. The chemical oxygen demand (COD) of raw sewage ranged between 380 and 865 mgO_2/L. The sewage used ware additionally polluted with ammonia nitrogen – between 64 and 102 mg NH_4^+ /L, phosphate – between 22 and 31 PO_4^{3-}/L as well as sulphates between 15 and 115 mgSO_4^{2-}/L. The investigations comprised of tree series of different organic loading rates. Depending on values of sewage/organic loading rates 46 -72 % of COD were eliminated at psychrophilic conditions. The presence of ammonia nitrogen and sulphates did not have a negative impact on the process of organic matter degradation. Anaerobic treatment is effective in removing biodegradable organic compounds, but mineral compounds like NH_4^+, PO_4^{3-}, S^{2-} remained in high concentrations. Therefore these compounds require to remove by an additional post-treatment step.

Future urban sanitation to meet new requirements for sea water quality.

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Marine environments and many large inland seas are affected by discharges from several states. It is therefore natural that the various policy documents, agreements and declarations were developed to work together to solve water quality issues. For Europe the most important inland seas are the Baltic Sea (including the Baltic Sea, Kattegat and Skagerrak), Black Sea and Mediterranean Sea. Work with the "Convention on the Protection of the Baltic Sea" started in 1992 and came into force in 2000 with the Helsinki commission (HELCOM), as the responsible administrative body. For the Black Sea work began on the Black Sea Convention "Convention on the Protection of the Black Sea" in 1992 and came into force in 1994 with Bulgaria, Georgia, Romania, Russian Federation, Turkey and Ukraine as a signatory.

Key EU Directive includes the Urban Waste Water Directive (1991), Water Framework Directive (EU Water Framework Directiva, WFD) (2000), Baltic Sea Action Plan (BSAP) (2007) and the EU Marine Directive (2008). The EU is expected to have an ever increasing role in the coordinated actions for inner seas (Baltic Sea, Black Sea and Mediterranean Sea). A large part of the Danube River Basin is located in the EU (Bulgaria, Slovakia, Slovenia, Czech Republic, Germany, Hungary, Romania and Austria), and non-EU countries with the Black Sea as the recipient includes Russia, Ukraine and Turkey, but in need of coordinated environmental policy. The European Commission and Environment Ministers of the Baltic Sea countries decided 2007 on a joint action to achieve good environmental status for the Baltic Sea, the Öresund and Kattegat, with a focus on eutrophication, hazardous substances, biodiversity and maritime issues (shipping, accidents, emergency services etc.). For the Black Sea similarly eutrophication is identified as the main problem together with other problems such as hazardous substances and biodiversity.

Multicriteria comparative analysis using ecolabeling procedure: refrigerator's selection case study

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The article presents the idea of different single criterion and multi-criteria methods of analysis focusing on a method known as Analytical Hierarchy Process (AHP). The authors suggest designing the hierarchy of criteria based on the concept of sustainable development and on criteria originating from the ecolabeling programs. The physiological rationalization of AHP as well as the problems of introducing into the analysis the economical criteria are also discussed.

The application of the AHP method for selecting the refrigerator is presented. The hierarchy of criteria is build using the concept of sustainable development, and categories developed by the "Nordic Swan" ecolabeling procedure to evaluate the environmental impact of refrigerators. The practical difference between GWP and TEWI as an indicator of refrigerant's impact on the environment is discussed.

The analysis is conducted using the AHP-HIPRE software. The data for the analysis are the real data obtained from the leading producers and the weights are assigned by the authors. The sensitivity analysis of the obtained results is also presented.

Key words: multicriteria analysis, AHP, ecolabeling, sustainable development

One stage Deammonification process performance at low temperatures

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Temperature has a great influence on one stage partial nitriatation with Anammox process since it has significant impact on the microbiological growth rate, oxygen mass transfer and chemical equilibrium. The objective of the study was to investigate the influence of two different temperatures on one stage deammonification process in a Moving Bed Biofilm Reactor (MBBR). The study was carried out for 250 days in a MBBR pilot scale plant of 200 L volume. In this reactor 40% of the total volume was filled with Kaldnes biofilm carriers of K1 type and reject water from sludge digester was used as influent. Different factors such as dissolved oxygen, redox, pH and conductivity were monitored online. All the nitrogen fractions, alkalinity, COD were analysed every week for both the influent and effluent. Different groups of bacteria such as ammonium oxidizing bacteria (AOBs) and nitrate oxidizing bacteria (NOBs) were regularly monitored by different activity test such as (Specific Anammox Activity test-SAA, Oxygen Uptake Rate test-OUR and Nitrate Utilization test-NUR). The load was 2.5 $gN/m^2/d$ and DO was 1.5 mg/l at 19^0Cand at 16^0C the load was 1 $gN/m^2/d$ and DO was 1 mg/l.

In this study the results showed that despite the temperature was decreased from 19^0C to 16^0C the process efficiency was still as high as 80%. It was found that at 16^0C high value of $0.8gN/m^2/d$ for nitrogen removal rate was obtained with an influent load of $1gN/m^2/d$. SAA test showed a value of 1.5 to 1.8 gN / m^2d activity of Anammox bacteria. OUR test showed that Nitrosomonous are still dominating bacteria with a value for OUR of 2.14g O_2 $/m^2/d$ and OUR for heterotrophic bacteria was 0.63 g O_2 $/m^2/d$. Dissolved oxygen was the most crucial factor that needs to be optimized carefully while investigating the influence of temperature for anammox process.

Keywords: partial nitrification-anammox process; temperature; moving bed biofilm reactor (MBBR);

Removal of dissolved oxygen from water using the sulphite form anion exchange resin

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Deoxygenation is an important step in the preparation of high-quality industrial water for a wide variety of commercial-scale processes. Ultrapure water is used in various industries, including heat power plants (boilers), food industries (beer making), microelectronics (semiconductor fabrication), and oil and gas industries (as injection water). The present-day industries impose stringent requirements on the concentration of dissolved oxygen in process water.

The removal of dissolved oxygen (DO) from water was studied experimentally using anion exchange resin AV-17-8 in sulphite form. The effects of various operating conditions, such as water flow rates, height of the resin bed, mineralization of water and run time on the removal of DO have been studied extensively. The possibility of efficient water deoxygenation at ambient temperature has been demonstrated.

Key words: dissolved oxygen, anion exchange resin, sulphite, capacity

Biogas production from fish wastes in co-digestion with sewage sludge

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Anaerobic digestion of biomass is a commonly used process utilizing various types of organic waste for producing biogas. Digestion of fish wastes is possible but is currently not so much used.

The fish wastes are generated during fish pretreatment (gutting, heading and filleting). Depending on the efficiency of the processing about 40-50% of total fish catch goes for wastes. Fish wastes have great potential as a source for methane production but also have limitation (high content of ammonia). Digestion of fish wastes is possible with co-digestion, there main issue lies in balancing several parameters in the co-substrate mixture: macro- and micronutrients, C:N ratio, pH, toxic compounds, biodegradable organic matter and dry matter.

The aim of this work is to find optimal co-digestion substrates to enhance biogas production from fish wastes by determining the most proper ratios of different co-substrates. This work examines the potential for methane production from anaerobic co-digestion fish wastes, grass and sewage sludge.

The experiments were carried out in mesophilic temperature with using *Automatic Methane Potential Test System* (AMTPS II). This equipment automatically measures methane production from batch test. For batch test inoculum is needed and different source for inoculum were used. Initial results showed that sludge together with fish intestings produced 0.5 Nm^3 CH_4/kg VS compared to 0.3 Nm^3 CH_4/kg VS for grass and fish meat. Sludge and fish as well as grass and fish intestings produced 0.4 Nm^3 CH_4/kg VS.

Phenolic endocrine disrupting compounds in urban rivers: monitoring and application as wastewater tracers

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The research focused on a monitoring of phenolic endocrine disrupting compounds (alkylphenols and bisphenol A) in urban rivers of the Kharkiv region (Ukraine). The Lopan and Udy rivers have been sampled using POCIS passive sampling devices for the detection of degradation products of phenolic compounds and carbamazepine as a tracer of wastewater discharges. Principle component analysis was applied for the identification of the correlation between endocrine disruptors, wastewater tracer and general environmental parameters. Regional patterns of the occurrence and distribution of endocrine disruptors in urban rivers were discussed in the relation to industrial, domestic inputs and potential diffusive sources. The work discusses the perspectives of the application of passive sampling technique for the monitoring of time-varying organic pollutants. As the results, the POCIS-measured concentrations of alkylphenols were at maximum levels downstream of wastewater influences. Trace amounts of compounds were detected in sites upstream of wastewater discharges, i.e. in transboundary, rural and urban areas of the Kharkiv region, indicating additional inputs of alkylphenols and bisphenol A from non reported sources. Metabolites ratio of phenolic compounds have been applied to describe the contribution of potential sources of endocrine disruptors and to assess the wastewater treatment efficiency in the Kharkiv region. Ukrainian rivers were found significantly contaminated by the targeted phenolic endocrine disrupting compounds that can be explained by insufficient natural dilution of wastewaters, inefficient treatment processes at sewage plants and, possibly, inputs from uncontrolled sources.

Competitive interactions among bacteria in bioaugmented activated sludge during oil-containing wastewater degradation

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Fats, oils and greases (FOGs) are important and burdensome organic constituents of most wastewater. The amount of lipids in municipal wastewater is approximately 30 – 40% of the total organic matter, measured as chemical oxygen demand (COD). FOGs have been discharged from food industries, restaurants, slaughterhouse, household *etc*. High concentration of these compounds in wastewater often causes a major problem in biological wastewater treatment processes. Bioaugmentation is a method for enhancing biodegradation of lipids by addition of microorganisms (indigenous or genetically modified) or enzyme supplements for treatment of wastewater.

The aim of the study was the experimental verification of microbial supplement usage in long-term wastewater treatment process. Efficiency of COD removal, lipolytic activity, the composition of *Proteobacteria* community and biodiversity of activated sludge in two bioreactors: without and with microbial supplement, were taken into consideration.

The methods denaturing gradient gel electrophoresis (DGGE) based on 16S rRNA gene PCR products and fluorescent *in situ* hybridization (FISH) with 16S rRNA gene probes revealed differences in the microbial community structure in the two bioreactors. According to the results obtained in this study, a bioreactor with microbial supplement is characterized by higher microbial community diversity than non-bioaugmented bioreactor and there was a significant difference among the beta and gamma-proteobacteria content in the reactor with microbial supplement.

N_2O emission from a partial nitrification/anammox process in a Moving Bed Biofilm Reactor

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[2] IVL Swedish Environmental Research Institute.

Autotrophic nitrogen removal by a partial nitrification/ anammox process is considered to be more environmental friendly compared with a conventional nitrification/ denitrification process due to no need of carbon dosage, less oxygen demand, low amount of CO_2 and N_2O emissions. The aim of this study was to investigate the N_2O emission from a one stage partial nitrification / anammox process in a moving bed biofilm reactor under continuous and intermittent aeration conditions in a pilot scale application.

A moving bed biofilm reactor (MBBR), with working volume of 200 L, has been operated at the Hammarby Sjöstadsverk research station. The reactor was filled with 80 L of Kaldnes biofilm carriers (K1) and was continuously fed with anaerobic digestion supernatant. The reactor has run for 2 years at 25°C under different aeration strategies, characterized by the ratio between non - aerated and aerated phase duration (R) and a dissolved oxygen concentration (DO). During the last 6 months, on-line measurement of N_2O was introduced. The Unisense microelectrode and the Teledyne analytical instruments (Model GFC-7002E) were used to measure the N_2O gas concentration in the liquid and gas phase, respectively.

Results showed that N_2O production was related to the nitrogen loads, dissolved oxygen concentrations and a ratio between non-aerated phase and aerated phase (R). In partial nitrification / anammox MBBR, around 1.05% of nitrogen load was converted into N_2O gas. Based on the experiments, it was found that the N_2O emission was 1.15% of nitrogen load (as the average value) during continuous aeration and 1.03 % of nitrogen load during intermittent aeration. N_2O production was mainly due to AOB in an aerobic condition and to heterotrophic denitrifying bacteria in anaerobic condition.

Keywords: partial nitrification-anammox process; N_2O gas emission; moving bed biofilm reactor (MBBR); aeration strategies

PCR-DGGE as a useful method for bacterial diversity monitoring in coke wastewater treatment

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Increasing environmental pollution caused by inappropriate treatment of coke wastewater is a serious problem in wastewater treatment plants. Coke wastewater, containing phenols, cyanides and thiocyanates, are harmful for activated sludge biocenosis and causes serious technological problems. As a effective method for this kind of wastewater treatment Annamox (**An**aerobic **Amm**onium **Ox**idation) process seems to be useful. Wastewater treatment can be carried out in membrane bioreactors (MBR), regarded nowadays as convenient in the lab experiments, due to their small size, and in most cases an effluent of much better quality than conventional systems in terms of organic matter, suspended solids, and nutrients. In order to monitor the bacteria biocenosis, its development and changeability, two-MBR system of partial nitrification-Anammox was design. The aim of the study was to perform bacterial biodiversity monitoring using polymerase chain reaction - denaturing gradient gel electrophoresis (PCR-DGGE) method, known to be one of the most effective molecular method in microorganisms' biodiversity research. The 16S rRNA coding gene was used as a molecular marker. On the basics of fingerprint obtained in molecular method Shannon biodiversity index estimations for total bacterial community were performed. The research revealed that two MBRs inoculated with the same activated sludge differ in biocenosis structure, but not at the level of biodiversity.