A microbubble plasma reactor for pretreatment of lignocellulosic biomass [Abstract]

3.4. A microbubble plasma reactor for pretreatment of lignocellulosic biomass
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Biofuels production has received growing attention due to the rising concern over depletion of fossil fuel and increased greenhouse gas emissions from fuel combustion. Currently, world leading producers of bioethanol use food crops such as corn and sugarcane as the main raw material. However, use of food sources for biofuel production is not sustainable as most countries are struggling to feed their population. As a result, research efforts are now shifting to lignocellulosic biomass as a renewable source that does not compete with food production. In converting lignocellulosic material to ethanol, one of the main challenges is the accessibility of enzymes to cellulose that is shielded by lignin. To facilitate this access, biomass needs to be pre-treated to degrade the lignin structure prior to enzyme exposure.

Session 4. In Water Treatment System

4.1. Integration of ozonation and biological treatment of industrial wastewater from dye house
S. LEDAKOWICZ, R.ZYLLA, K. PAZDZIOR, J. WRĘBIAK, J. SÓJKA-LEDAKOWICZ (Poland)

The textile industry demands huge amounts of water which after a production cycle becomes environmentally burdensome wastewater, loaded with contaminations – dyes, textile auxiliaries, salts and other chemicals. An environmentally sustainable development policy in textile industry requires development of new technologies to reduce water consumption as well as negative environmental impact of discharged wastewater. Therefore, closing of the water cycle within the factories is a promising method of decreasing its environmental impact as well as operational costs. Among the many processes which can be applied to textile wastewater treatment the biological one is recognized as environmental friendly and ecological, however it is not sufficient to remove or degrade the recalcitrant pollutants. Therefore, the biodegradation is coupled with chemical oxidation mostly by ozone. The goal of present project was to develop an innovative technology combining chemical and biological methods allowing for effective treatment of wastewater and the closure of technological water in textile plants. In combined chemical-biological treatment, first was ozonation while biodegradation was a second stage. Furthermore, to examine the progress of degradation, measurements of organic carbon compounds content (BOD_5, COD, TOC), colour and toxicity towards *Vibrio fisheri* have been done.

4.2. Synergetic biological and chemical ozone oxidation for micropollutants removal from wastewater
B. DOMENJOUD, A. GONZALEZ OSPINA, E. VULLIET, S. BAIG (France)

The environmental and human health risks induced by the presence of trace contaminants on the environment are nowadays of general acceptance among the scientific community as well as for the public authorities. Urban wastewater treatment plants (WWTP) were not conventionally designed to deal with trace organic contaminants. They are perceived as a continuous and major source of emission of micropollutants. Tertiary ozonation has demonstrated high performances covering a wide range of contaminants elimination and to be economically suitable. This is supported by a growing number of serious studies and by the fact that national strategies usually opt for a solution including an ozonation step. Nevertheless, the implementation of tertiary ozonation on site supposes an ozone contactor that has a substantial footprint in regard to the available space on most of the existing WWTP. In addition, a subsequent biological step is frequently seen to limiting the emission of some undesired by-products, whose formation mainly depends on the application conditions of ozone. Ozone oxidation reactions with nucleophilic organic substances are highly selective. Based on this characteristic of ozone reactions, an innovative approach was designed. It consists in evaluating the performances of ozone oxidation integrated to conventional activated sludge (CAS) treatment for the removal of pharmaceuticals. Applications of ozone upstream the biological treatment and on the sludge recycling loop, both at a same time or separately, were tested. Integrating ozone before or into the biological treatment results in a much lower footprint than tertiary ozonation in contact chambers and makes use of the possible synergistic effect of the biological and chemical oxidations. This configuration also presents the advantage of making use of the biological activity to deal with the possible undesired ozonation by-products.

4.3. Advanced online control for ozone-enhanced biologically active filtration system for municipal water reuse
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The ozone-enhanced biologically active filtration (O3-BAF) process plays an important role in the investigated water reuse concepts. The treatment train incorporating O3-BAF has been shown to be more cost-effective since it minimizes or eliminates the need for reverse osmosis. Ozone oxidizes trace organic contaminants and provides pathogen disinfection credit while BAF provides additional polishing effect for residual by-products and organic (e.g., COD). Controlling the ozone dosage is crucial to achieve treatment goals while minimizing overdosing to reduce energy usage and formation of by-products, bromate and NDMA. Operators usually determine the ozone dose based on historic data and a worst case design basis, which is usually conservative and leads to overdosing in real-time conditions. An online monitoring and control system reduces the operational cost by using the ozone more effectively and avoiding overdosing. In this study, a pilot system was integrated with an ozone generator, an ozone contactor, two parallel biologically activated filters (BAF), three UV-VIS sensors, and a master programmable logic controller (PLC) system. A comprehensive pilot study was conducted for 4 month at the Western Butler County Authority (WBCA), in Zelienople, PA. The impact of applied ozone dose, BAF Empty Bed Contact Time (EBCT) and filter media type were evaluated in terms of organic removal. Results show 1 mg of ozone can generally eliminate 0.6 mg of COD under tested conditions (Ozone dose from 0 to 15 mg/L), and subsequent BAF treatment can further eliminate 8 – 12 mg/L of COD, depending on the EBCT. The pilot was also equipped with online sensors to monitor the environmental parameters such as COD, TOC and Ultraviolet Transmittance (UVT) for influent, ozonized and effluent samples. An advanced multi-loop on-line control system, which trims the applied ozone dose based on influent and effluent TOC (or COD), can automatically adjust the process to achieve treatment goals while optimizing ozone consumption. The performances of the O3-BAF system with and without online control are compared under different test conditions to determine its process and economic benefits.

4.4. Application of ozone assisted membrane cleaning for nom fouled graphene enhanced polyvinylidene fluoride membranes
R. KHAYRULLINA, C. TIZAOUI, C. SPACIE (UK)

The membrane technology has many applications that range from food to pharmaceutical industries. However, one of the most important applications of this technology is development of membranes for water and waste water filtration. Depending on the type (UF, MF, NF, RO), membranes are capable of exhibiting high levels of selectivity for the removal of desired contamination as well as maintaining high water flux. Despite the great relationship between selectivity and flux, membranes have tendency to accumulate particles on the surface and in the pores which in turn reduces water permeation. This process can be identified as fouling, where one of the main fouling materials is natural organic matter (NOM) that is typically present in raw water. Many researchers investigated the effects of ozone treatment for membrane cleaning using various methods and membrane materials. Although most organic membranes fail to withstand the ozone treatment, polymeric polyvinylidene fluoride (PVDF) membranes show high ozone resistance due to high crystallinity of PVDF. As well as excellent ozone resistance, PVDF membranes exhibit good mechanical strength, thermal stability and chemical resistance. Hybrid ozone/PVDF membrane system has many advantages including: achievement of efficient separation with stable flux under low filtration pressures; simplified, reliable and low cost process with minimal required space;