

Pb²⁺ REMOVAL FROM LIQUID PHASE USING A CHELATING RESIN : THE EFFECT OF OPERATING VARIABLES AND APPLICATION OF THE SHRINKING CORE MODEL

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EXTENDED ABSTRACT

In the present study the Pb²⁺ uptake by Lewatit TP-207 is examined in a batch type reactor, under different operating conditions. The effect of agitation (0-650 rpm) and temperature (35-65°C) is examined under the same Pb²⁺ concentration (500 mg/l). Agitation effect is more pronounced since by increasing the agitation rate from 0 to 650 rpm the uptake is increased by a factor near to 9, while by increasing the temperature from 30 to 65°C the uptake is increased by a factor near to 2. Temperature effect is more intense in the absence of agitation. Furthermore, the process is modeled using the shrinking core model. Sorption of heavy metals on a chelating resin is not an ordinary ion exchange process. It is the ion exchange accompanied by an ionic, non-reversible reaction. Levenspiel used a shrinking core model to describe the rate of fluid-solid non-catalytic chemical reactions. This model has been adapted in the present study to describe the sorption rates of Pb²⁺ on the chelating resin. The model is applied on batch reactor data, at 30°C and rigorous agitation (650rpm), under three different Pb²⁺ concentrations (100, 500 and 1000 mg/l). It is found that the process is controlled by the chemical reaction step rather than the diffusion processes (solid or liquid film diffusion). Despite the satisfactory application of the model on the experimental data, reaction rate constant is found to be concentration-dependent, a fact not expected from theory since the specific rate of the reaction is only temperature-dependent. Resin swelling concept is used in order to explain the results. Swelling of the resin is increasing the particle radius and according to the equations of the model, bead radius is affecting the fitting of the model on the experimental results. When resin beads are immersed into the solution, water uptake is taking place, almost immediately, resulting in a new "swollen" bead radius. This is not been taken into account in the related literature, as Levenspiel's model is using a constant radius. Then, it can be proved that the rate constant is not concentration dependent as this dependence is a result of the change of particle radius due to swelling.

Key words: chelating resin, lead, ion exchange, swelling, shrinking core model

THE EFFECT OF A COMMON ANTIBACTERIAL PHARMACEUTICAL (TRICLOSAN) ON BIOLOGICAL WASTEWATER TREATMENT PROCESSES

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EXTENDED ABSTRACT

Pharmaceuticals used as antibacterial agents are present in many health care products such as toothpaste, soap and cleaners and are often found in wastewater effluents. Triclosan is a typical antibacterial agent. Its effect on the various biological processes in a sewage treatment plant, such as activated sludge, nitrification and anaerobic digestion, is studied in this paper. Batch experiments with and without triclosan were conducted in parallel and at various triclosan concentrations using synthetic wastewaters (with acetate and carbonate as the source of carbon for the aerobic activated sludge and the nitrification experiments, respectively), so that the impact of triclosan on these processes could be assessed as a function of its presence and concentration. These experiments showed that triclosan decreased the efficiency of the activated sludge process, to a degree that depends on the concentration of the pharmaceutical. At a concentration of 10 mg triclosan/l, the chemical oxygen demand (COD) removal was decreased by 25-30% compared to the COD removal observed in the absence of triclosan (reference). The nitrification process was also affected significantly at a concentration above 6 mg triclosan/l.

Anaerobic digestion experiments were conducted in digesters operated continuously in a draw-and-fill manner at 35⁰C with a sludge retention time of 20 days. The feed contained, apart from glucose and other nutrients, triclosan at a concentration of 10 mg/l. The dissolved COD in the digester increased significantly over a period of approximately 80 days, exhibiting inhibition of methanogenesis, but in the sequel, the digester was able to recover.

All three biological processes studied were seriously inhibited by the presence of triclosan at concentrations in the range of 2-10 ppm. However, after a certain acclimation period, the microorganisms adapted to the bactericide presence of triclosan.

Key words: pharmaceuticals, triclosan, inhibition, wastewater treatment

SKY LUMINANCE DISTRIBUTION IN CENTRAL EUROPE AND THE MEDITERRANEAN DURING SUMMER PERIOD

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EXTENDED ABSTRACT

In this work the conditions of illuminance in Central Europe and the Mediterranean are studied and the prevailing sky luminance distributions are defined for the summer period. The data used are five-minute values of global and diffuse horizontal irradiance and illuminance along with zenith luminance from Bratislava and Athens for a period of five years. The study is based on the 15 theoretical sky types defined by Kittler et al., which are represented in diagrams of the ratio of zenith luminance to diffuse horizontal illuminance against solar altitude. Due to the fact that the theoretical curves converge and above 35° they are intersected, each observation is classified in one of the 15 sky types, only when the value of the ratio of zenith luminance to diffuse horizontal illuminance lies in a zone of $\pm 2.5\%$ around the theoretical curve, which describes the specific category. If any observation is classified in more than one sky types, the corresponding ratio of global horizontal illuminance to extraterrestrial horizontal illuminance is compared to the average ratios of the various sky types, for the same solar altitude and the observation is classified in the sky type with the nearest value. It is found that the most frequent sky types in Bratislava are: the white-blue sky with a distinct solar corona and the very clear sky with low illuminance turbidity, while in Athens the cloudless polluted sky with a broad solar corona prevails.

Key words: Sky luminance distribution; Zenith luminance; Diffuse illuminance; Daylight climate; Central Europe; Mediterranean