COMPARATIVE STUDY OF PHENOLIC DEGRADATION BETWEEN BIOLOGYCAL AND SOLAR PHOTOCATALYTIC SYSTEMS

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Abstract

Biological wastewater treatment methods are considered to be the most convenient ones owing to their efficiency and low economic cost. Activated sludge is the most popular biological method for treating wastewater, particularly those containing phenols (Allsop et al., 1990). However, in small communities (less than 20.000 p.e.) and low industrial effluents, the so called low-cost or ecological methods, such as lagoons and constructed wetlands can be the adequate choice (Kadlec and Knight, 1996). Nonetheless, many organic pollutants present mainly in industrial but also in urban wastewaters are refractory to bacterial degradation. Also, many of these effluents can result toxic for the treating bacterial populations

Photocatalytic methods can be an interesting alternative as pre-treatment to improve biodegradability and reduce toxicity of industrial effluents . Many different organic pollutants can be efficiently degraded by TiO_2-photocatalysis and the chance of using solar light increases the potential use of this Advanced Oxidation Technology (AOT) in many countries (Malato et al., 2003).

The combination of both sorts of methods (TiO_2-photocatalysis and constructed wetlands) can be a useful solution for the treatment of non-biodegradable and/or toxic organics found in industrial waters.

In the present work, phenol degradation by TiO_2-photocatalysis (UV-lamp and solar), wetland mesocosm reactors and their combination has been studied.

In the photocatalytic experiments, phenol initial concentrations were varied between 10-200 ppm and initial pH was 5. Lab experiments were performed in 250 mL glass vessels at constant aeration. Solar experiments were carried out in a 400 L pilot plant.

Experiments with wetland mesocosm were carried out in batch with reactors containing gravel and planted with common reed (*Phragmites australis*), papyrus (*Cyperus alternifolius*) and a control with only gravel. Water was recirculated with a 5-W pump (250 L/h).

Different initial phenol concentrations were tested to determine the efficiency of the wetland mesocosms. In all cases, the reed bed showed the highest performance. Also, phenol volatilization experiments were carried out with the three reactors by mowing the plants and covering the reactors with plastic film. The reed bed showed the lowest evaporation since almost no degradation difference was observed between the covered and uncovered reactors.

Since phenol photocatalytic degradation yields intermediates such as hydroquinone and cathecol, experiments on the effect of such intermediates were carried out to determine their effect on phenol degradation.

Figure 1 shows the obtained first-order kinetic degradation rates from photocatalytic lab experiments and those from wetland mesocosms.

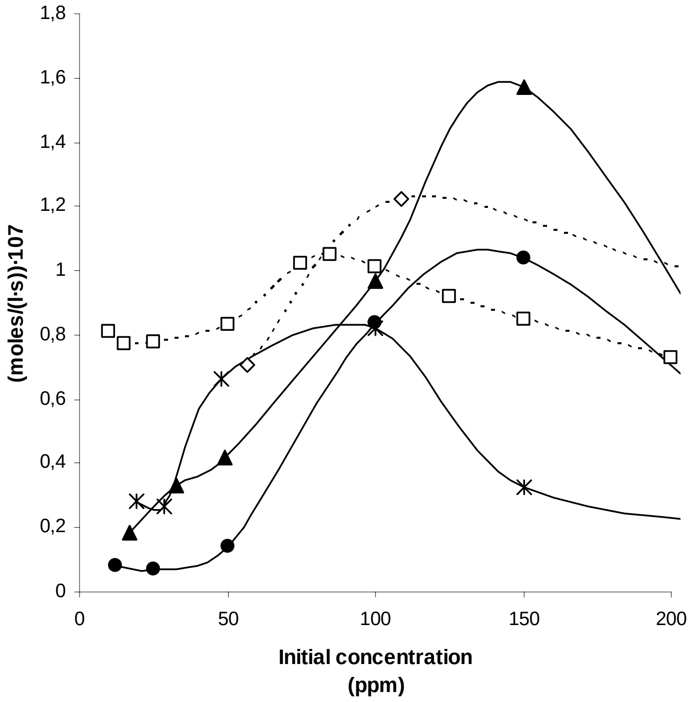

Figure 1. Phenol first-order kinetic degradation rates at different initial concentrations from photocatalytic treatment (in lab □, solar pilot plant ◊), wetland only gravel (ж), wetland with gravel + reed (▲) and gravel + papyrus (•).

According to the obtained results, the photocatalytic system seems to be more efficient than the wetland mesocosm reactor at concentrations below 100 ppm. Yet, the wetland mesocosm reactor with reed is more efficient at concentrations between 100-200 ppm. Above this range, both systems show notably lower efficiencies.

Also, the combination of both systems, solar photocatalytic and wetland, was tested. Results are quite interesting since the advantages of both system can result in an efficient, low cost system for phenolic wastewater treatment.

References.

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