PHENOLIC WASTES TREATMENT BY ADVANCED OXIDATION TECNIQUES AND WETLAND REACTORS

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Small hazardous waste producers, such as universities and research centres, generate small but greatly diverse waste streams. In these cases, hazardous waste management can be a rather complex, expensive task. The Canary Islands (Spain) are located about 2.000 km far from mainland. As a result, a large proportion of our waste management economic cost corresponds to their transport to treatment facilities in Europe. Additionally, other ethical aspects about waste export and related environmental risks must be considered. Thus, economic, simple techniques, such as natural biological methods and Advanced Oxidation Tecniques (AOTs) are welcomed.

TiO_2-photocatalysis is one of the most popular AOTs. When TiO_2 is irradiated with photons having energy equal or greater than the semiconductor band gap, radiation is absorbed and electrons are moved from the valence band to the conduction band giving rise to the formation of electron–hole pairs. Hydroxyl and other radicals can be generated and completely destroy many organic substances, and transform them into H_2O, CO_2 and mineral acids (Alfano et al., 2000). In addition to this, ozone is another strong oxidizing agent often used for remediation of contaminated groundwater, drinking water and refractory industrial wastewater (Uner et al., 2004).

Macrophyte-based treatment systems has gained international attention during the last two decades due to their simplicity, low construction costs and mantenience requirements (Hammer, 1989). However, much of the research on this field has been devoted to determine the effectivity of wetland plants to treat household effluents and discharges from small communities. Constructed wetlands have been used for the treatment of industrial wastewater, such as oil refining industry (Altmann et al., 1989), wood impregnation factory containing PAHs, BTX and phenolic compounds (Hine and Pilidis, 1995) and different xenobiotics including pesticides (Cheng et al, 2002). Yet, not much information is available on the use of wetlands and wetlands plants for the treatment of industrial waters containing toxic organics

Aqueous wastes containing very high TOC and phenol concentrations, 975 g/L and 350 mg/L, respectively, from a research lab were used as model waste. Wetland mesocosm reactors planted with Cyperus spp., were used as biological method. Basically, two AOTs (Advanced Oxidation Technologies) were tested, TiO_2-photocatalysis and ozonation. The experimental results were monitored by measuring phenol and TOC concentrations during 3 h of treatments. Ozonation provided the fastest phenol elimination, but the highest TOC reduction was given by photocatalysis. The best results were obtained by combining ozonation (2 h) followed by AC-TiO_2-photocatalysis (1 h). Wetland reactors were daily fed with the untreated waste to obtain initial TOC concentrations between 100-400 mg/L, while those of phenol were around 1.8 ppm. Phenol complete elimination was usually achieved in less than 3 h, while that of TOC required 2-3 days. Both AOTs and wetlands offer different advantages. In the election between AOTs, wetlands or a combination of both for the treatment of hazardous wastes, their volume and toxicity must be considered. Wetlands, owing to their low cost and simple design and operation, will be the proper system for small volumes of biodegradable, low toxic wastes. AOTs can be used as unique or pre-treatment method if that is not the case.

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