Heterogeneous catalytic ozonation of diethyl phthalate

Lobna Mansouri, Hussain Mohammed, Chedly Tizaoui, Latifa Bousselmi

ABSTRACT

Diethyl phthalate (DEP) is one of the phthalate esters having wide industrial applications, but its occurrence in the aquatic environment has been linked to disruption of the endocrine system. In this study, the removal of DEP with ozone alone (OA) and heterogeneous catalytic ozonation (HCO) with activated carbon (AC) was investigated. Results show that the addition of AC was effective to achieve almost 100% degradation of DEP in about 30 min using 2.86 g AC/L as compared to over 80 min without AC. It was also found that radical reactions were the main mechanism by which DEP was degraded and adsorption contributed significantly to the removal of DEP by OAC. Indeed, after 60 min, adsorption alone achieved about 75% removal, whilst OA achieved 92% removal. In contrast, as expected molecular ozone reactions were relatively insignificant. The contribution of adsorption and radical reactions to the overall removal of DEP were of similar rates at the beginning of the experiments but the latter declined due to competitive reactions. The notable decrease of DEP removal rate observed in the presence of radical scavenger tert-butanol (tb) indicates that the reaction between DEP and ‘OH proceeds mainly in the bulk of the aqueous phase. Moreover, the experimental results also revealed that in the absence of tb and after 40 min, almost 100% removal was observed as compared to only 64% when tb was added to the solution. This confirms that radical reactions play an important role in DEP removal by the OAC process. A model taking into account the various reactions in the bulk solution and on the surface of AC was developed and was found to predict well the experimental data. This study proves that HCO was effective to remove DEP and the changes of the contributory mechanisms underpinning the process were determined as function of time.

Keywords: Endocrine disruptors; Diethyl phthalate; Ozone; Heterogeneous catalytic ozonation; Activated carbon