BDE-209 – Kinetics of photodegradation in ethanol and water; influence of humic substances

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BDE-209 or decaBDE (2,2',3,3',4,4',5,5',6,6'–Decabromodiphenyl ether) is the most brominated flame retardant and it is applied in several materials such as plastics, electronic equipment and textiles to improve flame retardance properties by chemical and/or physical mechanisms (EHC162 1994). This flame retardant is already considered a priority contaminant and it is possible to find it in several environmental matrices such as air, soil, sediments and also in water, due to the manufacture, use and disposal of products in which this compound is applied (Pohl, Bosch et al. 2004; Vonderheide 2009).

Photodegradation is one of the major degradation pathways of contaminants in natural waters and the photodegradation of contaminants can remove them from the environment but, on the other hand, photoproducts of decaBDE may be more toxic than the parent compound. However, studies on photodegradation of BDE-209 have been conducted in organic solvents and at much higher concentrations than those which can be found in natural waters. Due to its high hydrophobicity, to date, no studies are known on photodegradation of BDE-209 in water, so this study aims to conduct a comparative assessment of the photodegradation of this compound in ethanol and water. This work includes the study of kinetics and the influence of aquatic humic substances on decaBDE photodegradation. In ethanol, the concentration of the irradiated solution of BDE-209 was about 2 mg/L and, in water it was about four hundred times lower (5 µg/L approximately). The concentration of BDE-209 in ethanol is of the same order of magnitude of a previous study (Xie, Chen et al. 2009); on the other hand, the concentration of BDE-209 in water is representative of levels found in environmental samples. Irradiation was performed in a sunlight simulator (Solarbox 1500) with an irradiance of 540 W/m^2 and during different time periods. Analysis in water was performed coupling two techniques: DLLME (dispersive liquid-liquid microextraction) for the preparation and preconcentration of the aqueous sample, and HPLC-UV for the quantification of decaBDE. The results show that BDE-209 photodegradation in water is much slower than in ethanol and that there is an evident influence of the natural

humic substances on decaBDE photodegradation.

References

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