Photodegradation of BDE-15 in Triton X-100 micellar solution

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PBDEs are frequently detected in water, soil, sediment and biota. They have been a major concern due to their persistence, bioaccumulation and even carcinogenicity.

This study has investigated the photochemical reactions of 4,4'-dibrominated diphenyl ether (BDE-15) in Triton X-100 (TX-100) solution by UV light. All photolysis experiments were performed in TX-100 solutions which were all above critical micelle concentration (CMC). BDE-15 photodegradation follows the pseudo-first-order kinetics under various conditions. The results showed that the degradation rates of BDE-15 increased with the increasing concentration of TX-100, and decreased when TX-100 was used in excess, because TX-100 can act as hydrogen donor, photosensitizer and light barrier. When the pH value was in the range of 1 ~ 11, the degradation rates increased with the increasing pH value due to the proton effect and free radical reaction. When pH reached 13, the corresponding degradation rate dropped significantly, which was attributed to the decreasing surface potential of micellar retarding the degradation process. BDE-15 was debrominated into 4-dibrominated diphenyl ether (BDE-3) and diphenyl ether (DE), subsequently. In addition, dibenzofuran (DF), ortho-hydroxydiphenyl and para-hydroxydiphenyl were identified as another group of photoproducts, indicating PBDEs can also undergo the photochemical rearrangement via C-O bond cleavage and recombination of the radical fragments.