34) Discussion of the photolytic decomposition of PFBS

Discussion of the Photolytic Decomposition of Perfluorobutane Sulfonate

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Questions on the photolytic decomposition of perfluorobutane sulfonate (PFBS) can be satisfactorily addressed by examining the photolytic behavior and decomposition mechanisms of related compounds. Based on photolysis studies of perfluorooctane-sulfonate (PFOS) and the mechanisms of photolytic decomposition of sulfonates, it is a reasonable proposition that PFBS is as resistant to light induced decomposition as PFOS.

Photolytic reactions occur by two types of mechanisms. The first mechanism, direct photolysis, can be defined as the direct absorption of a photon by the target species that leads to a chemical change.[1] Because PFBS has no absorbance over a wavelength range of 290-900 nm.[2] direct photolytic decomposition of PFBS cannot occur. The second mechanism, indirect photolysis, can be defined as a chemical or electronic excitation transfer from a light absorbing species to the test substance, which then undergoes some type of chemical change.[1] This type of decomposition involves production of a radical species which then reacts with the target substance. In the case of perfluorinated sulfonates, the ultimate result of such a reaction would be the rupture of the weakest bond in the molecule: the C-S bond.[3] Because the same functionalities are present in both PFOS and PFBS and that the same chemical bond is the site of decomposition, the reaction rates of the two with radical species should be very similar.

In a study on the photolytic decomposition of PFOS, neither direct nor indirect photolytic decomposition was observed based on loss of starting material.[4] None of the predicted degradation products were detected above their limits of quantitation. Mass balance for the degradation study was 100±11% under all experimental conditions. A minimum half-life for PFOS based upon that study was calculated to be ≥ 3.7 years.

The rates of photolytic degradation are highly dependent on aqueous environment and sunlight conditions. Given this limitation, the rate of decomposition of PFBS would be similar to those determined for PFOS in the same environment.

1. *Fate, Transport and Transformation Test Guidelines, OPPTS 835.5270 Indirect Photolysis Screening Test*; EPA712–C–98–099; United States Environmental Protection Agency, U.S. Government Printing Office: Washington, DC, 1998.
2. Grondin, J.; Sagnes, R.; Commeyras, A. Perfluorosulfonic Acids. III Hammett Functions of Perfluoroalkanesulfonic Acids and Mixtures with Antimony(V) Fluoride, *Bull. Soc. Chim. Fr.* **1976**, *11-12*, 1779
3. Dixon, David A.; *Fluorochemical Decomposition Processes* 3M Internal Report, Battelle Memorial Institute - Pacific Northwest Division, April 27, **2000**, pp 3 (See Public EPA Administrative Record, File AR-226)
4. Hatfield, T.L. *Screening Studies on the Aqueous Photolytic Degradation of Potassium Perfluorooctane Sulfonate (PFOS),* 3M Environmental Laboratory Report W2775 April 23, **2001** (See Public EPA Administrative Record, File AR-226)