

Effects of UV Irradiation Conditions on Decomposition of Perfluorinated Compounds in Aqueous Solution

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1. BACKGROUND AND OBJECTIVES

Perfluorinated Compounds (PFCs) have widely been used in many products because of their unique properties. However, PFCs are persistent and bioaccumulative. Recent studies revealed that PFCs contaminate the environment and PFCs have been recognized as micropollutant worldwide. Therefore development of the treatment is increasing their significance. This study focused on UV irradiation to treat semiconductor wastewater. Previous studies faced difficulties like 1) feeding PFCs concentration was higher than actual one and 2) process retention time was over 24 hours. The main objective was to study on the effects of UV irradiation conditions on decomposition of PFOA, PFNA, PFOS. In this study, Perfluorooctanoic acid (PFOA), Perfluorononanoic acid (PFNA) and Perfluorooctane sulfonate (PFOS) solutions were used. Each PFCs concentration was 10 µg/L to follow actual concentration in wastewater.

2. MATERIALS AND METHOD

(1) Oxidation with K₂S₂O₈ + H₂SO₄ aq

To examine the effect of K₂S₂O₈ + H₂SO₄ aq in *Milli-Q* water on decomposition of PFOA, PFNA, PFOS solutions, shaking experiment was conducted in 65°C, 100 rpm, within 24 h. by using of constant-temperature shaker.

(2) UV irradiation with chemicals

UV irradiation was carried out towards PFOA, PFNA, PFOS solutions. In this study, parameters were UV wavelength, reaction time, chemicals (Table 1).

(3) Analysis

The samples were analyzed by using HPLC-MS/MS

Table1 Parameters of UV irradiation experiment

Target compounds	UV wave-length (nm)	Concentration of chemicals(mol/L)		Reaction time (min.)
		K ₂ S ₂ O ₈ + H ₂ SO ₄ aq	NaCl aq	
PFOA	254,	8.1×10 ⁻² + 1.3,	—	10, 20,
PFNA	254 + 185	8.1×10 ⁻⁴ + 1.3×10 ⁻² ,	—	30, 60
PFOS		8.1×10 ⁻⁶ + 1.3×10 ⁻⁴	1.0	

after pretreated with solid-phase extraction.

3. RESULTS AND DISCUSSIONS

(1) Result of oxidation with K₂S₂O₈ + H₂SO₄ aq

98% of PFOA and PFNA were decomposed after shaking in 24h. On the other hand, PFOS was not decomposed. This result indicated K₂S₂O₈ + H₂SO₄ aq affect the decomposition of PFOA and PFNA only.

(2) Result of UV irradiation

Figure 1 shows efficiencies of UV irradiation to decompose PFOA, PFNA, and PFOS. After 60 min., UV irradiation with K₂S₂O₈ + H₂SO₄ aq decomposed 99% of PFOA and PFNA. 61% of PFOS was decomposed in 60 min. These experiments indicated that the decomposition rate were controlled by concentrations of K₂S₂O₈ + H₂SO₄ aq and reaction temperature.

4. CONCLUSION

UV irradiation with K₂S₂O₈ + H₂SO₄ aq decomposed 99% of PFOA and PFNA and also decomposed 61% of PFOS in 60 min. This study indicates the effects of K₂S₂O₈ on decomposition of PFCs by controlling concentration of chemicals and temperature of reaction in UV irradiation process. Further studies are required to apply the UV irradiation process for real water samples.

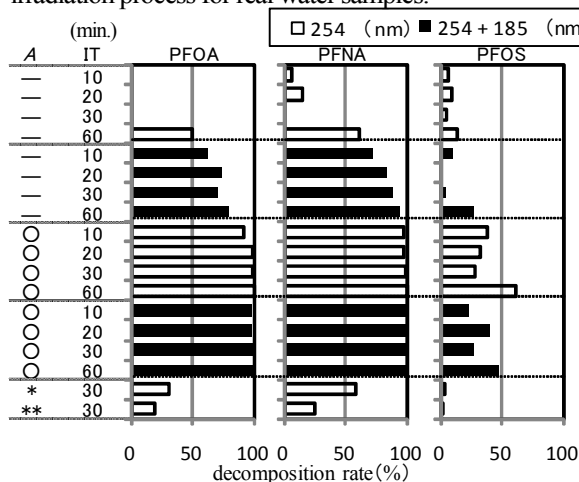


Fig.1 Example of UV irradiation experiments

A : K₂S₂O₈+H₂SO₄ aq; IT : irradiation time ;

*:100 times dilution of A; **:10,000 times dilution of A