-Communication-

Photocatalytic Degradation of Chloroform with TiO₂ Coated Glass Fiber Cloth

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1 INTRODUCTION

Pollution of river water, underground-water and tap water by organic chlorocompounds including trihalomethanes and organic solvents, has been recently a subject of public concern. Some studies about the degradation of such organic compounds by using TiO₂ powder as photocatalyst and UV light have been reported^{1,2)}. The decomposition reaction proceed fairly in these systems but it would be difficult to turn the systems to practical use, mainly because of the difficulty in separating the powder catalyst from water effectively and economically.

In the present study, the column type reactor system in which TiO₂ catalyst was fixed on the surface of a solid support, was constructed in order to develop a separation free system for the decomposition of the organic chlorocompounds. The decomposition of chloroform in water was tested.

2 Experimental

TiO₂ was coated on the surface of glass fiber cloth by means of the thermal decomposition of Ti-isopropoxide. The calcination temperature was 500 to 550°C. The glass fiber cloth coated with TiO₂ (anatase) was packed loosely in three pieces of quartz tube,

which were connected in series by using Teflon and glass tubes (Fig.1). The sample water containing 200 mg/l of CHCl₃ was circulated through the quartz tubes. The quartz tube columns packed with TiO₂ catalyst were illuminated with eight pieces of blacklight fluorescent lamp. Low pressure mercury lamp was also used instead of the black lamp. The temperature of the circulated water was controlled at 25°C or 40°C. The pH and concentrations of CHCl₃ and Cl⁻ were measured by means of glass electrode, FID-gaschromatograph and ion electrode, respectively.

3 Results and Discussion

Examples of the change in the pH and concentrations of CHCl₃ and Cl⁻ are shown in Fig.2. The results of the blank experiment, in which the sample water was circulated through the column without illumination, are also shown in the figure. In the blank experiment the concentration of Cl⁻ and pH value changed little but the concentration

Fig.1 Schematic illustration of the column reactor

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of CHCl_3 changed fairly with time. The change was thought mainly due to evaporation.

As the decomposition reaction proceeded, the decrease in the concentration of CHCl_3 and pH value and the increase in the concentration of Cl^- were observed.

The net change of the concentration of CHCl_3 , after the blank values were taken off, agreed fairly well (90 %) with the changes in the concentration of Cl^- and pH values, based on the stoichiometric reaction;

The net decomposed portion of CHCl_3 , after the correction for the blank was made, is shown in Fig.3. The run at 25°C and the run with small amount of the coated TiO_2 (run 1 and 2) showed small reaction rate. The run at 40°C with the TiO_2 catalyst calcined at 500°C (run 4) showed the largest decomposition reaction rate among the runs with

Fig.2 Changes of concentration of CHCl_3 , pH and concentration of Cl^- with time

experm. condition	pH	$[\text{CHCl}_3]$	$[\text{Cl}^-]$
blank	—△—	—●—	—○—
black light illum.	—○—	—●—	—○—
low press. Hg lamp	—□—	—■—	—□—

Fig.3 Net decomposed portion of CHCl_3

$$= \left\{ \left(\frac{C_b}{C_{b0}} \right) - \left(\frac{C_i}{C_{i0}} \right) \right\} / \left(\frac{C_b}{C_{b0}} \right)$$

C_b : concentration of CHCl_3 at time t in the blank experiment,

C_{b0} : initial concentration of CHCl_3 in the blank experiment,

C_i : concentration of CHCl_3 at time t in the experiment with UV illumination,

C_{i0} : initial concentration of CHCl_3 in the experiment with UV illumination,

Run	Cat. (TiO_2 amount)	Temp.	Illumination
1	A (19 g/m ²)	25°C	black light
2	B (18 g/m ²)	40°C	black light
3	A (19 g/m ²)	40°C	black light
4	C (48 g/m ²)	40°C	black light
5	C (48 g/m ²)	40°C	low press. Hg lamp

black light illumination. The run with low pressure mercury lamp (run 5) showed the maximum decomposition rate.

The results of the present study suggest the increased possibility of the practical application of the photocatalytic process to the water treatment.

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