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Study on environmental engineering application of photocatalyst immobilized using plasma spray coating technique

Tae Ho Kim[a*], Soo Wohn Lee[a], Huang Chen [a]
[a]Department of Materials Engineering, Sun Moon University

1. Introduction

Every year, massive green and red tides have occurred in coastal waters around the world. Both green and red tides can kill rapidly various species of caged fish and affect coral fishes, kill a few of them, and cause great economic loss and ecological damage. Related researches reveal that the formation of red and green tides is ascribed to the bloom of many kinds of algae species [1,2]. In order to reduce the fisheries damage by the red and green tides and protect ecological environment, suitable countermeasures should be taken. Recently, photocatalytic technology has been attracting much interesting in the field of environmental engineering application.

Photocatalytic reactions of nano-semiconductors are ideal and powerful to eliminate pollutants in air and water [3]. They arechemical stability, non-toxicity and high reactivity. Usually, ZnO, CdS, WO_3 and TiO_2 are used as photocatalysts for treatment of polluted water and air. Among them, TiO_2 is the best one [4]. Under UV light irradiation, electrons can be excited from the valence band of TiO_2 materials to conduction band, leaving photo-generated holes in the valence band [5]. Photo-generated electrons and holes play an important role in photocatalytic degradation of pollutants. In this work, we attempt to treat green tide and red tide with plasma sprayed TiO_2 coatings deposited on the foamed waste-glass.

2. Experimental Procedures

A commercial nano-sized TiO_2 powders (P25, 20-50nm, Degussa, Germany), was used to deposit photocatalytic coatings by plasma spraying technology. The foamed waste-glass is applied as the substrate with dimensions of $10\times10\times3.4cm^3$.

The purification test was carried out at room temperature (25℃). The coating sample was put into a batch reactor with 3 liter green tide or red tide and 1 liter nutritious water. Three lamps used in this work were 8W UV lights (386nm). The number of residual algae, transmission as well as pH value of the water was measured at regular intervals.

3. Result and Discussion

In this work, four kinds of tests (Blank, UV lamp, P25, P25 and UV lamp) were carried out for the green tide and red tide, respectively. Figure 3 shows the variation of the number of residual algae in the green tide and red tide with illumination time. It's noted that the number of algae in the

green tide increased largely in the first 3hours. It is ascribed to the reproduce of alga in the nutritious solution. It was found that the number of alga (chlorella) was higher for both P25 and blank tests. When the UV lamp turned on, the number of alga decreased quickly, indicating UV light is necessary to kill the algae. The lowest value(138×10^4) was achieved in the case using P25 coating as the photocatalyst and illuminated with UV lamp. In the case of red tide, the lowest value (3800) was also obtained in the case using P25 coating as the photocatalyst and illuminated with UV light. Moreover, it seems the UV lamp is not bale to kill the alga (prorocentrum micans) in the red tide as shown in Fig.3b. Without UV lamp, the P25 coating on the foamed waste-glass didn't work, because the number of alga in the red tide increased when illumination time went on as shown in Fig.3b. Hence, it can be concluded here that P25 coating on the foamed waste-glass is effective to purify the green tide and the red tide when they are illuminated by UV light.

Reference

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