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Photocatalytic Applications of Transformed Rutile Mineral

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The great leader Kim Jong Il said:

"We should exert every effort to develop science and technology, and thus overtake and outstrip other countries in this regard. We should work miracles in raising our science and technology to the highest world standard."

TiO_2 is chemically stable and has high photocatalytic activity, therefore many studies are vigorously carried out to use it as a photocatalyst and raw materials, preparations and applications are various.

Up to now photocatalysts were mainly made from titanium tetrachloride and buthoxytitanium [2－4] and there is no report on the use of rutile mineral.

This paper studied the applications of photocatalyst prepared by means of transforming method of using rutile mineral we had developed.

1. Decomposition Characteristics of Organic Compounds on Concrete Coated with the Photocatalyst

The sample was prepared using the same method as in the preceding research. [1].

To study photocatalysis, photolysis efficiency of the active red dye "2B－F",which is very stable under UV, was investigated on the photocatalyst.

1.1. Decomposition efficiency of active dye by the photocatalyst amount coated on the concrete

To determine the photocatalyst amount, various amounts of pure anatase samples were dispersed in a certain amount of distilled water and the surface ($50cm^2$) of concrete was smoothly coated with one of the dispersion solutions as mortar was almost hardened.

According to the method mentioned above, a series of concrete samples were prepared. A sample was sunk in a quartz glass beaker with 30ml of the dye "2B－F" ($11mg/dm^3$) for 48h under the dark condition to reach the saturated absorption and at that time the absorbance of the solution was regarded as the initial absorbance.

After UV irradiation for 1h, by measuring the absorbance of bleached solution using UV & visible spectrophotometer("UV－2201"), the decomposition efficiency was determined. The results were shown in the Fig. 1.

Fig. 1 showed that the maximum value was $2.4mg/cm^3$. As the catalyst amount increases

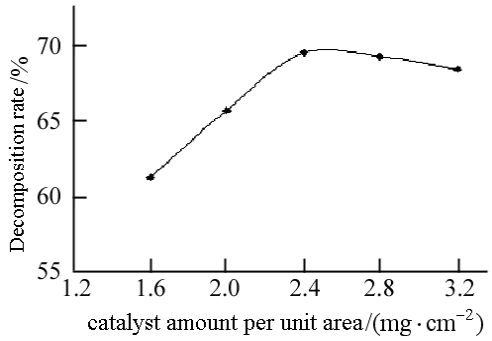

Fig. 1. Decomposition efficiency of the dye by catalyst amount

after the maximum value, the decomposition efficiency of the dye was decreased more and more. This is attributed to the desorption of absorbed dye on the photocatalyst. The more the photo catalytic amount per unit area, the more the absorption amount of dye, thus the amount of desorption increases.

1.2. Change of decomposition characteristics on various photocatalysts

In the case of the sample acid-treated after planetary ball-milling treatment, the decomposition efficiency was 92.2 % (94.5% for pure anatase).

The decomposition efficiency of sample treated by planetary ball-milling was 77.1%.

2. Photolysis Characteristics of the Dye by the Photocatalyst being Coated On Tile

2.1. Experiment

To determine the photocatalyst amount, the surface (20cm^2) of tile was coated with water glass (5%), various amounts of pure anatase samples were dispersed in 1～2 drops of distilled water and just as the tile was dried, the tile was smoothly coated with one of the dispersion solutions. According to the method mentioned above, a series of tile samples were prepared.

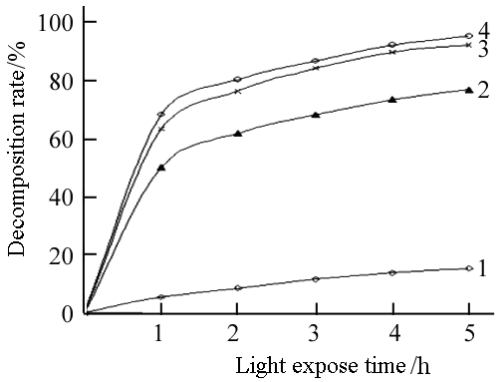

Fig. 2. Change in decomposition efficiency of active red dye by photocatalyst being coated on concrete
1—no catalyst, 2—ball milled sample, 3—ball milled and acid treated sample, 4—pure anatase

A sample was sunk in a quartz glass beaker with 30mL of the dye "2B-F" (11mg /dm^3) for 48h under the dark condition to reach the saturated absorption and at that time the absorbance of the solution was regarded as the initial absorbance.

And then under 250W UV light the absorbances of the solution were measured every one hour to determine the decomposition efficiency.

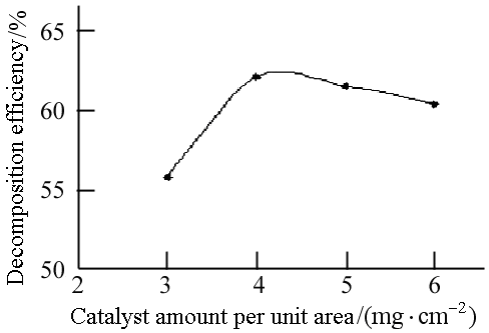

Fig. 3. Decomposition efficiency of the dye by catalyst amount

2.2. The optimal amount of photocatalyst

Fig. 3 showed a curve of the decomposition efficiency according to the amount of the catalyst. The optimum was 4mg/cm^3.

2.3. Change of decomposition characteristics on various photocatalysts

The result was shown in Fig. 4. As shown in Pic.4, when it comes to the case of the tile samples, the tendency was also similar to the case of the concrete samples.

The decomposition efficiency on photocatalyst treated by planetary ball mill for 10h was 71.9% under 250w UV light for 5h and this result was much higher than rutile mineral (41.9%).

But the decomposition efficiency on ball-mill treated, acid activated photo catalyst was 89.9% near to that of pure anatase(91.5%).

The high photocatalysis of only planetary ball mill treated catalyst is due to the increase of specific surface area and partial occurrence of lattice defect during treatment.

The ball-mill treated and acid activated catalyst reveals higher photocatalysis because surfacial rutile was transformed into anatase

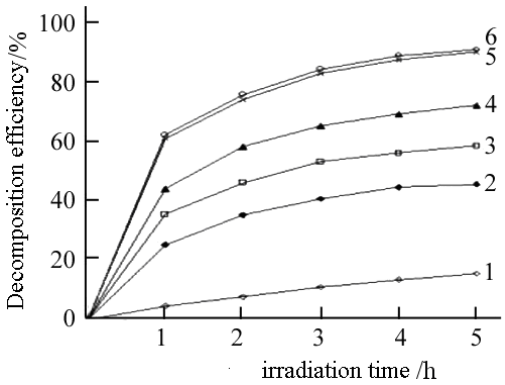

Fig. 4. Change in decomposition efficiency of active red dye by photocatalyst being coated on tile
1－no catalyst, 2－rutile mineral, 3－acid treated sample, 4－ball milled sample, 5－ball milled and acid treated sample, 6－pure anatase

Conclusion

It was investigated that good photo catalyst for facing could be manufactured by the mechano-chemical process from rutile mineral buried in our country.

The decomposition efficiency of active red dye by photo catalyst under the irradiation of 250W UV light was 77.1% in the catalyst processed by the planetary ball-mill and 92.2% in the acid-processed catalyst.

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