Photo-catalytically incidence of particle TiO2

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1 Introduction

The aim of this work was to test the photo-catalytic effects of the TiO_2 particles. The photo-activity of the TiO_2 particles is nowadays getting into the forefront of both scientific and technical interest. It uses the ability of the TiO_2 particles – after they are exposed to the UV radiation – for the degradation of various organic filths, germs, polluted water or soil, some noxious gasses etc. The research is focused on the escalation of particle firmness, possibilities of application on different mediums etc.

2 Photo-catalysis of TiO_2

Photo-catalysis is photochemical reaction. The acceleration of this reaction is escorted by present the catalyser. Photochemical reaction is inviting absorption of lights by materials, which molecules absorbed energy are broken up to radicals, ions or atoms. [1]

In actual time is a photo activity of Nan particle TiO_2 in front of scientific interests, on the score of hers general using in the area of innovate environment. Titanium dioxide belongs to mostly used photo-catalysers.

Photo-catalytically an effect of TiO_2 by the instrumentality of UV radiation at the normal temperature makes it possible to oxidative decomposing of organic structures and also bacillus. [2] The result of these effects is broken of all organic materials to elemental inorganic components. The superhydrophily induced by photo-catalytically way is the next important property of TiO_2. It offers a lot of possibilities of practical application. [3]

2.1 Photo-catalytically reaction utilization

Photo-catalytically reactions are exploited on cleaning of waters, air act. This technology is able to prevent contaminate of outside wall of buildings and also to compared with grow black glass covering of lamps in motorway tunnels, to prevent misting of frontal glass and driving mirror at the cars and next undesirable effects. [4]

3 Experimental part:

We used the TiO_2 particles: (AVO 1 – Pretiox, Degussa P25 and Solaronix SA – suspension 10 g/l TiO_2 in isopropylalcohol) for the experiment.

Pretiox is a fine crystalline powder without smell; density ρ = 3900-4100kg/m^3 (at 20 °C). The size of the nanoparticles is 0.15 - 0.40μm. Table 2 shows constitution of the TiO_2 pigment Pretiox.

Tab.1.:Constitution of the TiO_2 particles Pretiox: [5]

Components of product	Wt%
Titanium oxide TiO2	more than 92 (in solid)
Aluminium oxide Al2O3	less than 4
Oxide silicious SiO3	less than 1
Zirkonium oxide ZrO2	less then 1
Other inorganic matters	less than 0.5
Organic matters	less than 1

Degussa P25 is a fine crystalline powder without smell; specific surface area is 50 ± 15 m^2/g, moisture is $\leq 1{,}5$ % wt. Average primary particle size is 21 nm. Table 3 shows constitution of the TiO_2 pigment Degussa P25.

Tab.2.: Constitution of the TiO_2 particles Degussa P25: [6]

Components of product	Wt%
TiO_2 – content based on ignited material	≥ 99.50
Al_2O_3– content based on ignited material	≤ 0.300
SiO_2– content based on ignited material	≤ 0.200
Fe_2O_3– content based on ignited material	≤ 0.010
HCl– content based on ignited material	≤ 0.300
Sieve residue	≤ 0.050

The photo-catalytic effectiveness was tested by standard solution of the Orange 2 dye, with concentration c=0.01 g/l. Figure 2 shown diagram with CI ACID ORANGE 7 15510.

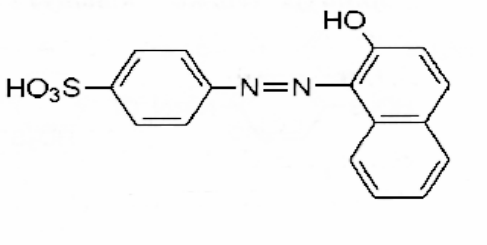

Fig.1.: *CI ACID ORANGE 7 15510* [7]

Particular photo-catalytic effects of TiO_2 were tested in this work. We used different quantities of TiO_2 and different periods of radiation. The standard solution of dye (20 ml) together with applicative quantity of TiO_2 was placed into the Petri-dish under the source of UV radiation. The distance between radiated solution and the UV lamp was 40 mm. Fig. 2 shows a diagram with the conditions of the radiation. The source of the UV radiation had the wavelength of 524 and 365 nm and the output of 2*8 W. Photo-catalytic effects were evaluated by the absorption of dye and the percentage of dye degradation.

Calculation of the percentage of dye degradation:

$$PDD = \frac{A_1 - A_2}{A_1} * 100$$

A_1 …….. Absorption of dye before radiation (zero quantity of TiO_2)

A_2 …….. Absorption of dye after radiation (applicative quantity of TiO_2)

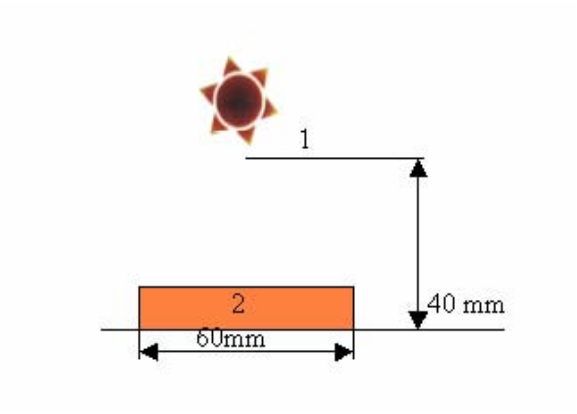

Fig. 2.: *conditions of the radiation*

Description: 1 - source of the UV radiation
2 - Petri-dish

4 Results and discussion:

Results are summarized on the fig. 3, 4 and 5. On this figures we can see that photo-catalytic effectiveness is not much changing with the quantity of the TiO_2 pigment. From the economic point of view it is more advantageous to use smaller weights with the acquisition of a good effectiveness. The time dependence shows that the strongest photo-catalytic effects are gained in the first 20 minutes. With a longer time of radiation we can get relatively constant progress of the dye degradation.

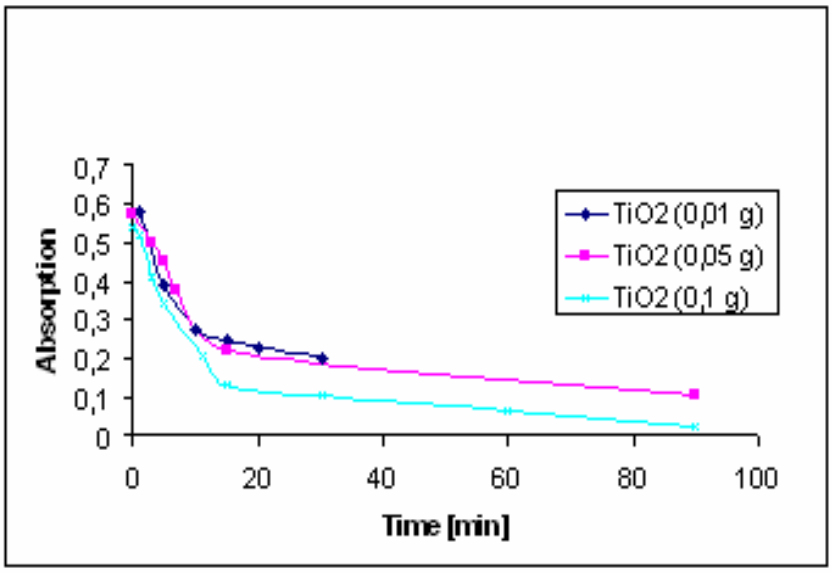

Fig. 3.: The photo catalytic effects of Pretiox at different quantities of TiO_2 and periods of the exposure to the UV radiation.

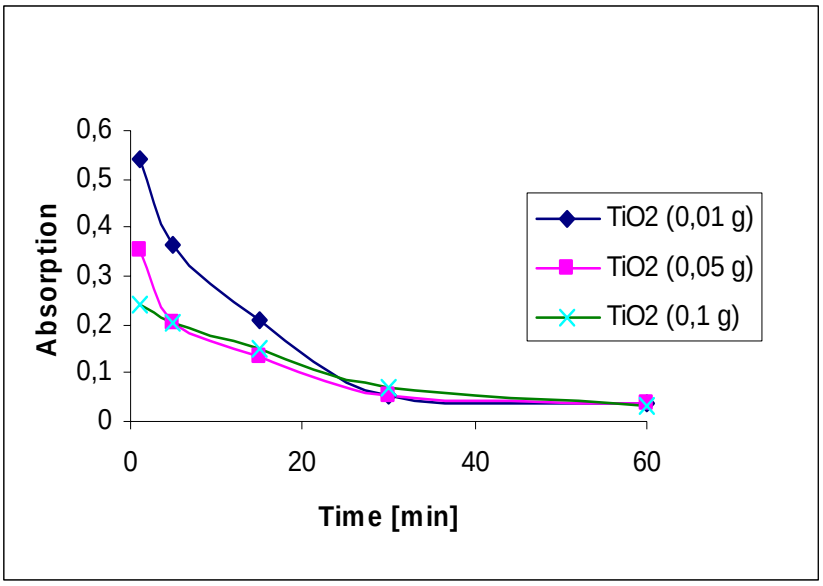

Fig. 4.: The photo catalytic effects of Degussa P25 at different quantities of TiO_2 and periods of the exposure to the UV radiation.

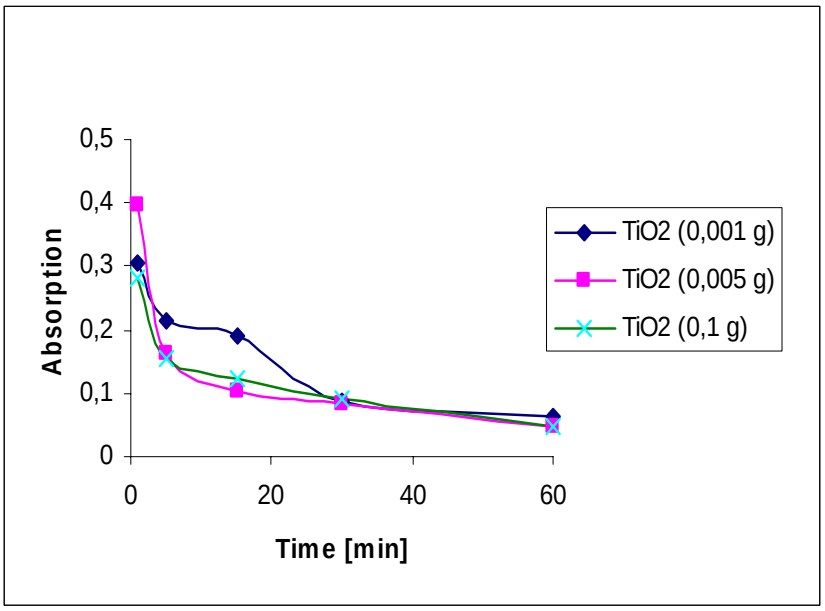

Fig. 5.: The photo catalytic effects of Solaronix SA at different quantities of TiO_2 and periods of the exposure to the UV radiation.

5 Conclusion:

The photo-catalysis is one of the most up-to-date methods used for the degradation of organic and partially inorganic filths. Nanoparticles of TiO_2 used as catalysts by photo-catalytic reactions prove excellent photo-catalytic effects at comparatively low concentrations and short times of radiation. Usage of this method for purification of polluted waters, soils, building facades etc. can lead to the improvement of the environment and life as well.

ACKNOWLEGNT

This work was supported by "Fotokat.", specific research of textile faculty and department of textile chemistry

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