

Reactions with the TiO₂ nanoparticles

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Abstract

In the article the photochemical dissociation of phenol in the participation of TiO₂ nano-particles and methyl3-aminocrotonate was done for the first time, the period was taken as 60 minutes, the processing of photochemical dissociation was verified by the curves drawn for reaction solution in the UV radiation “Varian Cary 50” device and the 60% decomposition of phenol was defined. Results confirmed by mass chromatography. The nano-TiO₂ were composed of rutile form TiO₂ by XRD. The size of nanoparticles was examined by TEM analysis and is about 10-30 nm general surface area of nanoparticles has consisted of 159.6 m²/g. Was carried photochemical degradation of phenol solution under UV irradiation by application of the photocatalytic performance of the synthesized nanoparticles. The phenol degradation was calculated using quantitative analysis, carried out on a 6890N GC-MSD gas chromatograph with an Agilent 5975 high-performance mass-selective detector. Prior to extraction, the pH value of the samples is reduced to pH <4.

Keywords: UV radiation, TEM, phenol, degradation, TiO₂

Introduction

TiO₂ nano-particles prepared for the process has been determined by TEM method and the results has been given in Picture 1. As seen from Picture 1 the sizes of the obtained nano-particles are homogenous and vary between 10-30 nm the results are according to the calculation with the Scherrer method. General surface area of nano-particles has consisted of 159.6 m²/g. TEM results have been according to the analysis of XRD.

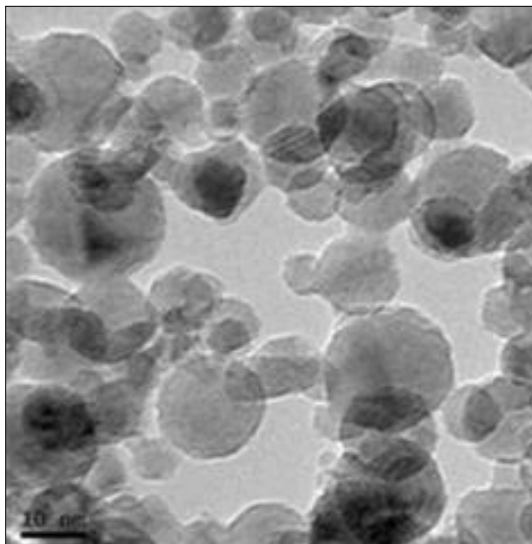


Fig 1: XRD appearance of TiO₂ nanoparticles

20 ml 1 mg/l phenol solution, 5 ml from the solution full equal disturbing 0,05 g TiO₂ nano-particles in it and 0,05 g methyl3-aminocrotonat have been taken for using in the process. Crotonats are usually used as fungicides. They are not dangerous for the environment.

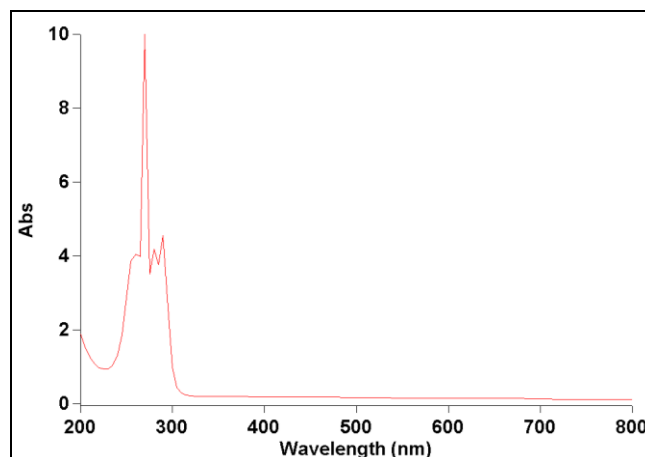
Analysis of the results

The matter is that we have considered more appropriate TiO₂ nano-particles as the works to be done by us have been

carried out in the participation of UV radiation, since TiO₂ nano-particles gets excited only during UV radiation ($\lambda < 387$ nm), it has only 5% excitement in the visible region [1, 2]. Furthermore, TiO₂ is chemically sustainable it is obtained in soft condition that's easily in the viewed case and the most important is that it is considered ecologically clean [3, 4].

In Graphic 1 it was given the dependence of absorption coefficient of the 5 ml solution with TiO₂, 20 ml 1 mg/l phenol solution, methyl3-aminocrotonate before the radiation on the wave length. It is clear from the graphic curve that the existence of curve in the 270 nm part which is characteristic for phenol in the solution is the evidence of the existence of the same substance.

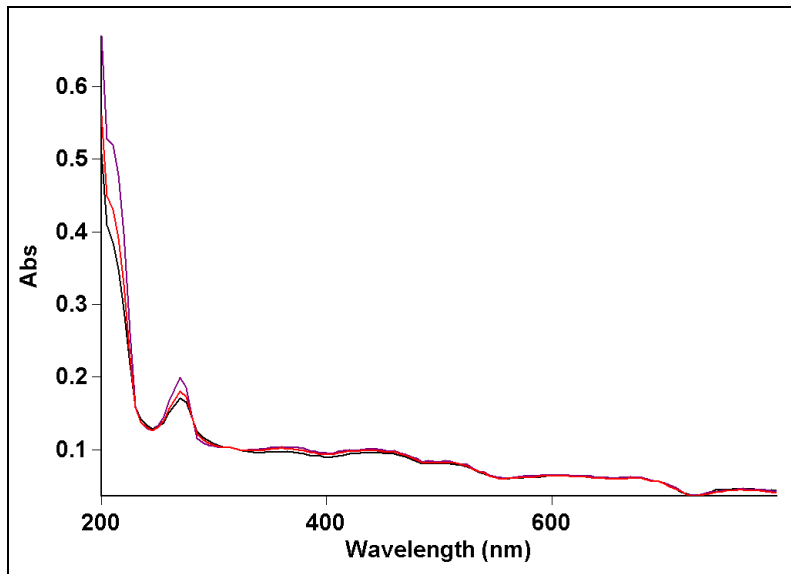
The works on the treatment of phenol from waste water in the participation of other composites with nano-particles are encountered in the world literature. It may be noted by referring the information that TiO₂ nano-particles has very good photo-dissociation together with combinations with N atom [5-7].



Graph 1: UV radiation curve of Ph+TiO₂/N

In Graphic 2 it is given the comparison of the curves obtained after photolysis process. It is seen from the graphic that the curves which are characteristic for phenol (270 nm)

is reducing gradually so that it is the dissociation of the ceratin part of phenol in the process.



Graph 2: UV radiation in the system of Ph+TiO₂/N (for 20,40,60 minutes)

The following are the chromatographic curves of the sample after the photolysis process (Picture 2).

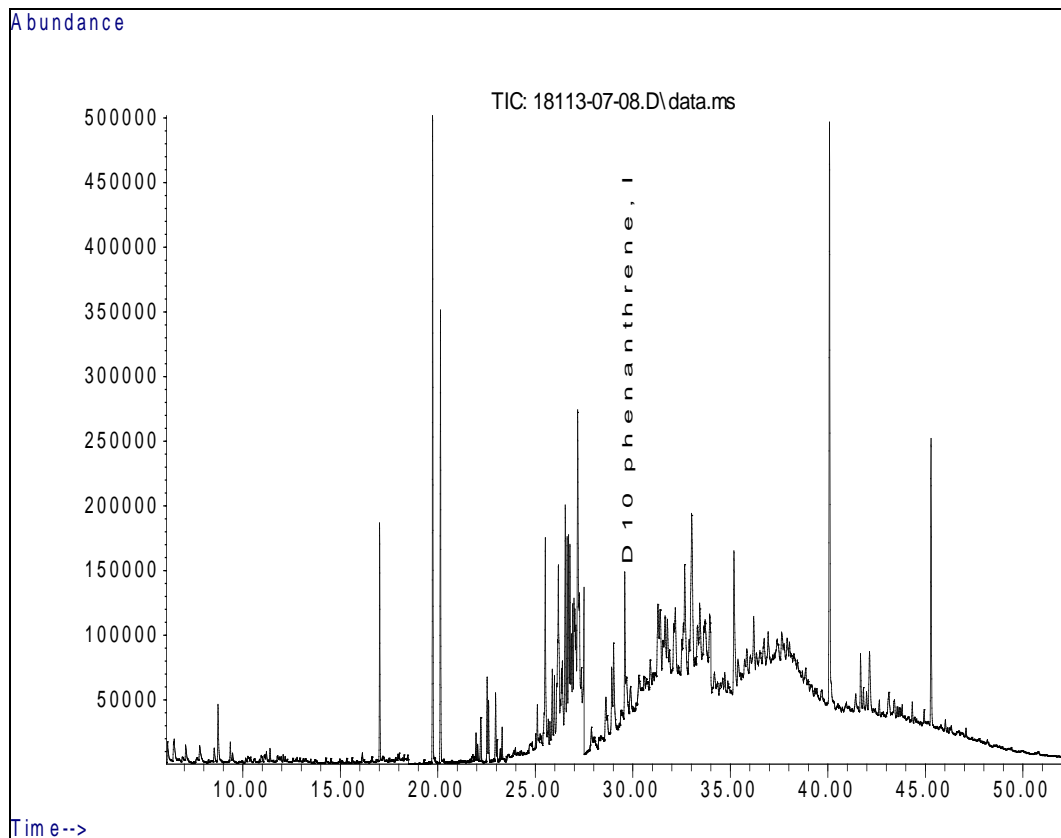


Fig 2: The general view of the chromatographic curves of the Ph+TiO₂/N system

This article has been directed to the solution of ecological problems for the environmental protection. So the dissociation of toxic substances from contaminated water through nano-particles is considered one of the most important and topical issues. In the modern area the contamination of water basin is the most important of the global ecological problems. As the fresh water reserve is getting reduced, maximum working out of treatment

methods of waste water and reducing the toxic substances to minimum are the most topical issues.

Results

1. The sizes of TiO₂ nano-particles are homogeneous and vary between 10-30 nm, the results are according to the calculations with Scherrer method. General surface area of nano-particles has consisted of 159.6 m²/g. TEM

results coincide with the results obtained from the analysis of XRD.

2. Dissociation of phenol from phenol solution in the participation of methyl3-aminocrotonate and upon the photo-analytic characteristics of synthesized TiO₂ nanoparticles has been carried out with UV radiation.
3. Dissociation of phenol in the participation of TiO₂ nanoparticles and methyl3-aminocrotonate has been 60%.

References

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