SYNTHESIS AND CHARACTERIZATION OF FLY ASH/TiO_2 PHOTOCATALYTIC NANOCOMPOSITES

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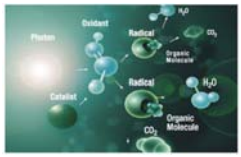
INTRODUCTION

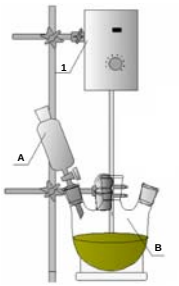


Water pollution problems have been an important issue correlated negatively with the health and the environment. One of the most important materials, used in water purification processes like photocatalysis, is titanium dioxide (TiO_2), which is widely used due to its high photocatalytic activity, nontoxicity and low price. Fly ash, a waste material produced in large quantities in coal burning power plants or steel mills, can be used as an effective catalyst carrier what results in higher catalyst efficiency and enables easier separation of a catalyst after process.

Nanocomposites were obtained by preparation route which primarily included fly ash modification by hydrochloric acid (HCl) in order to get higher specific surface of fly ash. The content of fly ash in the nanocomposite samples was from 16 to 20 %. Some samples were prepared with addition of small amount of commercial TiO_2 P25 Degussa (1-3 %).

EXPERIMENTAL

Preparation of fly ash/TiO_2 nanocomposites



1 mechanical stirrer (250 rpm)

A 2.1 ml Bardac 22
60 ml apsolute EtOH
20 ml H_2O

B 20 ml tetrabutyl titanate
20 ml apsolute EtOH
20 ml 3M AcOH
fly ash (FA4)

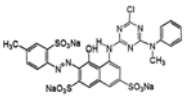
- reaction time **24 h** at **85 °C** in dryer

Composition of studied samples

Sample	TiO_2 (TiB)	FA4	TiO_2 (Degussa P25)
	mass %		
TiB	100	-	-
FA4/16-TiB	74	16	-
FA4/20-TiB	80	20	-
FA4/20-TiB-1	79.2	19.8	1
FA4/20-TiB-3	77.6	19.4	3

Photocatalysis

- quartz tube hosting *mercury lamp (UVP-Ultra Violet Products)*
- 75 mg catalyst/75 ml RR45 (c (RR45)= 30 mg/dm^3)
- model contaminant azo dye *C.I. Reactive Red 45 (RR45)*



Scanning electron microscopy (SEM)

- *Tescan VEGA 3*

X-ray diffraction (XRD)

- *Shimadzu LabX XRD-6000*

UV/Vis spectrophotometer

- *Perkin Elmer Lambda EZ 201*
- λ= 542 nm

FTIR spectroscopy

- *Spectrum One, Perkin Elmer*
- v = 4000 – 650 cm^{-1}

RESULTS

❑ FTIR spectroscopy

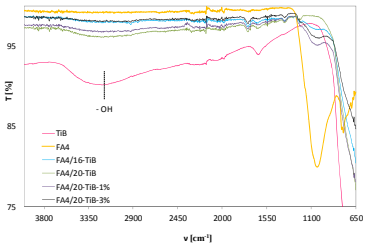


Figure 1 FTIR spectra of TiB 400, FA4 and FA/TiO_2 nanocomposite samples

❑ XRD analysis

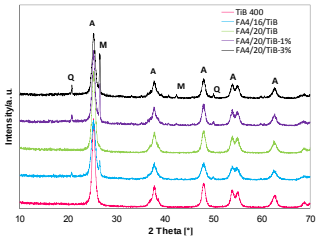


Figure 2 XRD patterns of TiB 400 and FA/TiO_2 nanocomposite samples with diffraction peaks of anatase (A), mullite (M) and quartz (Q) phase

❑ Photocatalysis

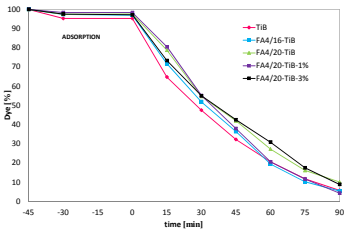


Figure 3 Photocatalytic activity of TiB and FA/TiO_2 nanocomposite samples

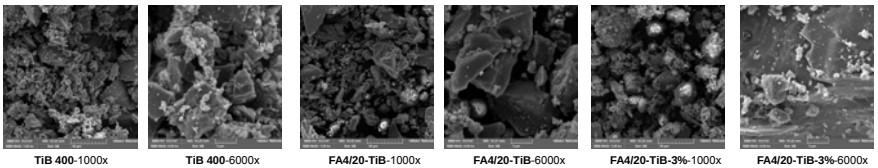


Figure 4 SEM images of TiB 400, FA4/20-TiB, FA4/16-TiB-3% with different magnification (1000x and 6000x)

Table 1 Content of dye on photocatalyst after desorption process

Sample	Dye %
TiB 400	6.67
FA4/16-TiB	7.95
FA4/20-TiB	14.08
FA4/20-TiB-1	5.70
FA4/20-TiB-3	11.61

CONCLUSIONS

- XRD analysis showed the presence of crystal phases of quartz, mullite (from fly ash, typical maximum 26.52° 2Θ) and anatase (from TiO_2, typical maximum at 25° 2Θ).
- SEM micrographs show that TiO_2 synthesis results in formation of typical anatase crystal structures of different crystal sizes. The micrographs of fly ash/TiO_2 nanocomposites showed modified morphology in comparison to pure TiO_2.
- The adsorption process of RR45 dye onto photocatalysts is minimal (the highest content is up to 4%).
- Fly ash/TiO_2 nanocomposite samples show good photocatalytic activity, especially for the sample FA4/20-TiB-1.
- Desorption process reveals that very low dye content remains on the photocatalysts after photocatalytic process.

ACKNOWLEDGEMENT

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