

SYNTHESIS AND CHARACTERIZATION OF FLY ASH/TIO₂ **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 (TiO₂), 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 (HCI) 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 TiO₂ P25 Degussa (1-3 %).

EXPERIMENTAL

<u>Preparation of fly ash/TiO₂ nanocomposites</u>

- mechanical stirrer (250 rpm)
- A 2.1 ml Bardac 22 60 ml apsolute EtOH $20 \text{ ml H}_2\text{O}$
- 20 ml tetrabutyl titanate Β 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)

<u>Scanning electron microscopy (SEM)</u>

• Tescan VEGA 3

<u>X-ray diffraction (XRD)</u>

Shimadzu LabX XRD-6000

UV/Vis spectrophotometer

- Perkin Elmer Lambda EZ 201
- $\lambda = 542 \text{ nm}$

FTIR spectroscopy

- Spectrum One, Perkin Elmer
- $v = 4000 650 \text{ cm}^{-1}$



RESULTS





Figure 1 FTIR spectra of TiB 400, FA4 and FA/TiO₂ nanocomposite samples

□ XRD characterization



Figure 2 XRD patterns of TiB 400 and FA/TiO₂ nanocomposite samples with diffraction peaks of anatase (A), mullite (M) and quartz (Q) phase

Photocatalysis



Figure 3 Photocatalytic activity of TiB and FA/TiO₂ nanocomposite samples

□ SEM characterization







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ble 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
14.00



CONCLUSIONS

- XRD analysis showed the presence of crystal phases of quartz, mullite (from fly ash, typical maximum 26.52° 2 Θ) and anatase (from TiO₂, typical maximum at 25° 2 Θ).
- SEM micrographs show that TiO₂ synthesis results in formation of typical anatase crystal structures of different crystal sizes. The micrographs of fly ash/TiO₂ 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/TiO₂ 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.

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