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Magnetically-extractable magnetite-silica-titania photocatalyst and its application in the degradation of 4-chlorophenol

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Statement of the Problem: For several decades, pollutants arising from industrial and household activities have been emitted into the soil, lakes, rivers and seas without any treatment and monitoring, causing serious damages to the wild life and to human health. Among the pollutants that have raised great concern, there is a large variety of organic compounds since many of them are persistent substances and are not easily degraded through conventional methods. Heterogeneous photocatalysis utilizing slurries of TiO_2 is presented as an alternative treatment to degrade organic pollutants in water. Despite high efficiencies have been reported for the application of TiO_2 in the degradation of organic compounds, its application in slurry reactors is still very challenging due to difficulties in the post-extraction of the catalyst, which currently restricts its application in scaled-up reactors.

Methodology & Theoretical Orientation: As TiO_2 is illuminated by UV, there is the generation of photoexcited electrons and valence band holes. Both species can act in the mineralization of organic compounds. A composite based on magnetite, silica and titania was synthesized in an attempt to make the application of photocatalysts in slurry reactors more practical. The titania mass composition was studied and the composites were characterized by several techniques.

Findings: An active magnetically-extractable photocatalyst based on magnetite, silica and titania was successfully produced. The material was able to degrade 4-chlorophenol from water. It demonstrated to have similar efficiencies at pH ~3 and ~7. A titania texture was observed to grow on magnetite-silica particles as the titania composition increased.

Conclusion & Significance: The growth of titania is more favorable on silica rather than directly on magnetite. The development of magnetically-extractable photocatalyst particles could make heterogenous catalysis in slurry reactors more practical, nevertheless it is also necessary to be accompanied by the development of magnetic reactors.

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