THE EFFECT OF PEROXYDISULFATE ION ON THE PHOTOCATALYTIC EFFICIENCY OF BiOI

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Heterogeneous photocatalysis is a promising method for eliminating organic substances from water. The efficiency of TiO_2 and ZnO, the most often used and commercially available photocatalysts, is based primarily on the hydroxyl radical ($^{\bullet}OH$) generation and requires UV light. Several photocatalysts have been synthesized during the last decades, which aim to enhance the efficiency of the separation of the photogenerated charges and decrease the energy required for the generation of electron-hole pairs, making to be more cost-effective this process. The operation of photocatalysts, which can be excited by visible light radiation, is mainly based on direct charge transfer. Their efficiency can be enhanced via the application of electron scavengers, especially if the electron scavenger transforms into a more reactive species than $O_2^{\bullet-}$. In this work, the effect of peroxydisulfate ion ($S_2O_8^{2}$, PDS) was studied in the case of BiOI photocatalysts [1]. PDS is an effective electron scavenger, and the formed $SO_4^{\bullet-}$ is a potent oxidizing agent having similar reactivity and potential (E_0 = 1.9 – 2.7 eV) as $^{\bullet}OH$ (E_0 = 2.6 – 3.1 eV) [2]. Thus, applying PDS enhanced efficiency is expected due to the hindered recombination of photogenerated charges and the formation of reactive $SO_4^{\bullet-}$.

The transformation of 1,4-benzoquinone (BQ) and sulfamethoxypyridazine (SMP), and trimethoprim (TRIM) was studied in the presence of PDS in UV (398 nm), and visible light irradiated suspensions. BiOI photocatalyst was proven to be efficient even under visible light irradiation. The PDS addition highly enhanced the transformation rate of both BQ and SPM, while SMP transformation was very slow, and PDS had no positive effect. The reusability test of the photocatalyst showed that the photocatalytic activity did not decrease during three consecutive cycles, and PDS did not cause any structural change in the photocatalyst.

The effect of matrix and matrix components should be investigated for practical reasons. The impact of the biologically treated domestic wastewater as a matrix, and the effect of its main inorganic anions, such as Cl^- and HCO_3^- were studied. The reactions between these ions and $SO_4^{\bullet-}$ produce $Cl^{\bullet-}$, $CO_3^{\bullet-}$ and can affect the transformation rate and way of organic substances. Our results showed that the efficiency of the BiOI photocatalyst had deteriorated significantly, partly because of the organic substances adsorbed on the surface of the BiOI and partly because of the structural changes caused by the HCO_3^-. The harmful effect of HCO_3^- could be partially prevented by lowering the pH.

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References
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