REMOVAL OF METHYLENE BLUE FROM WATER USING TiO_2 IMMOBILIZED ON A POLYMER SUPPORT

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Abstract

Among the water treatment technologies, advanced oxidation processes (AOPs) present great potential for treating a broad spectrum of contaminants. AOPs involve the *in-situ* generation of highly reactive oxygen species with low selectivity such as hydroxyl radicals, hydrogen peroxide, ozone, and superoxide anion radicals, providing complete mineralization to CO_2, H_2O, and inorganic ions or acids [1]. Titanium dioxide (TiO_2) is the best-known photocatalyst, and it was examined in a tremendous number of studies. The TiO_2 can be either immobilized or suspended in the reactor. Although the suspended system has the advantage of a larger surface area as compared to the immobilized system, the necessary separation of the catalyst particles is expensive and constitutes the main disadvantage in the commercialization of this system [2]. Adding polymer as support has been widely used in immobilized TiO_2 preparation to produce photocatalyst with improved mechanical strength, adsorption capability, and surface morphology [3]. The present study aimed to investigate the efficiency of three materials in which TiO_2 (Hombikat) was immobilized on polyvinyl chloride (PVC) support. For the preparation of the TiO_2/PVC materials, a patent-protected commercial formulation of PVC was used. TiO_2/PVC materials had a different mass ratio of TiO_2 to PVC (1, 2.5, and 5%) and were in the form of tablets (diameter of 5 mm and thickness of 2 mm). The efficiency of materials was tested for the removal of methylene blue (c_0 = 2.45·10^{-5} mol dm^{-3}) under the influence of simulated solar radiation (SSR) (I_{UV} = 0.223 mW·cm^{-2}; I_{vis} = 208.5 mW·cm^{-2}). Experiments were also conducted in the dark to investigate the contribution of adsorption to the total removal efficiency. All of the TiO_2/PVC materials showed greater removal efficiency compared to direct photolysis. The optimal mass ratio TiO_2 towards PVC to total removal efficiency was 2.5%. For the most efficient system 2.5%TiO_2/PVC/SSR, the influence of the solution volume as well as the mixing rate was also examined. From the obtained results, it can be concluded that for an optimal volume of 30 cm^3, the optimal mixing rate was 490 rpm. It was found that the optimal number of tablets was 29. The overall effectiveness of methylene blue removal for optimal reaction conditions and by using the most efficient system 2.5TiO_2/PVC/SSR was the highest at pH 4.6.

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References

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