

Rapid Degradation of High-Concentration Methylene Blue in the Combined System of Plasma-Enhanced Photocatalysis Using TiO₂-Carbon

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Abstract : The present study aims to investigate the degradation of methylene blue (MB) using TiO₂-carbon (TiO₂-C) photocatalyst combined with dielectric discharge (DBD) plasma. The carbon materials used in the photocatalyst were activated carbon and graphite. The thin layer of TiO₂-C photocatalyst was prepared by ball milling method which was then deposited on the plastic sheet. The characteristic of TiO₂-C thin layer was analyzed using X-ray diffraction (XRD), scanning electron microscopy (SEM) with energy dispersive X-ray (EDX) spectroscopy, and UV-Vis diffuse reflectance spectrophotometer. The XRD diffractogram patterns of TiO₂-G thin layer in various weight compositions of 50:1, 50:3, and 50:5 show the 2θ peaks found around 25° and 27° are the main characteristic of TiO₂ and carbon. SEM analysis shows spherical and regular morphology of the photocatalyst. Analysis using UV-Vis diffuse reflectance shows TiO₂-C has narrower band gap energy. The DBD plasma reactor was generated using two electrodes of Cu tape connected with stainless steel mesh and Fe wire separated by a glass dielectric insulator, supplied by a high voltage 5 kV with an air flow rate of 1 L/min. The optimization of the weight composition of TiO₂-C thin layer was studied based on the highest reduction of the MB concentration achieved, examined by UV-Vis spectrophotometer. The changes in pH values and color of MB indicated the success of MB degradation. Moreover, the degradation efficiency of MB was also studied in various higher concentrations of 50, 100, 200, 300 ppm treated for 0, 2, 4, 6, 8, 10 min. The degradation efficiency of MB treated in combination system of photocatalysis and DBD plasma reached more than 99% in 6 min, in which the greater concentration of methylene blue dye, the lower degradation rate of methylene blue dye would be achieved.

Keywords : activated carbon, DBD plasma, graphite, methylene blue, photocatalysis

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