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Photodecomposition of Urea in the Presence of Titanium Dioxide

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Abstract

Urea is used as a fertilizer, food supplement, and also as raw ingredient for the production of polymers and pharmaceuticals. If urea is not adequately processed, it can accumulate in the environment and pollute groundwater and surface water. Although urea is biodegradable, it has negative impacts on aquatic creatures in the long run. It causes eutrophication and algal blooms in waters. Therefore, as a feasible solution, the development of efficient photocatalysts for the breakdown of urea is essential. In this study, titanium dioxide (Merck 21 nm anatase) was used as a catalyst by applying a thin layer of TiO₂ onto glass sheets (1 cm×1 cm), the active surface. Such coated glass sheets were placed in prepared 400 nm urea solution exposed to UV light for 120 minutes. The concentration of urea was detected 15 minutes time intervals for the kinetic analysis. Urea concentration with the UV exposure time was determined by the spectrophotometric method. This approach determines the amount of water soluble urea in the medium via fast, accurate, and low-cost manner. The urea was determined based on its ability to inhibit the reaction between bromate ion with HCl reaction. The reaction was monitored spectrophotometrically at 505 nm by decolorization of methyl orange dye with bromine and chlorine produced by the reaction products. Results indicate that urea decomposition in UV irradiated solutions were faster than in the dark under the same conditions. Approx. 22 wt.% of urea was degraded within 120 minutes of UV irradiation when compared to 3.9 wt.% decomposition with the dark condition experiment. In addition, titanium dioxide plated glass sheets proved to be stable in repeated urea degradation cycles.

Keywords: Photocatalysis, Urea degradation, Titanium dioxide