Comparative study on photocatalytic oxidation and photolytic ozonation for the degradation of pesticide wastewaters

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ABSTRACT

Photocatalytic oxidation and photolytic ozonation have been employed to remove carbendazim, a commonly used fungicide. The effect of catalyst dosage, ozone dosage, and initial solution pH on the reaction was investigated. In the photocatalytic oxidation process, the optimum catalyst dosage and pH were found to be 1 g/L and 4, respectively. In the photolytic ozonation process, the optimum ozone dosage was 0.48 g/h and pH was 9. The pseudo first order rate constants achieved were 0.0212 min⁻¹ for photolytic ozonation and 0.0103 min⁻¹ for photocatalytic oxidation. Both treatment processes were compared based on the pesticide removal and mineralization. The results showed that photolytic ozonation performed better with 98% removal and 85.4% mineralization was achieved, whereas only 85% removal and 62.2% mineralization in photocatalytic oxidation after a treatment time of 3 h.

Keywords: Photocatalytic oxidation; Photolytic ozonation; Pesticide; Carbendazim

1. Introduction

The occurrence of emerging or newly identified contaminants in our water resources is of continued concern for the health and safety of consuming public. Water polluted with pesticides constitutes an increasing environmental pollutant, mainly in places such as India, where intensive agriculture is an important activity. During the last decade, the unregulated manufacture and usage of pesticide chemicals have had much more deleterious effects on our environment, than the benefits it bestowed to the society. So the use and manufacture of any pesticide is now a subject matter of controversy, not only in India but as well in abroad. Further, from pesticide manufacturing and formulating industries undesirable compounds are being released, knowingly or unknowingly, into the aquatic environment and because of the persistence and potential adverse effects the presence of pesticides has been recognized as a major issue in many countries [1]. Due to their chemical characteristics, they resist in variable degree the photochemical, chemical and bio-chemical degradation [2]. The current wastewater treatment methods adopted in industries are solar evaporation or biological treatment systems which are not effective in elimination of these different classes of pesticides.

In the last decade, a lot of research has been addressed to a special class of oxidation technique known as advanced oxidation processes (AOPs), pointing out its potential prominent role in the wastewater treatment [3,4]. These treatment processes are considered as very promising methods for the remediation of ground and...