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ORIGINAL PAPER

Removal of COD and decolorizing from landfill leachate by Fenton's reagent advanced oxidation

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Abstract Aqueous oxidation treatment of COD and color in landfill leachate with the combination of hydrogen peroxide and ferrous ion, Fenton reagent, has been studied. The effect of variables such as concentration of both reactants and pH has been investigated. Best concentrations seem to be 0.6 and 3.0 mol/L for H_2O_2 and Fe^{2+} ion, respectively. The other important variable, pH of landfill leachate should be near 7. From the experimental results can be known the determined process was the generation of hydroxyl radicals involving in advanced oxidation. Oxidation rates are even higher than those of other advanced oxidation systems involving ozone, UV radiation, and hydrogen peroxide.

Keywords Landfill leachate · COD removal · Decolorizing · Fenton reagent · Hydroxyl radicals

Introduction

Production of municipal solid waste (MSW) has increased markedly in the recent decades, simultaneously with accelerated population growth. Until recently, the commonest disposal method for MSW in China was burial in controlled landfills, an economical method, such as Hangzhou Tianziling Landfill, Xi'an Jiang Cun Gou Landfill, and Nanjing Shuige Landfill. However, landfill leachate contains high levels of chemical oxygen demand (COD), biochemical oxygen demand (BOD), color, and NH_4^+-N, which is one of the most difficult types of wastewater to be treated. In spite of the fact that two-stage up-flow anaerobic sludge bed-sequencing batch reactor (UASB–SBR) system (Sun et al. 2010) and three-stage aged refuse biofilter (Li et al. 2009) process can offer an efficient removal of NH_4^+-N and COD from the landfill leachate, being high operating expense, weak tolerance to shock loading and less settleability problem at high-loading rates still limit the development of the wastewater process. Excess COD will consume a huge amount of dissolved oxygen and leads to the anaerobic condition of the receiving water stream; and the color, highly recalcitrant in nature, not only hampers the aesthetics, but also blocks the passage of sunlight required for photosynthetic activities by the phytoplankton in receiving waterbody.

In recent years, advanced oxidation processes using ozone (O_3), titanium dioxide (TiO_2), Ultraviolet (UV), and Fenton's reagent (H_2O_2 and Fe^{2+}) have received considerable attention as effective pretreatment processes of less biodegradable wastewater (Lee et al. 2003). Among them, Fenton's reagent has been widely used because it is effective, easy to treat, reacts well with organic compounds and does not produce toxic compounds during oxidation (Jasudkar et al. 2012; Ojinnaka et al. 2012; Xiao et al. 2011; Zhang et al. 2011; Chitra et al. 2011). In fact, Fenton's reagent, a mixture of hydrogen peroxide (H_2O_2) and ferrous sulfate ($FeSO_4$), has been utilized to treat pigment (Kim et al. 2004) and dye wastewater (Nilesh and Sanjeev 2006). The process is based on the formation of highly reactive species, hydroxyl radicals, which react unselectively with many organic and inorganic compounds. The investigators found that Fenton oxidation is effective in degrading organic compounds and decolorizing of the wastewater that contains various types of reactive, acidic, and disperse dyes. Fenton oxidation has also been applied to treat other various types of industrial wastewater (Juan and Mari 2008; Silva et al.

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