Recent Advances in Advanced Oxidation Processes

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Advanced (Chemical) oxidation processes (AOP) differ from most conventional ones in that hydroxyl radical(OH·) is considered to be the primary oxidant. Hydroxyl radicalcan react non-selectively with a great number of organic and inorganic chemicals. The typical rate constants of true hydroxyl radical reactions are in the range of between 109 to 1012 sec-1.

Many processes are possible to generate hydroxyl radical. These include physical and chemical methods and their combinations. Physical means involves the use of high energy radiation such as gamma ray, electron beam, and acoustic wave. Under an applied high energy radiation, water molecules can be decomposed to yield hydroxyl radicals or aqueous electrons. Chemical means include the use of conventional oxidants such as hydrogen peroxide and ozone, two of the most efficient oxidants in the presence of promoter or catalyst. Hydrogen peroxide in the presence of a catalyst such as divalent iron ions can readily produce hydroxyl radicals. Ozone in the presence of specific chemical species such as OH- or hydrogen peroxide, can also generate hydroxyl radicals. Finally the combination of chemical and physical means can also yield hydroxyl radicals. Hydrogen peroxide in the presence of acoustic wave or ultra violet beam can generate hydroxyl radicals. The principles for hydroxyl radical generation will be discussed. Recent case studied of AOP for water treatment and other environmental of applications will be presented. These include the treatment of contaminated soils using electro-Fenton, lechate treatment with conventional Fenton, treatment of coal for sulfur removal using sonochemical and the treatment of groundwater with enhanced sonochemical processes.