Applications of Hydrogen Peroxide

Hydrogen Peroxide for Dechlorination Process

Chlorine and sodium hypochlorite are widely used in different industrial branches as oxidizers, disinfectants or bleaching agents. As a result, chlorine and sodium hypochlorite are present in many industrial wastewaters, e.g. process effluent from chlor-alkali plants, from chemical and metallurgical processes where chlorine is used as an oxidizing agent, from industrial bleaching operations, from cooling water chlorination and from off-gas scrubbing.

Due to its high toxicity chlorine has to be removed completely from wastewater before it is released into a municipal sewage system or receiving water. The chlorine resp. hypochlorite concentrations to be treated can range from a few milligrams per liter to more than 100 grams per liter.

Hydrogen peroxide is the environmentally friendly and cost-competitive dechlorination agent. In comparison to sulfur chemicals such as sodium bisulfite or thiosulfate, hydrogen peroxide does not add any sulfate contamination to the effluent. The reaction of hydrogen peroxide with dissolved chlorine (Cl2) respective sodium hypochlorite (NaOCl) only produces water, sodium chloride and molecular oxygen. The latter aerates and increases the dissolved oxygen content in the effluent. Hydrogen peroxide reacts stoichiometrically with hypochlorite at any pH between 7 and 14. It is effective at concentrations that range from parts per billion up to percentages. The reaction takes place so rapidly that typical peroxide decomposition catalysts like dissolved heavy metals or caustic have no negative effect. Although oxygen is produced, bubbles will not generally form at low chlorine concentrations because water dissolves almost 10 ppm of oxygen at room temperature. Oxygen may effervesce in more concentrated solutions, where venting space must be provided.

When elemental chlorine is dissolved in water, an equlibrium between Cl_2, HOCl and $^-$OCl is established. In basic media with pH above 7 the reaction takes place according to the following equation:

$$NaOCl + H_2O_2 \rightarrow NaCl + H_2O + O_2$$

In acidic media with pH lower than 7 the reaction beween hypochlorous acid and hydrogen peroxide still occurs but at significantly slower rates. The reaction with sodium hypochlorite is highly exothermic. When concentrated solutions of sodium hypochlorite are treated, cooling could be necessary.

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