ABSTRACT

The textile dyeing industry is considered to be the most polluting among all the industrial sectors. Most of the dyes are carcinogenic in nature and are not amenable to biological oxidation or chemical methods of treatment. Among the other organic contaminants in industrial wastewater, salicylic acid has been identified as a pollutant which arises from paper milling and cosmetic industries. At present treatment of industrial effluents is being carried out by different techniques such as filtration and coagulation, membrane filtration technologies, adsorption and by chemical oxidation. The techniques such as filtration and membrane technologies are not satisfactory due to various reasons.

Adsorption has been found to be an important method for the removal of organic contaminants. It has been widely used for the removal of dyes and various organic compounds. In the last few years advanced oxidation processes (AOPs) havebeeen found to be an effective method for the destruction of organic contaminants in water. Among the various AOPs, semi-conductor mediated photocatalysis in the presence of UV/sunlight has been found to be the most promising technique.

The present study aims at the removal of organic contaminants by adsorption and destruction of organics by photocatalytic oxidation. The effect of various parameters such as pH, catalyst loading, initial concentration,

temperature, the kinetics and reaction mechanism for both the techniques have been studied.

Adsorption of direct red 31 and salicylic acid has been carried out on activated carbon in a batch reactor. It has been observed that the adsorption of dye is more in the neutral pH region. Whereas the adsorption of salicylic acid has been found to be favourable in the acidic medium. The Lagergren's kinetic equation has been found to be valid and adsorption follows first order kinetics. The adsorption data fits into Langmuir isotherm model.

Azo dyes such as direct red 31, direct yellow 12, acid black 52 and salicylic acid has been found to undergo complete degradation on irradiation with UV or sunlight in the presence of ZnO. Among the various semiconductors tested TiO_2 and ZnO have been found to be very effective to ZnS and WO_3 in the degradation of the dye. The ZnO has been found to be more effective than ZnS in the degradation of direct red 31. Sunlight mediated photocatalysis has been found to be more effective in the degradation of the dye. The degradation rate of dyes increases linearly with increase in pH from 4 to 10 in the presence of ZnO. Whereas the degradation of salicylic acid has been found to be favourable at neutral pH. All dyes and salicylic acid have been completely mineralised to carbon dioxide, water and other unharmful inorganic ions such as sulphite, sulphate, nitrite and nitrate. The total organic carbon (TOC) of the degraded solutions has been determined experimentally

using a batch photocatalytic reactor. The TOC values determined have been found to tally with the theoretical values.

The reaction has been found to follow pseudo first order kinetics. The mechanism of the degradation reaction can be explained on the basis of Langmuir-Hinshelwood model. The hydroxyl radicals have been identified as primary oxidants in the photocatalytic degradation reaction. This has been confirmed by the increase in the degradation rate on addition of hydrogen peroxide and decrease in the rate of the degradation rate on addition of isopropyl alcohol.

Adsorption technique has been found to be useful method for the removal organic contaminants. However, complete removal of organics has not been achieved. Sunlight mediated photocatalysis has an advantage of utilising the naturally abundant radiation source and an enhancement of destruction rate. The photocatalytic degradation is an effective tool for the complete minearlisation of organics and for recycling of treated water.