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Synthesis and Characterization of Cobalt Oxide and Cu-Doped Cobalt Oxide as Photocatalyst for Model Dye Degradation

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Abstract : Major water pollutants are dyes from effluents of industries. Different methods have been tried to degrade or treat the effluent before it is left to the environment. In order to understand the degradation process and later apply it to effluents, solar degradation study of methylene blue (MB) and methyl red (MR), the model dyes was carried out in the presence of photo-catalysts, the oxides of cobalt oxide Co_3O_4, and copper doped cobalt oxides $(Co_{0.9}Cu_{0.1})_3O_4$ and $(Co_{0.95}Cu_{0.05})_3O_4$. They were prepared from oxalate complex and hydrazinated oxalate complex of cobalt as well as mix metals, copper, and cobalt. The complexes were synthesized and characterized by FTIR. Complexes were decomposed to form oxides and were characterized by XRD. They were found to be monophasic. Solar degradation of MR and MB was carried out in presence of these oxides in acidic and basic medium. Degradation was faster in alkaline medium in the presence of Co_3O_4 obtained from hydrazinated oxalate. Doping of nanomaterial oxides modifies their characteristics. Doped cobalt oxides are found to photo-decolourise MR in alkaline media efficiently. In the absence of photocatalyst, solar degradation of alkaline MR does not occur. In acidic medium, MR is minimally decolorized even in the presence of photocatalysts. The industrial textile effluent contains chemicals like NaCl and Na_2CO_3 along with the unabsorbed dye. It is reported that these two chemicals hamper the degradation of dye. The chemicals like $K_2S_2O_8$ and H_2O_2 are reported to enhance degradation. The solar degradation study of MB in presence of photocatalyst $(Co_{0.9}Cu_{0.1})_3O_4$ and these four chemicals reveals that presence of $K_2S_2O_8$ and H_2O_2 enhances degradation. It proves that H_2O_2 generates hydroxyl ions required for degradation of dye and the sulphate anion radical being strong oxidant attacks dye molecules leading to its fragmentation rapidly. Thus addition of $K_2S_2O_8$ and H_2O_2 during solar degradation in presence of $(Co_{0.9}Cu_{0.1})_3O_4$ helps to break the organic moiety efficiently.

Keywords : cobalt oxides, Cu-doped cobalt oxides, H_2O_2 in dye degradation, photo-catalyst, solar dye degradation
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