Abstract

The catalytic degradation of organic dye (methylene blue, MB) has been studied using green oxidation methods (tertiary-butyl hydrogen peroxide, TBHP, as the oxidant with several doped mixed-valent and regular manganese oxide catalysts in water) at room and higher temperatures. These catalysts belong to a class of porous manganese oxides known as octahedral molecular sieves (OMS). The most active catalysts were those of Mo^{6+}- and V^{5+}-doped OMS. Rates of reaction were found to be first-order with respect to the dye. TBHP has been found to enhance the MB decomposition, whereas H_2O_2 does not. Reactions were studied at pH 3−11. The optimum pH for these reactions was pH 3. Dye-decomposing activity was proportional to the amount of catalyst used, and a significant increase in catalytic activity was observed with increasing temperature. X-ray diffraction (XRD), energy dispersive spectroscopy (EDX), and thermogravimetric analysis (TGA) studies showed that no changes in the catalyst structure occurred after the dye-degradation reaction. The products as analyzed by electrospray ionization mass spectrometry (ESI-MS) showed that MB was successively decomposed through different intermediate species.