

Mn(II)- and Co(II)-Impregnated Coal Fly Ash as Catalysts for Wet Oxidation of 2-Chlorophenol

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Abstract

Fine coal fly ash powder from a thermal power station was thoroughly cleaned by repeated washing with water, dried and impregnated with Mn(II) and Co(II) separately by refluxing with 1.0 M aqueous Mn(II) chloride and Co(II) nitrate for 6 h. The materials were dried and calcined at 773 K for 5 h. Mn(II) and Co(II) entering into the fly ash particles were determined to be 45.05 and 60.89 mg/kg compared to 12.52 and 7.44 mg/kg for the washed fly ash, respectively. All the materials were characterized with XRD, FT-IR, and SEM measurements with respect to bulk and surface composition. BET surface area and pore properties of the materials as well as the cation exchange capacities were also measured. Mn(II)- and Co(II)-impregnated fly ash was further investigated for their application as oxidation catalysts. For this purpose, 2-chlorophenol oxidation in water was chosen as a model system. 2-chlorophenol is not easily biodegradable and is considered as a priority organic pollutant in water, mainly arising from industrial effluents. Mn(II)- and Co(II)-fly ash could bring about as much as 53.9 and 62.1 % oxidation of the pollutant (5.0×10^{-3} M) in 240 min with hydrogen peroxide (5.0×10^{-3} M) as the oxidant at 323 K. The work shows that an industrial solid waste can be converted to an effective catalyst by appropriate treatment and that recalcitrant organic pollutants can be destroyed on its surface.

Keyword: 2-Chlorophenol, Co-(II)-Fly Ash, Catalytic Wet Air Oxidation, Mn (II)-Fly Ash