

## Effects of heavy metals on the oxidative polymerization of phenol by manganese dioxides

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The oxidative polymerization of phenolic compounds by manganese oxides is considered as one of the main biogeochemical processes in the formation of humic substances [1]. Heavy metals in polluted soils may influence phenol polymerization, thereby mediating the natural formation of humic substances in the terrestrial environment. This study determined phenol oxidation by  $\text{MnO}_2$  in the presence of Co, Ni, Cu, Zn, Cd and Mn. All the metal ions suppressed the oxidative polymerization of phenol by  $\text{MnO}_2$  while the degree of suppression varied. Over the metal concentration range examined, the relationship between phenol oxidation reaction constant ( $k$ ) and metal equilibrium adsorption amount ( $q_e$ ) consisted of two distinct linear segments. At low metal concentrations, the  $k$  linearly decreased rapidly with increasing metal concentration. The  $k$  decreased comparatively more slowly thereafter at higher metal concentrations. The self-suppression effect of Mn exhibited a single straight  $k$ - $q_e$  line. These results suggest that the coexistence of manganese oxides, phenols, and heavy metals may lead to an altered balance of humic substances in the environment.

[1] Shindo and Huang (1982) *Nature*, 298, 363-365.