Catalysis of Nontronite in Phenols and Glycine Transformations

M. C. Wano

Department of Soil Science, National Chung Hsing University Taichung, Taiwan 40227, Republic of China

Abstract: The catalytic power of Ca-nontronite (0.2 – 2 μm) for the polycondensation of phenols and glycine and the associated reactions that involve the ring cleavage of phenols and the decarboxylation and deamination of glycine was studied in systems free of microbial activity. At the end of a 90-hr reaction period, the amount of CO_2 released from the Ca-nontronite-glycine-pyrogallol, Ca-nontronite-glycine-catechol, and Ca-nontronite-glyeine-hydroquinone systems were 5.1, 8.7, and 11.6 times higher, respectively, than those from the respective nontronite-free systems, showing the catalytic role of Ca-nontronite in the ring cleavage of phenols and the decarboxylation of glycine. The release of CO_2 and NH_3 from the Ca-nontronite-glycine system revealed that Ca-nontronite can catalyze decarboxylation and deamination of glycine. The ability of Ca-nontronite to catalyze the deamination of glycine was substantially enhanced by the presence of a phenol. The visible absorbances at both 472 and 664 nm of the supernatants, the total yields of N-containing humic polymers, and the fractions of glycine converted to nitrogenous polymers indicated that polycondensation of glycine and phenol was greatly catalyzed by Ca-nontronite. The total N-containing humic polymers formed in the systems decreased in the order: Ca-nontronite-glycine-pyrogallol > Ca-nontronite-glycine-cateehol > Ca-nontronite-glycine-hydroquinone > glycine-pyrogallol > glycine-hydroquinone > glycine-catechol. The infrared and electron spin resonance spectra of humic acid (HA) and fulvic acid (FA) formed in the supernatants of the reaction systems were quite similar to those of soil HA and FA. The catalytic power of Ca-nontronite in affecting the ring cleavage of phenols, deamination and decarboxylation of amino acids, and formation of humic substances derived from phenols with amino acids in soils and the related environments thus merits attention.

Key Words: Catalysis • Deamination • Decarboxylation • Glycine • Nontronite • Phenol • Polycondensation

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