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# The Interaction Between Roundup (Glyphosate) and Montmorillonite. Part II. Ion Exchange and Sorption of *Iso*-Propylammonium by Montmorillonite

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**Abstract:** The adsorption mechanism of *iso*-propylammonium ( $\text{PAH}^+$ ), the cationic component of Roundup, by various homoionic montmorillonites and the structures of the associations obtained in the interlayer space were investigated, using infrared, X-ray, and carbon analysis methods. Adsorption from aqueous and ethanol solutions of Roundup was studied. The infrared spectra were compared with those obtained by the treatment of montmorillonites with ethanol and  $\text{CCl}_4$  solutions of the free *iso*-propylamine (PA). The adsorption of PA from ethanol gives rise to protonation of the amine. PA sorbed from  $\text{CCl}_4$  solution forms an ammonium-amine association. Adsorption of  $\text{PAH}^+$  from alcohol solution of Roundup occurs by the mechanism of cation exchange. With transition metal exchangeable cations,  $\text{PAH}^+$  is sorbed in excess, forming hydrogen bonds between  $\text{NH}_3^+$  groups and hydroxyls resulting from dissociation of water molecules. The process of adsorption of  $\text{PAH}^+$  from aqueous solutions of Roundup depends on the concentration of the solution. If montmorillonite is reacted with 0.5% solution of Roundup,  $\text{PAH}^+$  is adsorbed by exchanging metal cations and the adsorption capacity of the clay does not exceed the c.e.c. If the montmorillonite is reacted with 5.0% solution of Roundup, the  $\text{PAH}^+$  exchanges protons originating from the hydrolysis of the interlayer water. Protons which are transferred from the interlayer space to the water solution are accepted by the anion component of Roundup. The amounts of  $\text{PAH}^+$  adsorbed from concentrated Roundup solutions are much higher than the cation exchange capacity of montmorillonite. Hydrogen bonds are formed between the ammonium and water or hydroxyl groups on the interlayer space. With the trivalent exchange ions Al and Fe, which tend to polymerize in the interlayer space, excess sorption gives rise to hydrogen bonding of  $\text{NH}_3^+$  to oxygen of the polymer.

**Key Words:** Adsorption • Exchange • Glyphosate • Herbicide • *Iso*-propylammonium • Montmorillonite

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