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Adsorption and diffusion of benzene in clay minerals under different soil water contents

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The problem of vapour invasion caused by volatile organic compounds (VOCs) entering the building or surface through adsorption, diffusion, convection and biodegradation in the vadose zone has attracted wide attention. However, in actual risk assessment of contaminated sites, only gas convection and diffusion effect or biodegradation have been considered, not including the adsorption of VOCs onto soil, which is of great importance for vapour intrusion.

The adsorption of volatile vapour onto organic matter (SOM) and clay minerals will greatly inhibit the upward migration of vapour. Sorption kinetics of benzene on varying widely organic-clay minerals and soil water contents were investigated. The results suggested that the organic matter in most shallow or deep soil was low, causing the exposure of adsorption points covered by organic matter on the clay mineral, which facilitated strong adsorption of benzene vapour on the clay minerals. The capacity of adsorption did show a significant dependence on the mineral specific surface area and porosity characteristics as well as the cation exchange capacity. In initial stage, surface adsorption was dominant and further slowly partitioned into the interior structure of mineral. The various of soil water content showed complicated transport and fate of benzene. The adsorption of Benzene successfully increased with the soil water content increasing from 0 to 20%, but the enormous amount of porous for air permeation lead to increasing effective diffusion coefficient of benzene. At higher soil water content, the competitive adsorption of benzene and water vapours on clay minerals caused decreasing adsorption capacity of benzene, and part of the gas dissolved in the water molecules which filled in soil pore. Subsequently, the migration of vapour was weak and less vapour transported into indoors or surface. Soil water content influences the adsorption, dissolution and diffusion of vapour intrusion process, which is an important parameter in the risk assessment of contaminated site, so much further research is needed in the future.