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Impact of Styrenic Polymer One-Step Hyper-Cross-Linking on Volatile Organic Compound Adsorption and Desorption Performance

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Highlights:

- Dichloroalkane hyper-cross-linked polymers applied for VOC adsorption/desorption
- Hyper-cross-linking increases adsorption capacity by 50-128% at $P/P_0 = 0.05$
- Adsorption/desorption rates decrease after hyper-cross-linking from pore narrowing
- Shorter cross-linker results in more VOC adsorption capacity but slower kinetics

Abstract

A novel one-step hyper-cross-linking method, using 1,2-dichloroethane (DCE) and 1,6-dichlorohexane (DCH) cross-linkers, expands the micropore volume of commercial styrenic polymers. Performance of virgin and modified polymers was evaluated by measuring hexane, toluene, and methyl-ethyl-ketone (MEK) adsorption capacity, adsorption/desorption kinetics, and desorption efficiency. Hyper-cross-linked polymers have up to 128% higher adsorption capacity than virgin polymers at $P/P_0 = 0.05$ due to micropore volume increases up to 330%. Improvements are most pronounced with the DCE cross-linker. Hyper-cross-linking has minimal impact on hexane adsorption kinetics, but adsorption rates for toluene and MEK decrease by 6-41%. Desorption rates decreased (3-36%) for all materials after hyper-cross-linking, with larger decreases for DCE hyper-cross-linked polymers due to smaller average pore widths. For room temperature desorption, 20-220% more adsorbate remains in hyper-cross-linked polymers after