Adsorption of phenol from decane solutions onto porous silica adsorbents

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The application of adsorption contacting systems for purification of organic compounds are often found to be the most effective methods for separation of various liquid solutions when a suitable low-cost adsorbent are identified. Adsorption used in purification or drying processes has been found to be superior to other techniques due to the low cost, simplicity in design, ease of use and also to the selectivity towards the target molecules to be adsorbed.

Adsorption of aliphatic or aromatic alcohols from most organic solvents represents a complex system due to the self-association of the alcohol molecules in an inert organic solvent system. Previous work indicates that this is a highly dynamic system where the alcohol forms oligomeric chains and cyclic aggregates by hydrogen bonding between the alcohol molecules. It is likely to believe that the ability of the alcohol to be adsorbed onto an adsorbent matrix is strongly dependent on the ability of the alcohol to self-associate in the solvent. This is due to the change in the hydrophilic-hydrophobic structure of the alcohol affecting the adsorption mechanism.

In the present work, adsorption of phenol onto meso-porous silica from decane solutions is studied. The experiments have been performed as batch experiments. Moreover, the self-association of the alcohol in the decane solutions has been studied in order to determine the concentration profile of the alcohol monomers and of the associated alcohol oligomers. The experimental data is compared with a simple adsorption model taking into account the self-association of the alcohol molecules in the hydrocarbon solutions, suggesting that only the alcohol monomer is adsorbing onto the silica surface. The adsorption isotherm and the observed high affinity of the silica towards the phenol molecules indicate a multilayer adsorption of phenol onto the silica surface. A simple BET adsorption model was fitted to the data in order to extract further quantitative information on the presented results.