Evaluation of Clay Adsorbants by Liquid Chromatography

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Composite materials derived from clay minerals are used or are being proposed for use as selective adsorbants for various industrial applications. These applications range from filtration and flocculation systems for water treatment to controlled-pesticide release applications in agriculture. Batch adsorption experiments have traditionally been the analytical technique of choice to evaluate the adsorption properties of these materials. We present a liquid chromatographic method to evaluate the adsorption characteristics of nano-composite materials constructed from clays. First, development of clay agglomerates using the synthetic-clay Laponite will be discussed. Sintered-clay agglomerates are prepared by a spray-drying technique followed by a period of heat treatment. Particles obtained from this process are 0.5 to 5 mm in diameter. These particles are subsequently packed in liquid chromatographic columns for evaluation. Second, adsorption characteristics between aqueous phase aromatic hydrocarbons and sintered-clay substrates will be discussed using retention data obtained using these columns. These preliminary data indicate that retention of aromatic hydrocarbons on sintered clay agglomerates significantly increases when compared to the pure clay material. By examining a series of substituted aromatic compounds, correlations between the collective structural and functional group properties of compound classes with retention characteristics are also made. Retention studies using methanol-water solutions indicate that reversed-phased mechanisms combine with electron donor-acceptor interactions of aromatic solutes and the sintered-clay to create a unique separation mechanism. These data indicate that sintered-clay particles may be highly-selective adsorbents with promising applications in water-treatment processes, solid-phase pre-concentration media, and industrial separation processes.