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### Study the Adsorption of Phenol on Attapulgite-Zeolite Nano-Structure Adsorbent from Aqueous Solution

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## Study the Adsorption of Phenol on Attapulgite-zeolite Nano-structure Adsorbent from Aqueous Solution

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**Keywords:** Attapulgite, Zeolite, Composite Nano-structure adsorbent, Adsorption, Phenol

**Abstract.** Attapulgite-zeolite composite nano-structure adsorbent was manufactured using natural attapulgite and zeolite. The obtained adsorbent was characterized by scanning electron microscope, energy dispersive X-ray spectrometer and mercury porosimeter. After elementary characterization of this adsorbent, batch tests were carried out to examine its removal mechanism of phenol. The influence of pH, contact time and initial phenol concentration were investigated. The pH variation studies showed that the optimum pH for adsorption of phenol was found to be 7. Adsorption equilibrium attained within 1 h time. The adsorption process followed pseudo-second-order kinetic model. Adsorption isotherm studies showed that Langmuir model fitted the experimental data better than Freundlich model. The attapulgite-zeolite composite nano-structure adsorbent in this study shows very good promise for practical applicability of phenol removal from aqueous solution.

### Introduction

Phenol and phenolic compound are frequently derived from petrochemicals, plastics, pharmaceutical, steel industries, paint and considered as a serious threat to human health even at low concentrations due to its toxicity and carcinogenicity properties. Thus, it is fully recommended to remove the phenol from industrial effluents before entering the water stream. It is now extensively recognized that adsorption provide a feasible, effective method for the removal of phenols from wastewaters [1]. Activated carbon is the most commonly used adsorbent in the adsorption process, due to its high adsorption capacity, high surface area and high degree of surface reactivity, whereas the regeneration was difficult and expensive[2]. The research is now focused on efficient, low-cost natural materials, e.g., clay materials [3]. The wide usefulness of these adsorbents is a result of their high specific surface area, high chemical and mechanical stability, and variety of surface and structural properties [4].

Attapulgite is a hydrated magnesium aluminum silicate mineral characterized by an elongated microfibrillar morphology, moderate surface charge, moderate cation exchange capacity, high specific surface area, and high adsorption capacity [5]. Zeolite is hydrated aluminosilicate that possess a three dimensional framework structure. This structure is formed by  $\text{AlO}_4$  and  $\text{SiO}_4$  tetrahedra that are connected by sharing an oxygen atom. When an  $\text{AlO}_4$  tetrahedron is substituted for a  $\text{SiO}_4$  tetrahedron, a negative charge appears which is neutralized by the exchangeable cations. The discovery of zeolite has eliminated many water pollution problems [6]. Based on the aforesaid traits of attapulgite and zeolite, a composite nano-structure adsorbent was manufactured using natural attapulgite and zeolite through compounding, granulation, calcination process.

The aim of this study was to investigate the potential candidate of attapulgite-zeolite composite nano-structure adsorbent as a new mineral adsorbent for the adsorption of phenol pollutants from aqueous solutions. The effect of pH, contact time and initial phenol concentration on the phenol adsorption, and the adsorption kinetic and equilibrium parameters were investigated.