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Editorial
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A Future Overview of the Usage of Minerals as an Eco-friendly Adsorbent for the Removal of Pollutants

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The removal of toxic pollutants from wastewater is considered as one of the significant problems that face the researchers. Many researchers did their best effort to choice the most applicable technology to remove the toxic pollutants. Most of their interest points towards the adsorption technique and the application of the low cost adsorbent materials such as mineral species. More than 3500 mineral species have been discovered. Nearly all the minerals were discovered in the Earth's rocks and ores. The composition of the Earth's crust is dominated by eight major elements (O, Si, Al, Fe, Mg, Ca, Na, K) and four minor elements (Ti, Mn, P, H), while all other elements are present only in trace quantities.

The removal of some pollutants by some minerals such as: zeolite, gypsum, bentonite, calcite, aragonite, dolomite were investigated. For example, zeolite is classified as tectosilicates or "framework silicates" group, with a three-dimensional framework of silicate tetrahedra with SiO_2 and negative surface charge that can be balanced by exchangeable cations. Hence, it is an appropriate adsorbent for removal of heavy metals. Zeolite is one of the natural inorganic compounds that can adsorb heavy metals by ion exchange mechanism. The efficiency of zeolite as an adsorbent can be improved by incorporating it with organic and inorganic materials. Zeolite composite based on activated carbon, cellulose acetate, and chitosan has been used for removal of heavy metals. Also, one of the most popular techniques for defluoridation that was used in countries like India, Kenya, Senegal and Tanzania was Nalgonda technique.

In this technique, calculated quantities of alum, lime and bleaching powder were mixed with water, after mixing the water was processed with flocculation, sedimentation, filtration and disinfection. The entire operation takes about 2-3 hours for around 200 people in batches. In very recent study, bauxite as an adsorbent for the removal of fluoride from contaminated ground water was used. Furthermore, apatite in different forms has been used for fluoride removal as it showed good prospective for defluoridation. Synthetic nano-hydroxyapatite, biogenic apatite, treated biogenic apatite, geogenic apatite were engaged to evaluate their effectiveness for fluoride removal. The removal of fluoride using synthetic hydroxyapatites was investigated. It was found that small sized were more efficient than the largest particle size. The removal of fluoride by raw red soil, raw Bauxite, raw bentonite, kaolinitic clay and raw marine sediment were also applied. The removal of radioisotope 18F, using the low-cost and effective minerals of hydroxyapatite, fluorspar, calcite, quartz, and quartz activated by ferric ions at natural pH was performed. The obtained results demonstrated that the sorption capacities followed the order: hydroxyapatite>fluorspar>activated quartz>calcite>quartz.

Additionally, the removal of zinc by different mineral adsorbents including, raw bentonite, clinoptilolite, chabazite, vermiculite, montmorillonite, zeolite and clays were evaluated. Several adsorbents like clay and hydrotalcite, zeolites have been used to remove nitrates from water and wastewater.

Clays are hydrous aluminosilicate are broadly defined as those minerals that make up the colloid fraction of soils, sediments, rocks, and water and may be composed of mixtures of fine-grained clay minerals and clay-sized crystals of other minerals such as quartz, carbonate, and metal oxides. Clays play an important role in the environment by acting as a natural scavenger of pollutants by taking up cations and anions either through ion-exchange or adsorption or both. The removal of nitrate with clays modified by acid thermo activation with HCl and H_2SO_4 obtained from calcium bentonite was studied. Calcium montmorrillonite showed better removal capacity. Surface-modified zeolites were utilized to remove nitrate from water. However, mordenite showed more effective ammonia removal than clinoptilolite for dairy and piggery wastewaters. Sulfate adsorption capacities were higher in subsoils than in surface soils.

In my opinion, the structural modifications of the minerals by introducing more suitable surface functional groups or compensation species in the solid matrix can be applied to enhance the affinity for certain contaminants as well as to improve their capacity to reduce the pollutants level below the corresponding imposed limits. Besides, a number of operation strategies, including determination of the optimum solution pH or aeration, should be confirmed to significantly enhance materials performance piggery wastewaters.