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# Adsorption-desorption mechanism and kinetic study of synthesized iron doped zeolite for phosphate in aqueous phase

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Zeolite-A and Fe-zeolite were synthesized using the sol-gel hydrothermal method. The removal of phosphate from an aqueous solution was performed by adding 2 g PO43-/L of Z-A and Fe-zeolite- A separately and compared. XRD, SEM, EDS, FTIR and XPS characterization techniques were used to decipher the adsorption- desorption mechanism. The synthesized Fe-zeolite-A adsorbed and desorbed phosphate much faster than any other reported study so far. The peak shift in the XPS (Fe-2p & O-s), as well as the band shift and change in intensity in the FT-IR spectra (–OH) of the zeolite backbone, confirmed the involvement of ligand exchange mechanism. In the working pH, $H2PO4^-$ acted as a ligand and formed a surface complex with Fe through OH bond, whereas at alkaline pH it was desorbed into the solution in the form of $HPO42^-$. The EDS data, Si–O–Al band shift and intensity change in FT-IR, along with the change in peak and intensity of Al-2p in XPS proved the involvement of Al in adsorption and desorption process. As zeolites are more selective to H+ ion, it exchanged its Na+ ion in the phosphoric acid medium due to reaction with acid. It was also confirmed by EDS data, XPS peak intensity and constant increase in pH of the solution towards neutralization due to the decrease in H+ ion. The adsorption data of phosphate onto Fe-zeolite- A fitted well with Langmuir's isotherm model and pseudo-second-order kinetic model, which means that the amount of $PO43^-$ adsorbed depends on the surface area of adsorbent regardless of the concentration. The amount of $PO43^-$ adsorbed by the metal ions is mg $PO43^-$/g Fe and 16.19 mg $PO43^-$/g Al and the adsorption rate was found to be 5.216mg/g Fe·min and 0.54mg/g Al·min.

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