Enhancement of synthetic zeolite (Crystal-Right) adsorption characteristics toward NH$_4^+$ by regeneration

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Received 10 January 2017; Accepted 25 May 2017

**Abstract**

Breakthrough (CC BTP) and exhaustive column capacities (CC EP) of synthetic zeolite (Crystal-Right [CR]) in original form and zeolite in several forms obtained after regeneration processes, toward ammonium was examined during subsequent NH$_4^+$ adsorption tests using different ratios of NaCl and NaClO for regeneration. The breakthrough point’s calculations were used for dimensionless adsorption power coefficients (APC) establishment that indicated CC BTP and CC EP values, respectively. It was shown that H$^+$ increased as a consequence of NaClO hydrolysis in the presence of brine sodium cations, and its bonding to zeolite active sites significantly reflected on column capacity values. The bonding of generated protons to basic synthetic zeolite structure oxygen bridges enhanced the number of active sites suitable for NH$_4^+$ ion-exchange. This catalytic effect of NaClO to H$^+$ enabled iterative usage of synthetic zeolite for NH$_4^+$ adsorption with enhanced adsorption properties. Optimal molar ratio of regenerants quantity ($R_{AT}$) and exhaustive column capacity expressed in moles and defined as $R_{AT}/CC_{EP}$ of 312.85 contributed to increase of column capacities with regard to the original zeolite. Adsorption processes G, H and I provided the highest specific APC breakthrough point of 0.81, 0.75 and 0.76 and APC exhausting point of 0.52, 0.54 and 0.53, respectively, which indicated better ammonia bonding onto those CR than the original CR and other regenerated CRs. Larger part of ammonia was bonded to CR crystalline structure by electrostatic adsorption and was successfully eliminated in strong oxidation process by NaClO in engaged regeneration modes (F–H). The best results of CR adsorption properties enhancement were obtained in regeneration modes (F–H), which were conducted using mixture of NaCl and NaClO in molar ratios of 10.62:1, 7.07:1 and 21.24:1, respectively. Ammonia removal efficiency was higher in three adsorption processes that were conducted with regenerated zeolite than removal efficiency obtained with native non-regenerated zeolite.

**Keywords:** Adsorption characteristics enhancement; Ammonia adsorption power coefficient; Regeneration; Synthetic zeolite; Breakthrough column capacity; Exhausting column capacity