

Ammonium adsorption properties of Australian zeolite in the presence of other ions

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Zeolites are aluminosilicate minerals with well-defined microporous structures and predictable ion exchange characteristics. Zeolites could potentially be used as an amendment to mitigate NH₄⁺ emissions from manure, soil and wastewater due to its high cation adsorption capacity and preferential affinity to NH₄⁺. A greater NH₄⁺ adsorption efficiency has been achieved by modifying exchange sites of zeolites to sodium form with NaCl treatment. Most of the previous studies on ion exchange behaviour of zeolites were based on binary equilibrium experiments. However, generally, most mediums used in practical applications consist of varying compositions of multi-species ion cocktails and detailed studies on how the presence of other ion species impinges NH₄⁺ adsorption by zeolites are rare. Therefore, this study was conducted to determine NH₄⁺ adsorption properties of Australian natural and sodium zeolites at high concentrations of N-NH₄⁺ with different combination of other ions Calcium (Ca²⁺) 600 mg/L, Magnesium (Mg²⁺)200 mg/L, Sodium (Na⁺) 600 mg/L, Potassium (K⁺)1000mg/L, Phosphate(P-PO₄³⁻) 50 mg/L, and acetate (CH₃COO⁻) 300mg/L, at pH 7. The concentrations were decided according to the preliminary evaluation of anaerobically digested swine manure generated within the research lab.

The presence of other ions significantly altered NH₄⁺ adsorption by zeolites. NH₄⁺ adsorption by both Australian natural and sodium zeolites was reduced by 44% and 57% respectively in the presence of Ca²⁺, Mg²⁺, Na⁺, K⁺, P-PO₄³⁻, CH₃COO⁻ ions at pH 7. Although NH₄⁺ adsorption by sodium zeolites was 25% higher than Australian natural zeolite in the NH₄⁺ ion only solution, sodium zeolite has a similar potential to adsorb NH₄⁺ as the Australian natural zeolites at the presence of Na⁺, Ca²⁺ and Mg²⁺ ions in the mixtures. However, these findings are indicating the potential applications in NH₄⁺ recovery from livestock manure treatments systems which contain high ammonium levels and other ions.