Evaluation of Zeolites Manufactured from Fly Ash as Adsorbents for Ammonium: Implications for a Slow Release Nitrogen Fertilizer

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The strong affinity of natural zeolites for NH_4^+ has been used in the processing of municipal and agricultural bio-solid waste waters and recovery of NH_4^+ -N. The end result of this process is a NH_4 charged zeolite which may have a practical secondary application, as N-fertilizers. Synthetic zeolites manufactured from fly ash share many similar characteristics and, with the current global inventory of fly ash, conversion to zeolites and their potential nutrient loading may provide another end use for this combustion by-product.

The focus of the long-term study is to determine the suitability of N-loaded zeolites manufactured from fly ash to act as slow release N fertilizers. The information presented here is related to the nature of these manufactured zeolites; their mineralogy, geochemical and adsorption characteristics and their ability to extract ammonium from an aqueous medium.

The main phase of the manufactured zeolite can be described as a compound consisting of the following basic formula: $Na_aO\ Al_2O_{3\,b}\ SiO_{2\,c}\ H_2O_d$. The structural make up is consistent with Cancrinite or Zeolite X. Element substitution and varying degrees of hydration results in departures from well defined diffraction patterns. Total and plant available chemical data indicate the materials are suitable for agricultural applications provided they are used as an amendment i.e. mixed with soils or other organic materials. The cation exchange capacity is in the range of 115 cmoles/kg, lower than clinoptilolite (165 cmoles/kg, a zeoilite typically used in agricultural applications) but much higher than typical soil components. Adsorption experiments indicate an optimum adsorption capacity of 800-1000 ppm N as NH_4.

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