

Enhancement of nitrogen release properties of urea-kaolinite fertilizer with chitosan binder

ABSTRACT

The use of controlled release fertilizer (CRF) has become a new trend to minimize environmental pollution. In this study, urea-kaolinite containing 20 wt% urea after one hour dry grinding was mixed with different concentrations of chitosan as a binder to prepare nitrogen-based CRF. Fourier transform infrared spectroscopy confirmed the hydrogen bonding between urea and kaolinite. Covalent interaction between urea-kaolinite and chitosan make the granules stronger. The nitrogen release was measured in 5 days interval using a diacetylmonoxime calorimetric method at a wavelength of 527 nm. The results illustrated that by increasing the chitosan concentration from 3 to 7.5%, nitrogen release decreased from 41.23 to 25.25% after one day and from 77.31 to 59.27% after 30 days incubation in water. Compressive stress at break tests confirmed that granules with chitosan 6% had the highest resistance and were chosen for ammonia volatilization tests. Ammonia volatilization was carried out using the forced-draft technique for a period of 10 weeks. The results showed that the total amount of ammonia loss for conventional urea fertilizer and urea-kaolinite-chitosan granules was 68.63 and 56.75%, respectively. This controlled release product could be applied in agricultural crop production purpose due to its controlled solubility in the soil, high nutrient use efficiency and potential economic benefits.

Keyword: Nitrogen fertilizer; Ammonia volatilization; Controlled release; Urea-kaolinite; Chitosan