ABSTRACT

The use of nitrogen fertilizers in agriculture is still inefficient because most of the nitrogen is easily lost, causing environmental pollution. Slow-release fertilizers are an alternative that can control the release of nutrients according to plant needs. Mesoporous silica is an ideal material as a carrier matrix in slow-release fertilizers because of its adjustable surface area and pore structure, which effectively stores and releases nutrients in a controlled manner. Glass has a high silica content, making it a potential precursor in the synthesis of mesoporous silica. The addition of cetyl trimethyl ammonium bromide (CTAB) functions as a template that regulates particle size, pore distribution, and surface area of silica. Therefore, this study focused on the synthesis of glass-based mesoporous silica by varying the concentration of CTAB surfactant as a templating agent. The research stages included the extraction of sodium silicate from glass powder, the synthesis of mesoporous silica with variations in CTAB mass of 0, 0.2, and 0.6 grams, loading of 32% CUAN fertilizer onto mesoporous silica, analysis of silica content using Atomic Absorption Spectroscopy (AAS), analysis of mesoporous silica functional groups using Fourier Transform Infrared Spectroscopy (FTIR), analysis of pore size using a Surface Area Analyzer (SAA), and testing of urea release rates using a UV-Vis spectrophotometer. The results showed that the silica content extracted from glass was 4,136 mg/L. FTIR analysis identified the presence of Si-O-Si and Si-OH groups. SAA analysis showed that the pores formed were meso-sized in Si 0, 0.2, and 0.6 CTAB samples, measuring 10.89 nm, 4.33 nm, and 4.12 nm, respectively. The urea release test showed that the Si 0 CTAB sample had the slowest release rate with a peak release on day 6 and a total release of 9.24%. In contrast, the Si 0.2 CTAB and Si 0.6 CTAB samples reached their release peaks earlier on day 4 with total releases of 25.9% and 44.04%, respectively.

Keywords: slow-release fertilizer, mesoporous silica, glass, CTAB, urea