

ENCAPSULATION OF UREA IN POROUS CALCIUM CARBONATE NANOPARTICLES DERIVED FROM DOLOMITE AS A VALUE ADDED LOCAL MINERAL RESOURCE

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Sri Lanka is endowed with extensive deposits of dolomitic marble that have not been exploited to manufacture value added products such as Calcium Carbonate Nanoparticles (CCNP) at an industrial-scale.

Urea, the commodity focused in this study, is a popular nitrogen (N) fertilizer in Sri Lanka. It has a high water solubility of 1079 g L^{-1} , (18.0 mol dm^{-3}) at 20°C and contains 46.7% of N. As such, it is easily and quickly absorbed by vegetation but its high solubility also means that considerable amount of it is washed off and those water bodies with blooming algae is direct evidence of the receipt of such urea rich wash-off. Unfortunately, the overuse of fertilizer by many farmers has placed both environment and public health in considerable peril.

Absorption of excess N by vegetation results in their overgrowth which is a critical factor for rice cultivation. Controlled supply and slow release of urea to the vegetation could help resolve most of above issues. As such, this study was carried out to develop an economical, easily adaptable and industry-scale method to encapsulate urea in calcium carbonate nanoparticles using local dolomitic resources. To synthesize CCNP, 0.5 mol dm^{-3} calcium sucrate solution prepared using dolomite and 0.5 mol dm^{-3} sodium carbonate solutions were used with cetyltrimethylammonium chloride/polyethylene glycol/ethylene glycol mixed solvent. These nanoparticles were characterized by XRD, FT-IR and SEM coupled with EDAX. The data confirms the presence of pure CaCO_3 nanoparticles and SEM images show their porous nature. 1.25 mol dm^{-3} urea solution was added drop-wise over 3 h and the mixture was stirred for 24 h. It was filtered and the residue washed thrice with distilled water and allowed to dry in a vacuum desiccator.

The material obtained was urea encapsulated CaCO_3 nanoparticles whose FT-IR spectrum displayed all bands corresponding to CaCO_3 and N-H at 3455 cm^{-1} and 1625 cm^{-1} , C=O at 1677 cm^{-1} and C-N at 1453 cm^{-1} clearly confirming the

presence of urea in CaCO_3 nanoparticles. Subsequent titrimetry of the material established that urea encapsulation of the CaCO_3 nanoparticles to be 99.0%.

Keywords: Urea, Calcium carbonate nanoparticles, Encapsulation, Value added local Dolomite