Using two- and three-fluid nozzles to spray dried microparticles of CRF formed by biopolymer-fertilizer

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Abstract

Controlled release fertilizers (CRF) were developed with biopolymer using spray drying to improve agriculture management.

Introdution

The requirement of food production improvement to supply feeding to growing global population has brought countless challenges to different research areas. One of them is persecute an increasing fertilizer use efficiently, reduction of toxicity in soil and decrease the negative effects of overdosing. Controlled release fertilizer system has been an alternative for it [1-4]. The purpose of this work was compare the microsphere and microcapsule structure of the CRF based on chitosan biopolymer. The CRF was prepared from chitosan added with nutrient (KNO_3) by spray drying technique (Mini Spray Dryer B-290-BUCHI, inlet temperature: 180°C, aspirator: 90%). For that, it was used two types of nozzle, two-fluid nozzle (flowrate: 9ml/min) to obtain microspheres and three-fluid nozzle (inner flowrate: 4ml/min, outer flowrate: 5,5ml/min) to achieve microcapsule (core-shell structure). These materials were characterized e compared by their structure (FTIR), morphology (SEM), and fertilizer release profile.

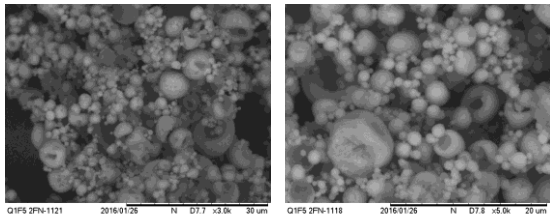

Figure1. Microspheres of chitosan-KNO_3 **(**Spray dried by Two-fluid nozzle)

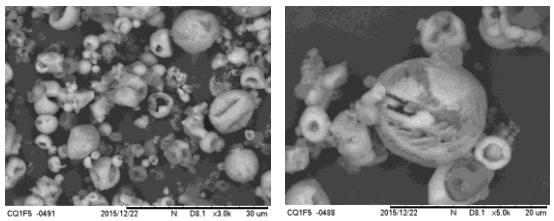

Figure2. Microcapsules of chitosan-KNO_3 (Spray dried by Three-fluid nozzle)

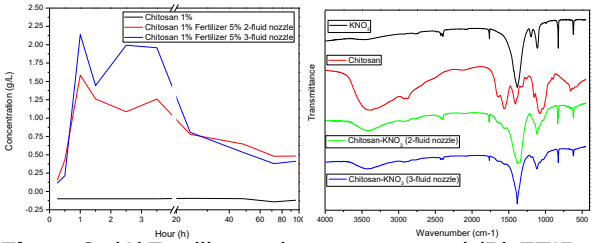

Figure3. (A)Fertilizer release curve and (B) FTIR

Results e Discussion

The morphology of spray dried biopolymer chitosan and fertilizer KNO_3 microparticles by two-fluid nozzle is showed below (Figure 1). As it showed, the microparticles are spherical and have wide particle size distribution. However, the microparticles spray dried by three-fluid nozzle exhibit some capsule structure (Figure 2), which indicates the formation of core-shell structure. The fertilizer release curve (Figure 3A) shows that microcapsule has a greater profile fertilizer release than microparticles. In the FTIR spectra of the composites(Figure 3B), it is possible to observe the main bands of KNO_3 (N-O symmetric stretch at 1381cm^{-1} and N-O aliphatic at 823cm^{-1}) and Chitosan (C=O vibration at 1650cm^{-1} and combination of N-H deformation and C-N stretching vibration at 1320cm^{-1}).

Conclusion

The two- and three-fluid nozzles have formed different structure of the studied material. The core-shell structure is interesting to produce materials for controlled release fertilizer.

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