Chitosan-sugarcane bagasse composites as fertilizer-releasing materials obtained via spray-drying

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Abstract

Microspheres of chitosan-sugarcane bagasse was prepared by *spray-drying* and used as controlled release of KNO_3.

Introduction

In the current agricultural scene is undeniable the need to increase food production. There is growing interest in this field in finding diverse strategies to enhance productivity and reduce costs[1]. The main objective was to use the spray-drying technique to microencapsulate the fertilizer KNO_3(F) in the chitosan-sugarcane bagasse (Chi-B) matrix to obtain a controlled release material. The Chi-B-F solutions were prepared as follow: (M1) Chitosan (4%w/v) was dissolved in acetic acid (5%w/v) using *Turrax* and after 30 minutes a dispersion of B (0.5 and 1 %w/v) and KNO_3 (10%w) were added and stirred in a *Turrax* for 30 minutes; (M2) Chitosan (4%w/v) was dissolved in acetic acid (2%w/v) and after 1 hour the B (0.5 and 1%w/v) and KNO_3 (10%w) were added without previously dispersion and stirred for 30 minutes. The feed solutions were spray-dryer in a Mini Spray Dryer B-290-BUCHI and the set of parameters (C1 and C2) as inlet temperatures, pump, aspiration rate and flow meter were, respectively, (C1) 180 ºC, 65% (20mL/min), 38 m^3/h and 0.41 bar and (C2) 160 ºC, 35% (12mL/min), 35 m^3/h and 0,41 bar. The samples were named as $Chi_xB_yF_z$-C(1,2)M(1,2), where x, y, and z is the percentage and 1 and 2 the spray-dryer parameters.

Results and discussion

Conductivity measurements (Gehaka-CG200), Fig. 1, were used to verify the release of the K^+ in the solution with time. Based on desorption curves the plateau was reached at 30 h and no significant difference were observed with conditions used unless for Chi4F10-C2M2 and Chi4B0.5F10-C2M2 microspheres. Morphology of the microspheres, Fig. 2, shows regular spheres with different size. For samples prepared with bagasse previously dispersed (C1) it is possible to see fibers out of the microspheres corroborating with the release results since the fertilizer was mixed with bagasse. Also the dispersion of the bagasse generate, after desorption tests, a self-supported swelled material, Fig. 3.

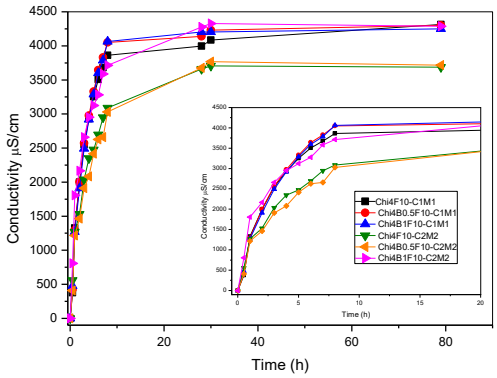

Figure 1. Desorption of KNO_3 from microspheres.

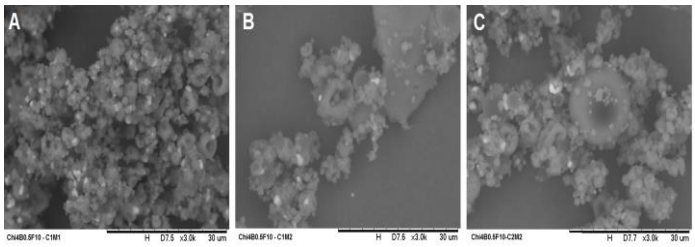

Figure 2. SEM of the surface of the microspheres (A); (B) Chi4B0.5F10-M2C1; (C) Chi4B0.5F10-M2C2.

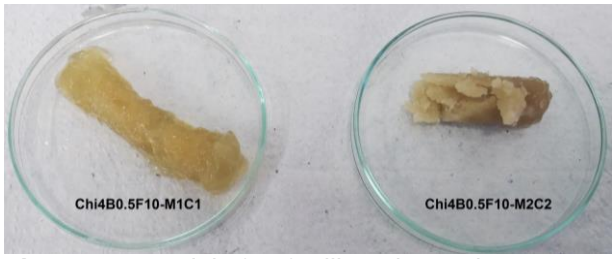

Figure 3. Material after fertilizer desorption.

Conclusion

Feed solution preparation method influences the morphology and so the release of the fertilizer in water medium. Microspheres of chitosan-sugarcane bagasse prepared by spray drying are an interesting material to be used as controlled release material.

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