

Characterization of green composites based on PHB and montmorillonite for KNO₃ and NPK delivery system

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Abstract

Green composite were prepared for using as carrier for controlled release fertilizers (CRF).

Introduction

Controlled release fertilizer is a new trend for using a safer fertilizer and reducing environmental pollution¹. There is a demand for natural and biodegradable polymers to prepare CRF². The composition of green composite is based on polyhydroxybutyrate (PHB), starch (S), glycerol (G) and montmorillonite clay (MMt). Contents of NPK (nitrogen, phosphorus and potassium) and potassium nitrate (KNO₃) added to green composites were characterized by FTIR, SEM, XRD and TG. The green composite materials were processed in a chamber mixer at 162°C, 60 rpm for 10 minutes.

Results and discussion

Table 1: Composite percent of green composite

Green Composite	wt. %				
	PHB	S	G	MMt	Fertilizer
PHBSG	50	35	15	-	-
PHBSGMMt	45	31,5	13,5	10	-
PHBSGMMtKNO ₃	40	28	12	10	10 KNO ₃
PHBSGMMtNPK	40	28	12	10	10 NPK

The structural and thermal features shows a decrease in the PHB crystallinity and the previous mixture of montmorillonite and fertilizers exfoliated the clay layers.

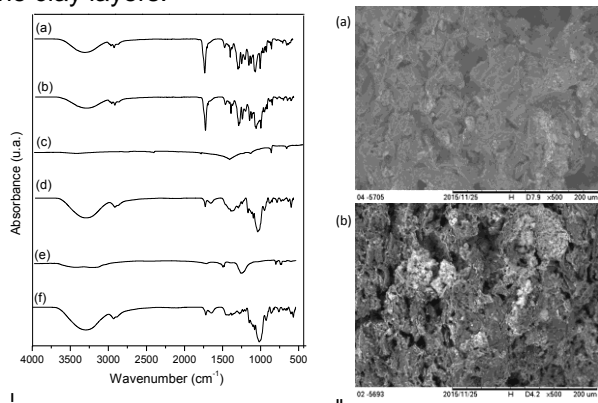


Figure 1: I - FTIR spectra of (a) PHBSG, (b) PHBSGMMt, (c) KNO₃, (d) PHBSGMMtKNO₃, (e) NPK and (f) PHBSGMMtNPK; II – SEM of (a) PHBSGMMtKNO₃ and (b) PHBSGMMtNPK

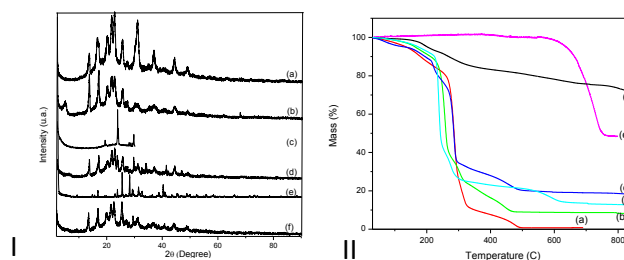


Figure 2: I - X- Ray diffractograms of (a) PHBSG, (b) PHBSGMMt, (c) KNO₃, (d) PHBSGMMtKNO₃ (e) NPK and (f) PHBSGMMtNPK; II - TG curves of (a) PHBSG, (b) PHBSGMMt, (c) PHBSGMMtKNO₃, (d) PHBSGMMtNPK, (e) KNO₃ and (f) NPK.

KNO₃ green composite shows faster release in water than NPK green composite because of the high solubility of KNO₃.

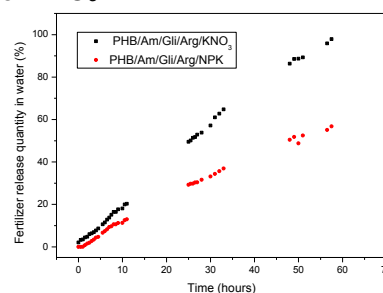


Figure 3. Release behavior of KNO₃ and NPK from PHBSGMMtKNO₃ and PHBSGMMtNPK, respectively, in water measured by conductivity.

Conclusion

Green composite keep biodegradable properties and good fertilizer release in water. The structural and thermal evaluation indicated a homogeneous composite that preserves the individual characteristics of the compositions composite with decreasing PHB crystallinity and exfoliated structure layered clay.

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¹ AZEEM, B.; KUSHAARI, K.; MAN, Z. B.; BASIT, A.; THANH, T. H. Journal of controlled Release **2014**, 181, 11-21.

² CALABRIA, L.; VIECELI, N.; BIANCHI, O.; OLIVEIRA, R. V. B.; NASCIMENTO FILHO, I.; SCHMIDT, V. Industrial Crops and Products **2012**, **36**, 41-46.