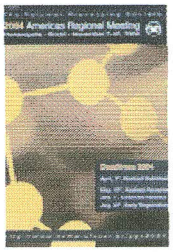

EFFECTS OF CASSAVA FIBERS AND WHEAT FIBERS IN STARCH FOAMS PACKAGING

L.G. Carr[1*], D.F.Parr[2], A.B.Lugão[2], P.M. Buchler[1]

1 São Paulo University, Escola Politécnica - laura.carr@poli.usp.br; and pbuchler@usp.br; 2 Nuclear and Energetic Research Institute - duclercp@iq.usp.br and ablugao@ipen.br

Abstract - The utilization of renewable resources in packaging can provide solutions to ecological problems such as waste quantity. Agricultural resources can be an alternative as raw material and starch can be used because this natural polysaccharide can form resistant foam when wet and warm. The starch foam is obtained by thermopressing process that consists in two parallel steel plates where starch dough (cassava starch, water and additives) is processed to form a rigid structure by swelling, gelatinization and network formation. Natural fibers can be used to improve the mechanical properties of starch foams. In this project were added 1, 2 and 3% of cassava fiber (long fiber) and 1, 2 and 3% of wheat fiber (short fiber) in the starch dough and the foams were characterized by physical methods (compression resistance and density). Most fibers quantity result in foams with higher density, whatever the fiber kind. In other side, most fibers quantity did not improve the foam compression resistance. The results show that did not happen the intrinsic adhesion of the fiber-matrix interface.

THE EXTENDED ABSTRACT MUST BE WRITTEN WITHIN NO LONGER THAN 2 PAGES.

Introduction

The development of starch-based foams is an important challenge on science of biodegradable materials in face of innumerous products that can be made as the alternatives for replacement packages of petroleum-based plastics. As a renewable source, the starch materials can avoid the serious ecological problems raised from accumulated waste. The function of starch in production of biodegradable packaging material is the formation of a structure by swelling, gelatinization and network building. The utilization of natural fiber as reinforcement in polymer composite as reiforced material is useful purposes. In this work was developed biodegradable materials as expanded foams, from cassava starch and the addition of two fiber tipes, long (cassava) and short (wheat) to verify the influence in mechanical properties foam..

Experimental

2.1. Materials

Cassava starch and fiber were supplied by Fadel Ind. e Com. Ltda, SP, Brazil. Polymeric additive 300 USP was supplied by Biolab. Wheat fiber was Vitacell 200 from Clariant. Gel content was made with starch thermally modified in water around 70-80 °C for 45 min. Were added 1, 2 and 3% of cassava fiber and 1, 2 and 3% of wheat fiber in the formulation.

All the dough components was vigorously mixed until completely homogenous mixture from Fisatom.

2.2. Methods

Preparation of foams

Starch foams were prepared using a laboratory baking machine from Santos Dumont S.A. (SP-Brazil). The engine consists of a double steel mould, horizontally placed, heated by internal resistances (200°C) . The top of the mold can be lowered to mate with the bottom part by a hydraulically system. Dimensions of the mould were xxx mm long, xxx mm wide, xxx mm deep and 2 mm plate separation.

The dough was applied on the lower surface of the mold before quickly closing the lid. Baking time were the minimum required to avoid bubbled foams and comprised 1-3 min. The resulting final starch-foam is low moisture content, as typically contained 3-4% moisture. Due to this low moisture content, the rectangular foam has a dry aspect and brittleness. Flexibility was improved after 48 h hours in 75% RH and 25 °C at the ambient of the laboratory.

Physical tests

The starch foaming were processed along a period of a day in the heated mould and the complete foams were considered that in wich no fail or material fault were observed, the others incomplete foams were named failed. Batches of foams were processed during two weeks and the % lost was calculated by the ratio (failed foams: total foams).

Foams were equilibrated at 75% relative humidity (R.H.) at 23 °C for 48h prior to mechanical testing. Foams maintained at constant relative humidity were placed in ziplock polyethylene bags and then removed one by one for testing.

Foam density

10013

The control of the foam density of the samples was made weighting a measured area of the foam sheet. The ratio weight (g)/ a(mm).area (mm^2), where a is a constant thickness of the molded foam, is considered the density of the sample.

Compression resistance

Compression testing was performed using a Texture analyzer TA.XT2i from Stable Micro Systems equipped with a cylindrical probe (36 mm diameter) and a cylindrical base (63 mm). The probe was lowered onto a sample of the foam, in constant velocity of 1mm/s, when in contact with the surface, the strength is recorded until the deformation of 15 mm, also if occurs the rupture of the sample. Three rectangular were normally tested. The compression resistance after aging was analyzed with foam 2 placed into storage in the atmosphere condition of the laboratory in periods of 2, 10 and 30 days. After each period the samples (3) were tested.

Results and Discussion

Most fibers quantity did not improve the foam compression resistance., as shown in Figure 1. Foam made with lower quantity of cassava fiber shown higher resistance and decrease according the quantity increase. Foam made with wheat shown the same compression resistance with 1 and 3%, and lower result in 2%. Fiber addition improve the flexibility foam until 2%, with more quantity, the flexibility decrease, as shown in Figure 2. It happened with both fiber source. Most fibers quantity result in foams with higher density, Figure 3.

Lawton, Shogren and Tiefenbacher (2004) added aspen fiber to baked cornstarch foams to improve its mechanical properties. Foam trays were made with fiber content of the batter ranging from 2.5 to 45%. The strength of the foam increased as fiber content of the trays increased, until fiber content reached about 15%. Trays containing between 15 and 30% fiber had no significant difference in tray strength. Trays containing more than 30% fiber had lower tray strength, probably due to the lack of uniform fiber distribution at higher fiber content.

Zaini et al (1996) studied the effect of size and fiber content on the mechanical properties of polypropylene and reported that all size of fiber showed a similar trend of deckling mechanical properties with increasing fiber concentration and composites with larger sized fiber showed higher modulus, tensile and impact strength.

Wollerdorfer and Bader (1998) studied the influence of fibers in mechanical properties of biodegradable polymers. During the extrusion, the fiber were shortened by injection moulding and these short fibers provide a considerable reinforcing effect.

Glenn et al (2001) made starch foam with addition of softwood fiber with 5-7 mm long. The study showed that softwood fiber improved the flexibility and other functional properties of the baked foams, and reduced foam density.

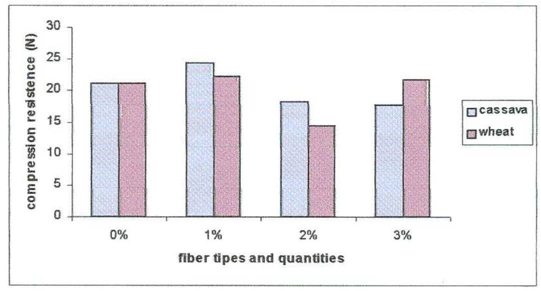

Figure 1- Compression resistance of foam with different tipes and quantity of fiber.

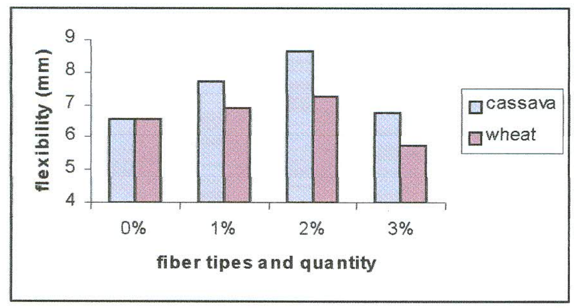

Figure 2- Flexibility of foams with different kind and quantity of fiber

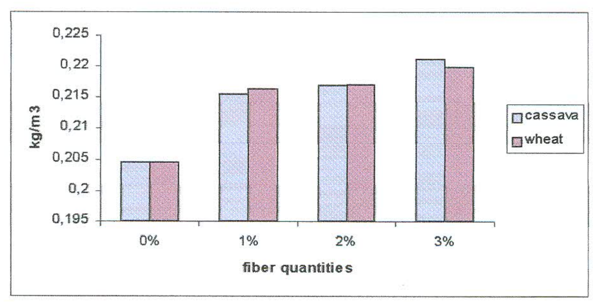

Figure 3- Density of foams with different kind and quantity of fiber

Conclusion

The fibber did not had a interfacial interaction with starch matrix because this addition did not improved the foam mechanical properties.

Acknowledgements

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