DEVELOPMENTS IN BIOPLASTICS PACKINGS

¹Parra, D.F.; ¹Lugao, A.B.; ¹Otaguro, H.; ¹Gasparin, E.; ¹Bueno, N.R.; ¹Ponce, P.; ²Carr, L.; ²Tadini, C.

¹Centro de Química e Meio Ambiente - IPEN/CNEN-SP; ²Escola Politécnica - USP

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Bioplastics from renewable resources have their importance based on the control or reduction of CO₂ emissions and sustainable development of carbon based polymeric materials. 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 Foam made by cassava starch has good physical characteristics as foam made by other resource starch. Batter stability is important parameter for industrial process of foam and can be achieved controlling parameters such as viscosity and free water. Starch paste must have sufficient elastic strength to trap the expanding steam bubbles in the paste, but, if it viscosity were very high, the paste would be more resistant to foam expansion. A formulation that presents more stability has in consequence more process ability, foam with low density, good compression resistance and flexibility, desired to replace usual foams of polystyrene (FIG.1). In all samples the flexibility and density increase in aging, due to water absorption and consequent plasticization of the starch and compression resistance decrease due to starch chains relaxing into lower free volume state with lower energy. The development of additives to improve the resistance to long cycle of freezer-unfreezing was accomplished. And to better performance of cassava starch foams for application for long time on contact with humidity materials is need to developing resistant-coated foams, as the matter of future works. Films from starch cassava formulated with the blends studied in the last years had been presented good performance of flexibility and low water permeability, indicating potential application as edible films A response surface methodology was applied to the results obtained to understand the behavior of the blend in terms of better mechanical properties and lower water vapor transmission. Predictive models indicated that blends formulated with polyethylene glycol up to 0.3 g exhibited good elongation. This behavior is adequate for films that require flexibility. However, levels above 1 g of glycerol increased Water Vapor Transmission Rate (WVTR), reducing the applicability of these films in wet environments. Films made with levels up to 0.5 g of glutaraldehyde presented lower water permeability due the crosslinking effect. PHB polyester (poly(3-Hydrohybutyrate)) is an interesting biodegradable polymer intensely investigated as cast and sheet films with applications on food industry or in medicine. The films obtained are typically brittle and many scientists have attempted to reduce this brittleness by blending with other polymers. The Starch foam trays nucleation density and the cooling rate determinate the spherulite size in the blends and consequently interfere in the crystallinity (%). Therefore fast cooling promotes loss of crystallinity and additives can be used to improve mechanical properties in function of crystallinity reduction. PHB from Usina da Pedra was blended with PEG poly(ethyleneglicol) 300. The resulted blends showed, by DSC technique, crystallinity decreasing associated with an increase in the additive content. In these blends the crystallization takes longer time (temperature is shifted to lower values) than on pure PHB, probably because of the lower nucleation density. Blends of PHB/PEG in films obtained by casting method that were then irradiated at a dose rate of 5.72 kGy/h with a 60Co source. Samples were melted at 200 °C and

quenched to 0 °C in order to evaluate film crystallinity levels by Differential Scanning Calorymetry (DSC). DSC analyses were performed with the samples (10 mg) under N₂ atmosphere, heating at 50 to 200 °C (10 °C.min⁻¹), cooling at 200 to 50 °C (10 °C.min⁻¹); and heating at 50 to 200 °C (10 °C.min⁻¹). The thermal and mechanical resistance of the films after irradiation at low doses (5, 10, 20 kGy) are studied. Water vapour transmission decreased with increasing irradiation dose, indicating that the films' performance as water vapour barrier had improved. Critical loss of the mechanical properties was observed at 40 kGy. Irradiation of our PHB /PEG blend with ionizing radiation resulted in decrease of crystallinity. In this blend, crystallization took longer (shifting of the crystallization temperature to lower values) than in pure PHB probably due to a lower nucleation density. The presence of PEG interferes with the intramolecular interactions within the PHB macrochains; however, upon irradiation, we observed a cross-linking effect up to 10 kGy. Pronounced degradation occurred at higher irradiation doses (40kGy), with loss of mechanical properties. The vapour barrier property of the PHB/PEG blend was enhanced at low irradiation doses, probably owing to the cross-linking effect that reduced the pore size within the blend structure, thus avoiding the water vapour transmission observed in pure PHB films at (FIG.2).



FIGURE 1 - Starch foam trays.



FIGURE 2 - Water Permeability test for irradiated PHB films.