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New Melt Process Technique to Prepare Blends with Chitosan

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Abstract – Chitosan is obtained from chitin which is a natural abundant biodegradable polymer. The interest in chitosan is increasing due to its renewable character and its special properties such as its fungicide and bactericide action. However, the use of chitosan is limited because it can be only processed from aqueous solution in the presence of acids such as acetic and formic acids. In this work we described the production of blends of chitosan-poly(lactic acid) and poly(vinyl alcohol) by a new protocol involving a two slept blending process. A blend of PVA and chitosan prepared by the solution method was incorporated in PLA by melt processing rendering a true melt blend which was characterized by scanning electron microscopy.

The preparation of blends with chitosan by melt process is of great interest since chitosan is a functional polymer usually processed only from its solution [1]. Melt processing can increase substantially the application of chitosan in several areas in a more versatile way, by common processing techniques applied to thermoplastics. In a previous work we studied similar blends produced by emulsion processing with very interesting results [2, 3]. Blends of poly(lactic acid) (PLA) and Chitosan which are incompatible were prepared using poly(vinyl alcohol) (PVA) as a third component. In the present work we described a new approach to produce blends of chitosan by melting processing, by a two stage process. In a first step a blend of PVA and chitosan was produced by solution blending and in a second step the PVA/chitosan blend is melt processed whit PLA to give a thermoplastic material. This innovative process lead to innovative blends displaying a very good compatibility between the components. The blend of PVA and Chitosan was prepared by mixing aqueous solution of both polymers and drying. The resulting blend was dried and grinded and mixed to PLA in an intensive mixer at 170 °C. The resulting blend was characterized by scanning electron microscopy (SEM), infrared-spectroscopy (FTIR) and differential scanning calorimetry (DSC). FTIR showed some degree com miscibility when the three components are present. This effect was not observed for the binary blends and was attributed to a synergistic effect in the ternary blend. The addition of a hydroxyl containing plasticizer (glycerol) to the PVA/chitosan blend increases the miscibility of the system as we can see by SEM analysis. Figure 1 shows the SEM micrograph of fragile fracture surfaces of PLA/PVA/chitosan 75:22.5:2.5 blends 1*a* and 1*b* with plasticizer and 1*c* and 1*d* non-plasticized. In 1*a* and 1*c* are showed the surfaces as it was generated after fracture and in 1*b* and 1*d* the surface after extraction in hot water to eliminate the soluble components (chitosan and PVA). Figure 1*b* shows a very good dispersion of the components and Figs 1*a* and 1*c* do not shows pull-out which could indicate poor compatibility between the components. This result shows that our approach is very efficient and opens a new class of blend which, to the best or our knowledge, was not yet described. The authors acknowledge CNPq for the grant and FAPESP for the financial support.

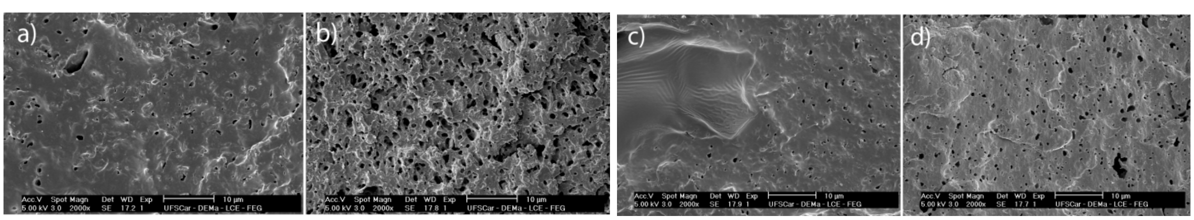

Figure 1: Scanning electron micrograph of PLA/PVA/Chitosan 77:22.5:2.5 blends after fragile fracture in liquid nitrogem, a) plasticized, b)plasticized after extraction, c)non-plasticized and d) non-plasticized after extraction.

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