



BLENDS POLYPROPYLENE/STARCH THERMOPLASTIC

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Abstract

In this study, PP/TPS blends were obtained. Firstly, TPS with 30wt% glycerol, 20wt% water and 2wt% carboxylic acids (citric, malic) were processed in twin screw extruder. After this, blends containing 50wt% of PP and 50wt% of TPS were processed with and without carboxylic acid and maleic anhydride addition. The samples were characterized by SEM and mechanical properties.

Keywords: TPS, Starch, Polypropylene, Blends.

1 INTRODUCTION

Polypropylene (PP) is a synthetic polymer produced from fossil sources. Due to their long term natural decomposition it is not considered biodegradable. Because of its physical and chemical characteristics it is widely used in the industry, and is currently the second most consumed polymer in Brazilian market. One of the most attractive features of polypropylene is the resistance to chemical attack, providing a longer life cycle [1]; however, this same advantage becomes a big problem when disposing of this material because its decomposition becomes very difficult and slow.

On the other hand, the increasing demands for environmentally friendly products have focused on polymers from renewable resources and biodegradable polymers. One of these polymers, which have been widely studied, is the thermoplastic starch (TPS). However, TPS suffers from several limitations, such as poor mechanical properties and water sensitivity [1]. An effective method for overcoming this issue is to blend it with synthesized polymer [2]

The objective of this work is study blends of polypropylene and TPS, with and without carboxylic acids, before and after of addition of maleic anhydride into the PP.

2 MATERIALS AND METHODS

2.1 Materials.

Corn starch containing about 14% moisture (Amidex 3001) was supplied by Corn Products Brazil Ltda. The glycerol and carboxylic acids: citric and malic was supplied by Casa Americana Ltda. The chemical structure is shown in Figure 1.



Figure 1. Chemical structure of carboxylic acids: (a) citric acid and (b) malic acid.

The polypropylene was supplied by a company that performs injection molding. This polypropylene is the RP347 from Braskem. It is a random copolymer of propylene and ethylene and Melt Index 10g/10min (230°C/2.16kg). The Polybond 3200 has 1 wt% maleic anhydride.The samples with maleic anhydride contain 10wt% of Polybond.

2.2 Preparation of TPS.

Corn Starch was dried at 110°C for 48h in vacuum (250mbar). Afterwards, corn starch was





mixed with 30 wt% glycerol, distillated water and acid for 20 minutes at 1500rpm in a mechanical stirrer IKA[®] Werke Eurostar. This mixture was stored in an oven at 25°C for at least 24h [3].

The TPS was prepared in a twin-screw extruder (L/D 16) connected to a HAAKE torque rheometer, with four heating zones with temperatures ranging from 100 to 125° C, and a screw speed of 100rpm.

Figure 1 – SEM of blends PP/TPS 50/50 with citric acid, malic acid and without acid and with and without maleic anhydride addition.









2.3 Preparation of Blends.

The PP/TPS blends with different carboxylic acids addition was prepared in a twin-screw extruder. The processing temperatures along the extruder barrel was of 160°C. The screw speed was of 100rpm. The blends contain 50wt% of PP and 50wt% of TPS.

2.4 Characterization.

Young's Modulus (MPa)

After processing, the blends were injected to form samples for the tensile test. The mechanical

properties were measured using an Instron Universal Testing Machine. The Young's modulus was determined using testing velocity of 1mm/min and the others tensile properties were obtained using a testing velocity of 20mm/min (based on ASTM D638 10). The results of mechanical properties reported in this work correspond to the average of at least 7 measurements.

Samples of thermoplastic starch were observed by SEM Philips XL 30. Firstly, the samples were cryogenically fractured, after gold was deposited and the samples were analyzed at 10 kV.



Figure 2 – Mechanical Properties: Young's Modulus (a) and Tensile Strenght (b)

3 RESULTS AND DISCUSSION

Figure 1 presents the morphology of PP/TPS blends with and without citric or malic acids, and before and after the maleic anhydride addition. It can be seen that all blends present a co-continuous morphology.

Figure 2 shows the mechanical properties of the PP/TPS blends with and without citric and malic acids, and before and after the maleic anhydride addition. For comparison purposes, the PP and the PP with maleic anhydride are also shown in Figure 2.

The results show that both the tensile strength and modulus of blends decreased, when compared to the ones of PP and PP/PP-g-MA. The sample without acid, and with maleic anhydride additon, presents the best combination of properties, among the studied blends. Comparing the blends with different carboxylic acids, it can be noted that the ones with maleic acid have larger modulus and tensile strength than the ones with citric acid. A reduction in mechanical properties due to acid addition could be attributed to the residual acids. The residual acids played as the plasticizer, which reduced the interactions among the macromolecules, which resulted in the decrease of the mechanical properties [2]. Then, the malic acid addition may result in a lower amount of residual acid in the blends, which would explain the improved properties of the blends with this acid.

4 CONCLUSIONS

PP/TPS/PP-g-MA blends with carboxylic acids presented a reduction in mechancial properties, when compared to the ones without acid. The acids can reduce the PP/TPS interaction, due to the presence of residual molecules that act as plasticizers and not as compatibilizers.

5 ACKNOLEDGEMENTS

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6 REFERENCES

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