RHEOLOGICAL MODELIZATION OF ABS+PC RECYCLED BLENDS FOR INJECTION MOLDING

M.A. Sellés [1], S. Sánchez-Caballero[2], F. Parres[1], J.E. Crespo[1], R. Navarro[1]

[1]Instituto de Tecnologia de Materiales, Universitat Politècnica de València, Spain
[2]Instituto de Diseño para la Fabricación, Universitat Politècnica de València, Spain
e-mail: maselles@dimm.upv.es

Abstract

Acrylonitrile-butadiene-styrene copolymer (ABS) is a very broadly used material across various industries; however, in order to improve its manufacturability, it is generally blended with polycarbonate. ABS is a rubber-modified copolymer of styrene and acrylonitrile. The development of ABS also has undergone several notable changes that have been carried out because of need for improved the manufacturability. Polycarbonate (PC) is an engineering thermoplastic material with three key characteristic properties that make it useful in many applications: toughness, transparency, and heat resistance. However, PC is not easily processed. Generally, if attempting to make a more processable PC, the toughness decreases, making it inadequate for engineering applications.
When these materials are recycled, the general characteristics of the ABS and the PC demean, but they fit perfectly in industrial purposes. In the present work it is carried out a study of the rheological behaviour of the blends of ABS and recycled PC, and its influence in the injection process. The aim is to present a model of the rheological behaviour, validating the pattern with the obtained data of the different rehearsals carried out in a capillary rheometer.
It is difficult, due to their high cost, that a small company has a rheometer in their facilities to be able to find the curves of viscosity of their materials. As a result of the presented modelization, they will be able to obtain these curves only from a series of points measured in a MFI (Melt Flow Index).

Keywords: *ABS, PC, Recycled, Modelization, Injection Molding*

1. Introduction

In order to avoid the limitations and, thus, to characterize the recycled material for evaluation in subsequent phases, a model for rheological evaluation of materials is proposed in this document, which is based on the following aspects:

- Evaluation of the rheological characteristics of potential starting materials.
- Determination of material behavior model based on the study of flow rate ranges.
- Correction of model, based on the recycled blend composition.

This rheological behavior modelization serves also as an aid to small companies in the sense that it is difficult (given the relatively high cost that would be the acquisition of a capillary rheometer) to accurately identify the rheological behavior of the recycled material [1]. In this way, if characteristics of ABS and PC blends are known, and with the help of this model, a company could determine the material behavior in a specific section of the viscosity curve [2].

2. Materials and Methods

We have used 3 types of blends, all formed by mixing recycled ABS and PC, but with a different percentage. The first mix is composed by simply recycled ABS. The second is a blend of ABS and a 5% CP, and finally, the third has a 10% blend of PC.

Using the standard test for determining the rate of bulk material flow and volume, we have established the MFI index of the different mixtures, using a viscometer. Results are shown in Table 1.

Table 1. Melt Flow Index for the three mixtures

Mixtures	MFI
1	52 gr / 10 min
2	58 gr / 10 min
3	63 gr / 10 min

3. Results

With the three blends, tests were performed in a capillary rheometer. 90 tests were conducted (5 tests x 2 temperatures x 3 x 3 nozzles).

The variables used for each experiment were those reflected in Table 2:

Table 2. Variables used for experiments

Material	Temperature	Nozzle (L/D)
ABS		10
ABS + 5% PC	220 ºC	20
ABS + 10%PC	240 ºC	30

It has been also evaluated different types of mathematical models, choosing the Cross-WLF, which offer as a result the material viscosity in terms of physical conditions to which it is subjected.

Moreover, the dependence parameters that directly influence the viscosity of the material are [3,4]:

1. Temperature of the material during the process, Tm [K].

2. Shear rate at which the material is undergoing the process, [1 / s].

3. The pressure at which the material is subjected during the process, p [Pa].

4. Conclusions

It is important to note that the model fits reality very accurately, as has been corroborated. The approach may be perfectly good for many applications.

In addition, from tests performed and subsequent graphical representation, it has been clearly observed in the viscosity curves how the addition of recycled polycarbonate ABS provides a lower viscosity. This quality greatly improves the processability.

References

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