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EVALUATION OF THE PROCESSING CONDITIONS AND THE CONCENTRATION OF NANOCLAY IN SOY BASED BIOPLASTICS

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Summary

Plastic materials are the most commonly used materials due to their extraordinary properties (Plastic Europe, 2008),increasing the number and the new applications each day Indeed, combining different polymers allows us to make materials properties without limits. The problem is that a big majority of plastics materials are petroleum-based and it is known that oil resources are not eternaland, on the other hand, a large part of this plastics are non recyclable and causes an accumulation of waste.In this context the substitution of petroleum-based plastics by bio-based plastics is seen such as a promising alternative (Alvarez-Chavez et al, 2012). However, nowadays, the challenge is divided in two parts. On the one hand, scientists have to develop technologies which allow us to produce those new materials and on the other hand, they have to adapt it for existing applications. One alternative has been the development of biodegradable materials from renewable resources (mainly proteins and polysaccharides).New researches are devoted to develop new protein-based materials, which were able to replace fossil-based polymer for high quality applications such as superabsorbent.Nowadays, bioplastic applications are limited mostly to food, medical or agriculture industry. However, it appears that more and more bioplastics replace conventional plastics. For example, biopolymers were made in order to replace PVC pipes, or making cell-phone coating.

The European bioplastics production had double in 2013 compared to 2010 for reach 509 000 tons and increases each year. (MatériauxPlastiquesetcomposites, 2015). However, bioplastics production remains low compared to the 240 million tons of conventional plastic (Plastic Europe, 2008). Bioplastics are composed by a polymer matrix (polysaccharide, protein ...), a plasticizer (in order to reduce intermolecular forces among polymer chains, increasing mobility and reducing the glass transition) and some additives to improve the processabilityor properties of the final product. In this study, soy protein (polymer matrix), glycerin (plasticizer) and nanoclay (additive) were used.In fact, this product is known as nanobiocomposites.

Soy proteins, a co-product with soybean oil and it is one of the cheapest proteins in nature, shows superabsorbent properties due to the presence of hydrophilic amino acids. (Tian et al, 2012).Soy protein concentrates aresuitable raw materials for the production of bioplastics, which has been demonstrated to be suitable for performing bioplastics exhibiting

a high water uptake (Liu and al, 2005; Song and al, 2011). In addition,lamellar nanofillers have been postulated to improve mechanical and barrier properties (Alexandre et al, 2000; Angellier-Coussy et al, 2013). Natural Montmorillonite (MMT-Na^{+}) is one clay minerals widely used in polymer science as filler(Peelmanet al, 2013). It is widely available in the nature as micron-size tactoïds, which consists on several hundred of individual platy particles held together by electrostatic forces, the gap between each layer is about 1 nm which stack together, by Van der Waals forces, to form the primary particles of the material (tactoïds) (Kumar and al, 2010). The introduction of this materials leads to increase the water uptake capacity, while the mechanical properties of the hydrogel increase at the same time (especially strength and stiffness) (Bagheri Marandi and al, 2010). However, the efficient dispersion of nanoclays in biopolymer matrices is a key problem in bionanocomposite development, where exfoliation is the desirable arrangement for improving the properties of nanocomposites (Yang and al, 1999). The dispersion of these particles within the polymer structure is complex.

Most of the protein-based bioplastic properties can be easily controlled by adjusting different parameters such as the soy/plasticizer ratio, the quantity of filler orthe moldingtime and temperature (Felix and al, 2013). However, the strength of the polymer is too low and these properties are really influenced by moisture absorption(Liu et al, 2005).

The overall objective of this work is to develop SPI/MMTnanocomposite plastic materials, plasticized with glycerol by using injectionmolding process. Nanoclay was incorporated with the intention of improving the water absorption.Rheological and tensile strength measurements have been carried out in order to evaluate the structure of bioplastics. Moreover, X-rays diffraction and microscopy have been assessed to analyze the nanoclay incorporation into the material and evaluate its influence on the structure.

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