Subject: Development, characterization and optimization of barrier properties of biocompostable biobased polymers for packaging applications

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Abstract:
Since the invention of plastic from a synthetic polymer in 1907, plastic, by its ubiquity, has radically impacted all of our lifestyles. Plastic is indeed one of the most versatile materials ever produced. This massive use, linked to the fact that the plastic waste sorting cycle is not efficient enough, has made plastic unpopular, as a source of very significant pollution. It is in this context that this thesis is inserted, where the focus will be specifically on plastic packaging (food, pharmacological, industrial), and more particularly on the barrier properties of these packaging. The aim of this thesis will therefore be to offer packaging made from biodegradable biosourced polymers, with barrier properties specific to different uses and meeting industrial constraints as to their capacity for implementation.

Skills:
Engineer or Master degree in the field of materials and/or process engineering. A first experience in the field of polymers will be appreciated.
Qualities: taste for experimentation, autonomy, rigor and motivation, ability to work in a team.

Scientific fields: Engineering Sciences, Materials, Physico-chemistry

Keywords: polymers, biobased materials, barrier properties

Description:
Many products (in food, pharmacy, cosmetics, etc.) are currently packed in plastic films which have the essential role of isolating the product from its external environment, while preserving its intrinsic qualities (preservation of aromas, maintenance of a certain relative humidity, controlled partial pressure of oxygen, etc.). These are called barrier properties (none or very low permeability (diffusion) to gases (such as oxygen), vapors (such as water vapor) and flavors). It is also possible to extend these properties to light for certain applications.

The use of multilayer films (using the properties specific to each material) remains the most efficient way to economically design packaging. However, their implementation is not necessarily compatible

(for example, sealability requires specific mechanical and / or thermal characteristics) but the major problem in the current environmental context is that the technologies known to date do not allow recycling of these complex films.

The subject of the thesis, which is part of the work of several researchers on the problem of "Bio-based Materials and Packaging", concerns the development and characterization of a biocompostable bio-based polymer for packaging applications, for barrier properties will need to be optimized.

The polymer charged by bio-based reinforcements should have specific barrier properties such as resistance to moisture, gases (and radiation). The polymer will have to be selected, then formulated and implemented by extrusion. The polymer will then be characterized for its thermal (DSC, ATG) and mechanical (DMA, traction, bending) properties. After the laboratory-wide development phase, a scale-up will be considered at the pilot scale.

The barrier properties can be improved by a metal coating using plasma deposition technology.

The major bottlenecks of this project are:

1) Extrusion step: for this step, the blocking point is the homogenization of the raw materials in the extrusion screw (s) and their resistance to the high processing temperature. The polymer must therefore meet specifications in terms of viscosity, glass transition temperature, degradation temperature, etc.
The final product will be studied from the point of view of chemical homogeneity and mechanical properties (Young's modulus, elastic limit, tensile strength, HDT, etc.)

2) Coating step: it will be necessary to ensure the polymer temperature resistance during coating, the good adhesion and the non-diffusion of the coating.

How to candidate?
Contact the 2 supervisors by sending:

- Cover letter, CV and all transcripts after graduation
- Letter of recommendation from the head of M2 program (or equivalent)
- Letter of recommendation from the M2 internship tutor (or equivalent).

Any incomplete application will not be reviewed.