Living Lab Biobased Brazil
Education Research Innovation

Start-end date: **01/09/2022 – 01/03/2023**	NHL STENDEN university of applied sciences	UFMG
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Problem/assignment

Plastics are used in many aspects of society, but their use and improper disposal have become a world problem. Currently, the majority of trash is deposited or disposed of in a landfill By 2050, over 12,000 Mt of plastic garbage will be in landfills or the environment if present manufacturing and waste management patterns continue. Polyhydroxyalkanoate (PHA), is a class of biological polymer produced from renewable sources by microorganisms, is one of the prospective substitution possibilities. PHBV is a well known PHA biodegradable matrix, that can be used for natural fiber-reinforced biocomposites, but it has disadvantages such as high cost, poor heat stability, brittleness, and a slow crystallization rate.

Research has shown that polymers blended with plasticizers can increase the crystallization rate and affect the flexibility and impact characteristics of PHBV, enhancing its mechanical and thermal properties. This study aims to evaluate the use of triethyl citrate (TEC) and lauric acid (LA) as potential plasticizers to improve the biopolymer elasticity and make more accessible PHBV as an alternative to sustainable polymer.

Used methods/project phases

The TEC and LA were mixed with neat PHBV by two screw extrusion The materials were blended in various formulations 10,15,20% TEC and 10,15,20% LA.
PHBV was set directly into the mainfeeder settings to avoid calculation errors, as for the addition of the plasticizers, the liquid TEC was disposed of by a side feeder and the LA batch was also directly set into the mainfeeder. Subsequently, when the material leaves the machine, it passes through a water bath to solidify and it straightly goes into a cutter, where the blending string is cut into small pellets.

An injection machine was used for the molding process to produce samples for tensile and impact tests.the tensile test was perfomed to analyze the resistence of the blends when a axial force is applied. The impact resistance properties were analyzed through the result of Charpy impact tests The test is carried out to analyze the resistance to the impact of the samples of the polymer and different blend percentages.

In addition , the pure polymer and the blends were subjected to thermal analysis via DSC to compare the thermal behavior of different percentages of PHBV and the influence of the plasticizer on the polymer. In this test, the melting and crystallization temperature of the analyzed materials will be observed by evaluating around 5mg samples of each composition. As to analyze the chemical structure of the samples and identify the various functional groups contained in the bioplastic composites, an FTIR Spectrometer was used.

Results
Triethyl Citrate worked better as a plasticizer for the biopolymer PHBV than Lauric Acid. The combination of LA and TEC showed an slight influence on impact strenght, but it affirms that both compounds might be utilized to soften or modify the impact of PHBVB. Since it is a mechanical property that measures the tensile stiffness of a solid material, one may deduce that the mix containing TEC, especially 20%, is a more flexible material since it needs less stress to create the same amount of strain as the other samples. However, it is advised to research the biodegradability of each sample to examine other significant characteristics and determine whether the mixture would function effectively as a biopolymer in various life application areas.

Extra info/advice/link to final document and presentation
Sustainable Polymers.pdf