ENZYMATIC DEGRADATION OF POLYURETHANE USING FUNGI

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Introduction. Polyurethane (PU) is one of the most recalcitrant plastics used from a very long time and is one of the main components of garbage, so biodegradation of this polymer is an alternative that has been explored in the last years using bacteria and some results have been obtained. Research using filamentous fungi dates from about 20 years and this kind of microorganisms represent an important source of enzymes. Enzymatic attack to PU is carried out by different enzymes depending on the type of monomers used to synthesize it being the ether type more resistant.
In this work three fungal strains were tested on their capacity to degrade polyether PU and their enzymatic activities were tested and compared with FTIR sprectra of the PU in order to elucidate which is the enzyme responsible for the biodegradation.

Methods. Fungal strains were cultured in four different liquid media containing PU as nutrient source and a complementary carbon or nitrogen source that were glucose, glycerol, urea and ammonium sulfate in ratios 1:1 and 1:2. Cultures were agitated for 30 days at 30°C and after that time, solid PU and biomass were filtered. The resulting fermented broth was analyzed for extracellular protein (1), phenols release (2), protease (3), esterase (4) and urease (5) activities. Also, the residual PU was tested for thermogravimetric (TGA) and infrared analysis (FT-IR).

Results. The most important results concerning enzymatic activity are the ones corresponding to esterase and urease activity when ammonium sulfate was added. These were the treatments in whose the three fungal strains showed enzymatic activity being those activities 0.1 and 1400 U/L respectively, but no patron was detected among the strains.
The TGA and FTIR analysis showed that in almost every treatment with fungi, PU suffered alterations. In the FTIR spectra showed in figure 1, can be seen that the signals corresponding to the carbon-nitrogen bond are lost in the treatments with fungi and the weight loss due to thermal degradation in TGA analysis was very marked in the treatment with glucose-PU in a ratio 2:1 as can be seen in figure 2.

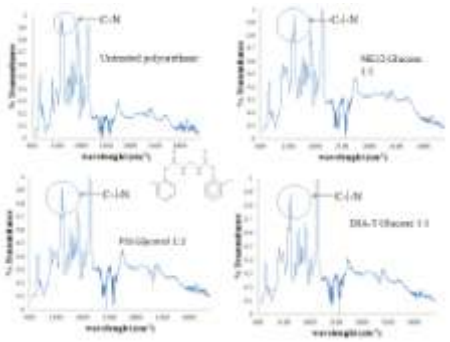

Fig.1 FTIR spectra of treated and untreated PU. Treatments are indicated in figure.

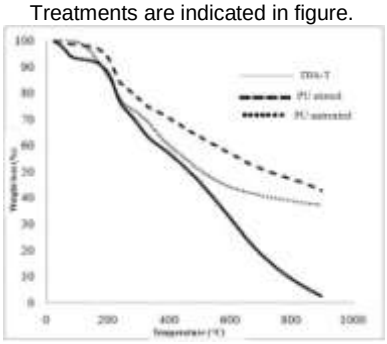

Fig.2 TGA analysis of treated and untreated PU.

Conclusions. An urease enzyme could be the responsible for the cleavage of the carbon-nitrogen bonds of PU, according to the FTIR spectra and it's necessary to add an additional carbon source to improve PU degradation. Protein and enzymatic activities could be different depending on culture time and kinetic studies are needed.

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