

## INVESTIGATION OF THE ENZYMATIC DEGUMMING AND STEAM EXPLOSION'S IMPACT ON THE CHEMICAL AND BIOLOGICAL PROPERTIES OF THE NATURAL FIBERS

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Today the textile production is considered as one of the most polluted fields across the world. And the size of the global textile market is expected to be increased by 26% in 2030. The high demand for clothing has necessitated the search for sustainable alternatives to mitigate the environmental impact. One such alternative being studied is the utilizing natural fibers instead of synthetic fibers due to their promising properties. The major benefits of using natural fibers at industrial skills are sustainability, biodegradability, eco-friendliness and lightweight. Utilizing the natural fibers such as flax, hemp, jute, nettle can decrease the waste release.

For the use of natural plant fibers as textile materials, the degumming process, also known as retting, must be performed in order to make fiber bundles become more separable from the wood's part of the stem. Methods of fiber degumming have been divided into four categories: physical, enzymatic, chemical and biological. The suggestion of the use of steam explosion and enzymatic retting as eco-friendly methods that can reduce fiber damage without influencing on cellulosic structure are proposed.

To determine and increase the effect of the degumming on the natural fibers, the flax, hemp fibers were taken as samples to perform the enzymatic degumming following the steam explosion method. For the enzymatic activity, pectate lyase (Bioprep100L, Novozymes) was used. As a chelator to remove  $\text{Ca}^+$  ions from the fibers, EDTA (Ethylenediaminetetraacetic acid) was proposed to utilize during the enzymatic retting to improve mechanical properties of the fibers.

Three groups were observed to investigate the effects of enzymatic retting on natural fibers: the control group (utilizing water only), the second group using pectate lyase enzyme with water, and the third group employing a pectate lyase enzyme buffered solution with EDTA as a chelator. After enzymatic degumming, the obtained biomass from three groups were got through the steam explosion at 200 °C for 4 min.

As a result, according to chemical analysis of sugar content using HPAE-PAD ion chromatography, it was revealed that the second group that is used only the pectate lyase and water following the steam explosion method showed the best result in comparison with the other groups. It was determined that the percentage of rhamnose and arabinan sugars, which represent the pectin content significantly decreased that cause a partial or a full elimination of pectin ( $\approx 0,05\%$  for flax and  $\approx 0\%$  for hemp), while the glucose content slightly increased ( $\approx 94,67\%$  and  $\approx 94,74\%$ , respectively) meaning that cellulose was not damaged during the retting methods. It can also be suggested that the group with EDTA chelator did not lead to successful results due to its influence on pectate lyase, causing the inactivation of enzyme.

Although the obtained results, demonstrating the efficient retting outcomes with pectate lyase that that can be used at industrial scale for the further processes of textile production, the additional analyses on mechanical properties, including determination of tensile strength, elongation must be performed.