OPTIMIZATION OF COLD ALKALINE EXTRACTION OF HEMICELLULOSES WITH ULTRASOUND FROM ROBINIA PSEUDOACACIA

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ABSTRACT

At present, sustainability and the reduction of the carbon footprint are two most important issues in theindustrial sector and in society in general. The production of environmentally friendly and sustainable materials has become a priority in many industries. Obtaining hemicelluloses, lignin, nanocelluloses or other high value-added materials from high-yielding forest species can be an efficient and sustainable way of producing materials with improved properties. High-yield forest species are cultivated specifically for biomass production and pulp production, which means that their cultivation and production can be highly sustainable in terms of resources and environmental impact. The use of these species can help reduce deforestation and overexploitation of natural forests, and allow the production of biomass and materials more efficiently.

The biomass chosen for this study was Robinia pseudoacacia, which is a fast-growing and highly productive energy crop. This raw material has been provided by the experimental forest engineering plantations of the University of Huelva In this work, Robinia pseudoacacia was subjected to cold alkaline extraction (CAE) with and without the simultaneous application of ultrasound, the main objective being to obtain a liquor rich in hemicelluloses. The CAE could be a first stage of a cascading biorefinery. The modeling and optimization of the process was proposed, based on a central composition factorial design with a total of 16 experiments, operating in the following ranges: soda concentration 80-120 g.L-1; operating time 30-90 minutes and temperature 20-40 °C. This design was used to study the influence of the independent variables on the behaviour of the dependent variables. The independent variables were alkali concentration (Xa), process temperature (XT) and operation time (Xt); while the response variables were yield, concentration of glucan, xylan, arabane, acetyl groups, total hemicelluloses and Klason lignin.

Cold alkaline extraction is operationally and environmentally advantageous over other alkaline and hydrolytic fractionation methods. Therefore, it does not require high pressures or temperatures, which reduces energy consumption. It also allows minimal degradation of hemicellulose derivatives to furfural. On the other hand, cold alkaline extraction has improved soda-anthraquinone pulping processes, where pulp yield is increased while preserving the integrity of cellulose as the main component.In addition, the use of these species of fast-growing can help reduce deforestation and overexploitation of natural forests, improve the sustainability of biomass production, and have a positive impact on the local economy.

This whole study is carried out with a broader objective of integral exploitation of the lignocellulosic material or Biorefinery and under the hypothesis that the application of ultrasound could contribute to a greater efficiency of the extraction process of hemicelluloses via cold alkaline extraction.

Keywords: Biomass, Cold Alkaline Extraction (CAE), Hemicelluloses, Ultrasound.