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Evaluation of the Recovery of Furfural from Wood Scraps †

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Abstract: 2-Furfuraldehyde, commonly known as Furfural, is a product of the hydrolysis and dehydration of pentose carbohydrates contained in lignocellulosic. Furfural is currently a commodity chemical, identified as one of the most promising chemical platforms directly derived from biomass, to produce chemicals, biofuels, and additives. Wood scraps are a good source of natural pentoses that contains up to 25%. Taking this into account, the goal of the research was to evaluate the recovery of furfural from wood scraps. The process of recovery of furfural was carried out by acid catalyzed pentoses dehydration, associated with a hydrodistillation. As a catalyst, we used a solution of hydrochloric acid of 10 wt. %. The physicochemical analysis of the samples obtained allowed to characterize and evaluate the recovery process. The results showed that under the experimental conditions evaluated, the degree of recovery of furfural was about 5%.

Keywords: furfural; recovery; biomass

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1. Introduction

2-furfuraldehyde, commonly known as furfural, is a product of the hydrolysis and dehydration of pentose carbohydrates contained in lignocellulosic. It was first isolated by Dobereiner in 1832 as a byproduct of formic acid synthesis.

Furfural is currently a chemical commodity, identified as one of the most promising chemical platforms directly derived from biomass, to produce fine chemicals such as biofuels, plastics, and additives [1,2].

The interest in furfural production through biomass conversion is not only due to the economic availability of raw materials but is a more ecological alternative than using fossil fuels from the petrochemical industry [3,4].

Large amounts of waste are produced by the wood industry, being this one of the most important sources for biomass production, containing up to 25% of natural pentoses [5–7].

Taking this into account, in this work the recovery of furfural from wood scraps was evaluated.

2. Material and Methods

The process of furfural recovery was carried out by acid-catalyzed pentoses dehydration, according to Figure 1. First, the wood scrap was grinded in order to decrease its size. Subsequently, a known amount of grinded wood scrap was added in a hydrodistillation equipment with 300 mL of a hydrochloric acid solution of 10% wt. and the mixture was brought to its boiling point to promote polysaccharides hydrolysis. The distilled fraction was neutralized with sodium carbonate and then sodium chloride was added.

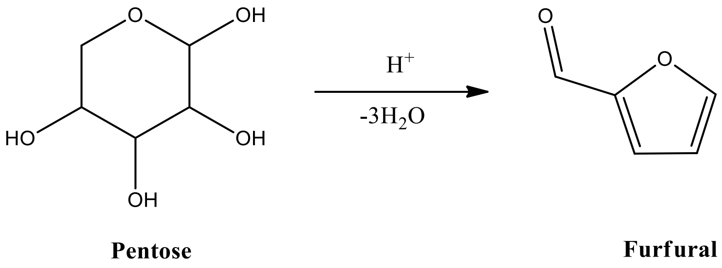

Figure 1. Acid catalyzed pentose dehydration process.

To isolate the desired product, a second hydrodistillation was carried out until 50 mL of distilled was obtained. The collected fraction was saturated with sodium chloride and then transferred to a separate funnel. Three extractions were carried out using 20 mL of diethyl ether as solvent. The solvent was evaporated until a yellow oily compound is observed.

The recovery was evaluated with the following Equation (1):

$$R\,(\%) = \left(\frac{m_0}{m}\right) \cdot 100 \quad (1)$$

where m_0 (g) is the weight of furfural and m (g) is the weight of wood scraps powder.

3. Results and Discussion

Among the organic compounds that can be obtained from biomass, furfural is probably one of the most important molecules. Considering that wood scraps are a source of pentoses, we evaluated the recovery of furfural by a simple process.

Previously in this study, we optimized a protocol by furfural recovery from wheat bran, obtaining a recovery of 3.4 %. Then we evaluated the effect of the use of soft experimental conditions on the furfural recovery. A set of experiments were carried out with this protocol, over different ratios (weight of wood scrap/volume of hydrochloric acid solution), and the recovery was analyzed. As can be seen in Table 1, furfural recoveries of 4.8–5.5 % were obtained. These results showed that over the experimental conditions evaluated, an excess of the hydrochloric acid solution is used to catalyze the dehydration of pentoses from wood scraps. Although an excess of catalyst was used in all experiments, the furfural obtained has shown the same physicochemical properties as commercial furfural.

Table 1. Evaluation of furfural recovery at different wood scrap used.

Entry	Wood Scrap [% wt.]	Furfural Recovery [%]
1	25	5.4
2	20	5.0
3	15	5.5
4	10	4.8
5	5	5.1

4. Conclusions

The isolation of furfural through pentose dehydration over soft conditions was analyzed. Under soft experimental conditions, furfural was successfully recovered from wood scrap with a degree of recovery around 5%. However, additional studies must be done to reduce the amount of catalyst used in the process.

Institutional Review Board Statement:

Informed Consent Statement:

Data Availability Statement:

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