FURFURAL EVALUATION OF PRETREATIONS IN THREE VARIETIES OF BIOMASS

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Abstract -
The importance that the use of biomass brings with it nowadays provides a positive change, due to the reduction of environmental impacts to flora, soil and living beings, which affects the biological chain, therefore, this work has as an objective to carry out a comparative evaluation at a pilot level of pretreatments of three varieties of lignocellulosic biomass for obtaining furfural; These resources are sugarcane bagasse, rice husk and corn cob. The results revealed that the furfural obtained corresponds to a concentration of 1.75 g/L of the three resources in quantities of 200, 206 and 222 milliliters respectively, in acid hydrolysis it was treated with acid concentrations at 6%, 8% and 10%, resulting in an adequate acid concentration of 8%, in the HPLC analysis the highest concentration of furfural that was obtained was 2.75 g/L, which corresponds to the rice husk and with a yield of 42.96%. The relationship between the composition of hydrolysates (three varieties of biomass) and the yields of furfural was obtained, from an optimization process design with input raw material of 2021.3 g in a stabilization time for minute 16 reaching a maximum production of furfural equivalent to 3 liters, using as physical and chemical pretreatments such as alkaline and acid hydrolysis and LHW (liquid hot water).

Keywords - Biomass, Acid Hydrolysis, Sugarcane Bagasse, Rice Husk, Corn Husk, Pretreatment, Furfural

I. INTRODUCTION

Furfural has been characterized as an aldehyde that can contribute to the development of renewable energy, this in order to provide other options that help create additional sources, so that other chemicals and fuels are obtained, the study on furfural and its performance has been more relevant in these times so that there is a set of resources that have been exploited from nature for many years and these can be completed. Consequently, the reduction of several reserves of resources used to energy production, it should be mentioned that there has been a clear indication that invites us to invest in other options and this is known not only by science but also by the same nature, since it is the one who provides different raw materials such as biomass, a situation that benefits the environment and all species that benefit from the most exploited resources.

Similarly, biomass should be considered to provide a breakthrough in the field of chemistry, as it is necessary to bear in mind that organic matter can produce products such as ethanol and/or furfural sugar, provided that it entails a process of catalyzed hydrolysis, especially in acid, so the use of furfural can be used to separate compounds by means of solvents, an example of this may be unsaturated compounds and saturated ones.

In this same order of ideas, pretreasances have to be an important aspect to know the possibility and the results provided by residual biomass, specifically in relation to furfural performance, for this it should be taken into account that when evaluating pretreasses these can include processes such as weeding, desarenado, degreasing and homogenization, in order to know what information can be obtained , it is proposed to carry out this study and to be able to evaluate these results.

II. METHODOLOGY

a) Raw material collection

For the process of collecting raw materials different collection sites were determined, since different types of raw materials are used, among which can be found, the rice shell, which was collected in the Piladora "La espiga" in San Carlos province of los Ríos, in turn the corn tusa was collected in the Commercial Danilo Jiménez in Zapotal new, being recepted in a granted way.

b) Treatment of raw materials

Natural Drying

As a post-raw material collection step, it is placed under the sun, with the aim of removing the moisture existing in them. In this section of the process it was necessary to apply the manual quartet method, which consisted of depositing the different raw materials existing in an area that has the characteristics of being clean, dry and smooth. Keeping in constant mixing with the help of a shovel, making sure that it is together, and in turn dividing it into four equal sections. As a next step, the opposing parts are removed, resulting in half of the material, this process is performed under an interval of 30 minutes, until the amount of material is necessary for testing.

Grinding

By obtaining the moisture-free raw materials, it goes into the grinding process, which aims to reduce the

size of the material entering, in the case of the corn tusa the grinding was made with a hammer mill as a tool, entering the system 7118.2g, resulting in the obtaining of 6202.2g, which leaves us a loss of 980g of material. In the case of rice shell, it was necessary to apply a ball mill as a tool, presenting as input 2021.3g, with the application of grinding was obtained 1832.3g, leaving as loss a total of 198g. On the other hand, in the process of the cane bagasse, a grinding was applied under the use of the hammer mill, entering the process 2931g, after that is obtained as a result 2426g, leaving as loss 505g of material.

Sieved

Once the grinding process of the different raw materials is complete, it goes to the sieving process, which was done manually with sieves of different diameters, and each raw material income with different weight.

Distillation

At this stage of the process was carried out in the oil laboratory belonging to the faculty of Chemical Engineering of the University of Guayaquil, in the action corresponding to hydrolysis it was necessary to apply sulfuric acid in different concentrations, being these 6%, 8% and 10%, in turn in the distillation equipment a thermometer is introduced , which will perform the function of recording the temperature throughout the process.

Redistillation

As the last section of the process the product of the distillate process is collected, which presents as an outlet a slightly acidic aqueous substance from the furfural, this product is subjected to a new distillation process in conjunction with water and sulfuric acid, this solution should reach a point where the water is considered to have evaporated completely, leaving as a net furfural result.

III. RESULTS

The results obtained in the development of the research are presented, in relation to the characterization of the raw material and the product obtained from distillation, the determination of the furfural content is shown by the presentation of data and results processed through Excel, which facilitates the generation of the conclusions according to the experimentation carried out.

Change in performance according to concentration

a) Rice shell

Summary	Account	Sum	Average	Variance
Sample 1	3	207	69	13
Sample 2	3	208	69,333	1,333
Sample 3	3	205	68,333	58,333

Table 1 *Performance by concentration - Rice shell*
Crafted by: Authors

Based on the statistics presented it is determined that furfural yield in relation to the concentration of sulfuric acid with respect to the rice shell, generates the following graph.

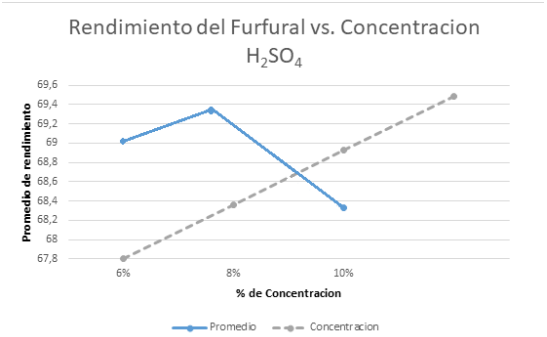


Figure 1Furfural yield relative to H_2SO_4 concentration - Rice shell
Source: Authors

Based on the graph presented above, it can be determined that the furfural yield in relation to the concentration with which it is performed, has a higher gain when treated with a concentration of H_2OS_4 of 8% with 69.33 ml, on the other hand the lower yield obtained was reflected when applying its process witha concentration of H_2SO_4 to 10% obtaining a 68.33ml. Having a decrease trend as the concentration of H_2OS_4.

b) Sugarcane bagasse

Summary	Account	Sum	Average	Variance
Sample 1	3	203	67,666	6,333
Sample 2	3	206	68,666	10,333
Sample 3	3	195	65	49

Table 2 *Performance by concentration - Sugarcane bagasse*
Crafted by: Authors

In relation to the data processed under the statistical methods, it is determined that the following graph shows the relationship between furfural performance and the concentration of H_2OS_4used.

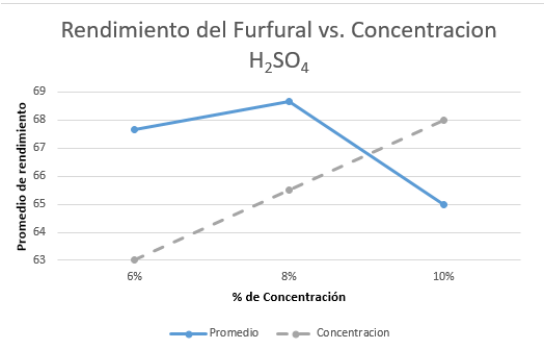


Figure 2 Furfural yield relative to H_2SO_4 concentration – Sugarcane bagasse
Source: Authors

Based on the graph presented, it is determined that this represents the relationship between the concentration of H_2OS_4 used in the process and the

furfural performance obtained, under this comparison it is determined that the highest yield rate was 68.66 ml, obtained by processing the raw material with 8% concentration of H_2OS_4,while the lowestreflected yield corresponds to 65 ml, corresponding to the process carried out with a concentration of H_2OS_4 of 10%. Indicating a growth trend between 6 and 8% concentration, however, when applying 10% it decayed.

Corn tusa

Summary	Account	Sum	Average	Variance
Sample 1	3	203	67,666	6,333
Sample 2	3	206	68,666	10,333
Sample 3	3	195	65	49

Table *3 Concentration yield - Corn*
Crafted by: Authors

With regard to the measures worked, it is sought to determine the relationship between the concentration used with the maize tusa and the yield it obtains, represented in the following graph.

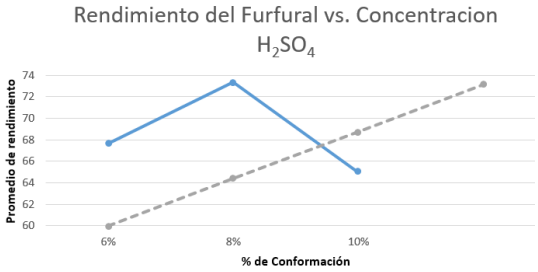


Figure 3 Furfural yield relative to H 2_2SO_4 concentration – Corncob
Source: Authors

According to the graph, it determines the yield of the maize tusa according to the concentration used of H_2OS_4, it was determined that the highest yield was73.33 ml, usinga concentration of H_2OS_4 to 8%, on the other hand, it is determined that the lowest yield existing was 65 ml, this with the application of a concentration of H_2OS_4 to 10%. Presenting a growth rate trend to apply the concentration of 8%, however, using a concentration of 10% it showed a decline.

Chromatography Analysis

Physical method
Based on the analyses applied under the chromatography method at the UBA Analitycal Laboratories Accredited Laboratory, the interaction representing the measurement of furfural concentration is determined, in relation to the final product obtained, in relation to the application of the physical method, as shown below:

Raw Material	Furfural concentration (%)
Corn cob	0,05
Rice shell	0,11
Sugarcane bagasse	0,044

Table 4 *Chromatography Analysis–Physical Method*
Crafted by: Authors

Chemical method
According to the analyses carried out under the chromatography method at the Accredited Laboratory UBA Analitycal Laboratories, which determines the action it represents with the measurement of the concentration of the final product obtained, in relation to the application of the chemical method, as shown below:

Raw Material	Furfural concentration (%)
Corn tusa	2,578
Rice shell	2,745
Sugarcane bagasse	2,599

Table *5*
Chromatography Analysis - Chemical Method
Crafted by: Authors

IV. DISCUSSION

Based on the results of this research work it is determined that under the applied process, it is evident that different types of yields were obtained for each raw material, these being of different proportions according to the raw material applied, obtaining for the corn tusa with the parameter of 8% concentration of H_2OS_4 a furfural yield of 40.34%, however, in relation to rice shell under the same concentration conditions of H_2SO_4 represents a result of 42.96% of furfural yield, on the other hand, the yield evidenced by sugarcane bagasse under the same specified concentration conditions has a yield of 40.67%. On the other hand, Vergara (2015) in its experimental research work, carried out a similar process by using different types of raw materials, with an interaction of H_2OS_4 with a concentration of 15%, where the results corresponding to the yield achieved represent a variation between each raw material, being that for the corn tusa a furfural yield of 48.45% was obtained, on the other hand, the furfural yield obtained in the rice shell determines 20.04%, in turn the furfural yield achieved in the cane bagasse represents 15.91%. However; Veliz (2019) in the development of her experimental research came to determine her own conclusions under the application of a methodology in which she presents a variation between the quantities of raw material used, relative to a concentration of H_2OS_4 determined at

10%, in which the author states that the highest furfural yield achieved was 34.58%. %.

V. CONCLUSION

Furfural could be obtained with a concentration of 2.75 g /L from cane bagasse, rice shell, and corn tusa, for this purpose was worked during acid hydrolysis with different concentrations of acid (6%, 8% and 10%), resulting in a higher concentration of furfural from the rice shell raw material with 2.75 g/L and a yield of 42.96% determined for all raw materials.

An optimization process for furfural obtaining was designed using a simulation program (Simulink) resulting inndo with 2021.3 g of raw material, its stabilization time is given in the 16th minute in which it reaches the maximum production of furfural of 3 liters.

Se concludes that the chemical method is best suited to furfural production; presenting a yield of 42.96% with the raw material rice shell with the variation of acid concentration to 8% for hydrolysis, while the physical method the yield was 1.72%.

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