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TO STUDY EXTRACTION OF FURFURAL FROM SUNFLOWER HULLS

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Abstract

Production of furfuraldehyde from pentosan in flower hulls was dispensed in a trial to provide added merchandise from flower hulls that is often burnt around sunflower-seed oil mills of Bharat. This method concerned the conversion of flower hulls into saccharide that was then cyclodehydrated to furfuraldehyde victimisation dilute oil of vitriol. Product was characterised by meter method like bromine- bromide excess technique. Furfuraldehyde obtained was analysed victimisation gas natural action (GC) and gas natural action with mass photometer (GC-MS). The merchandise was colourless, however turned Xanthus and so dark brown upon exposure to air and light-weight. Furfuraldehyde obtained was in liquid kind, with a relative molecular mass of 96.2 g/mole and also the formula of $C_5H_4O_2$.

Keywords: *Acid chemical reaction, flower hulls, furfural, GC-MS, xylose*

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1. INTRODUCTION

The interest for manufacturing chemicals from renewable resources has redoubled within the last decade in direct reference to the declining reserves and increasing costs of fossil fuels. Rapidly growing worldwide energy demand has triggered a renewed interest in producing fuels from biomass to add to worldwide energy supplies. Renewable biomass resources have the potential to serve as a sustainable supply of fuels and chemical intermediates [1]. Biomass is made up of four major components: cellulose, hemicellulose, lignin, and starch. Hemicelluloses are the second most abundant plant material after cellulose. The hemicellulose present in biomass undergoes hydrolysis in acidic media to form xylose (pentose), and then xylose is dehydrated to form furfural. There is no synthetic route available for furfural production; therefore furfural is exclusively produced from renewable biomass resources by acid catalyzed dehydration of pentoses. Due to its unsaturated bonds and aldehyde group, furfural is a highly versatile and key derivative used in the manufacture of a wide range of important chemicals, and it is likely to be of increasing demand in different fields, such as oil refining, plastics, pharmaceutical, and agrochemical industries [2]. Lignocellulosic biomass contains approximately 42-54% cellulose, 23-36% hemicellulose and 22-28% lignin. Cellulose is a polymer of glucose and hemicellulose, and it is composed of pentose and hexose (Nigam and Singh 2010[3]. Furfural can also be produced by dehydrating pentose sugars or by the acid hydrolysis of biomass obtained from cornstalks and corncobs, peanut shells, wheat straw, sugar cane bagasse, cotton stalks, wood chips and other waste products (Saha 2003; Akpinar et al. 2009[3]Hulls is that the material of deseeded helianthus head as agro wastes that is generated as agriculture additionally as edible refinery. The annual production of helianthus Hulls in India is 1.8 million metric ton and this quantity is foreseen to extend within the future. The northern a part of the state of Mysore, India may be a semi-arid tropical region, standard for the assembly of pulses and oil seeds (sunflower) .It has been according that due to their high content of reducing sugars, it's attainable to provide furfuraldehyde and alkyl radical alcohol from helianthus hulls. Furfuraldehyde is a compound derived from a spread of agricultural by-products, together with corncobs, oat, wheat bran, and wood. The name furfuraldehyde comes from the Latin word furfural that means bran, touching on its usual supply. It's an organic compound of pyromucic acid. The world marketplace for furfuraldehyde is anticipated to achieve regarding USD 1200.9 million by 2020. The present value for furfuraldehyde is around USD 1,500 per weight unit [5].

Furfural may be obtained by the acid catalyzed dehydration of 5-carbon sugars (pentoses), particularly xylose [6].

$$C_5H_{10}O_5 \rightarrow C_5H_4O_2 + 3H_2O$$

These sugars may be obtained from hemicellulose present in lignocellulosic biomass, which can be extracted from most terrestrial plants. Between 3% and 10% of the mass of crop residue feedstocks can be recovered as furfural, depending on the type of feedstock. Furfural and water evaporate together from the reaction mixture, and separate upon condensation. The global production capacity is about 800,000 tons as of 2012. China is the biggest supplier of furfural, and accounts for the greater part of global capacity. The other two major

commercial producers are Illovo Sugar in the Republic of South Africa and Central Romana in the Dominican Republic. In the laboratory, furfural can be synthesized from plant material by reflux with dilute hydrochloric acid [7], or other acids [8]. In industrial production, some lignocellulosic residue remains after the removal of the furfural. This residue is dried and burned to provide steam for the operation of the furfural plant. Newer and more energy efficient plants have excess residue, which is or can be used for co-generation of electricity [9][10] cattle feed, activated carbon, mulch/fertilizer, etc. It also has been used as a glue extender in the North American board industry [11].This synthesis is similar to the production of hydroxymethylfurfural by the acid catalyzed dehydration of 6-carbon sugars (hexoses).

2. MATERIALS AND METHOD

Raw Materials:

- Sunflower Hulls
- HCL
- NaCl
- Diethyl Ether

2.1 Hydrochloric Acid:

Hydrochloric acid is a corrosive, robust mineral acid with several industrial uses. A colourless, extremely pungent solution of acid in water, once it reacts with an organic base it forms a complex salt.

Hydrochloric acid was traditionally known as aecidium sails, hydrochloric acid, and spirits of salt as a result of it absolutely was made from halite and inexperienced vitriol and later from the with chemicals similar common salt and acid. Free acid was initial formally delineated within the sixteenth century by chemists like Glauber, Priestley, and Davy in their research project.

2.2 NaCl:

Sodium chloride also referred to as salt or sodium chloride, is an ionic compound with the formula NaCl representing a 1:1 magnitude relation of atomic number 11 and chloride ions. With molar masses of 22.99 and 35.45 g. mol^{-1}, severally, 100 g of NaCl contain 39.34gm sodium and 60.66 Cl. sodium chloride is the salt most chargeable for the salinity and brine extracellular fluid several cellular organisms. Within the variety of edible or flavourer it's normally used as a flavouring and food preservative. Large quantities of NaCl compounds used as feedstock's for more chemical syntheses. A second major application of binary compound is de-icing of roadways in sub-freezing weather.

2.3 Diethyl Ether:

Diethyl ether is an organic compound. It's colourless, extremely volatile burnable liquid. It is normally used as a solvent in laboratories and as a beginning fluid for a few engines. It had been formally used as a anaesthetic, till non-flammable medicine were developed, like inhalation general anaesthetic. It's been used as a narcotic to cause intoxication.

3. EXPERIMENTAL METHOD

- Fifty grams of dried helianthus hulls (dried in the oven temperature of 110^0C for one to two hours) grind into minute particles of size 1 millimetre, 250ml of 1M binary compound HCl, and 62.40gm NaCl were introduced into a three-neck round bottom flask.
- A fractionating column and a condenser were connected and the reaction mixture was heated and stirred with a stirrer.
- Distillation was ascertained when quarter-hour at the distilling temperature of 100^0C. The liquid was set to flow into an extraction flask containing 250ml diethyl ether.
- Two layers were fashioned with diethyl ethyl-furfural containing layer at the top and therefore the binary compound layer at the lowest of the flask.
- The bottom binary compound layer was charged into reaction flask by a come tube connected to the one in all the neck.
- The high diethyl ether-furfural layer was subjected to the easy distillation unit to get rid of diethyl ether and a transparent yellow liquid remained. Whenanalysed by GC-MS furfuraldehyde made up our minds.

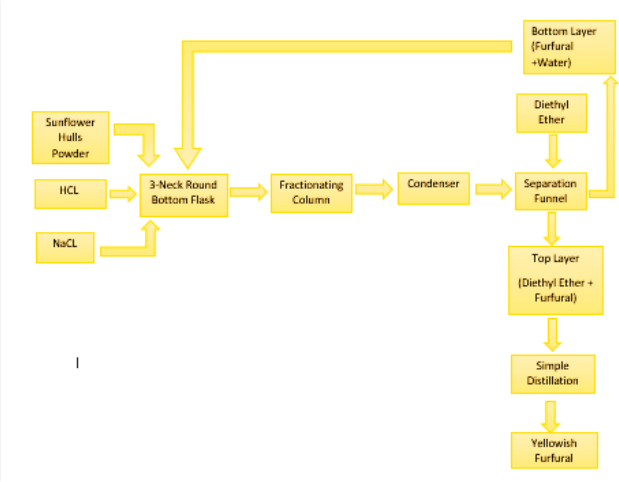

Fig. 1: Process Flow Diagram

3.1 SEPARATION PROCEDURE

1) As we tend to obtain the extract layer of Furfural-diethyl ether from the chemical reaction method is subjected to the easy distillation.
2) During unit operation we've got to keep up the temperature at 34.6^0C that is the boiling point of ether.
3) Because the low boiling purpose ether get filter out by condensation.
4) And the remaining one is our product i.e. Furfural.

4. RESULTS AND DISCUSSION

The hydrolysis of sunflower hulls with aqueous HCl was also performed with different concentrations of acid, with the method described above. Table is a tabulation of the experiment.

Table No.1: Effect of Acid concentration on Product Yield

Product Yield	Acid Concentration (HCL)			
	1M	2M	3M	4M
Grams	3.48	4.75	4.99	5.8
Weight %	6.96	9.5	9.98	11.6

The hydrolysis of sunflower husks was carried out using Hydrochloric acid (HCL) of different concentrations. We compare the rate of hydrolysis of the different concentrations acid on the sunflower husks. The results indicate that with HCL, furfural was seen to produce even after 1.30 hrs of hydrolysis.

The yield of product effect with change with acid concentration. The optimum yield of Furfural at 4M concentration of HCL was found to be 11.6 wt. %

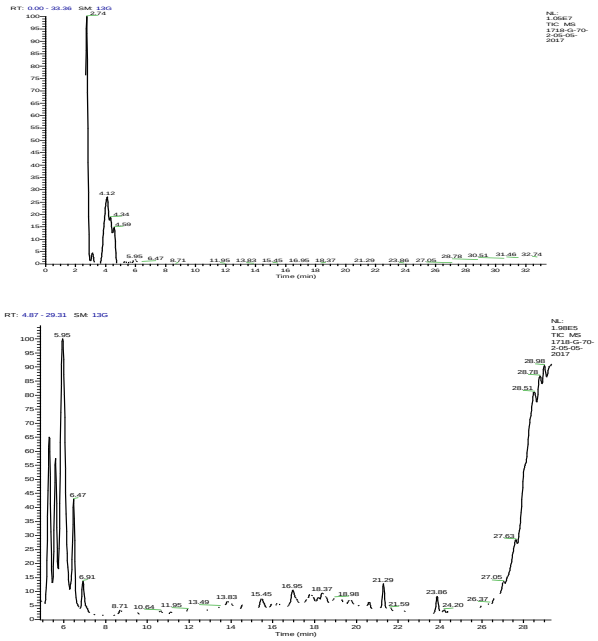

Fig.2: GC-MS Analysis Of furfural

Results obtained from GC-MS are shown in above Figure 2: furfural incorporates a retention time of 4.30 min with relative abundance of 60 minutes.

5. CONCLUSION

Furfural has been successfully synthesized from sunflower husk by acid hydrolysis method. Furfural was identified using GC-MS equipment. It has a formula of $C_5H_4O_2$ and a molecular weight of 96.2 g/mole. It is a yellowish liquid, which smells like bitter almond. It is colourless but turns yellowish and then brown upon exposure to light and air.

As the molarity goes increases then the production of furfural oil increases. The optimum %yield of furfural at 4M molarity of HCl was found to be 11.6 wt. %

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