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Optimization of Production of Ethanol by using Sugarcane Juice as a Raw Material Instead of Molasses

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Abstract - Unlike fossil Fuels Ethanol is one of the renewable energy sources produced by decomposing of sugars. Traditionally Distilleries are producing it by decomposing Molasses which is by product of sugar manufacturing process. The challenge is to increase the production of ethanol and getting high yield by changing the raw material i.e. using Sugarcane juice instead of Molasses. Further process changes, Design changes and Biological changes are studied.

***Key Words*:** Ethanol, Yeast, Distillation, Sugarcane, Fuel

1.INTRODUCTION

Ethanol is an essential part of the fuel industry in chemical engineering. Since humans are using organic and inorganic compounds those may be naturally found or prepared by some chemical and physical processes. Coming to the automobile industry ethanol usage in petrol was initially 5% and now it has been increased to 10%. It is having a huge impact on rising petrol prices. Now there are chances that the percentage of ethanol in petrol can be again increased and raised to 30%. In the future, we might be running all vehicles 100% on ethanol only as we can see a lack of sources of crude oil and they are going to get vanished soon. For many years we are producing ethanol from molasses with good efficiency.

In recent days if we see the demand for ethanol has increased as its part of fuel and energy. To fulfil that demand we need to produce ethanol and other resources also. Ethanol production from the raw material is dependent on the content of Reducing Sugar in that particular material. As we know sugarcane juice is having an abundant amount of sugar content that can be reduced and ethanol can be obtained more efficiently. The thesis is related to the optimization of the process for production of ethanol from sugarcane juice. Some design, process, and biological changes are to be observed and some suggestive measures to be given.

India is leading sugarcane producer in the world but a huge amount of sugarcane remains unprocessed due to unavailability of the facilities. Main agenda of this study is to utilize the unprocessed sugarcane for production of ethanol.

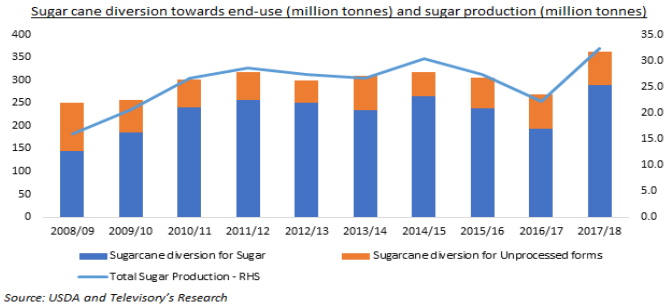

Fig -1: Sugarcane production and processing

2. PAPER BODY

Preliminary Analysis

Preliminary analysis is carried out to check properties of sugarcane syrup

Sr. No.	Component	Molasses	Sugar Juice
1	Brix	85-88	40-70
2	Tot al reducing Sugars (TRS)	48-53%	_=Brix -4
3	Reducing Sugar (After fermentation)	1-1.5%	Nil
4	pH	5 to 6	5 to 6
5	Fermentable Sugar (FS)	48-53%	36-66%
6	Unfermentable Sugar (UFS)	47-52%	Nil

Table -1: Preliminary Analysis

Scope of Work

In order to achieve the objective, the following scopes have been identified and to be applied:

- To study the amount of ethanol yield from Sugarcane Juice fermentation process.
- To investigate the effect of yeast quantity, temperature, and fermentation period on the ethanol yield using batch fermentation.
- To suggest necessary design and process changes to the industry.

Cumulative Observation, I

Sample ratio components is 1:5
It is combination of juice in the ratio of 1:4 that means 85 ml of concentrated juice is added to 415ml of water.
2.5 gm of urea is added to the solution while adding 2.5gm of yeast.

The above sample is prepared to treat with Fali Fueling activated fermentation yeast for fermentation and below mentioned readings are taken on 25th January 2022 on the time mentioned in the table

Sr. No.	Parameter	Readings		
		12:30	18:00	21:45
1	Weight of empty Gravity Bottle	20	20	20
2	Weight of Gravity bottle with Water	44.4	44.4	44.4
3	Weight of Gravity bottle with Alcohol	45	46.4	46.2
4	Ratio	1.02459	1.081967	1.0737705
5	Temperature	29 C	26 C	23 C
6	Alcohol %	Fail	Fail	Fail

Table -2: Cumulative observation table I

Cumulative Reading II

Sample ratio components is 1:4
It is combination of juice in the ratio of 1:4 that means 100 ml of concentrated juice is added to 400ml of water.
2.5 gm of urea is added to the solution while adding 2.5gm of yeast.
The above sample is prepared to treat with Thermosacc XL fermentation yeast for fermentation and below mentioned readings are taken on 25th January 2022 on the time mentioned in the table.

Sr. No.	Parameter	Readings		
		13:15	19:00	22:30
1	Weight of empty Gravity Bottle	20	20	20
2	Weight of Gravity bottle with Water	44.4	44.4	44.4
3	Weight of Gravity bottle with Alcohol	43.6	43.2	46.2
4	Ratio	0.9883	0.9727	0.9312977
5	Temperature	27 C	31 C	28 C
6	Alcohol %	13%	13.70%	7.80%

Table -3: Cumulative observation table II

Cumulative Reading III

Sample ratio components is 1:4
It is combination of juice in the ratio of 1:4 that means 100 ml of concentrated juice is added to 400ml of water.
2.5 gm of urea is added to the solution while adding 2.5gm of yeast.
The above sample is prepared to treat with Fali Fueling activated fermentation yeast for fermentation and below mentioned readings are taken on 25th January 2022 on the time mentioned in the table

Sr. No.	Parameter	Readings		
		12:00	17:30	21:00
1	Weight of empty Gravity Bottle	20	18	20
2	Weight of Gravity bottle with Water	44.6	38.7	44.4
3	Weight of Gravity bottle with Alcohol	44.4	38.2	43.7
4	Ratio	0.9918	0.9758	0.9734
5	Temperature	27 C	31 C	28 C
6	Alcohol %	12%	18.30%	20.05%

Table -4: Cumulative observation table III

Material Balance

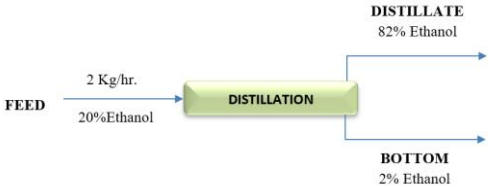

Fig -2: Overall Material Balance

$$X + Y = 2 \quad \text{.....[i]}$$

- Material Balance of Ethanol:

Ethanol in Feed = Ethanol in Distillate + Ethanol in Bottom

$$0.2 * 2 = 0.82X + 0.02Y \quad \text{.....[ii]}$$

$$Y = \frac{0.4 - 0.82X}{0.02}$$

$$Y = 20 - 41X \quad \text{.....[iii]}$$

Put equation [i] in [iii],

$$X + (20 - 40X) = 2$$

$$X + 20 - 41X = 2$$

$$10 - 20X = 1$$

$$-20X = 1 - 10$$

$$X = \frac{-9}{-20}$$

$$X = 0.45 \text{ kg/hr.}$$

Now equation [i] becomes,

$$Y = 2 - 0.45$$

$$Y = 1.55 \text{ kg/hr.}$$

Distillate Flow rate = 0.45 kg/hr.

Bottom Product = 1.55 kg/hr.

Ethanol in Distillate = 0.82 * 0.45

= 0.369 kg/hr.

Ethanol in Feed = 0.2 * 2

= 0.4 kg/hr.

$$\% \text{ Recovery of Ethanol} = \frac{\text{Ethanol in Distillate}}{\text{Ethanol in Product}} * 100$$

$$= \frac{0.369}{0.4} * 100$$

= **92.25 %**

3. CONCLUSIONS

To fulfill the demand of fuel market and to utilize the unprocessed sugarcane we can produce ethanol directly from sugarcane syrup instead of molasses. The yeast used for molasses for fermentation is not that much usefull because of excess sugar present, hence changing the yeast can give us better outcomes. As shown in material balance part we have derived 92% alcohol recovery by this process.

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The heading should be treated as a 3rd level heading and should not be assigned a number.

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