Ethanol Production from Sweet Sorghum

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Abstract **-** The aim of this study was to determine the sugar content of different sweet sorghum cultivars at different harvest times and also determine the cultivar that will produce the highest ethanol yield at optimized fermentation conditions. Four sweet sorghum cultivars, Honey green and Sugar graze were harvested at 3 and 6 months and the juice were extracted from the stems. The juice was used for ethanol production and the effect of pH, yeast concentration dilution factor and the addition of a nitrogen source on the ethanol yield were investigated.

The results showed that the cultivar contained the highest sugar content at 3 months. A maximum ethanol yield (0.48g.g-1) was observed at a pH of 4.5, a yeast concentration of 3 wt%, a dilution rate of 1:1 and when ammonium sulphate was added to the fermentation broth as nitrogen source. Glycerol yield formed as a by-product during fermentation and at a maximum ethanol yield was 0.05 g.g-1.

Keywords: *Sweet sorghum, Fermentation, Ethanol, Sugar content.*

I. INTRODUCTION

India's economy mainly based on agriculture, since almost 70 % peoples are dependent on agriculture so for the economic growth of Nation, we have to concentrate on agriculture, so we need to implement advance control strategies, which give maximum profit, with minimum raw material and at minimum cost. One of the techniques to proceed in such a direction is to cultivate such a crops which gives maximum yield or by processing on the crops we are getting different by products, which give maximum profit. Thus we step up in the same direction & we have tried to produce ethanol from sweet sorghum. Ethanol is nothing but anhydrous alcohol or ethyl alcohol. When we remove the water contents from the alcohol then it becomes Ethanol. Ethanol is produced form variety of sources such as sugarcane, sweet sorghum, maize, soybean, or we can say that from those crops, which contains glucose. Currently the ethanol is produced from sugar cane, but when we compare it with sweet sorghum; we find that ethanol production from sweet sorghum is too much beneficial. Since in India there is always scarcity of water in some areas. Where sweet sorghum is much more than that of sugar cane. Thus sweet sorghum is one of the great substitutes for sugarcane to produce Ethanol. As we find that day need of fuel increases and that why their prices are also increases. Since ethanol is one of keep the prices of fuel within the certain limit.

A. Objective

1) Simple method of Ethanol generation.
2) To use ethanol as motor fuel.
3) Better utilization of Waste Agriculture Material.
4) To reduce import of fuel.

B. Problem Statement

Generally we can produce ethanol from sugarcane. But it has lot of dis-advantage. So we will produce Ethanol from sweet sorghum. As the sweet sorghum can yield two times within a year, so we get more amount of biomass. Sweet sorghum crops take less amount of water for growth. Also it has less investment cost than that of sugar cane. It has affect due to bacterial attack like "WHITE MAWA" which is seriously affected on the sugar cane.

Today, the most popular alternative to oil is bio-fuels. Ethanol, king of the challengers to petroleum, is already found blended with gasoline at pumps across the country.

C. Future Scope

1) We have to utilize waste agriculture material and produce the ethanol. Ethanol can be used as optional fuel. It will help to increase the economy of farmer. India's economy mainly based on agriculture. As the farmer economy increases, India's economy also increased.
2) The fermentation of sweet sorghum juice, processes of bagasse bioconversion to bio ethanol and to give a better understanding about the production process of ethanol from sweet sorghum juice
3) The experimental methods used in this study. It explores the possibility of employing different parameters in order to increase the ethanol yield during the fermentation of sweet sorghum juice.

II. PROCESS DESCRIPTION

The main aim is to produce ethanol from sweet sorghum juice by controlling the whole process through the micro controller.

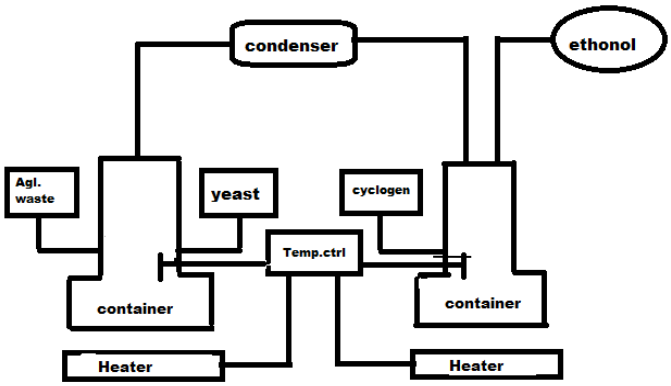

Fig. 1 Block Diagram of ethanol production cycle

The model mainly consist of two distillation columns, juice feed tank, yeast culture tank, fermentation tank, condenser, accumulator, and two solenoid valves. The cylindrical juice feed tank & the yeast culture tank are connected to the fermentation tank through the solenoid valves SV1 & SV2, on to the fermentation tank the stirrer is implemented for the continuous stirring of the reaction mixture. Also there is provision for co_2 removal through the tank.

The output of fermentation tank is given to distillation column 1 as a feed. Distillation column 1 consist of 8 sieve plate below the distillation column 1, heater 1 is mounted for heating the reaction mixture. The top product of distillation column 1 is given to distillation column 2 through the condenser. Distillation column 2 is a hollow tube in this column cyclohexane is added for the ethanol and water separation. The top product of distillation column 2 after passing through condenser given to the column as a reflux. The bottom product of this distillation column 2 is collected in the accumulator as an ethanol.

III. WORKING DETAILS

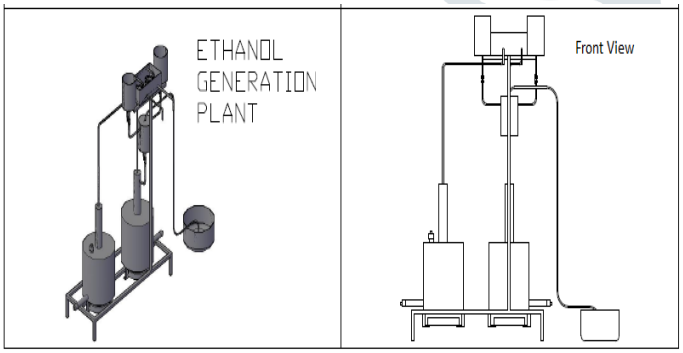

Fig. 2 Block Diagram of Ethanol Generation Plant

A. Operations Involved

1) Fermentation Process
2) Distillation
3) Aerobic fermentation.
4) Batch distillation.
5) Anaerobic fermentation
6) Continuous distillation.

B. Procedure

In working initially we are extracting the juice from the stem of sweet. Sorghum crop by passing the stem through the milling machine. This juice is then introduced in the juice feed tank. The yeast is introduced in the yeast culture tank. This juice and yeast are then added in to the fermentation tank at proper proportion by passing through solenoid valves

The solenoid valves opens for particular time interval only and remains closed otherwise. Their opening time is set thought he timer. Thus only the required quantity of juice and yeast are introduced in to the fermentation tank.

In fermentation tank fermentation process occurs i.e. bacteria form yeast consumes or eat the sugar contents or glucose from juice and releases alcohol. During this process CO_2 gas is released which then passed to the atmosphere through water bath. In order to avoid escape of alcohol vapour along with CO_2 the whole fermentation process requires near about 48 hours. The reaction mixture then allows passing into the distillation column 1 though the manual valve. In distillation column 1 separation of alcohol and molasses takes place. The temperature of distillation column 1 is set at 123. At this temperature all the alcohol get converted into the vapour. This vapour are condensed and given as a feed to the distillation column 2.

The actual temperature of distillation column 1 is measured by thermocouple 1. As the temperature of distillation column set at 123 C. When the actual temperature goes beyond the set point, then heater 1 gets automatically off. Now the top product of distillation column 1 is alcohol, which is alcohol + water. So for the production of ethanol it's needed to remove water. So this alcohol feed into distillation column 2. In distillation column 2, we are adding cyclo hexane. This cyclo hexane absorbs the water contents from the alcohol. To separate the cyclo hexane from ethanol distillation column 2 at 65^C. At this temperature cyclo hexane are converted into vapour. This vapour are allow to cool by passing through the condenser and the condenser liquid is collected in the settler. In the settler two layers are formed upper layer contains water and bottom layer contains cyclo hexane which is again added to distillation column 2 as a reflux. The bottom product of distillation column 2 is a pure ethanol and which is our main product. This ethanol is collected into the accumulator.

IV. METHODOLOGY

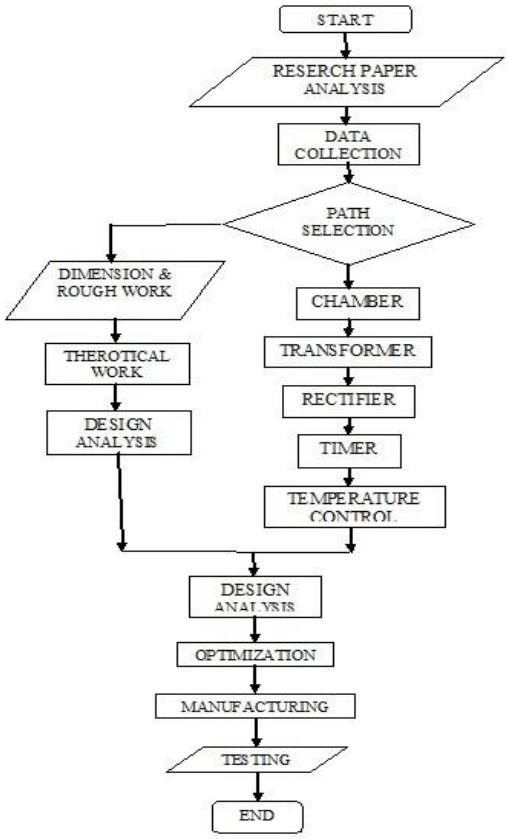

Fig. 2 Flowchart of Methodology

V. APPLICATIONS

1) *Industrial methylated spirits (Meths.):* Ethanol is usually sold as industrial methylated spirit which is ethanol with a small quantity of methanol is added and possibly some colour. Methanol is poisonous so industrial methylated spirits is unfit to drink. This avoids high taxes, which are levied on alcoholic drinks.
2) *As a Fuel*: Ethanol burns to give carbon dioxide and water and can be used as fuel in its own right, or in mixtures with petrol (gasoline) "Gasohol" is a petrol / ethanol mixture containing about 10-20% ethanol. Because ethanol can be produced by fermentation this is useful way for countries without an oil industry to reduce imports of petrol.
3) *As a Solvent*: Ethanol is widely used as solvent. It is relatively safe and can be used to dissolve many organic components which are insoluble in water. It is used, for example in many perfumes, in cosmetics.

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