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Strategies for Production of Ethanol and Value Added Products from Agriculture Wastes

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Abstract**:** ***Microbial ethanol has attained importance status because of the following reasons: i) the depletion of the naturally available energy resources like coal, lignite; ii) increase in urban development, global warming, pollution levels; iii) lack of availability of technologies to utilise tidal, wind and solar energy. Hence, non-renewable sources of energy are less favourable compared to microbial ethanol.***
Keywords: Ethanol, agriculture waste, value added product, fermentation

I. INTRODUCTION

Non-renewable sources of energy are less favourable compared to microbial ethanol [1]. In Virudhunagar district, wide varieties of crops are under cultivation [2]. The cultivation of these crops generates tons of agriculture wastes every year. Cellulosic biomass [3] from these agriculture wastes [4] can be converted into ethanol using microorganisms such as bacteria [5] and fungi [6]. In India, agriculture wastes are collected directly from farmers [7] for ethanol production. Cellulosic ethanol production from switchgrass plant is one of the major projects in United States of America. As lignin content interfere the ethanol production, extensive research was focused towards reduction of lignin content [8] Generally, wastes generated during cultivation of cereals and plant tubers are subjected to series of processes such as thermal pretreatment, liquefaction, saccharification, filtration, starch hydrolysis before proceeding to distillation of ethanol . In case of waste generated during sugarcane and sugar beet cultivation, raw juice and molasses are produced first and later ethanol is distilled [9]. Plant biomass and agro by-products are subjected to removal of lignin and acid hydrolysis before fermentation [10]. Various kinds of fermentation namely batch, semi-continuous, continuous are used for ethanol production using starch hydrolysate, raw juice, molasses and acid hydrolysate [11]. Distillation is the final and ultimate step in the ethanol production [12]. The following could be used as strategies for production of ethanol and value added products from agriculture wastes.

II. COLLECTION OF AGRICULTURAL WASTES

Agriculture wastes from various farmlands could be collected directly from farmers and could be transported.

III. STARCH HYDROLYSATE PRODUCTION

Cereals and plant tubers waste could be subjected to series of processes such as thermal pretreatment, liquefaction, saccharification, filtration and starch hydrolysate production [13]. Cereals and plant tubers should be washed, cut and milled using mixer/juicer. The resultant mash should be treated with microbial amylase and incubated at 85 $^{\circ}$C for 20 min. After that, the mash should be cooled to room temperature (25 $^{\circ}$C) and could be liquefied.

The mash should be autoclaved at 115 $^{\circ}$C for 20 min. The mash should be cooled to room temperature (25 $^{\circ}$C) and microbial xylanase and β-glucanase should be added. The mash should be subjected to 50 $^{\circ}$C for 120 min and later should be cooled to room temperature (25 $^{\circ}$C). Glucoamylase and *Saccharomyces cerevisiae* should be added to the mash [14]. Saccharification (30 $^{\circ}$C), filtration, starch hydrolysate production should be done and later the hydrolysate should be proceeded for fermentation and distillation (strategies v) and vi).

IV. JUICE AND MOLASSES PRODUCTION

Raw juice should be obtained from sugarcane waste using the mixer/juicer. Sugarcane should be burnt (or) burnt sugarcane should be obtained from farmers. It should be subjected to cutting, crushing/mashing and crystallisation [15]. Both, raw juice and processed (crystallised) sugarcane i.e. molasses should be proceeded for fermentation and distillation (strategies v) and vi).

V. LIGNIN REMOVAL AND ACID HYDROLYSIS

Agro by-product wastes should be subjected to removal of lignin using resin, alkaline extraction using 2% green liquor and later acid hydrolysis (3% sulphuric acid) at 121 °C for 1 hour. This should be followed by filtration, washing, drying, detoxification and regeneration of resin [15]. The resultant acid hydrolysate could be proceeded for fermentation and distillation (strategies v) and vi).

VI. FERMENTATION

Starch hydrolysate, raw juice, molasses, acid hydrolysate obtained from [ii), iii) and iv) strategies] could be subjected to batch, semi-continuous, continuous fermentation as described by methods available [15].

VII. DISTILLATION

The fermented product obtained from strategy v) should be subjected to distillation using ethanol distillation unit [16] and ethanol could be estimated using method available [17].

VIII. CONCLUSION

Microbial ethanol has attained importance status because the exhaustion of the naturally accessible energy assets and increase in urban development, global warming, pollution levels, lack of accessibility of expertise to exploit tidal, wind and solar energy. Hence, non-renewable sources of energy are not as much of encouraging paralleled to microbial ethanol.

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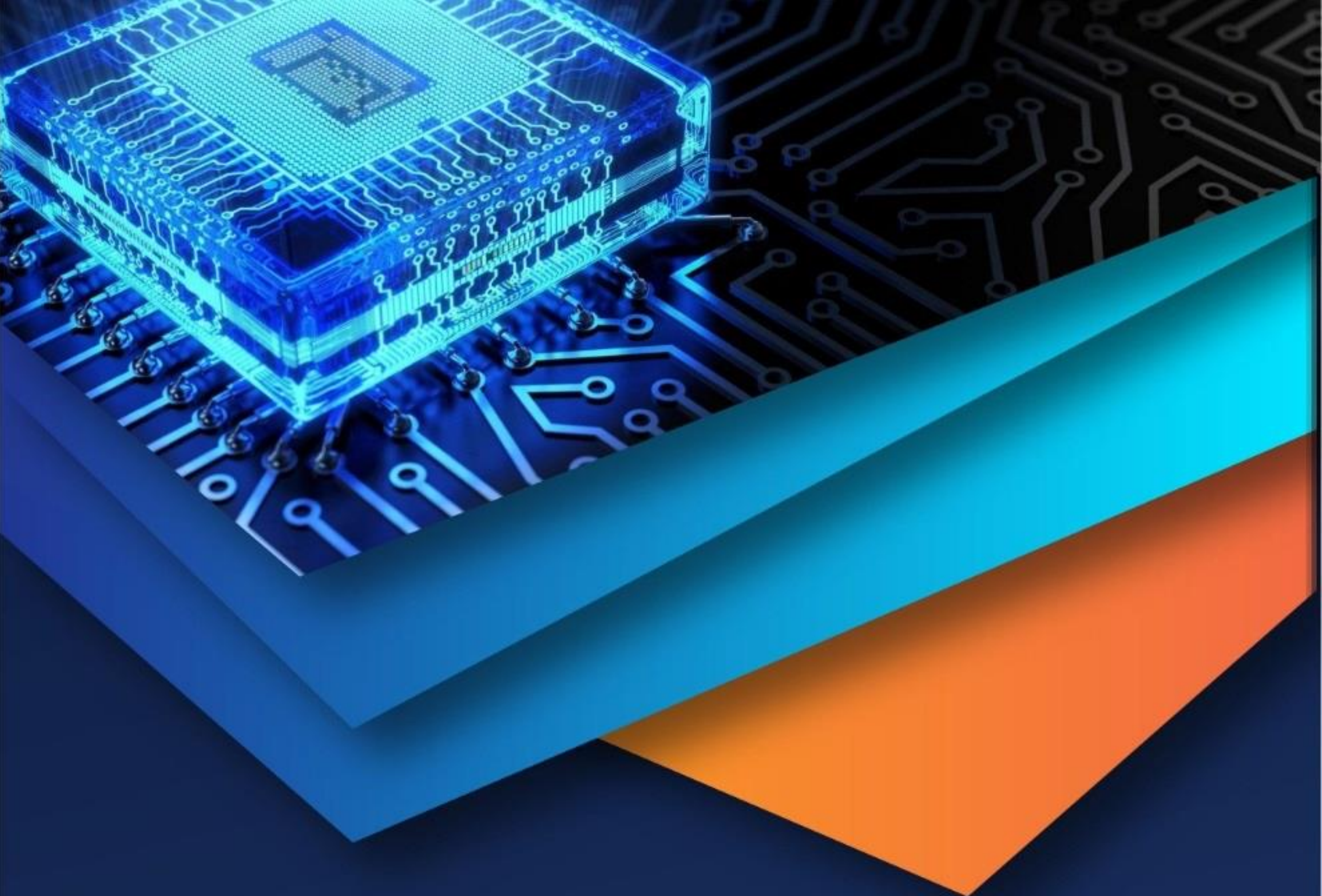

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