# Life cycle assessment of Bioethanol

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## Introduction

Liquid biofuels are widely acclaimed replacement to fossil fuels to minimize the dependence on fossil fuels and improves the energy security to promote economic development. The first generation biofuels can be produced from sugar and starch based feed- stocks such as sugarcane, corn, potato, cassava. Due to the use of food or feed grains appears unsustainable as the process requires cultivable land and generates conflicts between industrial and food/feed use of feed-stocks. Therefore, it cannot be successfully become a viable fuel source. The production of second generation bioethanol which is produced from ligno-cellulosic biomass, not used for food, is gaining momentum as it does not compete with food or feed(1). Ligno-cellulosic biomass (rice straw, corn cob, wheat straw, sugarcane bagasse, cotton stalk) are best alternative as these are abundant, renewable and relatively cheap. The area of research mainly focus on the energy balance, greenhouse gas emission and other impact categories and also the production cost to discuss their potential environmental as well as socioeconomic impacts.
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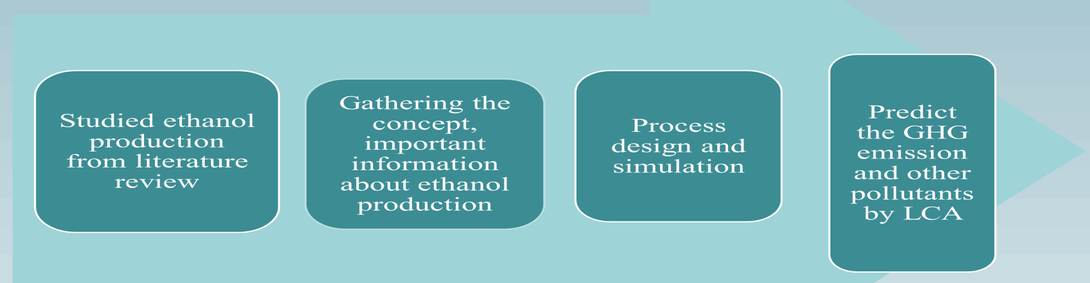
## Objective

- To study and design the ethanol production processes.
- To predict the GHG emission from ethanol production processes.




## Methods

### Bioethanol production from the biochemical conversion pathway-

**1- Pre-treatment of lignocellulosic biomass-**

- To destroy the structure of cellulosic biomass cell wall.
- Make cellulose more accessible to the subsequent process of hydrolysis.

**2- Hydrolysis –**

- Hydrolysis is used to convert cellulose and hemi-cellulose to glucose and xylose.
- The temperature is about 50º C for hydrolysis.
- Cellulase and xylanase are used as an enzyme.

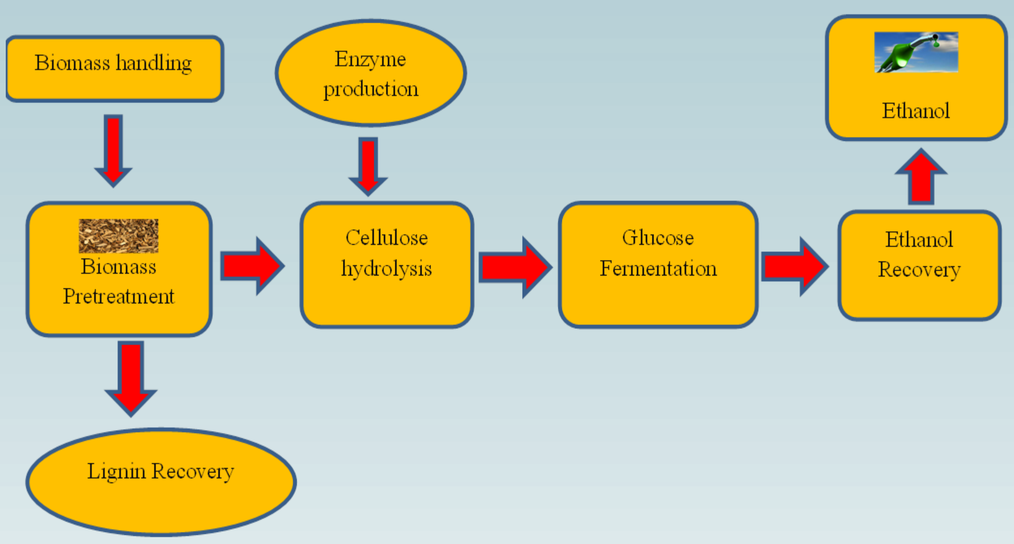
**3-Fermentation**

- Fermentation is used to convert simple sugars into ethanol.
- *Saccharomyces cerevisiae* is mainly used as a yeast.
- Temperature is about 30-37ºC.

**4- Ethanol purification**

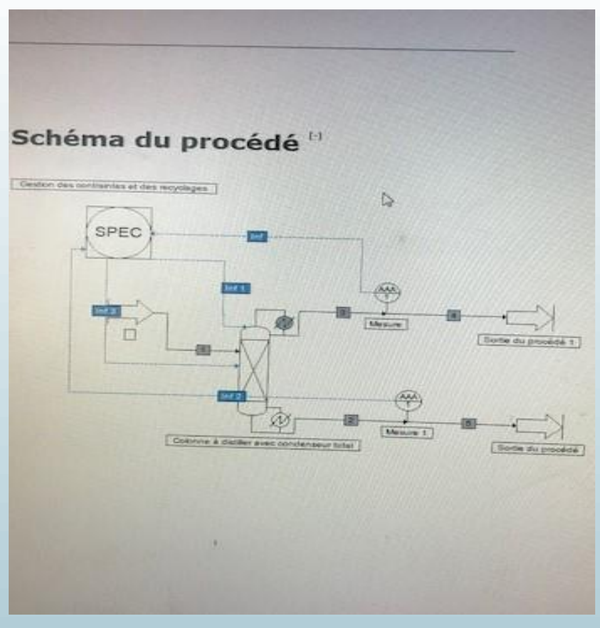
- Extractive distillation is used.
- Mostly Ethylene glycol is used as a solvent.

❑ Each step is simulate by the chemical simulator **PROSIMPLUS.**
❑ The primary objective of simulation is to generate the mass and energy balances from which the requirements for raw-materials, consumables, utilities and energy needs are calculated.




## Results

❑ Simple distillation of Ethanol-water mixture is carried out by the **PROSIMPLUS** by a **McCabe-Thiele method** with a flow rate of distillate with 15.7 kg/s and feed stage is 7 whereas number of stage is 25.




## Conclusions

**SCOPE OF THE FUTURE WORK-**

- ❖ PROSIMPLUS is used to simulate all the processes.
- ❖ Woody biomass is used as a main raw material.
- ❖ LCA of woody biomass through the biochemical conversion pathway will be carried out.

## Bibliography

1. **Jeswani, H. K., Falano, T., & Azapagic, A. (2015).Life cycle environmental sustainability of lignocellulosic ethanol produced in integrated thermo-chemical biorefineries. *Biofuels, Bioproducts and Biorefining*, *9*(6), 661-676.**