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Course

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### Biomass to Ethanol

Biomass is an organic material obtained from living organisms. Ethanol fuel, a renewable and sustainable source of energy is developed from biomass. Biomass can be found in forest debris, scrap lumber, certain crops (corns and stalk), manure and also from some waste residues that can be used in producing energy. Since all the previously mentioned will always be existent and green energy production can continue indefinitely, this is a renewable energy source. Conversion of biomass to ethanol fuel produces a clean form of energy.

### Significance

The global decline in petroleum reserves, the ever-increasing demand for transportation fuels and the need to curb the greenhouse effect necessitates the production of renewable energy; in particular, generation of ethanol from biomass.

### Process

The production of ethanol from biomass uses lignin, cellulosic biomass and other components known as extractives. Cellulosic biomass is a complex carbohydrate polymer found in plant cell walls having hemicellulose and cellulose. A pretreatment process is used to reduce the plant size, break down hemicellulose to sugars and also to open the structure of the cellulose component. Hydrolysis of the cellulose by enzymes transforms it into glucose sugar, which is then fermented to ethanol. Additionally, sugar from the hemicellulose is fermented. The process is powered by burning lignin that is used as the fuel. The aforementioned production can be done either through wet or dry milling; their main dissimilarity being the initial treatment to the feedstock. The by-products apart from the ethanol manufactured include high quality and nutritious poultry and livestock feed. Carbon (IV) Oxide generated during fermentation can be utilized as a preservative in

carbonated soft drinks.

The above process is quite costly and in a bid to shrink the cost, scientists are developing an efficient and economical technique known as simultaneous saccharification and fermentation (SSF) for manufacturing ethanol. This is a procedure that combines cellulose hydrolysis and fermentation steps in one place to produce high yields of ethanol.

#### Benefits

Renewable energy like biomass has several merits. Firstly, it is a source of clean energy since no harmful emissions are produced and this helps curb greenhouse effects. Carbon (IV) oxide produced is recycled by the ecosystem and used by plants. Secondly, it is in abundance since organisms will potentially never get exhausted. Thirdly, biomass conversion has a positive energy balance since ethanol produced has an estimated positive net energy balance of about 2 to 36 times the input energy. Lastly, the ethanol produced is biodegradable and can easily be disposed.

#### Challenges

Despite the several benefits mentioned above, this method of energy generation has its demerits. Firstly, the ethanol produced has lower energy content compared to gasoline of equivalent quantity. Secondly, the less volatile nature of ethanol poses startling problems to engines, especially during cold seasons. Thirdly, the cost of producing ethanol is high because of the high cost of enzymes used. Lastly, it is difficult to transport ethanol through pipelines because of its solubility in water.

Works Cited

Liu, Siqing. "Conversion of Biomass to Ethanol by Other Organisms." *Biomass to Biofuels* (2010):  
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