ENERGY FROM BIOMASS

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With the help of high pressure technology the scientists have developed an important process having ability to continuously produce high grade oil from a remarkable range of domestic and industrial rubbish with far reaching implications.

Some countries like Pakistan, Bangladesh, India, China and Indonesia have an excess of certain biomass products like sugarcane, rice husks, coconuts, bananas which can be rapidly converted to synthetic fuel for useful applications.

Biomass is the product of the photosynthetic reactions:

$$CO_2 + H_2O + \text{Sunlight} — \underset{\text{Photosynthate}}{(-CH_2O-)} + O_2$$

(Overend and Chorner, 1984).

The photosynthate produced is used by the plant to provide metabolic energy and is also the source of carbon building block used to construct the major plant components. In the case of wood and other lignocellulosics there are three main structural polymers and minor amount of extractives. On a moisture and ash free basis biomass is mainly composed of 50% cellulose, a long chain polymer of B-D-Glucose in pyramose form linked by 1, 4 glycosidic bonds to form cellobiose repeating units; 25–30% hemicellulose, a shorter chain length polymer made up of pentose and hexose sugars in association with lignin and cellulose polymers; the remaining 20–25% of the mass composed of lignin is relatively reduced polymer consisting of randomly linked phenyl propane units (Papper).

Biomass (cellulose, lignin and refuse) liquefaction has potential for providing useful liquid and gaseous fuel. Solar energy is continuously turned into stored chemical energy in plants *via* the process of photosynthesis.

The cellulose material as feed stock is mixed with metal catalyst and a processing liquid like tetralin, before being pumped in suspension into a high pressure reactor vessel, an autoclave, the temperature of which remains at 350–400°C.

By liquefaction process biomass can be converted directly to gasoline like hydrocarbon *via* two stage process of high pressure liquefaction in the presence of carbon monoxide and aqueous alkali followed by catalytic hydrodeoxygenation using commercial available catalyst.

The final product is characterized by number of analytical techniques and is primarily a mixture of alkylated benzenes and cyclic aliphatics, characteristics of high grade (Elliot and Baker, 1984).

Detail of Laboratory Scale Liquefaction Reaction

Following are the important factors which effect the liquefaction of biomass (Naqvi, 1985).

(a) Different types of Catalysts.
(b) Different types of Reducing gases.
(c) Temperature.
(d) Pressure.
(e) Solvent.

In a laboratory scale liquefaction reaction suitable biomass such as lignin obtained from wood was mixed with catalyst and a suitable solvent such as tetralin. The reducing gas was mixed in a stainless steel autoclave reactor for 2 hours at various temperatures such as 350–380°C and a pressure of about 35–75 atmosphere. In most hydrogenation reactions tetralin is used as the most classical hydrogen donor solvent for the study of liquefaction reaction. It is considered to be one of the most convenient hydroaromatic solvent with sufficient hydrogen donor ability.

Fuel gases were analysed by GC and IR spectrometery and product obtained from the reactor were distilled and separated. In these liquefaction reactions various catalysts such as Ruthenium based catalysts, Nickel catalyst and Na_2 (CO_3) were used. Reducing gases such as Carbon monoxide, Hydrogen and Nitrogen were used in various reactions. It was found from various reactions that carbon monoxide and hydrogen are better reducing gases. Hydrogen can also be used in hydrogenation reactions. The oil yield increased with increase in temperature. The deoxygenation may be possible with increase in temperature. In lignin X-B cleavage (benzylic cleavage) may occur under hydrogen atmosphere. The reaction may take place by free radical mechanism.

References

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