Non bacterial way of production of alcohols and biofuel

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1 INRODUCTION

Fossil fuels are generally composed as a mixture of crude oil which is typical compound containing many hydro carbons that can be combusted and water. The composition of this mixture of crude oil and water varies with ambience temperature and many other environmental parameters. The extant of crude oil availability is also lessening gradually. Moreover the market demand for fuels is rising day by day with increasing population and automobile usage. Use of fuel in fuel cell to overcome energy crisis in countries like India and Pakistan is also a reason for excess demand for the fuel. This scenario is forcing a hike in the fuel costs. Moreover the war features and other international politics abmolish fuel rates. This hike in fuel rates reached an abnormal value of 143$/barrel (1barrel~=117.34Lts.) in July 2008. All these scenario forces people to find out an alternate fuel for automobiles. Though automobiles can get another fuel, the matter of fact is that all the vehicle engines throughout the world cannot be replaced at a stroke. This at least requires a 30-50 year time for complete change. Thus there arose an absolute need for raise in interest for biofuels. Biofuels resemble the normal petrochemicals and function similar to them in automobile engines that are using petrochemical now in the market. However there arises a change in octane/cetane number and efficiency of fuel per liter. However out of these biofuels that can be synthesized we look for probable fuel that best suit as petrochemicals.

Obtaining of biofuels can be done by fermentation of the biomass (containing good amount of starch/cellulose/sugar content) like cane, corn/maize which can be generalized as the mass that is obtaining from a biological source. The process involved in getting the biofuel from biomass takes part in several unit processes which are already in practice. Out of the available techniques, the most prevailing method now is biological fermentation of the biomass using yeasts. Yeasts are a growth form of eukaryotic microorganisms classified in the kingdom fungi. Even the alcohoic beverages are also obtained through fermentation of grapes which are indeed a form of biomass in anaerobic atmosphere for a long time. Indeed, alcoholic beverages contain smaller alcohols that also substitute as petrochemical for combustion. Biofuels can also be prepared from plants with higher amount of oil content like jathropa, oil palm, soy bean, algae, etc.,. Its oil can directly be used as biodiesel after reducing its viscosity. Both the ways are benevolent. However there is an interesting competition between these two ways of extractions. Fuel from seed oil involves a time taking and a very market risk as there is every possibility for spoilage of crop in that long time. For example if we take the crop of jathropha, an ingenious plant to southern asia, takes a long time of 3-4 years to grow. Though it resist for the drought conditions, its existence is at doubt for such a long time. Its seeds have to be cared a lot for their existence as there is every possibility for it to be lost from the plant, especially in rural parts of India. So, obtaining them through another slow but effective process i.e., by yeast fermentation of biomass is opted by many industries. However, this is also catalyzed by biocatalyst and other strains are established on bacterium races meant for this reaction to increase the desired product in greater extent. To have a rapid production of biofuel an artificial fermentation reaction is needed that creates

absolute production in accordance with the demand. It however also depends on availability of feedstock.

Normal production plants are now able to deliver the fuel by 3-4 weeks time. But the urgency may cause a low concentrated alcoholic product. This effects combustion of fuel and at a long run effects the engine too. So, obtaining of purity and rapidity in biofuel production is only possible through artificial synthesis of biofuel from selective feedstock.

Let us get through the various unit processes involved in this non bacterial biofuel production plant in detailed. For renting quality in understanding, let us first stay away from economical calculations and let us do the price estimation at last.

On an over look, we can just say that the feedstock is processed through the following chemical unit process step wise. Though it cannot be taken as a mere chemical flow chart, but can be compared with it.

a) The feedstock is selected so as to obtain maximum biomass from a unit raw stock.
b) The feedstock is subjected for crystallization and then is processed for catalytic hydrolysis. This reaction is called as catalysis of cellulose or cellulolysis. If the feedstock contains greater extent of cellulose composition in it, it is likely profitable to use and exploit that nature of the feedstock and thus producing cellulosic ethanol or any other cellulosic fuel. If once we are prepared with hydrolysis of cellulose, it is a known fact that the reactor takes up even hydrolysis of the few more polysaccharides like hemicelluloses, etc. However, we can understand that the hydrolysis of some compounds such as lignin is not possible.
c) After obtaining the hydrolyzed lignocelluloses, the unhydrolysed part of feedstock which mainly contains lignin and other similar carbohydrates are meant for separation to separate lignin from the hydrolysed sugars. Depending upon the case, a unit process that converts polysaccharide cellulose to disaccharide can be installed. The expected product would be sugar of different carbon number.
d) The purified sugars can then be processed to a catalytic reduction using a hydrogen iodide (HI) solution. Once, the sugar gets reduced and alcohols of various carbon numbers are obtained.
e) The obtained high carbon alcohols can then be subjected for anaerobic pyrolysis stimulating the parameters for an adjustable product yield. Product can start from a single carbon methane gas to butanol, which is now being called as biobutanol representing the source which is found as a best substitute for gasoline.
f) The obtained mixture of hydrocarbons is then subjected for distillation where we can obtain almost pure forms of different hydrocarbons and then transferring them to use them in their respective utilizing equipments.

2 Cotton crop for biodiesel production:

Cotton is a soft, staple fiber that grows around the seeds of the cotton plant (Gossypium sp.), a shrub native to tropical and subtropical regions around the world, including the Americas, India and Africa. The fiber most often is spun into yarn or thread and used to make a soft, breathable textile, which is the most widely used natural-fiber cloth in clothing today. Successful cultivation of cotton requires a long frost-free period, plenty of sunshine, and a moderate rainfall, usually from 600 to 1200mm (24 to 48 inches). Soils usually need to be fairly heavy, although the level of nutrients does not need to be exceptional. In general, these conditions are met within the seasonally dry tropics and subtropics in the Northern and Southern hemispheres, but a large proportion of the cotton grown today is cultivated in areas with less rainfall that obtain the water from irrigation. Production of the crop for a given year usually starts soon after harvesting the preceding autumn. Planting time in spring in the Northern hemisphere varies from the beginning of February to the beginning of June. The area of the United States known as the South Plains is the largest contiguous cotton-growing region in the world. It is heavily dependent on irrigation water drawn from the Ogallala Aquifer. Out of different varieties of cotton organic cotton is notable cotton. Organic cotton is cotton that is grown without insecticide or pesticide.

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Worldwide, cotton is a pesticide-intensive crop, using approximately 25% of the world's insecticides and 10% of the world's pesticides. According to the World Health Organisation (WHO), 20,000 deaths occur each year from pesticide poisoning in developing countries, many of these from cotton farming. Organic agriculture uses methods that are ecological, economical, and socially sustainable and denies the use of agrochemicals and artificial fertilizers. Instead, organic agriculture uses crop rotation, the growing of different crops than cotton in alternative years. The use of insecticides is prohibited; organic agriculture uses natural enemies to suppress harmful insects. The production of organic cotton is more expensive than the production of conventional cotton. Although toxic pollution from synthetic chemicals is eliminated, other pollution-like problems may remain, particularly run-off. Organic cotton is produced in organic agricultural systems that produce food and fiber according to clearly established standards. Organic agriculture prohibits the use of toxic and persistent chemical pesticides and fertilizers, as well as genetically modified organisms. It seeks to build biologically diverse agricultural systems, replenish and maintain soil fertility, and promote a healthy environment.

Cotton fiber, once it has been processed to remove seeds (ginning) and traces of honeydew (a secretion from aphids), protein, vegetable matter, and other impurities, consists of nearly pure cellulose, a natural polymer. Cellulose content in cotton is nearly 90%. So cotton is treated as an excellent source of cellulose. Moreover, as cotton is an established crop and is being already under use, there is no need for awareness in cultivation of crop. The major feature is that spoiled or futile cotton can be used for biofuel synthesis.

Moreover equipments and processors for cotton management are well known and existing. So there is no absolute need for equipments arising. In india, Large amount of cotton farmers are under loss due to irregularity in precipitation. All of them come to a profitable edge is utility of cotton as a source of cotton instead of usage as a fabric materializes. Thus it can be stated that in a country like India, use of cotton for synthesis of biofuel is ideal than use of switchgrass or jatropha.

3 Hydrolysis of lignocelluloses that is obtained from cotton:

CELLULOSE HYDROLYSIS: Cellulose can get hydrolyzed by normal conventional acid hydrolysis as depicted in many abstracts before. However they show an interesting stimulated hydrolysis by using an acid catalyst under ionic liquid medium. This nature can be exploited for hydrolyzing cellulose to sugar. Cellulose in ionic liquid medium when heated with stirring at 100 °C, ambient pressure a clear solution is formed. To this cellulose solution then we add quickly H2O (1.75 mole equiv. to cellulose) and appropriate amount of 98 wt % H2SO4. The reaction was then vigorously stirred. At different time intervals, samples were withdrawn, weighed, and quenched immediately with cold water for evaluation of product. The aqueous solutions were neutralized with NaOH, centrifuged at 10,000 rpm for 5 min, measured the volume and subjected to total reducing sugar (TRS) and glucose analysis. The reduced sugar yield can vary up to production of a 90-95%yield which is extremely preached as efficient.

This hydrolysis of cellulose in a ionic liquid with acid as a catalyst is the best way to obtain sugar from cellulose. Moreover, if you recall the prices of the reagents being used in the above cellulosis, it is obvious that it is a low expensive process. The obtaining can be manipulated over variety of ionic liquid solvents which is the future plan of this idea. There was an interesting paper presented by Dalian Institute of Chemical Physics and Graduate School of the Chinese Academy of Sciences in similar experiment where they have found and outstanding 95%sugar as output. Refer to fig 1.

Research was done by auburn university on dilute acid catalysis and the kinetics of normal cellulose hydrolysis using acid catalyst but in absence of ionic liquid solvent. They have stated a very interesting fact that the cellulosys is a single ordre kinetic reaction. They have extended their paper even through the probable reaction mechanism of cellulose hydrolysis.It was also shown that the crystallization ability of cellulose effects the hydrolyzation rate a lot.

cellulose and hemicelluloses gets hydrolysed to sugars and the obtained partially hydrolyzed solution is meant for separation where lignin is removed from the solution.

4 Catalytic reduction of the sugar solution to convert them to alcohols:

Though an endothermic reaction, it is not a difficult task to obtain a reduced mixture of hydrolyzed feedstock. In general, HI is employed for reducing the carbohydrates to sugars. It is ideal is we use HI in limited extent when compared with that of sugar so

as to obtain varieties of partially hrdrolyses hydrocarbons. This conversion results into formation of iodine gas and a dilute solution of alcohol on product side.

4. Concentrating the alcohol and cracking:
The dilute alcohols can be then assumed to have a mixture of pentathol and hexanol as major products. The solution can be meant for distillation through various techniques that are already known to us and then the obtained product alcohols of higher concentrations are let for anaerobic pyrolysis. It is known that pyrolysis allows us to adjust the product by pressurizing reaction with varying parameters. Thus the required bioalcohol can be prepared and can be substituted for gasoline. A table containing the details on few products obtained after the chemical processing is done is as follows.

Depending on choice of fuel in accordance to the desire, parameters can be adjusted for a maximum yield of such a product.

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