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Hyacinth and River Grass Utilization for Production Methanol and Hydrogen as Fuel

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Abstract

Sustainable Environment Development includes use of Biomass such as Hysinth and river grass to produce Methanol and Hydrogen Liquid. The Hysinth and river grass to methanol and hydrogen liquid synthesis is crucial in renewable industry for fuel. The Hysinth and river grass Gasification is useful to produce methanol as well as further hydrogen gas shall be developed with separate process. The objective is to perform design parameters to produce Hysynth to methanol and hydrogen gas from a syngas by use of hysinth and river grass biomass gasification process. Biomass gasification includes syngas compression at 80 bar, this is considered as optimum pressure for methanol production. The objective is also to review and make utilization of Hysinth and River grass in rivers for production of methanol fuel as well as hydrogen fuel in India.

Keywords: Hyacinth, Methanol, CNG Gas, Liquid Bio Methane, Liquid Hydrogen CO2 utilization

1 Introduction

Hyacinth and river grass shall be useful to convert it into Methanol and Hydrogen (Gas & Liquid). Methanol is currently produced from coal via gasification in the world. Methanol synthesis involves Gas to Liquid technology. Methanol is used as fuel in the transportation such as heavy loaded vehicles, railways, Metros and marine yacht. Methanol is used in energy sector like Cars, Compressor, Diesel Generator, Boiler, Tractors and Trucks. At present, Methanol is unitized in retail cooking in which it is changing Liquefied Petroleum Gas, Kerosene and Wood charcoal in various states (Assam) in India. Methanol Blending (20%) in diesel or gasoline will lead to reduction in 20% import of crude oil from Russia as well as crude oil from Middle east. India will save in rupees for saving 20% cost on import of crude oil. This will direct impact on reduction in inflammation cost in Indian market.

Methanol blending (20%) will reduce Green House Gas (CHG) emissions by 20% in which Carbon Di oxide CO2, Carbon Particles, NOx, SOx will be reduced. This will have direct impact of improvement of air quality and reduction of Pollution in the environment. Reduction of pollution in the environment shall save global worming threat as temperature is increasing 1Meter as well as avoid ozone layer depletion in the environment.

Combustion of Biomass hysinth and river grass requires external air and oxygen. Coal to methanol is possible with additional by product as Bio Char. Biomass hysinth and river grass gasification requires cleaning and pretreatment of hysinth and river grass to remove impurity. Fractional distillation as well as purification is carried out to obtain methanol.

Biomass hysinth and river grass to methanol production Pilot Plant includes pressure range 35 bar to 90 bar and temperature range 200 degree C to 350 degree C.

Biomass hysinth and river grass to methanol production the output gas is known as mixture of gaseous. Mixture of gaseous contains carbon monoxide CO and Hydrogen H2. Gas Mixture includes carbon monoxide CO 25 to 35%, Hydrogen H2 30 to 35%, Carbon di oxide CO2 10 to 20%, Methane CH4 3 to 6%, Nitrogen N2 5 to 15% and also contains other minor gas impurities. At the time of removal of Carbon di oxide CO2 along with impurities by amine scrubbing process the gas composition changes to Hydrogen H2 50 to 60%, carbon monoxide CO 25 to 35%, Carbon di oxide CO2 5 to 10%, Methane CH4: 3 to 6%, Nitrogen N2: 5 to 20%.

Methane is further treated and processed separately to produce CNG gas as well as Liquid Bio Methane.

Carbon Mono oxide CO is processed in hydrocarbon recovery and further utilized in industrial applications. Carbon di oxide shall be utilized as Green Fuel.

Hyacinth and river grass Gasification process is carried out by partial oxidation at temperatures range of 700 to 900 ◦C under the air, oxygen, steam or carbon dioxide.

Hyacinth and river grass Biomass Gasification process involves following three main process operations

- Biomass drying
- Biomass Gasifying with development of gases, volatile compounds as well as char
- Secondary reaction in which the gasifier develops syngas.

Hyacinth and river grass Gasification is a highly endothermic process that occurs under air or oxygen. As a result, the gasification system needs an external energy source, such as oxygen or air. The syngas is a mixture of several gases, including hydrogen, carbon dioxide, carbon monoxide, methane, and hydrocarbons.

Methanol produced from river grass and hysinth is regarded as a green energy source. The carbon dioxide released during the methanol synthesis process is balanced and is needed by different plants for photosynthesis, which results in the emission of oxygen gas.

Hyacinth and river grass Gasification under the air or oxygen is carried out. In Gasification process oxygen as well as air plays vital role. The outlet of gases are combination of gases such as carbon dioxide, methane carbon monoxide and hydrogen. Carbon dioxide release during methanol production is taken by plant during photosynthesis.

Biomass Hysinth and river grass to Methanol is emerged as fuel for various industries.

1.1 Hyacinth Utilization

Hyacinth and river grass biomass gasification is a way forward path to produce methanol and Hydrogen liquid, which is considered green energy in the industrial uses. As methanol will eventually replace fossil fuels like coal and natural gas in the manufacturing of chemicals and fuels,

it is regarded as one of the most valuable green energy carriers of the future. Methanol is emerged as useful a fuel for cooking, vehicles including cars and trucks as well as marine applications..
Methanol pilot plant are being set at industrial level. Commercial scalable methanol plants are in the process to set up at mega level in the world. Natural Gas is currently main source of production of methanol. Currently, methanol, petrol, and dimethyl ether are all produced in various industrial facilities. By using the natural gas steam reforming technique, methanol is actually made from syngas. At pressures of 60 to 100 bar and temperatures of 250 to 340 C, the syngas to methanol process is completed in a fixed bed tubular reactor using a Cu-ZnO catalyst. Methanol reaction requires pressure of 60 bar to 100 bar and temp of 250 degree C to 340 degree C in a reactor in presentence of Catalyst of Cu.
Methanol production requires hydrogen and carbon di oxide standard ratio during reaction. The (H2 & CO2) or (CO + CO2) ratio should be taken into account. The ideal (H2 & CO2) or (CO+CO2) molar ratio for traditional methanol production methods should be 2. In order to maintain the gasification process' intended parameters, a heating reaction is needed to keep the temperature between 800 and 900 C.

1.2 Process Description

Hysinth and river grass Gasification process develops mixture of gaseous. Mixture of gaseous are treated and further processed by purification method. Purified gaseous are stored at specified tanks. Methanol production requires hydrogen and carbon di oxide standard ratio during reaction. Mixture of gaseous are preheated and then further processed through filtration process for sulphur removal. Mixture of gaseous are then passed and processed with High Temperature reaction and Low Temperature reaction process.
One bypass piping line is required for transfer required mixture of gaseous stored at mixture of gaseous tank. mixture of gaseous is further mixed with the main gas stream of Low Temperature reaction process by with H2 & CO ratio as 2. Moisture is removed from Mixture of gaseous. Mixture of gaseous are scrubbed and the gas then enters the N-methyl diethanolamine MDEA absorption tower to be cleaned of CO2 and sulphur contaminants.
At a pressure of 10 bar, the purified syngas is kept in a special gas storage tank. Syngas is compressed using a compressor to a pressure of 70 bar. A high pressure buffer tank is used to store pressurised syngas. The gas is then further heated to the necessary temperature, or about 340 degrees Celsius. This cleaned gas is then transported via a multi-tube fixed bed methanol reactor and a catalytic guard bed reactor.
The methanol is a final product and non-converted purified mixture of gaseous is further processed in a gas liquid separator by condensation process. The non reacted purified mixture of gaseous is then passed through liquid separator and is further compressed. This compressed gas is stored in buffer tank. The purified mixture of gaseous is then recycled. In a methanol reactor, where gas is treated at the inlet of the pre heater chamber, it is recycled once again. By releasing pressure, methanol is collected from the gas liquid separator. Methanol is collected as final product.
Methanol development Pilot scale plant involves following process systems

- Water gas reactor System
- Absorption column System

- Striping column System
- Syngas Compressor with high pressure system
- Gas Tank high pressure system
- Pre heater system along with accessories
- Filtration for removal of Sulphur
- Reactor
- Heat exchanger system
- Condensation unit system
- Methanol separator system
- Purified gas separation system
- Methanol Storage system
- Tanks
- Gas compressor system
- Thermic fluid Hot air & flue gas generation system
- Cooling tower system
- Steam generator and boiler system
- Flare stack flaring unit system
- PLC Control system (SCADA or PLC)
- Gas Analyser system online

The gasification process involves development of bye product bio char. Bio Char is not considered for valuation in terms of commercial aspect. Bio char is produced approximately 80 to 100 grams from 1 kilo gram of dry biomass.

The mixed feed gas stream after compression is heated up to the reaction temperature 200 deg C.use reactor effluent. This mixture of gaseous then enters the Methanol Reactor. This reactor is useful for main reaction under catalyst. The mixture of gaseous processed under catalyst as follows

$$CO2 + 2H2 \rightleftarrows CH3OH \quad \ldots\ldots\ldots\ldots\ldots\ldots \quad (1)$$

Reaction Temperature is 150 deg C to 280 Max deg C
In this reaction methanol is maintained by specific ratio of the temperature and pressure. Rate of yield is improved at Higher pressure and lower temperatures.

Additional reaction occurs as follows

$$CO2 + H2 \rightleftarrows CO + H2O \ldots\ldots\ldots\ldots\ldots \quad (2)$$

Carbon monoxide and Water is release in the above reaction. Both Methanol and additional reaction step by step in which heat is expelled in the reaction.
Other compounds like alcohols and acetones are separated with concentration less than 5000 ppm. Purified form of methanol is achieved in separator.

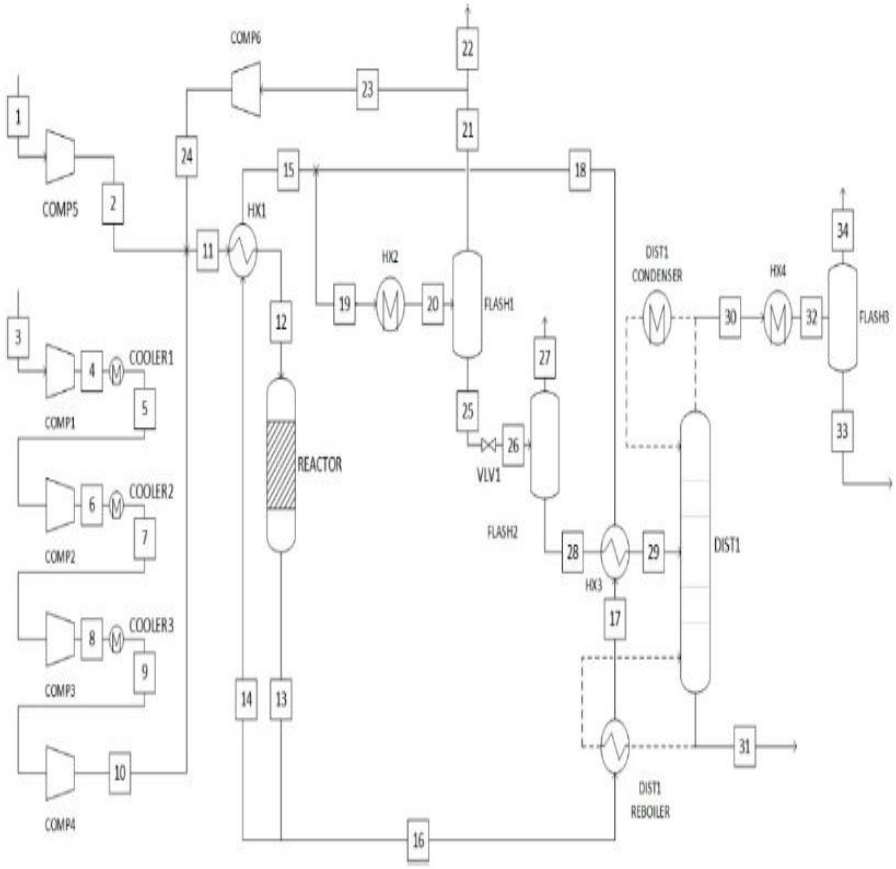

Fig.1:Process of Methanol Synthesis

The heat created during the process reaction is dissipated on the shell side of the tubular reactor by heat exchange with boiling water. Consequently, boiling water on the tube bundle's shell side maintains the reactor's isothermal condition. The per pass conversion in the reactor is very low and hence required a large recycle to attain the required overall conversion.

The recycle reaction is monitored by conversion percentage and then further bleed off. The output stream from the synthesis reactor consisting of methanol and un-reacted gases then pass through the HP separator after recovering heat from it. This partially cooled crude methanol containing gas is further cooled by air cooler followed by cooling water cooler.

Thus, crude methanol is gets separated from the non reacted mixed feed gases and recycled in separator at low pressure. The non reacted gas from top of Separator at high pressure is processed back into the reactor vide the recycle gas looping system.

The excess amount of hydrogen (H2) and inert such as nitrogen present is removed as purge and sent to the flare stack. Further, separation of crude methanol and non reacted syngas occurs in the Low Pressure Separator from where the crude methanol obtained as the bottom product is sent to the purification system and then further mixed feed gases to an absorber scrubber.

The demineralized water or the recovered water from refining column is used to absorb crude methanol present in lighter gases. The absorbed methanol water solution along with the condensed crude methanol in separator at High Pressure & another in separator at low pressure is collected in the crude methanol tank. The gases obtained at the top of High Pressure Separator and absorbers are rich in methane Purification Crude methanol collected in crude methanol tank undergoes fractionation in a two column system. Paraffinic and aromatic components are removed in the first column known as the Topping Column. The rich purified methanol bottom product from this column having methanol content more than 80% is sent to another column i.e. Refining Column where final separation of water from methanol takes place to get final purified methanol to meet international grade purity of 99.97 %.

Topping Column- Steam is used as heating purposes. Vapours generated in the re boiler rise up through the column and get removed as paraffinic cut from the top. The Reflux is provided by the top column to increase the purity of the final methanol product. The Partial condenser also helps to remove any volatile organic components present in the system.

As heat energy recovery system two re boilers are used to transfer the vapor load to the column. The first one uses hot mixed feed gas as a heating media while second one uses steam media to fulfill the balance heat required to achieve the required vapor pressure load in the column. The methanol high purity of 80% rich stream is drawn as a side product and is further fed to final refining column. The bottom of the column which is almost pure water is disposed of as effluent water. Balance water of it as per requirement is used as a makeup D M water for recover column.

Refining Column- The methanol & water high purity of 80% stream is then fed to separate water and methanol. The methanol separated as a product is of 99.95% purity. The bottom water recovered is fed back to DM water collection tank for water recycle.

Recovery Column-The gases from Low Pressure separator, first column, second column is fed to the absorber scrubber column where DM water or recovered water is used to scrub the methanol vapors. The top gases with methane and other non-condensable gases is fed to recovered methane gas stream for reformer fuel

2. Conclusion

- The Main utilization of Hysinth and river grass is converted to methanol and Hydrogen liquid as a fuel. Plant Technology is developed.
- The high biofuel production from water hyacinth due to its high content of lipids and carbohydrates compounds and pronounced results encourage the quick announcement for a country-wide project in different governorates of the country with the main goal of producing biodiesel and bioethanol with high amounts. Water hyacinth is a promising source for the production of biofuel (as biodiesel and biofuel), glycerol, pigments, and other active compounds.

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