Biomass Gasification Methanol Synthesis

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1. Introduction

Clean energy generation has been the world's concern and goal for the last decades. Biomass is one of the most reliable sources of clean energy utilized by industries nowadays. However, this utilization of such sources requires the implementation of certain chemical processes to reach the desired fuel. The biomass gasification process is used to convert the biomass (wood, sludge and waste) into synthesis gas which can be used as a feedstock to other industries producing fuels.

Heavy hydrocarbon fuels are becoming widely used in our everyday life. However, these fuels have been a threat to the environment. These fuels cause an increase in the emissions of carbon dioxide which cause many environmental hazards such as the depletion of the ozone layer. Modern technologies have shifted the view to the use of light hydrocarbons as fuels. Light fuel hydrocarbons may be a result of many processes such as the treating of associated and non-associated gases from oil wells, and the most recent way of using the unwanted biomass wastes to produce these light fuels.

Our main target in this project is to optimize and design a gasification and methanol synthesis process by which light fuels such as methanol could be easily obtained from the biomass. However, it discusses the production of light hydrocarbon fuels such as methanol from biomass wastes like animal manure of woody wastes. The pathway to produce these fuels is by the gasification of the biomass in a fluidized bed hydro-gasifier. Gasification is a thermo-chemical process intermediate between pyrolysis and combustion. Limited amount of oxygen is fed at an elevated temperature to produce the energy rich gas or syngas.

The syngas consists mainly of methane gas, carbon monoxide, hydrogen, carbon dioxide, and water vapor. This syngas is then passed through an acid gas removal unit and treated for any traces of hydrogen sulfide gas, which is a caustic gas when inhaled. After the acid gas treatment, the gas is then allowed to pass through a steam pyrolysis reactor where the syngas and the LNG both react with steam to increase the hydrogen and carbon monoxide contents of the gas to be fed to the fuel production unit (methanol reactor).

The rich gas then passes to the methanol reactor where carbon monoxide reacts with hydrogen gas to yield the light hydrocarbon fuel. This light fuel passes then through the other units where the product is concentrated to yield a low water content fuel. The methanol produced may further be used to generate electricity using methanol fuel cells where methanol undergoes a certain electro-chemical reaction to produce current to be supplied for other processes or applications.

2. Key Features

The poster defines different types of biomass and concentrates on animal waste which we consider as feed for our process. The poster shows the process flow diagram, and simple steps explaining the biomass gasification methanol synthesis process.

3. Conclusions

The poster presentation will be concluded with a list of possible recommendation and future changes that can be made to make this process successful and efficient. Also, it will be shown that biomass gasification is more effective than combustion of biomass or any other form of fuel. The biomass effectiveness on the production of methanol fuel showed a high degree of efficiency and success. In addition, the performance of this process towards the production of methanol fuel was also effective.

4. References and Bibliography

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Author Biographies

The four lead authors are Senior Chemical Engineering Students in the Department of Chemical Engineering at the American University of Sharjah, Sharjah, UAE. In the Senior year of Chemical Engineering, every group of students works on a Senior Design Project where they implement their engineering knowledge and design skills to develop a feasible process to improve or even to explore new processes in certain fields. The project presented is concerned with the production of the light fuels, methanol, from using a different aspect rather than combustion and that is biomass gasification, which is mostly the pyrolysis of biomass to syngases which may be used to produce methanol.

Dr. Taleb Ibrahim is an Associate Professor in the Department of Chemical Engineering at the American University of Sharjah. He supervises the project presented.

Mr. Abbas Taher is a Research Engineer at Aqua Engineering Co. LLC, Dubai, UAE.