SIMULATION OF PYROLYSIS AND GASIFICATION OF BIOMASS BY ASPEN PLUS

MUHAMMAD AQEEL BIN AZHAR

2012872832

FACULTY OF CHEMICAL ENGINEERING
UNIVERSITI TEKNOLOGI MARA
SHAH ALAM

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1.0 Research Background

1.1 Introduction

Fossil fuels have been used as the main energy source for many years. The creation of the combustion engine and the ever expanding motor industry have just increased the worlds dependency on them. Due to the nature of the fossil fuels being a non renewable energy source, an obvious sustainability issue arises. How many more years can the oil reserves sustain the need for fuel. To overcome this problem, an alternative to conventional fossil fuels have to considered. As of late, biomass has been seen as a major candidate to replace conventional fossil fuels.

Biomass is organic matter that originates from living matter. It is as mentioned a good energy source because of its abundance. Most of the industries in the world produce some sort of waste. For example the food industry produces waste in the form of manure and organic compounds, and furniture industries producing vast amounts of debris in the form of wood. Biomass is said to be renewable because of the fact that waste will always exist and the harvesting of crops will always occur, yielding more organic matter to be turned to biomass fuel.

This research was done to simulate the pyrolysis gasification of biomass by using aspen plus software. In simplified terms, pyrolysis is the breakdown, or decomposition of organic matter at elevated temperatures in the absence of oxygen. The term pyro means fire while lysis means separate and this process is irreversible. The focus on pyrolysis in this study is because it converts biomass to syngas.

Gasification on the other hand is the process by which and organic carbon based material is converted to carbon dioxide, carbon monoxide, and hydrogen. This process, like pyrolysis occurs at high temperatures but with a controlled amount of oxygen and without combustion. This reaction produces syngas as fuel. Syngas is considered to be a renewable energy because of the fact that it is derived from biomass and biomass is a renewable source.

The simulation of this process of pyrolysis gasification of biomass will be done by using aspen plus version 8.8 and by using the Soave Redlich Kwong to achieve a higher rate of accuracy in calculations.

1.2 Problem Statement

The process of pyrolysis and gasification of biomass is broken down into two parts. The pyrolysis of biomass involves the decomposition of biomass into constituent elements. The gasification of the constituent elements produces syngas which is the goal of the simulation.

1.3 Objective Of Study

i. To simulate the decomposition of biomass in pyrolysis

ii. To simulate the gasification of the decomposed biomass material to form syngas

1.4 Scope Of Research

I. The initial step of this study is researching the fundamentals regarding pyrolysis, gasification and biomass. The identification of which type of pyrolysis which is either fast pyrolysis of slow pyrolysis, whereby fast pyrolysis takes a short time at relatively high temperatures, somewhere between 300-500 degree Celsius. In this process char accumulates faster due to the higher temperatures. Slow pyrolysis or vacuum pyrolysis is pyrolysis that takes place in a vacuum where the material is heated in order to decrease boiling point and avoid any unwanted side reactions. The research was also done to identify the correct reactor to be used in aspen plus.

II. The gasification stage of the study is also researched and the proper reactor to be used in simulation either the RSTOIC, RYIELD, or RGIBBS reactor should be used so the reaction can be simulated most accurately as possible to produce the desired product which is syngas to be used as a source of energy.