CHAPTER I

INTRODUCTION

The main energy source in the world depends on fossil fuel resources such as oil, natural gas, coal etc. The use of fossil fuel required for generation of energy such as transportation fuel, electricity and other products are becoming scarce and that climate change and global warming are related to greenhouse gases emissions of fossil fuel to the atmosphere has increased continuously. Therefore, the development sources of energy for sustainable and environmental-friendly have been interested.

Biomass is a renewable energy source which has received increasing attention as an effort to reduce greenhouse gases emission, much less CO_2 is added overall to the atmosphere compared with the fossil fuel counterpart processes, and alleviate volatile oil prices. Lignocellulosic biomass should be used for the production of fuels such as bioethanol and biodiesel because they are abundances, inexpensive feedstocks, avoid competition with human food and animal feed, and reduce environmental risks. Bioethanol derived from biomass, one of the modern forms of biomass energy, has the potential to be a sustainable transportation fuel, as well as a fuel oxygenate that can replace gasoline, with several advantages such as high octane number, low cetane number, and high heat of vaporization.

Thailand is one of the major agricultural producers and exporters. It has a massive potential of agricultural products releasing so much agricultural residues such as sugarcane bagasse, corn stover, cassava rhizome, rice straw etc. Agricultural residues are lignocellosic biomass which can be utilized as raw materials to produce bioethanol fuel grade (99.5% purity). Thailand also currently has a strong fuel ethanol growth rate. In 2012, the number of operating ethanol plants will likely increase to 21 plants with total production capacity of 3.715 million liters/day, up from 19 plants with production capacity of 3.065 million liters/day in the previous year (USDA Foreign Agricultural Service). The country has set an ambitious target for its fuel ethanol program for replacing all octane-91 gasoline with gasohol, a 10% blend of bio-ethanol with 90% gasoline, by 2012 (EPPO, 2012).

Corn stover, sugarcane bagasse and cassava rhizome are attractive lignocellulosic biomass for bioethanol production in Thailand because they are second generation biofuels that is non-edible material, agricultural residues and indirect land uses. High productions of corn, sugarcane and cassava are 4.96, 98.40 and 26.6 million tons respectively (OAE, 2012) and available unused these residues for energy are 2.97, 6.17 and 1.62 million tons respectively in 2012 (adapted from DEDE, 2009 and OAE, 2012). However, usage of only one feedstock has disadvantage. There are not any sorts of feedstock available throughout a year because of discontinuous harvest time resulting in fluctuating price.For security multi-feedstocks is introduced and considered one of the best solutions in terms of flexible feedstocks, higher sustainability, long term bioethanol production, etc.

In order to evaluate the efficiency of biofuels in terms of environmental aspect, life cycle assessment (LCA) is one of the most effective tool to assess environmental impacts. This assessment includes two main procedures. The first one is to collect the data which involves making detailed measurements during the processing of the product, from farming of raw materials used in production and distribution, through its use, possible reuse or recycling and finally disposal. The second one is to characterize the collected data into environmental categories and then interpret the results which benefit their process and improve their products.

This work focused on bioethanol production from potential lignocellulosic biomass in Thailand. The purposes of this work consist of four main parts. The first one was to design bioethanol conversion process to find process specification and the performance of various process design alternative cases. In this case, the study focused on muti-feedstocks as corn stover, sugarcane bagasse and cassava rhizome. The second one was to evaluate process designs in term of economic criteria such as total capital cost, total operating cost, net revenue and so on. The third one was to analyze process designs in term of sustainability that consists of three main factors in the process (mass, energy and water). The last one was to be more sustainable based on life cycle assessment (LCA) by reducing the environment impacts from the process that focused on main factors are acidification, eutrophication and global warming potential. Finally, compared alternative case designs to find the best sustainable process design in term of sustainability.