CO-PYROLYSIS OF BIOMASS FOR PRODUCING FINE CHEMICALS

Nurul Asyikin Badir Noon Zaman, Noridah Osman

Nomenclature

IPCC	Intergovernmental Panel on Climate Change
IRENA	International Renewable Energy Agency
HDPE	High-Density Polyethylene
MSW	Municipal solid waste
PE	Polyethylene
PS	Polystyrene
PP	Polypropylene
PLA	Polylactic acid

INTRODUCTION

The issue of decreasing fossil fuels has become a critical topic nowadays. Fossil fuels, including coal, petroleum, and natural gas, play an important role as a worldwide energy source. Previous research has calculated the formula for when fossil fuel reserves are probably to be depleted, and the results stated that the coal reserves are available until 2112. After 2042, the only energy source left is fossil fuel [1]. Fossil fuels release toxic gases such

as carbon monoxide, sulphur, nitrogen dioxide, and the principal product, carbon dioxide. According to *IPCC*, the emission of carbon dioxide was reported will change the climate, and the temperature of Earth is predicted to increase by 2°C in 2100 compared to the current average temperature, which is 1.7°C [2]. To solve this issue, many researchers have proposed various methods of substituting fossil fuel energy for alternative energy sources with high efficiency and more environmentally friendly. The use of renewable energy sources such as solar, wind, and hydro energy not only has a low maintenance cost, but the emission of greenhouse gases such as carbon dioxide could be reduced by 70% by 2050, as reported by International Renewable Energy Agency (IRENA). In recent years, research on biomass energy has become very popular. Biomass is defined as an organic material that is derived from plants or animal sources. The biomass composition consists of three components: lignin, cellulose, and hemicellulose [3]. They are abundant and can be easily found in many forms, such as from agriculture residues, wood residues, dedicated energy crops, and municipal solid waste [4].

Previously, the production of fuel from the pyrolysis of biomass is abundantly studied as a future solution to replace the usage of fossil fuels. The pyrolysis process can be defined as a thermo-degradation of biomass or waste without oxygen and performed under temperatures 400 to 700°C. This process produced three final products: bio-oil, bio-char, and non-condensable gases such as CO, CO_2, H_2, and some of the light hydrocarbons [5]. The bio-oil produced can be used in various applications, such as in the production of fuels or even as a precursor in petroleum refinery feedstock. Besides, the higher amount of chemicals existing in bio-oil may have the advantage of being used in a wide range of applications, especially in the chemical industry [4]-[5]. However, the high levels of oxygen contained in bio-oil make it difficult to be directly used as a fossil fuel. Hence, the bio-oil produced needs to be upgraded to reduce the oxygen content and increase the quality of bio-oil. Previous research indicates that biomass contains 47-51 wt% and 42-46 wt% of carbon and oxygen, respectively [8]. The oxygenated pyrolysis oil produced will reduce the calorific value, increase the acidity of the oil, and cause corrosion problems. There are a few ways to upgrade pyrolysis oil, such as hydrodeoxygenation, catalytic cracking, and steam reforming. However, these methods are costly, and the usage of catalysts would cause some problems to happen. Thus, to overcome this problem, many researchers have shown that using the co-pyrolysis technique can improve the