CHAPTER I

INTRODUCTION

Nowadays, plastic wastes from petrochemical industry are important environmental problems because of their tremendous amount and durable nature. Variety of plastic products provides fundamental contribution to our modern society such as building materials, packaging materials, and equipments. Unfortunately, these products are a starting point of plastic wastes management. The most common way to get rid of plastic wastes which difficult to recycle is dumping them to landfill site, but the physical properties and chemical properties give rise to problems. However these methods are not sustainable solutions in the long run. Plastic wastes have high resistance to biodegradation; therefore, they do not decompose and take up large amounts of valuable landfill space, providing breeding sites for mosquitoes and rodents, and presenting life and health hazard. Moreover, landfill has become more difficult because of resistance by the nearby populations and lack of available space in many regions. In many cases, landfill would result in contamination of soils and underground waters. In the same way, incineration generates toxic gas such as CO, SO_x, NO_x dioxin, etc [1] depending on initial raw materials. Because of these reasons, thermal conversion under sub-stoichiometric condition is one of interesting plastic wastes management process.

Thermal conversion under sub-stoichiometric condition may be broadly categorized as pyrolysis and gasification. Pyrolysis is a process in which decomposition of materials, polymer, occurs in the absence of oxygen or in an inert atmosphere at high temperature to break their structure into smaller fractions such as monomer, dimer, and oligomer. Gasification is similar to pyrolysis but limited oxidizing agents in atmosphere are present and the products contain higher gas fraction than pyrolysis [2]. These thermal conversions differ from incineration because they allow the recovery of chemicals with added value, depending on the type of waste, time, temperature, and reactor used in the process, which can further be used as fuels replacing petroleum products or as raw materials in many industries.

In conventional reactor, the system is heated by fuel burner that requires long startup/shutdown time and storage of combustible fuels. Uneven distribution of energy inside the reaction chamber and raw materials and low efficiency are also common for conventional heating. Microwave induced thermal conversion is a novel process that uses high dielectric material which can absorb microwave radiation and then the energy is transferred to heated materials which cannot absorb microwave radiation such as plastic waste or municipal solid wastes. In this method, temperature can be adjusted by varying microwave power [3]. In addition, this method requires short time to attain high temperature that is high enough for molecular fragmentation. This heating process is very effective since heat will be evenly distributed throughout the reactor and the transformation of electricity to microwave energy is known to be very efficient results in energy saving of the overall process. The operation of microwave system is also relatively safe as the temperature inside the reactor chamber will drop down rapidly as soon as the power is turned off with no residual heat like that of conventional heating.

Shoe sole scrap is a composite material that have 3 main components namely ethylene-vinyl acetate copolymer, natural rubber, and polyethylene forming in 3 layers structure. It is regrettable that shoe sole scrap from industry has a large amount of about 20% by weight of EVA/NR sheet before being cut into sizes. Because ethylene-vinyl acetate copolymer is partially crosslinked and natural rubber is a thermoset polymer; therefore, they cannot be either melted or soluble and cannot be remolded into other shapes without degradation. As a result, shoe sole scrap is difficult to reprocess. Therefore, the aim of this research was to study thermal conversion of EVA/NR composite by microwave induced and comparison with conventional processes which using same quartz reactor, quantity, reaction time, and atmosphere at 700 ^{o}C. Investigation of product distribution at different microwave power, carrier gas, and ratio of microwave absorber (silicon carbide, SiC). Gas products were characterized by GC/FID/TCD and their carbon component was determined by a standard mixed gas. The gas production under 100% Ar and 99% Ar/1%O_2 atmosphere was studied to compare the effects between pyrolysis and gasification reaction in both microwave heating and conventional process.