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Plastic Waste to Fuel

Hlae Yi Myo
Lecturer,Department of Mechanical Engineering
Technological University, Monywa
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Abstract: The waste plastic is generated in Myanmar, amount of many per day because people use the plastic in almost all daily activities. Also, plastic are an integral part of our modern life are used in almost all almost all daily activities. Waste plastic are the cause of many of the serious environment problems the world face today. Especially, Myanmar is a agricultural country. So waste plastic need to dissolve in Myanmar for Agriculture. Increasing cost of the protroleum products are the big troubles of today's world. For this reasons, Myanmar need to convert fuel such as petroleum from plastic waste for domestic demand. So in this paper, technologies for converting waste plastic into fuel are studied.
Keywords
Index Terms: Waste plastic, fuel, diesel oil, petrol oil, and pyrolysis.

I. INTRODUCTION

Waste plastics are one of the most promising resources for fuel production because of its high heat of combustion and due to the increasing availability in local communities. Unlike paper and wood, plastics do not absorb much moisture and the water content of plastics is far lower than the water content of biomass such as crops and kitchen wastes. The conversion methods of waste plastics into fuel depend on the types of plastics to be targeted and the properties of other wastes that might be used in the process. Additionally the effective conversion requires appropriate technologies to be selected according to local economic, environmental, social and technical characteristics.

In general, the conversion of waste plastic into fuel requires feedstocks which are non-hazardous and combustible. In particular each type of waste plastic conversion method has its own suitable feedstock. The composition of the plastics used as feedstock may be very different and some plastic articles might contain undesirable substances (e.g. additives such as flame-retardants containing bromine and antimony compounds or plastics containing nitrogen, halogens, sulfur or any other hazardous substances) which pose potential risks to humans and to the environment.

The types of plastics and their composition will condition the conversion process and will determine the pretreatment requirements, the combustion temperature for the conversion and therefore the energy consumption required, the fuel quality output, the flue gas composition (e.g. formation of hazardous flue gases such as NOx and HCl), the fly ash and bottom ash composition, and the potential of chemical corrosion of the equipment,

Therefore the major quality concerns when converting waste plastics into fuel resources are as follows:

(1) Smooth feeding to conversion equipment: Prior to their conversion into fuel resources, waste plastics are subject to various methods of pretreatment to facilitate the smooth and efficient treatment during the subsequent conversion process. Depending on their structures (e.g. rigid, films, sheets or expanded (foamed) material) the pretreatment equipment used for each type of plastic (crushing or shredding) is often different.

(2) Effective conversion into fuel products: In solid fuel production, thermoplastics act as binders which form pellets or briquettes by melting and adhering to other non-melting substances such as paper, wood and thermosetting plastics. Although wooden materials are formed into pellets using a pelletizer, mixing plastics with wood or paper complicates the pellet preparation process. Suitable heating is required to produce pellets from thermoplastics and other combustible waste. In liquid fuel production, thermoplastics containing liquid hydrocarbon can be used as feedstock. The type of plastic being used determines the processing rate as well as the product yield. Contamination by undesirable substances and the presence of moisture increases energy consumption and promotes the formation of byproducts in the fuel production process.

(3) Well-controlled combustion and clean flue gas in fuel user facilities: It is important to match the fuel type and its quality to the burner in order to improve heat recovery efficiency. Contamination by nitrogen, chlorine,

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Hlae Yi Myo, *Mechanical Engineering Department, Technological University Monywa, (e-mail: Hlae Yi Myo@gmail.com). Mandalay, Myanmar, 09-885721837.*

and inorganic species, for instance, can affect the flue gas composition and the amount of ash produced. When using fuel prepared from waste plastics, it must be assured that the flue gas composition complies with local air pollution regulations. In the same way, ash quality must also be in compliance with local regulations when disposed at the landfill. If there aren't any relevant regulations, both the producers and consumers of the recycled fuel should control the fuel quality and the emissions at combustion in order to minimize their environmental impact.

Table 1.1 classifies various plastics according to the types of fuel they can produce. It can be observed that thermoplastics consisting of carbon and hydrogen are the most important feedstock for fuel production either in solid or liquid form.

As shown in Table 1.2, PE, PP and PS thermosplastics are preferable as feedstock in the production of liquid hydrocarbons. The addition of thermosetting plastics, wood, and paper to the feedstock leads to the formation of carbonous substances and lowers the rate and yield of liquid products.

Table 1.1: Polymer as feedstock for fuel production

Types of polymer	Descriptions	Examples
Polymers consisting of carbon and hydrogen	Typical feedstock for fuel production due to high heat value and clean exhaust gas.	Polyethylene, polypropylene, polystyrene. Thermoplastics melt to form solid fuel mixed with other combustible wastes and decompose to produce liquid fuel.
Polymers containing oxygen	Lower heat value than above plastics	PET, phenolic resin, polyvinyl alcohol, polyoxymethylene
Polymers containing nitrogen or sulfu	Fuel from this type of plastic is a source of hazardous components such as NOx or SOx in flue gas. Flue gas cleaning is required to avoid emission of hazardous components in exhaust gas.	Nitrogen,polyamide, polyurethane Sulfur: polyphenylene sulfide
Polymers containing halogens of chlorine, bromine and fluorine.	Source of hazardous and corrosive flue gas upon thermal treatment and combustion	Polyvinyl chloride, polyvinylidene chloride, bromine-containing flame retardants and fluorocarbon polymers

Table 1.2: Product types of some plastics pyrolysis

Main products	Type of plastics	As a feedstock of liquid fuel
Liquid hydrocarbon	Polyethylene (PE) Polypropylene (PP) Polystyrene (PS) Polymethyl metacrylate (PMMA)	Allowed. Allowed. Allowed. Allowed
Liquid hydrocarbon	Acrylonitrile-Butadiene-Styrene copolymer (ABS)	Allowed. But not suitable. Nitrogen-containing fuel is obtained. Special attention required to cyanide in oil.
No hydrocarbons suitable for fuel	Polyvinyl alcohol (PVA) Polyoxymethylene (POM)	Not suitable. Formation of water and alcohol. Not suitable. Formation of formaldehyde.
Solid products	Polyethylene terephthalate (PET)	Not suitable. Formation of terephthalic acid and benzoic acid.
Carbonous products	Polyurethane (PUR) Phenol resin (PF	Not suitable. Not suitable.
Hydrogen chloride and carbonous products	Polyvinyl chloride (PVC) Polyvinylidene chloride (PVDC)	Not allowed Not allowed.

III. STUDYING OF PRODUCTION FUEL TECHNOLOGIES

3.1 All plastics are polymers mostly containing carbon and hydrogen and few other elements like chlorine, nitrogen, etc. Polymers are made up of small molecules, called monomers, which combine together and form large molecules, called polymers. When this long chains of polymers break at certain points, or when lower molecular weight fractions are formed, this is termed as degradation of polymers. This is reverse of polymerization or de-polymerization. If such breaking of long polymeric chain or scission of bonds occurs randomly, it is called

Random depolymerisations. Here the polymer degrades to lower molecular fragments. In the process of conversion of waste plastics into fuels, random depolymerisation is carried out in a specially designed reactor in the absence of oxygen and in the presence of coal and certain catalytic additives. The maximum reaction temperature is 3500℃. There is total conversion of waste plastics into value-added fuel products.

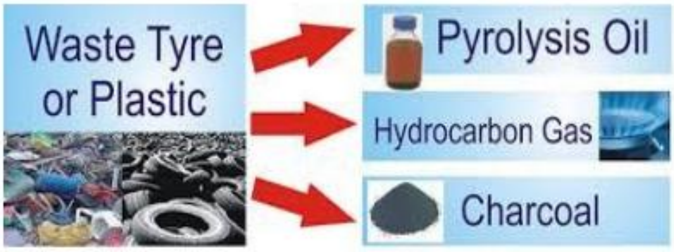

Figure.1 Waste cycle production(from internet journal)

Figure .1 shows (1)Solid plastic fuels (2)Liquid plastic fuels and (3) Gases plastic fuels for fuel production. So fuel production are studied as three catrogies (1) Solid Fuel Production), (2) Liquid Fuel Production and (3)Gases Fuel Production.

3.2 Solid Fuel Production

3.2.1 Scope of solid fuel in this compendium

Solid fuel, as referred in this compendium, is prepared from both municipal and industrial non-hazardous waste. Additionally, the solid fuel outlined here excludes coal and coal-derived fuels as well as solid biofuels such as firewood and dried manure but it may contain biofuels as a component. This compendium differentiates two types of solid fuel: refuse derived fuel (RDF), also called solid recovered fuel (SRF) and refuse-derived paper and plastic densified fuel (RPF).

3.2.2 Production method

The solid fuel production process usually involves two steps, pretreatment and pellet production: □ Pretreatment includes coarse shredding and removal of non-combustible materials.Pellet production comprises secondary shredding and pelletization (<200˚C). However, pretreatment is not required if the solid fuel producer can collect waste with suitable properties. Two types of commercial production systems are a large-scale model with pretreatment for the separation of undesirable contamination such as metals and plastics containing chlorine and a small-scale model without pretreatment equipment.

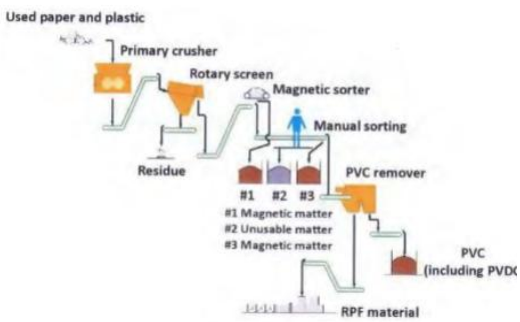

Figure.2 Schematic diagram of pretreatment process
(From internet)

3.3 Liquid Fuel Production

3.2.1 Scope of Liquid fuel in this compendium

Liquid fuel within this compendium is defined as plastic-derived liquid hydrocarbons at a normal temperature and pressure. Only several types of thermoplastics undergo thermal decomposition to yield liquid hydrocarbons used as liquid fuel. PE, PP, and PS, are preferred for the feedstock of the production of liquid hydrocarbons. The addition of thermosetting plastics, wood, and paper to feedstock leads to the formation of carbonous substance. It lowers the rate and yields of liquid products. Depending on the components of the waste plastic being used as feedstock for fuel production, the resulting liquid fuel may contain other contaminants such as amines, alcohols, waxy hydrocarbons and some inorganic substances. Contamination of nitrogen, sulfur and halogens gives flu gas pollution. Unexpected contamination and high water contents may lower the product yields and shorten the lifetime of a reactor for pyrolysis.

3.2.2 Production Method

The production method for the conversion of plastics to liquid fuel is based on the pyrolysis of the plastics and the condensation of the resulting hydrocarbons. Pyrolysis refers to the thermal decomposition of the matter under an inert gas like nitrogen.

For the production process of liquid fuel, the plastics that are suitable for the conversion are introduced into a reactor where they will decompose at 450 to 550 □C. Depending on the pyrolysis conditions and the type of plastic used, carbonous matter gradually develops as a deposit on the inner surface of the reactor. After pyrolysis, this deposit should be removed from the reactor in order to maintain the heat conduction efficiency of the reactor. Figure.3 presents a schematic diagram of a liquid fuel production plant.

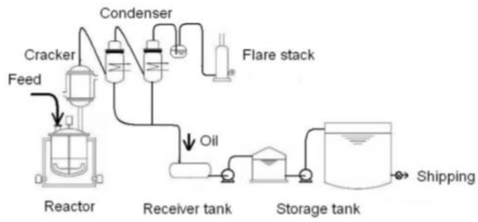

Figure.3 Schematic diagram of a production plant of plastics-derived fuel(From internet)

3.3 Gases Fuel Production

3.3.1 Scope of gaseous fuel in this compendium

The gaseous fuel described in this report refers to the flammable gas obtained from the thermal treatment of waste plastics. There are two types of gaseous fuel: □ Gaseous hydrocarbon: hydrocarbons that are in a gaseous state under normal temperature and pressure (0 ˚C, 1 atm). □ Synthesis gas or syngas: mixture of hydrogen and carbon monoxide In the conversion of plastics to gaseous fuel, the waste plastics undergo thermal decomposition in a tank reactor, resulting in the formation of liquid fuel as the main product and gaseous fuel up to about 20 wt%, as the minor product. Gaseous hydrocarbons become the main product after residing in the reactor for an extended time at a reaction temperature under controlled decomposition conditions and the use of a specific reactor. Under specific conditions, carbon and carbohydrates can be used as feedstocks for the production of gaseous fuel like methane and hydrogen.

3.3.2 Production Method

The gasification process includes a series of steps such as pretreatment, gasification, gas cleaning and storage. Polyethylene and polypropylene thermally decompose at temperatures up to about 700 °C and under a inert atmosphere to form a mixture of gaseous hydrocarbons, methane, ethane, ethylene, propane, propylene, and various isomers of butane and butane1. On the other hand, most of the organic substances undergo gasification yielding syngas 2. Gasification proceeds at elevated temperatures, higher than 800 and practically 1000 °C. Depending on the types of reactors and reaction conditions, carbonous matter and carbon dioxide are formed, and nitrogen from the air is contained in the product gas. Figure .4 shows diagram for Gases Fuel Production.

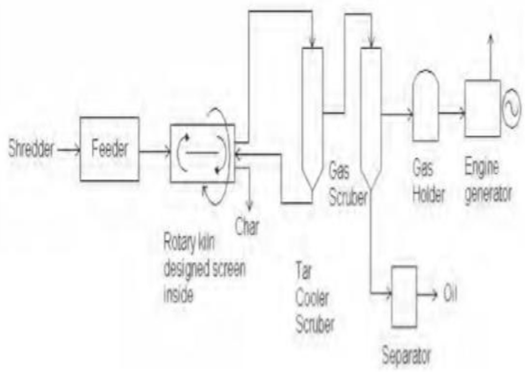

Figure 4: Schematic diagram of a production plant of plastics-derived gaseous fuel(From internet)

IV. CONCLUSION

This study shows technologies for converting waste plastic to fuel. By studying these technologies, the problems cause of waste plastic can be dissolved. At present, Fuel is usually used for machines.Moreover , this paper reduce waste plastic area by converting waste plastic to fuel .

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1. Hlae Yi Myo **received** her Bachelor of Technology (B.Tech) degree in 2005 and Bachelor of Engineering (B.E) degree in 2006 in Mechanical Engineering from Mandalay Technological University, Myanmar. And then she received Master of Engineering (ME), Mechanical Engineering in 2014 , Mandalay Technological University, Myanmar. Her study interests include the fuel production depending on waste plastic.

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