

# FUELS FROM PLASTIC WASTES

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**Abstract-** Originally, plastic is made from petroleum or natural gas in a chemical process that combines smaller molecules into a large chainlike molecule, often with other substances added to give it particular qualities. Processes like gasification of granulated plastic and catalytic pyrolysis can be used to convert plastic, the long hydro-carbon chain back into smaller hydro-carbon chains of naphtha, diesel, heavy diesel, kerosene etc. These fuels can then be used anywhere from boiler fuel in power generation to use in automobiles. This paper aims to provide the best possible review of this much needed conversion with the hope of visiting lowered fuel prices in the near future by improvements in the design.

**Keywords:** Waste-energy, diesel, gasification, pyrolysis, eco-friendly, fuels.

## I. INTRODUCTION

According to the United Nations Environment Programme, global plastic consumption has gone from 5.5 million tons in the 1950s to 110 million tons in 2009. Due to the technical limitations or inconvenience of recycling, only a fraction of that material resurfaces in new plastic products. This leads to extra-ordinary amounts being dumped in landfills for thousands of years. The Pacific Ocean is home of the world's biggest landfill: the Great Pacific Garbage Patch. The Plastics Division of the American Chemical Council asked the Earth Institute's *Earth Engineering Center* to explore ways of recovering the energy inherent in non-recycled plastics. The resulting report, released in August 2011, determined that the amount of energy contained in the millions of tons of plastic in U.S. landfills is equivalent to 36.7 million tons of coal, 139 million barrels of oil, or 783 billion cubic feet of natural gas. If all this plastic were converted into liquid fuel, it could power all the cars in Los Angeles for a year. And the fact is there are now technologies that can put all this waste plastic to good use. As stated earlier, plastic is a long chain hydro-carbon made from smaller chained hydro-carbons like oil, diesel, kerosene etc. Following are the processes in detail which yield the maximum efficiency in this conversion:

### A. Gasification of granulated waste plastic

Industrial makers of plastic parts generate a lot of plastic wastes, which sometimes is granulated before being dumped into a landfill so companies are not paying to dump airspace. This process involves complete gasification; there is no melting or slagging. The burner takes the granulated plastic, sized in diameter between 2 and 10 millimetres, from a solid to a liquid to a gas immediately in the combustion chamber. That gas is actually producing the heat we need to transfer into the boiler system. During the gasification of the granulated waste plastic, temperatures are very high-1,850 degrees Fahrenheit. The studies indicate emissions profiles cleaner than that of natural gas. Stack tests conforming to U.S. EPA standards were conducted on the burner unit by an independent testing company. The emissions testing evaluated the burner fueled with pelleted No. 4 low-density polyethylene (LDPE) from Korea; granulated No. 2 high-density polyethylene from discarded plastic barrels; and granulated, dirty No. 4 LDPE mulch-

film. Three main categories of pollutants were tested: particulate matter; gases (sulphur dioxide, nitrogen oxide and carbon monoxide); and dioxins/furans. Test results proved that this is an extremely clean-burning system.

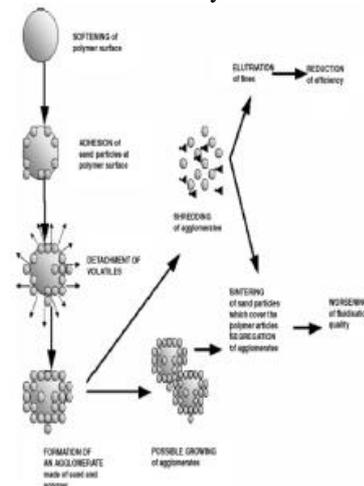
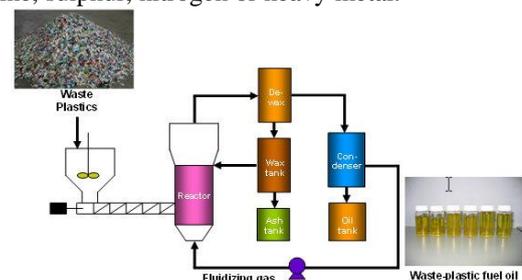


Fig1. Stages of plastic particles undergoing gasification

### B. Catalytic Pyrolysis of waste plastic

While interest in combusting and gasifying plastic appears to be growing, there is another route to making practical use of all the waste plastics modern society produces. Through catalytic pyrolysis, a system was devised to convert waste plastics into liquid hydrocarbons, coke and gas, which can then be used as boiler fuel for power generation. The technology uses lower temperatures than gasification-significantly lower, so it's more energy efficient to produce. Through "random depolymerisation," or selective breaking of carbon-to-carbon bonds, in addition to feeding in proprietary catalytic additives, the reactor melts and vaporizes waste plastic in one step at temperatures between 840 and 1,020 degrees F. On average, 78 percent of every pound of plastic fed into the system is converted to liquid hydrocarbons, coke and gas. The resultant coke can be further processed to produce additional fuel oil. This catalytic pyrolysis system processes polyolefins like polyethylene and polypropylene with up to 5 percent other plastic materials, plus up to 25 percent additional nonplastic waste, such as paper, glass, sand and water-making it ideal for processing municipal wastes. The output oil contains no chlorine, sulphur, nitrogen or heavy metal.



Process of Pyrolysis of Waste Plastics Technology

Fig2. Process of pyrolysis of waste plastic

## II. PLASTIC TO FUEL CONVERSION TECHNOLOGY ACROSS THE GLOBE

A series of plants adopting either one of the above mentioned processes have been set up across many countries by a range of leading companies. Their fuel production capacity ranges from a mere 4 litres of fuel to lakhs of tonnes, they are obviously related to the size of waste plastic feeder and the time taken for 1 cycle of the process to complete. Following are some of the already set up and fully functional plant datas:

1. UK: Cynar produces a synthetic fuel suitable for all internal combustion engines. 20 tonnes per day per module.
2. Washington, DC: Boosts easy installation, high efficiency, no second-time pollution. Plant converts 6,000 tons of plastic into nearly a million barrels yearly.
3. Circle Pines, MN and International: They have a modular unit that produces 775 litres of fuel for every ton of plastic waste processed. System capacity is rated at 185 tons per month.
4. New York/Canada: JBI, Inc. 20-ton processor, 4,000 lbs. of plastic feedstock per machine per hour.
5. Philippines: www.polygreen.com.ph 5,000 kilos of fuel per day.
6. Hong Kong: Ecotech Recycling Social Enterprise Prototype machine can process three tons of plastic waste into 1,000 litres of fuel oil per day.
7. Pune, India: Rudra Environmental Solutions, the yield is claimed to be 50 to 55% of the plastic disintegrated.
8. Annamalai University, Tamilnadu, India: Produces 50 litres of the petroleum products in two hours.



Fig3. A plastic to fuel conversion plant at JBI, Inc., NY.

## III. CONCLUSION

This conversion as we have already seen is nothing but beneficial. The gas emissions and ash produced during the process also falls under the permitted conditions against pollution. A huge lot of terra-firma is also saved with such undertakings. In addition, the following table shows the fuels so obtained are better than normal boiler fuels too. The fuel quality from our P2O process is notably better than the typical boiler fuel purchased by large industrial users, as shown below.

	Boiler fuels	Fuel from plastic
Sulphur	4%	0%(<4 ppm)
Sediment & Water	1%	0%
Carbon residue	High	Low

The fuel obtained is ultra-low sulphur fuel. Ultra-low sulphur diesel is a type of diesel fuel that contains 15 parts per million (ppm) or lower sulphur content. This diesel fuel is often referred to as “clean diesel” because the sulphur content has been reduced by more than 95%. In 2010, the U.S. Environmental Protection Agency (EPA) mandated that 100% of highway diesel imported into or refined in the U.S. must meet this low sulphur standard. The reduction of sulphur in diesel enables and preserves the operation of advanced emissions control systems on light- and heavy-duty diesel vehicles. The use of advanced emissions controls leads to an environmental benefit where oxides of nitrogen and other pollutant particulates are drastically diminished.

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