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STUDY OF CONVERSION OF WASTE PLASTIC INTO INDUSTRIAL FUEL

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ABSTRACT

***Plastic** is the general common term for a wide range of synthetic or semi synthetic organic amorphous solid materials used in the manufacture of industrial products. Plastics are typically polymers of high molecular mass, and may contain other substances to improve performance and/or reduce costs. Monomers of Plastic are either natural or synthetic organic compounds.*

The common word plastic should not be confused with the technical adjective plastic, which is applied to any material which undergoes a permanent change of shape (plastic deformation) when strained beyond a certain point. Aluminum, for instance, is plastic in this sense, but not a plastic in the common sense; in contrast, in their finished forms, some plastics will break before deforming and therefore are not plastic in the technical sense.

KEYWORDS: *Waste plastics, Pyrolysis, Alternative fuel, catalytic conversion, Hydrocarbon, petrol.*

1. INTRODUCTION

Plastics can be classified by chemical structure, namely the molecular units that make up the polymer's backbone and side chains. Some important groups in these classifications are the acrylics, polyesters, silicones, polyurethanes, and halogenated plastics. Plastics can also be classified by the chemical process used in their synthesis, such as condensation, polyaddition, and cross-linking. Plastics can also be classified by various physical properties, such as density, tensile strength, glass transition temperature, and resistance to various chemical products. They have already displaced many traditional materials, such as wood, stone, horn and bone, leather, paper, metal, glass, and ceramic in most of their former uses.

2. RAW MATERIAL

The raw materials include following:

1) Polyethylene: Buckets, drums, Chapels, sandal, bottles, plastic parts, carry bags etc.
2) Polypropylene: Pipe fitting, filter cloths etc.
3) Polyamide: Nylon ropes
4) Polyvinyl Chloride (PVC): PVC pipes and fittings
5) Polystyrene: Cloths and fiber
6) Rubber: Tires, automobile parts
7) Electronic Goods: Telephone sets, computers, keyboards, monitors
Laptops, electronic devices etc.

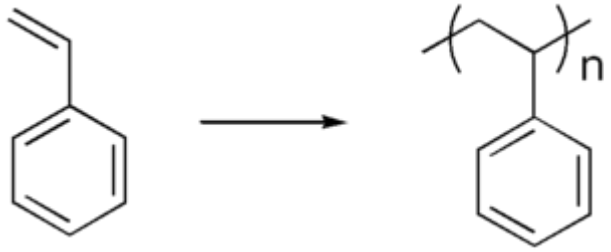
3. TYPES

1) **Cellulose-based plastics:** In 1855, an Englishman from Birmingham named Alexander Parkes developed a synthetic replacement for ivory which

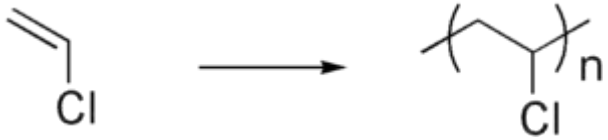
he marketed under the trade name *Parkesine*, and which won a bronze medal at the 1862 World's fair in London. Parkesine was made from cellulose (the major component of plant cell walls) treated with nitric acid and a solvent.

2) **Bakelite:** The first plastic based on a synthetic polymer was made from phenol and formaldehyde, with the first viable and cheap synthesis methods invented in 1909 by Leo Hendrik Baekeland, a Belgian-born American living in New York state.

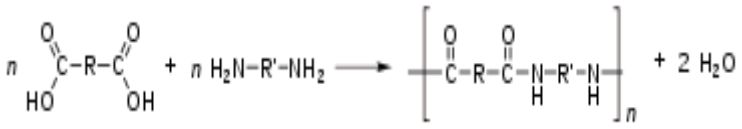
3) **Polystyrene and PVC:** Polystyrene is a rigid, brittle, inexpensive plastic that has been used to make plastic model kits and similar knick-knacks. It would also be the basis for one of the most popular "foamed" plastics, under the name *styrene foam* or Styrofoam.



PVC has side chains incorporating chlorine atoms, which form strong bonds. PVC in its normal form is stiff, strong, heat and weather resistant, and is now used for making plumbing, gutters, house siding, enclosures for computers and other electronics gear.



4) **Nylon:** The real star of the plastics industry in the 1930s was polyamide (PA), far better known by its trade name **nylon**. Nylon was the first purely synthetic fiber, introduced by DuPont Corporation at the 1939 World's Fair in New York City.



5) **Bioplastics:** Some plastics can be obtained from biomass, including:
- From pea starch film with trigger biodegradation properties for agricultural applications (TRIGGER).
- From biopetroleum.

4. TYPES OF PYROLYSIS TECHNIQUES

In our study, we intended to divide Pyrolysis into Pyrolysis with the use of catalysts and Pyrolysis without the use of catalysts. Pyrolysis process, which uses catalysts, can take place in two different kinds of batch reactor

1) Pyrolysis using expensive catalysts: Here the catalysts used are metal promoted silica- alumina or mixtures of metal hydrogenation catalysts with HZSM-5. The optimization of waste plastic as a function of temperature in a batch mode reactor gave liquid yields of about 80% at a furnace temperatures of about 600 degrees centigrade and one hr residence time. The Pyrolysis oil obtained at the temperature of maximum yield are relatively heavy in nature. However, hydro processing at relatively low hydrogen pressures (200-500psiag) at 430-450 degrees centigrade either thermally or catalytically converts them into a much lighter product. Sodium carbonate or lime addition to the Pyrolysis and co processing reactors results into an effective chlorine capture and the chlorine content of Pyrolysis oil reduces to about 50-200ppm and that of the hydro processed oils to 1-10ppm. The volatile product from this process is scrubbed and condensed yielding about 10-15%gas and 75-80% of a relatively heavy oil product.

2) Pyrolysis using synthesized catalysts from fly ash:

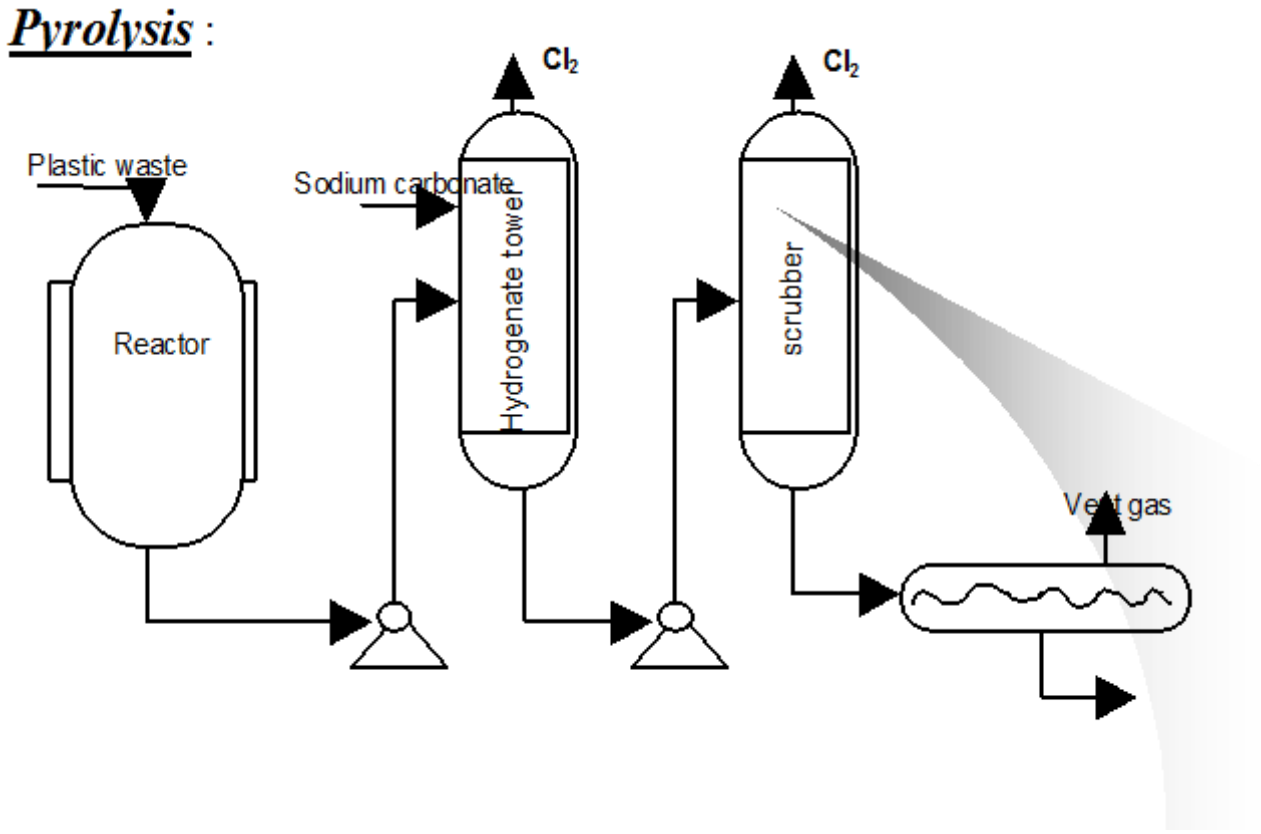


Fig. 1 Pyrolysis process set up

Component	Mordenite	HY	Silica Alumina	Fly Ash
SiO2	91.7	74.9	87	53.56
Al2O3	8.23	24.0	13	27.71
Na2O3	0.03	1.1	-	0.37
Fe	-	0.03	-	5.53
SiO2/Al2O3	(-) 18.9	5.31	6.69	1.93

The setup of the Pyrolysis batch reactor is shown in Figure 1. The mechanical agitator was installed in the batch type reactor wrapped around with electric heater for controlling the Pyrolysis temperature of waste plastic.

5. UNIQUE FEATURES OF THE PROCESS AND PRODUCT OBTAINED ARE:

- All types of Plastics Waste including CD's and Floppies having metal inserts, laminated plastics – can be used in the process without any cleaning operation. Inputs should be dry.
- Bio-medical plastics waste can be used.
- About 1 litre of Fuel is produced from 1 kg of Plastics Waste. Bye-products are Coke and LPG Gaseous Fuel.
- Any possible dioxin formation is ruled out during the reaction involving PPVC waste, due to the fact that the reaction is carried out in absence of oxygen, a prime requirement for dioxin formation.
- This is a unique process in which 100% waste is converted into 100% value-added products.
- The process does not create any pollution.

Though the fuel so produced from the plastics waste could be used for running a four-stroke/100 cc motorcycle at a higher mileage rate, the inventor agrees that separation of petrol from the liquid fuel could be a complex generation. Nevertheless the product is good enough for use as an alternative clean fuel in boilers and other heating systems.

6. ADVANTAGES

- Reduces pollution helps in waste plastic degradation.
- Cheaper and quality fuel.
- Perfect solution for waste plastic, rubber, tyre management.
- Raw material readily available.
- Plant is energy self sufficient.

7. APPLICATIONS

Filtered crude oil can be used in:

a) Boilers (replacement for LDO and furnace oil)
b) Electric generators
c) Furnaces
d) Diesel stoves in hotels and food industries
e) Hot air generators
f) Hot water generators

8. CONCLUSION

This study shows without doubt that one-way PET bottles are as 'ecologically favorable' as refillable glass under non-deposit circumstances. A plausible alternative could be to revise the Packaging Ordinance, such that ecologically favorable packaging systems would be included in a deposit without being discriminated when compared to refillable packaging. It cannot be explained to consumers that they should return the empty bottles to the store if they are subsequently transported to the other side of the world for recycling. This way we are losing environmental gain that is the prime reason behind bottles collection. This study has shown that it does not matter whether collected PET is recycled into polyester fibre, sheet, strapping or back into PET bottles: they all offer equal benefits to the ecological profile of PET.

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