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RESEARCH ARTICLE

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EXTRACTION OF CRUDE OIL BY USING DIFFERENT TYPES OF PLASTIC WASTE

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ABSTRACT

Plastic materials are a type of material that cannot be decomposed easily in a short period of time. We are surrounded by a lot of plastic materials in our day by day life. As a result of increasing level of private consumption 0of these plastic materials, in also every field, huge amount of plastic waste are discharged to the environment. It is undesirable to dispose of waste plastic waste by landfill due to poor biodegradability. Since the plastic are originated from the petroleum, resource, the possible technologies of converting them into fuel have attention to meet the future fuel demand Plastic waste is regarded as potentially economy source of energy. Lots of us have come across a variety of products that use plastic materials today. As a result of the increasing level of private consumption of these plastic materials huge amounts of wastes are discharged to the environment. Pyrolysis is a process that converts waste plastics into valuable liquid products that can be utilized as an energy source for numerous purposes such as diesel engines, generators, vehicles, etc. Crude oil is the ultimate source of plastics and out of total 100 million tons plastics produced every year all over the world, 25omillion tons is dumped. By throwing away such heavy amount of waste plastics, wasting lots of energy in the form of crude oil that is used to make plastics. The wasted energy can be recovered back using Pyrolysis process. This process save our conventional energy source i.e. crude oil. In this our project aims too solve the twin problem of environment pollution due to plastic and need for an alternative fuel source.






B.A.PATIL SHWETHA K C MANJUNATHA K ONKARAMURTHY C R S ANEKAR REVANASIDDAPPA N

INTRODUCTION

The world's first fully synthetic plastic was Bakelite, invented in New York in 1907 by Leo Baekeland who coined the term 'plastics'. Many chemists contributed to the materials science of plastics, including Nobel laureate Hermann Staudinger who has been called "the father of polymer chemistry" and Herman Mark, known as "the father of polymer physics". The success and dominance of plastics starting in the earlyo20th century led to environmental concerns regarding its slow decomposition rate after being discarded as trash due toits composition of very large molecules. Toward the end of the century, one approach to this problem was met with wide efforts toward recycling.

Plastic is a material consisting of any of a wide range of synthetic or semi-synthetic organic compounds that are malleable and can be moulded into solid objects. Plastics are typically organic polymers of high molecular mass, but they often contain other substances. They are usually synthetic, most commonly derived from petrochemicals, but many are made from renewable materials such as poly acetic acid from corn or cellulosic from cotton linters. Plasticity is the general property of all materials that are able to irreversibly deform without breaking, but this occurs to such a degree with this class of mouldable polymers that their name is an emphasis on this ability. Due to their relatively low cost, ease of manufacture, versatility, and imperviousness to water, plastics are used in an enormous and expanding range of products, from paper clips to spaceships. They have already displaced many traditional materials, such as wood, stone, ohorn and bone, leather, paper, metal, glass, and ceramic, in most of their former uses. In developed countries, about a one third of plastic is used in packaging and another one third in buildings such as piping used in plumbing or vinyl siding. Other uses include automobiles (up to 20%oplastic), furniture, and toys. In the developing world, the ratios may be different - for example, reportedly 42% of India's consumption is used in packaging. Plastics have many uses in the medical field as well, to include polymer implants; however the field of plastic surgery is not named for use of plastic material, but rather the more generic meaning of the word plasticity in regard to the reshaping of flesh.

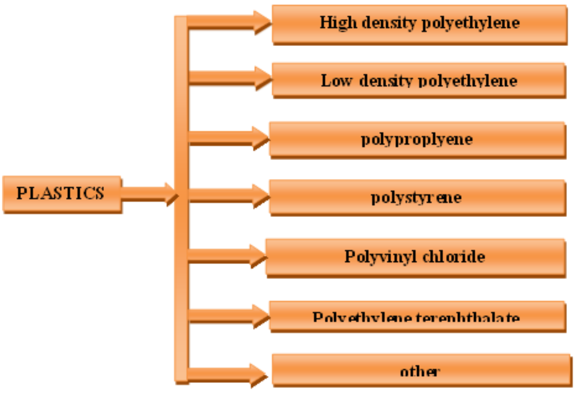
Plastics are synthetic organic materials produced by polymerization. The Plastic Waste is a big issue in India. According to Central Pollution Control Board (CPCB), India Generates 5.6 Million tons of Plastic Waste annually and approximately only 60% of Collected Plastic Waste is re-cycled, the balance of 40% could not be disposed of tons of Plastic waste is dumped on land and huge amounts are disposed of into the water bodies. These plastic wastes could instead be used for producing fuel. Pyrolysis of waste plastic could provide a better way to dispose of the waste plastic which causes environmental pollution. The project is thus selected with an objective of using this non degradable waste plastic as a source to extract fuel which after analysis can be used as an alternative source of energy. Therefore, it is possible to convert waste plastic into fuels. Plastic wastes such as, polypropylene, low density polyethylene, high density polyethylene, polystyrene are the most frequently used in everyday activities and disposed of to the environment. The conversion of oil from plastic has dual benefits. First of all the oil produced can be used as a fuel for domestic purposes and also in vehicles and industries when further refined. Secondly the various types of pollution caused due to waste plastics can be minimized.

Types of Plastics

The types of the waste plastics are low density polyethylene (LDPE), High density polyethylene (HDPE), Polypropylene (PP), Polystyrene(PS) and Polyvinyl chloride(PVC).

Different Plastic wastes

Table 1 Applications of different plastics



Marking	Polymer Name	Common Applications
1 PETE	Polyethylene Terephthalate	(PETE) is the most the commonly used plastic. It is used in soft drink bottles, water containers, vegetable oil bottles, dish detergent bottles, peanut butter jars, and most other clear plastic waterproof packaging.
2 HDPE	High Density Polyethylene	(HDPE) also very common, is used to make film containers, vitamin bottles, milk jugs and butter tubs. Most store bags are formed from this plastic. Since it has a crystalline structure, "clear" products made from HDPE are transparent but hazy.
3 V	Polyvinylchloride (PVC)	(PVC) is used in the manufacture of food wraps, vegetable oil bottles, blister packages and clear health and beauty bottles.
4 LDPE	Low Density Polyethylene	(LDPE) is used to make caps, plugs, netting, shrink wrap, garment bags and many other plastic bags. This plastic is similar in structure to HDPE but is less dense and more flexible.
5 PP	Polypropylene	(PP) Some plastics made with PP are refrigerated containers, butter tubs, yogurt containers, some bags, bottle tops, carpets and some food wraps.
6 PS	Polystyrene	(PS) plastics include throwaway utensils, meat packing, protective packing, and some thick rigid coloured plastic products. Plastics that have a wax coating over other coverings are also included in this category.
7 OTHER	All Other Resins	The plastics included in this category are either layered, mixed plastics or thermo sets.

Table 2: Identification of different plastic waste

Sl no	Test	Polyethylene (PE)	Polypropylene (PP)	Polystyrene (PS)	Polyvinyl chloride (PVC)
1	Water	Floats	Floats	Sink	Sink
2	Smell after burning	Like candle wax	Like candle wax-less to stronger than PE	Sweet	Hydrochloric acid.

PRECAUTION OF PYROLYSIS

- Do not let any material come into contact with the skin, eyes and mouth.
- Work In always well-ventilated area.
- Before Started the work, hand glove, and masks are use. Toprtectthe bad gases and skin diseases.
- Vapours can accumulate in low areas remove all sources of ignitions.
- Prevent further leakage or spillage of safe to do so.
- Provide the adequate ventilation especially, in confined areas.

MATERIALS AND METHODOLOGY

Municipal plastic wastes (MPW) normally remain a part of municipal solid wastes as they are discarded and collected a household plastic wastes. The various sources of MPW plastics includes domestic items like food containers, milk covers, water bottles, packaging foam, disposable cups, plates, cutlery, compact disc(CD) and cassette boxes. Fridge liners, vending cups, electronic equipment cases, drainage pipe, carbonated drinks bottles, plumbing pipes and guttering, flooring.

In this project work pyrolysis method is used to convert household plastic wastes like food containers, milk covers, water bottles, packaging foam, and waste cooking oil cover. The highest portion of plastic is disposed to landfill. Waste plastics have been shredded then washed before pyrolysis. From above factors from municipal plastic waste have been used as raw materials. Waste plastics have been washed before pyrolysis. In this project work milk plastic cover and oil covers are selected and feed to reactor to convert waste plastic into useful liquid fuel compounds.

The milk plastic wastes respectively, these are used as feed stocks to produce liquid fuel compounds. Plastic cover and oil covers are selectively collected from local hotels, home and hostels. Crushed water bottles normally remain a part of municipal solid wastes as they are discarded and collected a household plastic wastes. The various sources of Crushed water bottles includes domestic items like cool drinks, water bottles, such as public places like parks, schools , hospitals, stadium etc.

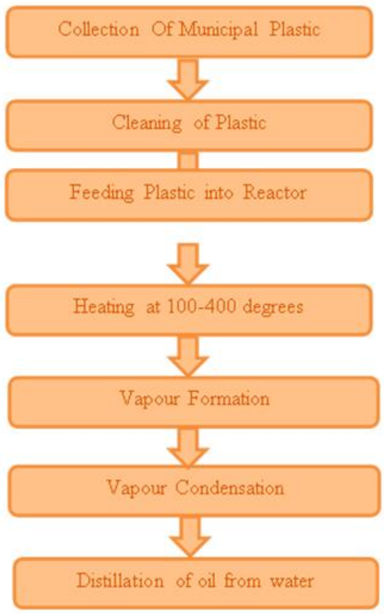
Preparation of raw material

1. One kg of waste plastics are taken and washed several times with water to remove dust and soil particles.
2. Later it is cut into long pieces.
3. They are dried at room temperature for about 30 minutes to further reduce the water content.

Process Description

1. The waste plastic is placed into the reactor for drying.waste plastic is fed into the reactor as Feed-1 kg.
2. The reactor is placed in a heating stove and maintained the temperature of the waste plastics.
3. Vapor form the reactor is sent to a pipes. The pipe ends from the condenser are collected and condense the gases. From the condenser, two products condensable vapors are obtained.
4. The condensable vapors are collected as oil in a tank.
5. The entire time required for the process is 2-3 hours.

Process of Flow Chart



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Design parameters of a Pyrolysis unit

Design for reactor

Material used = Mild steel

Yield stress for mild steel = F_y= 370Mpa,

Taking, Factor of safety for steel as 1.15

Allowable stress = $\frac{Fy}{FS}$

σ =$\frac{Fy}{FS}$=$\frac{370}{1.15}$

σ =321.74 Mpa

Maximum pressurePmax = 10 Pascal

Thickness of reactor, t =$\frac{Pmax\ X\ d}{2X\sigma}$

Where, d =diameter

$\frac{10X275}{2X321.74}$

Thickness of reactor, t = 4.274 mm

Thickness of reactor is 4.274 mm, but for considering safety and availability of materials, we have taken thickness of reactor is 5mm.

Specification of components

Reactor

Height (H) = 445mm

Internal diameter(ID) = 265mm

Outer diameter(OD) = 275mm

Thickness (t) = 5mm

Condenser

Type of condenser = water cooled condenser

Shape of condenser = bulb shape

diameter of water inlet and outlet = 10mm

Length of condenser (L) = 400mm

Thermometer

Type of thermometer= Digital

Sensing device = Probe sensor

Thermometer range = 0^0-600^0C

PYROLYSIS PROCESS

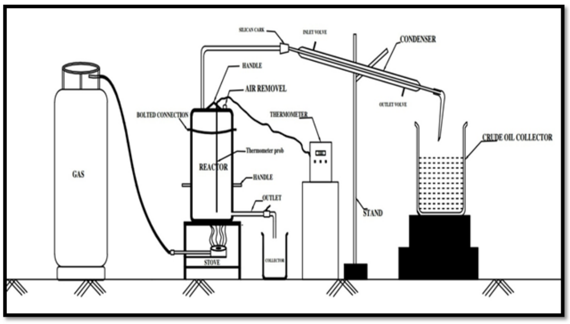

Fig-Line diagram of experimental setup

1. Reactor
2. Combustion chamber
3. Condense
4. Plastic input
5. Fuel Collection

Above fig shows, the experimental setup of pyrolysis process. The apparatus was designed to operate at high temperatures and atmospheric pressure. The heart of the experimental apparatus was a vertical tubular reactor. A feeder was attached to the reactor upper end this enabled controlled amounts of plastic pellets to be added before or during operation. At the bottom of the reactor attached a furnace for the purpose of heating the reactor. Biomass and charcoal with blower is used as a heating source to heat the reactor. Dueto increasing reactor temperature the plastic starts to evaporate, these vapours leaving the reactor and passed into a condenser, condenser maintained at atmospheric temperature. Then finally collected the liquid fuels in the containers or bottles. Temperatures and pressure were monitored continuously by using thermometer and pressure gauge.

STEPS INVOLVED IN THIS PROCESS

1. Feeding

Feed the milk coverto reactor through feeder and closes the reactor inlet. Before feeding into the reactor clean and wash the any debries in the milk cover.

2. Heating

To increase the temperature of reactor, heat the product of reactor inside by using heating source. (i.e. through the stove). The boiling point of milk cover is 80-260^0C.

3. Condensing

The plastic get evaporated at high temperature, this vapour is condensed to atmospheric temperature by using straight and bulb tube condensers.

4. Liquid collection

Out coming product from the condenser is collected at liquid collector.

5. After complete burning of the plastic waste

The residue remain in the reactor is collected and disposed off. And the reactor is cleaned for the next trails.

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6. Purification

Involves many purification processes. In this method we take equal proportion of plastic fuel and water in a container and shake well, allow it for 5-7 hours to settle down. Now water along with some crystals is collected at bottom and pure plastic fuel is collected at the top container.And Purify or remove the dust from the plastic fuel by using filter papers.

7. After the purification of fuel properties of fuel.

The various tests are conducted in this study are flash and fire test, density, etc.

TEST CONDUCTED ON EXTRACTION OF CRUDEOIL

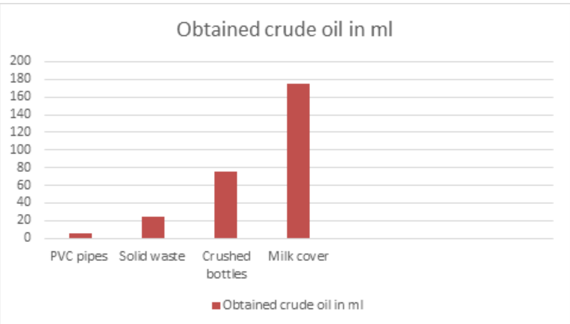
1. Flash point test
2. Fire point test
3. Density test
4. Specific gravity

RESULTS ANALYSIS

Table-4 Quantity of fuel obtained

Sl noooo	Type of waste plastics	Trails	Weight of waste plastic (kg)	Temperature (^{o}C)	Obtained crude oil (ml)	Residue weight of waste plastic (gm)
1	PVC pipes	1	1	100-200	5	120
		2	1		10	76
2	Solid waste	1	1	160-220	20	153
		2	1		30	126
3	Crushed bottles	1	1	390-570	60	86
		2	1		90	190
4	Milk cover	1	1	260-360	140	150
		2	1		210	78

GRAPHICAL REPRESENTATION



Graph 1 Type of plastic vs obtained crude oil in m

COMPARISON BETWEEN CRUDE OIL AND DIESEL

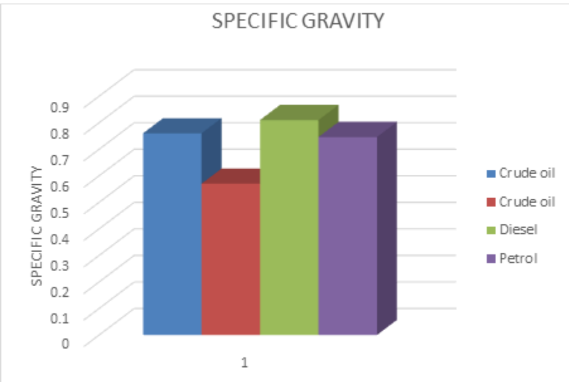
Table 5 Comparison between crude oil and diesel

SL NO	PROPERTIES	DIESEL	CRUDE OIL HDPE (bottles)	CRUDE OIL LDPE (milk cover)	CRUDE OIL PVC(pipes)
1	Colour	Light green	Light yellow	Dark brown	BLACK
2	Flash point	50 ^{0}C	$48^{0}C$-58 ^{0}C	-	-
3	Fire point	56 ^{0}C	$58^{0}C$-$68^{0}C$	-	-
4	Density	850 kg/m^3	769 kg/m^3	572 kg/m^3	-
5	Specific gravity	0.85	0.76	0.572	-

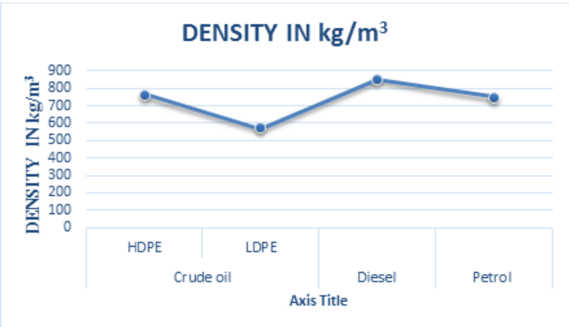
COMPARISON BETWEEN CRUDE OIL AND PETROL

Table 6 Comparison between crude oil and petrol

SL NO	PROPERTIES	PETROL	CRUDE OIL HDPE (Bottles)	CRUDE OIL LDPE (milk cover)	CRUDE OIL PVC (pipes)
1	Colour	Wine red	Light yellow	Dark brown	BLACK
2	Flash point	-------	$48^{0}C$-58 ^{0}C	-	-
3	Fire point	-------	$58^{0}C$-68 ^{0}C	-	-
4	Density	746 kg/m^3	769 kg/m^3	572 kg/m^3	-
5	Specific gravity	0.746	0.76	0.572	-



Graph 2 specific gravity v/s combination of oil



Graph 3: Density vs combination of crude oil

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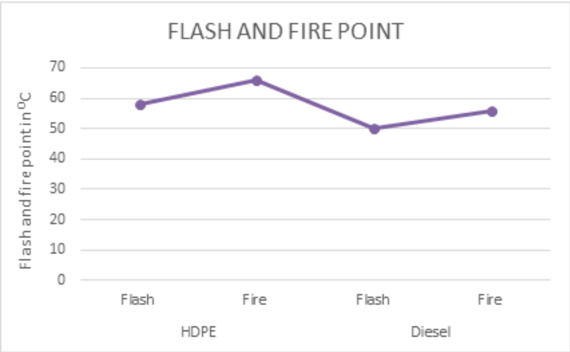

Graph 4 Flash And Fire v/s combination of crude oil

CONCLUSION

1. In this pyrolysis process we are concluded that the plastic waste leads to production of fuel oil, valuable resource recovery and reduction of waste problem.
2. It can effectively reduce the hazardous impact of waste accumulation on the earth.
3. Pyrolysis process is having potential of effective conversion of waste plastic into fuel.
4. As the confirmation tests of the products (crude oil) obtained are satisfied when compare to diesel and petrol, thus the product obtained through this process can be used as fuel.
5. The pyrolysis process has been developed sufficiently economic when large scale implementation of this unit.
6. It is conclude that the fuel obtained by this method is good alternative fuel and having properties similar to conventional fuel like petrol and diesel.
7. The flash and fire point of the obtained crude oil is similar to the flash and fire point of the diesel, so that obtained crude oil having comparatively same properties as that of diesel and petrol with respect to waste plastic materials.

SCOPE OF FUTURE WORK

1. The sludge obtained in this process, it may be used in the road construction.
2. The sludge waste may be mixed with peat soil and study their properties. By using that properties check whether soil is suitable for construction work or not.
3. The obtained crude oil which is further purified in a chemical lab and test with the vehicle.
4. The combination of HDPE, LDPE, and PVC pipes are tested in this project the output from these waste plastic is just similar to the acid so further it can be studied and check their properties.

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