
REVIVE
GREEN
EARTH

CONTENT

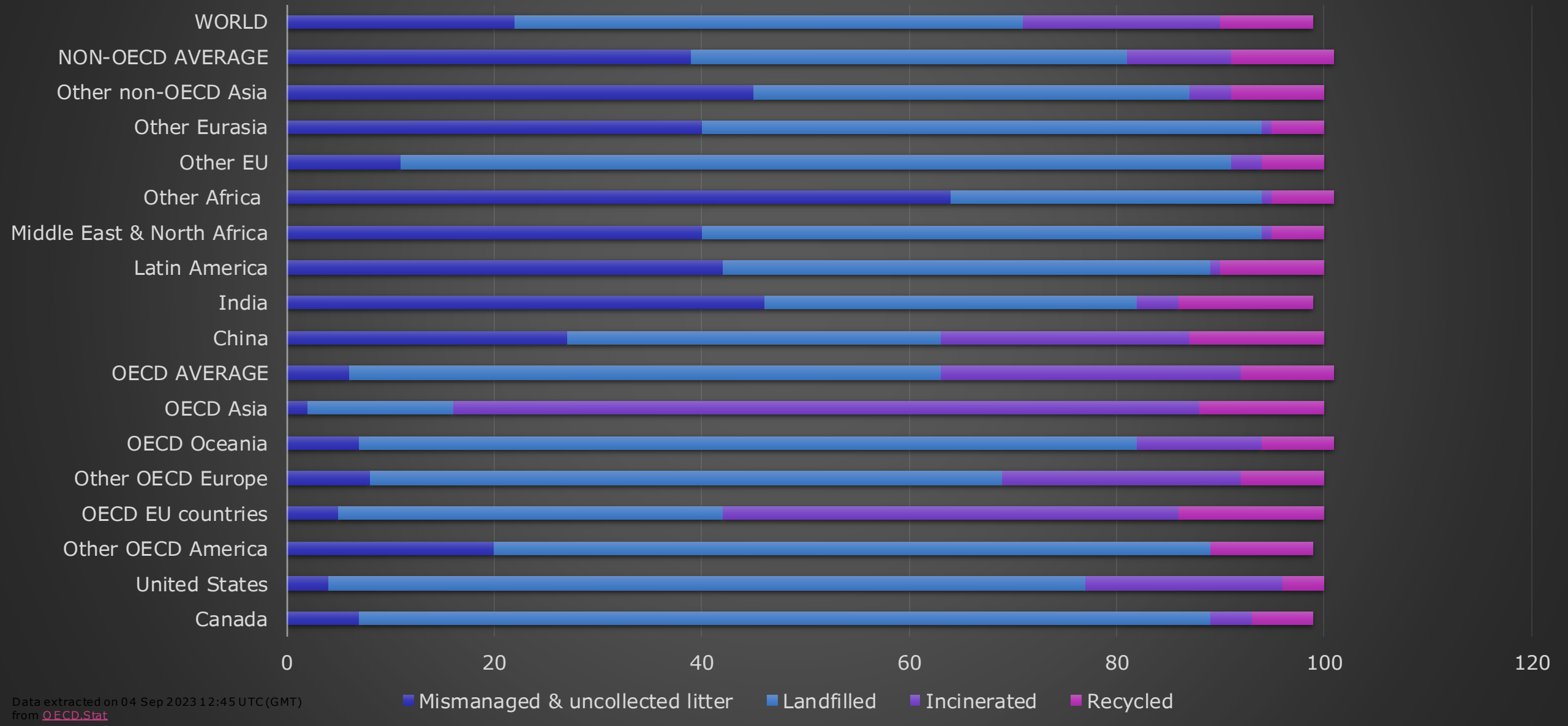
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INTRODUCTION

- There is an increase generation of waste plastics in the world. For more than 50 years the global production of plastics has continued to rise, thereby polluting the environment.
- Pyrolysis process becomes an option of waste-to-energy technology to deliver bio-fuel to replace fossil fuel.
- It is also nontoxic or non-environmental harmful emission unlike incineration.

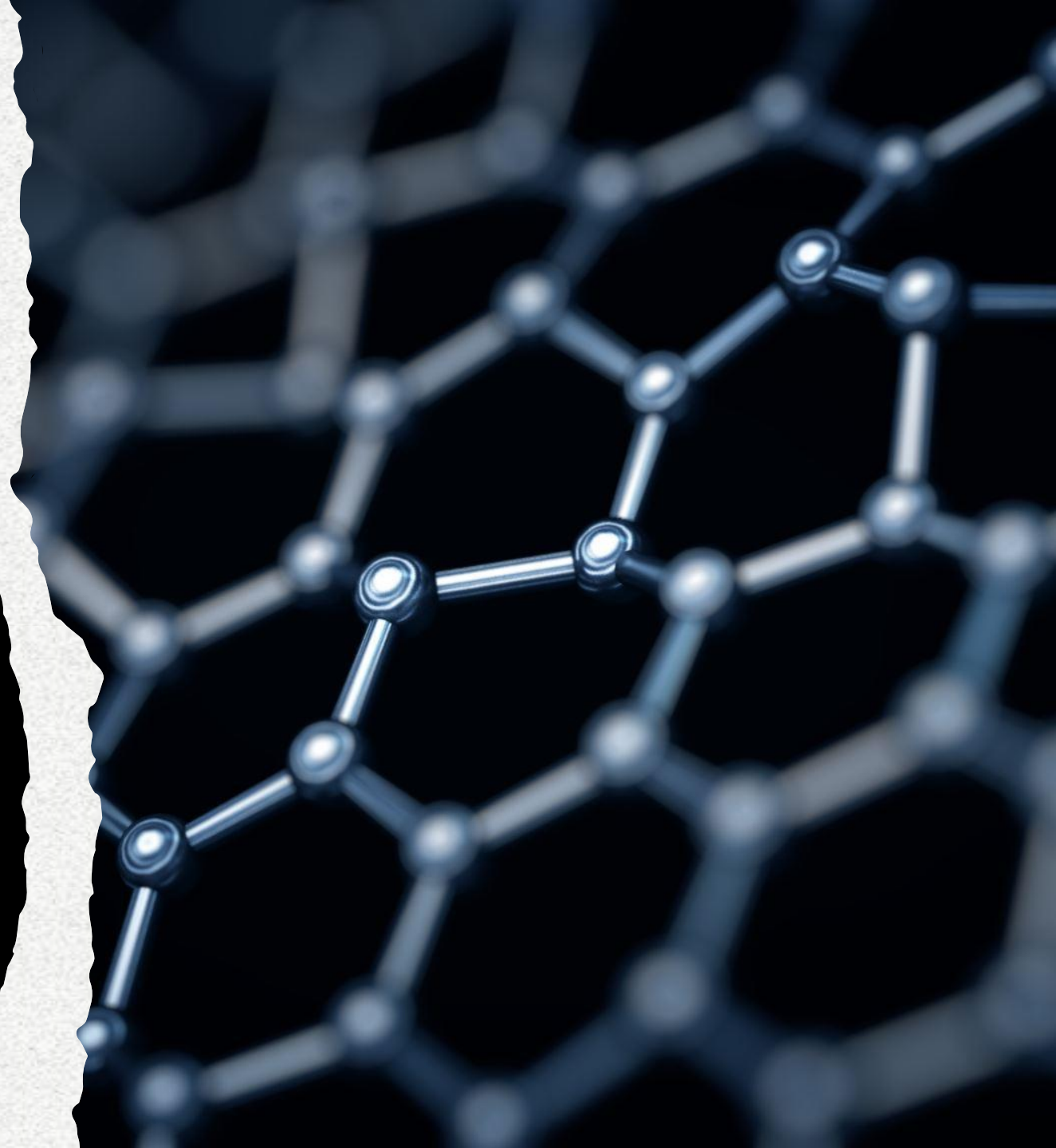
The above graph shows the plastic generation and the amount of plastics that is subjected to recycling



Data extracted on 04 Sep 2023 12:45 UTC (GMT) from OECD.Stat

LITERATURE SURVEY

- The results obtained on the co-processing of polyethylene and polypropene into petroleum are very encouraging as this method appears to be feasible to convert plastic materials into petroleum products.





OBJECTIVES

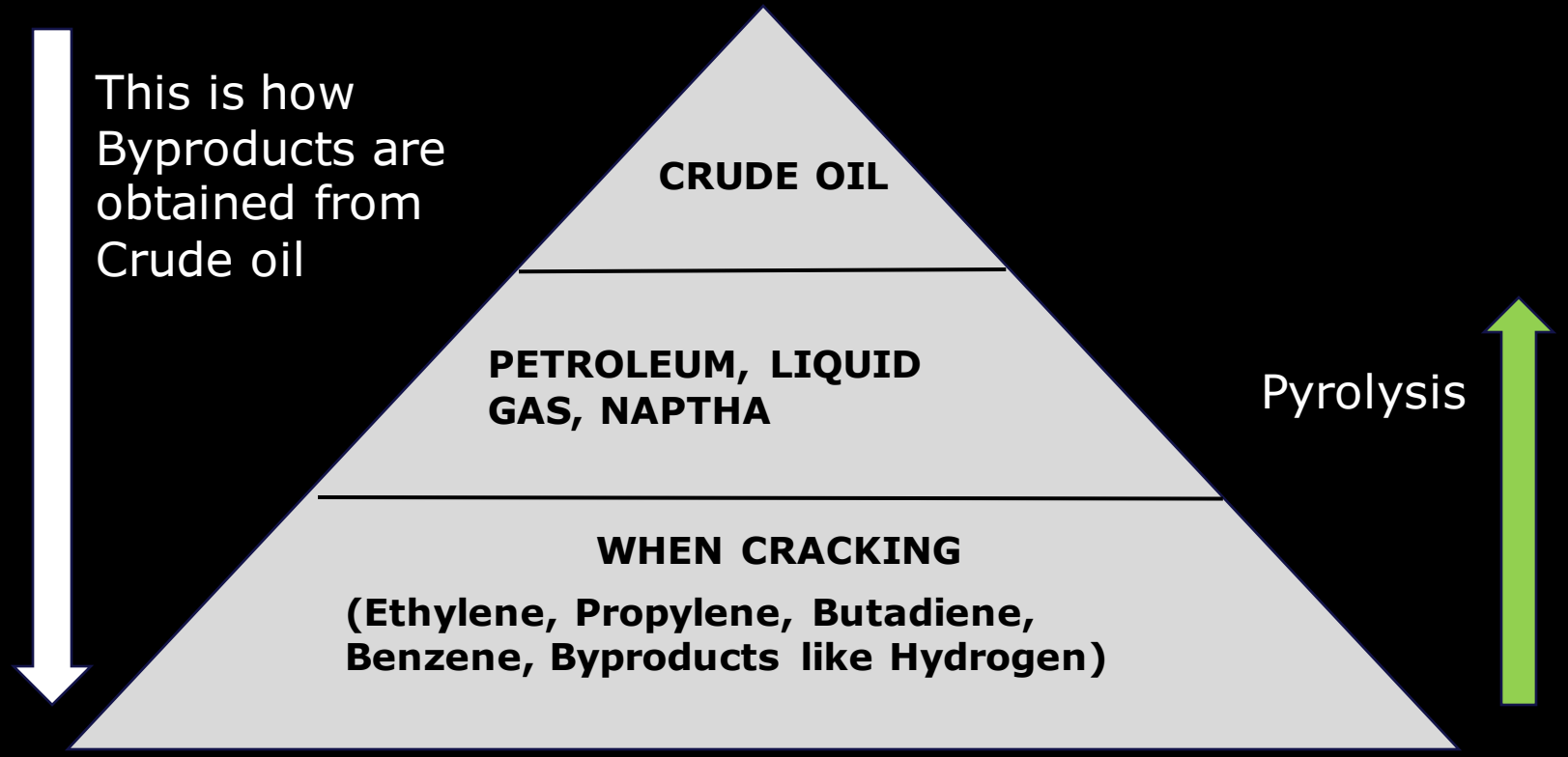
- To raise awareness in both developed and developing countries on plastic waste and if it is possible to use it for conversion into petroleum products, this could be generated and marketed at cheaper rates compared to that of the available petroleum products in the market.

DIFFERENT GRADES OF PLASTIC

1 PET	2 HDPE	3 PVC	4 LDPE	5 PP	6 PS	7 OTHER
POLYETHYLENE TEREPHTHALATE	HIGH-DENSITY POLYETHYLENE	POLYVINYL CHLORIDE	LOW-DENSITY POLYETHYLENE	POLYPROPYLENE	POLYSTYRENE	OTHER
WATER BOTTLES; JARS; CAPS	SHAMPOO BOTTLES; GROCEY BAGS	CLEANING PRODUCTS; SHEETINGS	BREAD BAGS; PLASTIC FILMS	YOGURT CUPS; STRAWS; HANGERS	TAKE-AWAY AND HARD PACKAGING; TOYS	BABY BOTTLES; NYLON; CDS
						

PETROCHEMISTRY

This is how Byproducts are obtained from Crude oil



COMPOUNDS WE USE

Ethylene and Propylene compounds cannot be used directly.

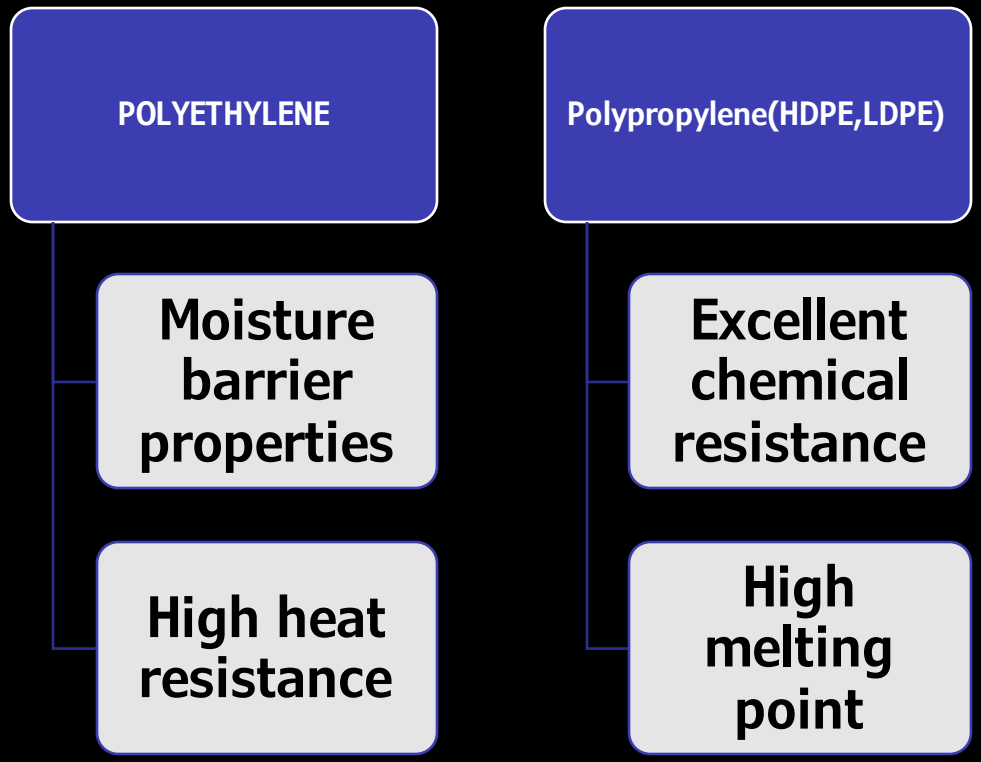
Both these compounds can be further reacted to attain more useful compounds.

Polymerization reaction by adding catalyst and providing high pressure.

Long chain molecules having new properties, Ethylene into Polyethylene and Propylene into Polypropylene is the final product.

In this wee use only recycled Polyethylene and Polypropylene compounds for the production of Crude Oil. Not the core products of Crude oil.

PROPERTIES

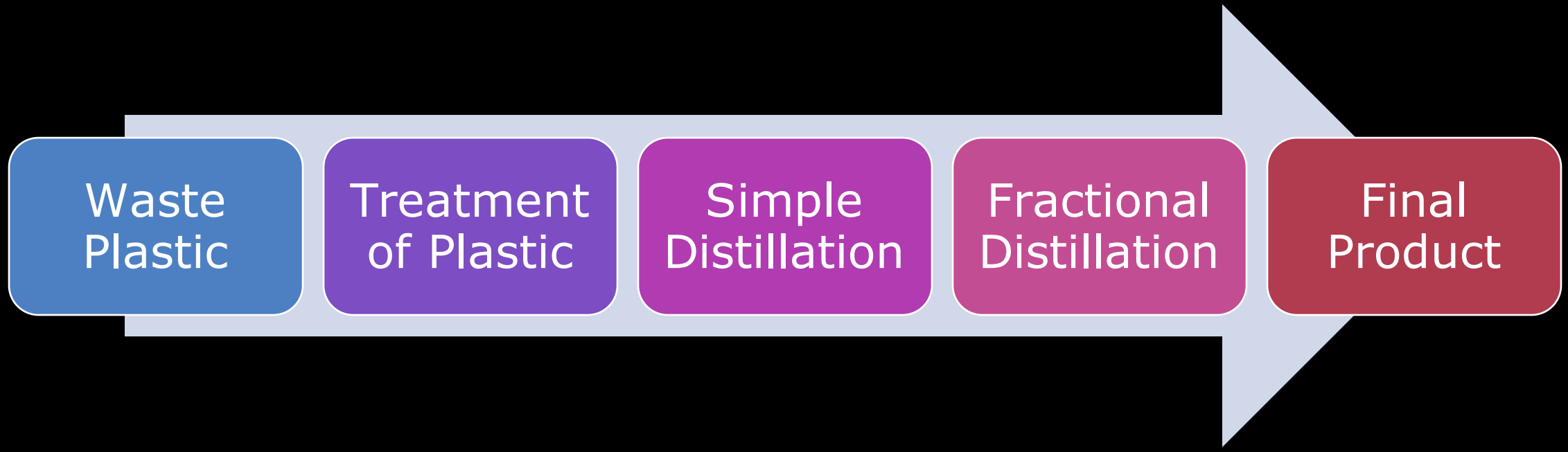


Usually they are manufactured in the form of plastic bags, chairs, bottle caps and other components which we usually come across in our day to day life.

METHODOLOGY

- Identification of waste plastics (PE/PP/LDPE/HDPE)
- Subjecting the waste plastic for Pyrolysis process.
- Condensation of the gas to obtain raw fuel by the process of Simple Distillation
- Conversion of raw fuel into its pure form by the process of Fractional Distillation

SUBJECTING THE WASTE PLASTIC FOR PYROLYSIS PROCESS:



EXPLAINING ABOUT THE 3 IMPORTANT PROCESS OF THIS EXPERIMENT



PYROLYSIS



SIMPLE DISTILLATION



FRACTIONAL DISTILLATION



THE FOLLOWING TERMS AND PROCESSES THAT HAVE MENTIONED ARE EXPLAINED IN FURTHER SLIDES. MAIN MOTIVE IS TO HAVE A CLEARCUT IDEA ABOUT THE 3 IMPORTANT PROCESS OF THIS PROJECT.

1. PYROLYSIS

Plastic Pyrolysis is a chemical reaction which involves the molecular breakdown of larger molecules into smaller ones in the presence of heat.

During molecular vibration, the frequency at which molecules vibrates is directly proportional to the temperature of molecules.

During pyrolysis, due to high temperature the molecular vibration is high.

At high molecular vibrations, every molecule in the object is stretched and shaken and the molecules start break down into smaller ones.

2. SIMPLE DISTILLATION

Simple distillation is a procedure by which two liquids with different boiling points can be separated.

Plastics can be distilled in a similar way. For this plastic is first converted into liquid form and then into vapor which eventually forms the end product wax.

For this we boil plastic in a reactor containing CO_2 at a temperature range of 600-700

CO_2 is used to prevent inflammation This heating in the absence of O_2 is termed as pyrolysis.

Further this liquid plastic is boiled and turned into vapor which consists of pure plastic.

The vapor is further condensed into wax which makes the end product.

3. FRACTIONAL DISTILLATION

Fractional distillation is used for separation of various components of crude oil.

Crude oil is added in the reactor and is heated with high-pressure steam.

The mixture starts boiling and vapor is formed. At this point, various substances enter into the vapor phase.

The vapor rises up in the fractional distillation column which consists of several plates.

The plates have holes that allow the vapor to pass through it.

The temperature is maintained low at the top of the fractionating column.

Components with the highest boiling point will condense in the lower part of the column while substances with a low boiling point will condense at the top.

The condensed vapors or liquid fractions are then removed from the sides of the column.

The collected liquid fractions can further be passed through condensers to cool them even more.



SETUP OF THE PROVED EXPERIMENT

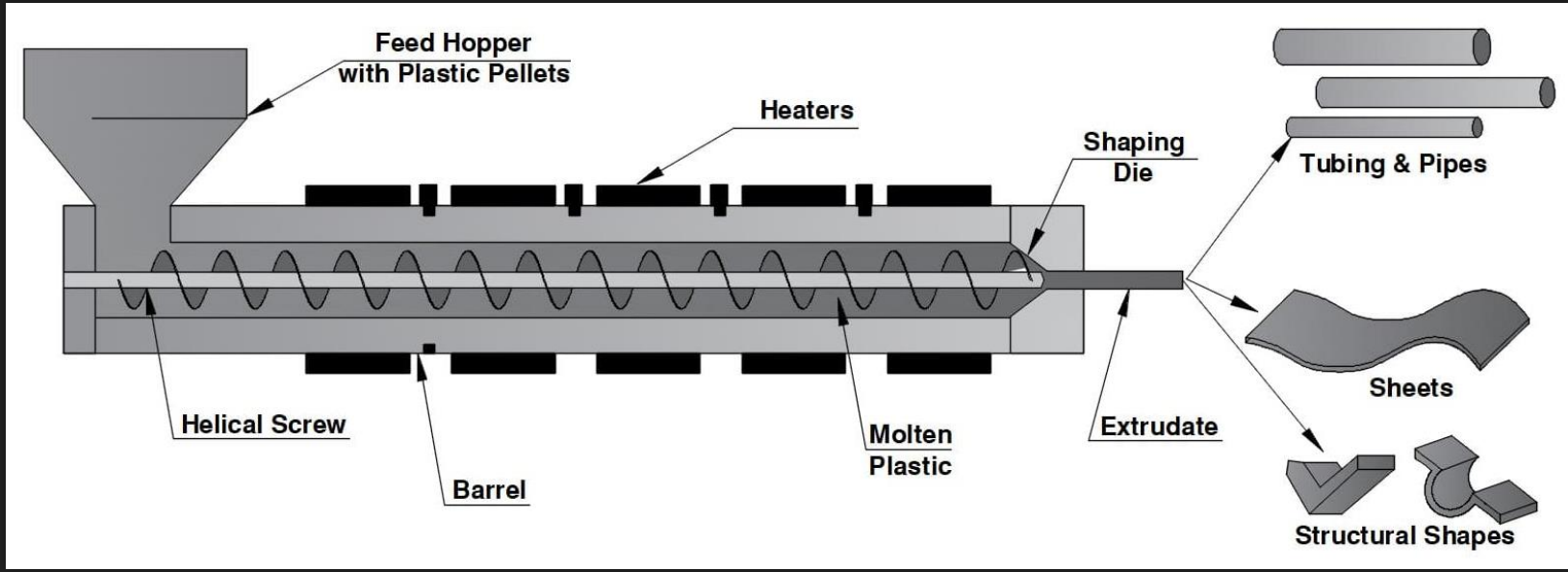
COLLECTION & IDENTIFICATION OF WASTE PLASTIC

- The collection of waste plastic is quite an easy task as compared to other wastes, the plastic wastes are abundant and can be obtained in large quantities from the household, roadsides, hospitals, hotels etc.
- These waste plastics are separated (Identification of different grades of Waste plastic). Grade 1,2,4 are mainly used for the process.



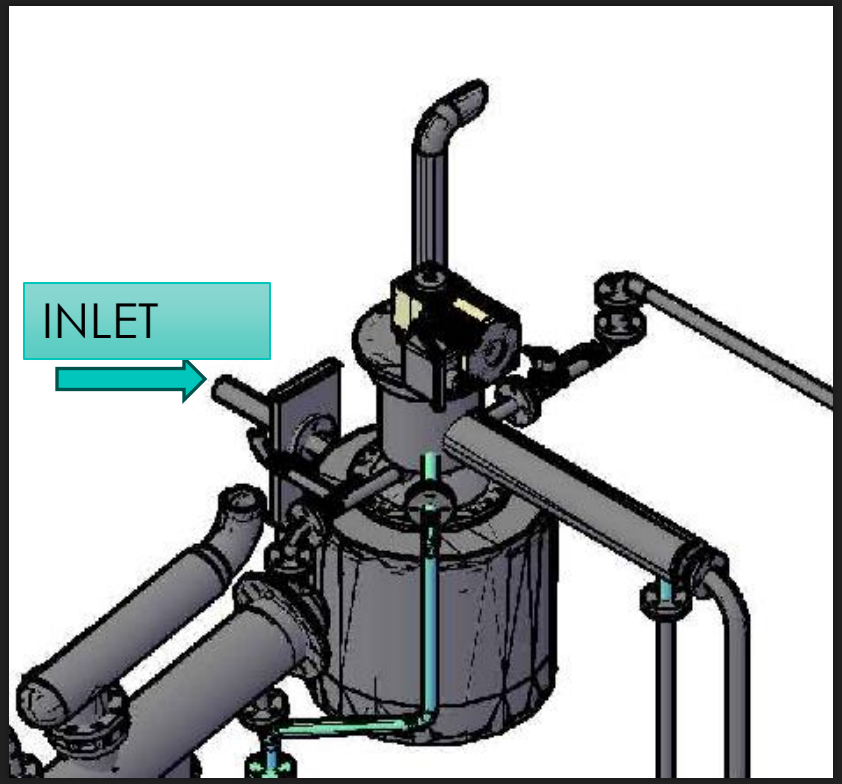
1. **CLEANING** (To remove all the dirt present in the waste particle)
2. **CRUSHING** (They are crushed into small powder like materials)
3. **DRYING** (Remove all the moisture content by blowing with hot air)

PLASTIC EXTRUSION LINE



The treated plastic present in the hopper of the plastic extrusion line pass through it with help of a helical screw which rotates the assisting the movement of the plastic. While inside it the plastic gets heated by the heater present on the surface of the barrel at !50-200°C. This is extruded out through the die.

FIRST STAGE OF SIMPLE DISTILLATION



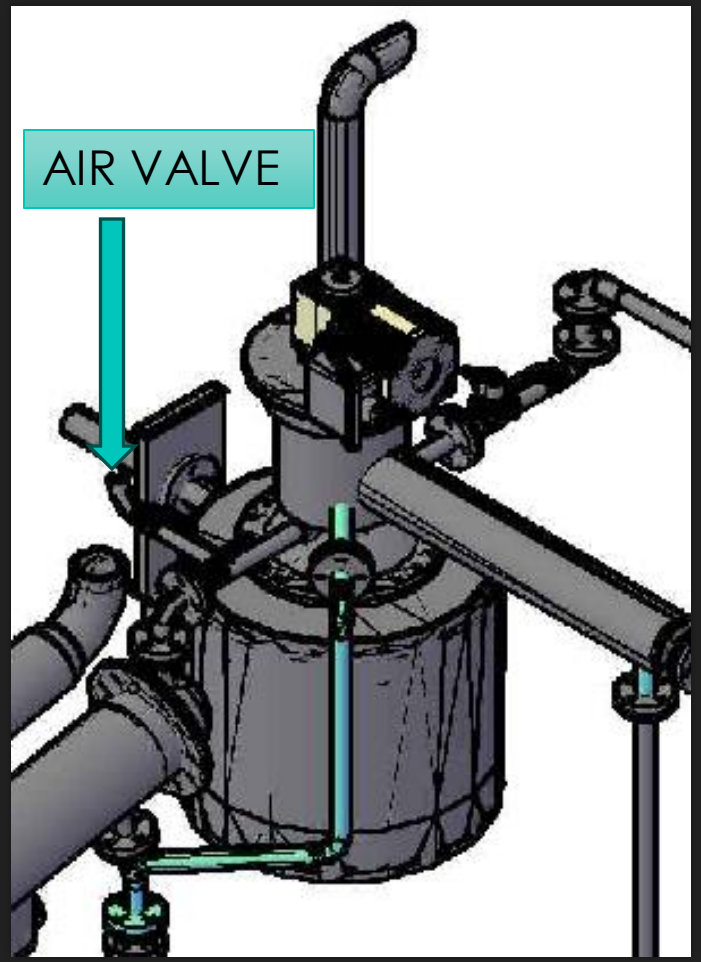
This enters the Simple Distillation chamber through an inlet which is controlled by a pneumatic valve. The pneumatic valve only lets in a typical amount of this extruded plastic. This amount is calculated and controlled by a measuring device called the level gauge.

EXOTHERMIC REACTION

- The plastic entering the chamber is heated at a temperature of 350-600°C in the presence of CO_2 to avoid oxidation. This produces CO_2, H_2O some amount of soot and other Hydrocarbons which includes pyrolysis oil(wax) and ethylene gas.
- Ethylene gas is compressed and stored in a tank which can be used for household purpose.
- The water gets evaporated due to high temperature.

$n(C_2H_4) + (3n + 1)O_2 + 3nCO_2 \rightarrow 2nCO_2 + 2nH_2O$ + other hydrocarbons + soot+ other trace gases and toxic compounds(removed by filtration)

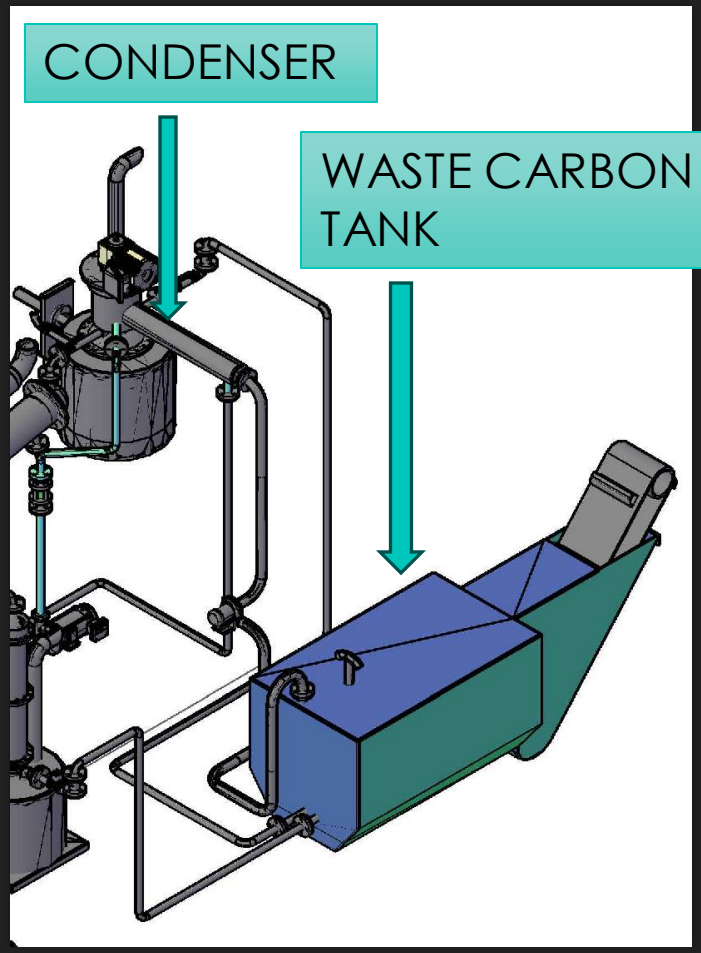
ELIMINATION OF SOOT (CARBON COMPOUNDS)



- The Boiler has a stirrer which contains a hollow shaft and stirrer blades. The shaft is controlled by a motor. The carbon (soot) produced inside the boiler during the process gets accumulated in the center of the stirrer blade which is led out by vacuum through the hollow shaft.

- An **air valve** is present to provide the suctional force. The valve is opened only when we need to vacuum out the carbon and carbon fumes.
- During the reaction all the inlets and gaps are closed. There exists a small gap between the joining of the motor, which is outside the boiler, and the hollow shaft, which is inside.

WASTE CARBON DISPOSAL

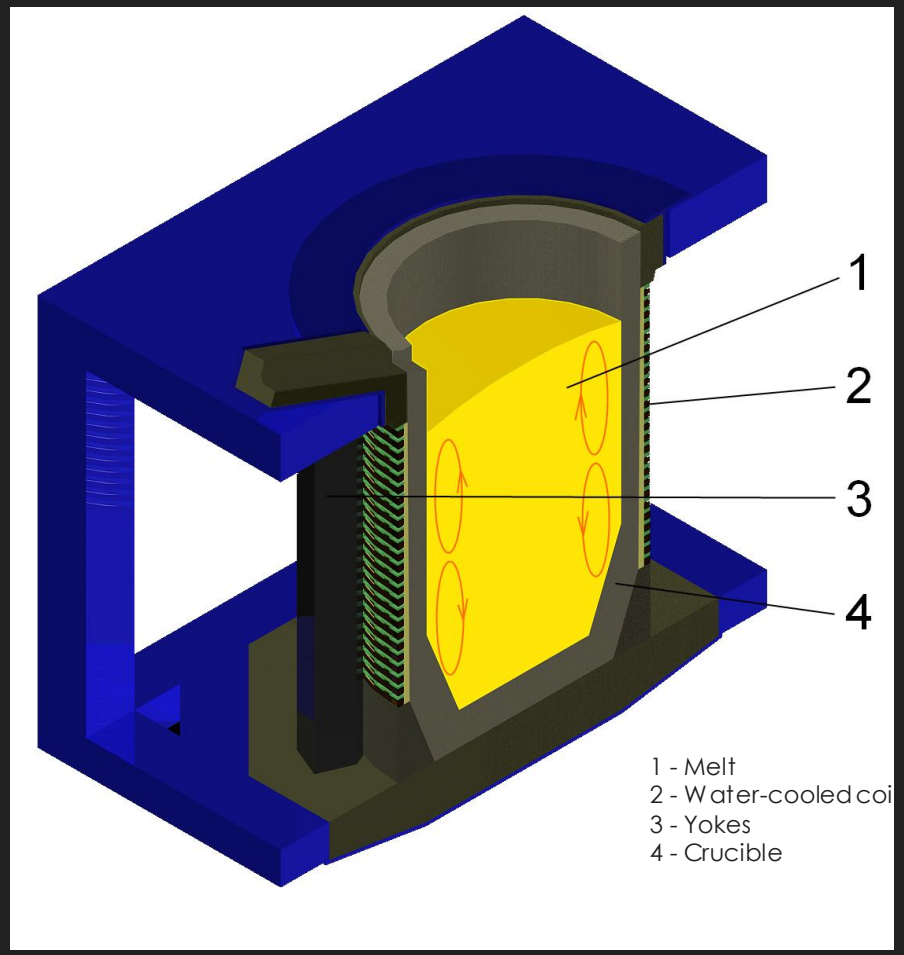


The Carbon and Carbon fumes which were vacuumed out moves into a condenser which is at a temperature of 1-5°C. This turns the gas to liquid and it passes through a blower into the **Waste Carbon Disposal Tank**. The rest of the byproducts of the thermal decomposition process pass through another condenser into a storing tank.

BUSH COOLING SYSTEM

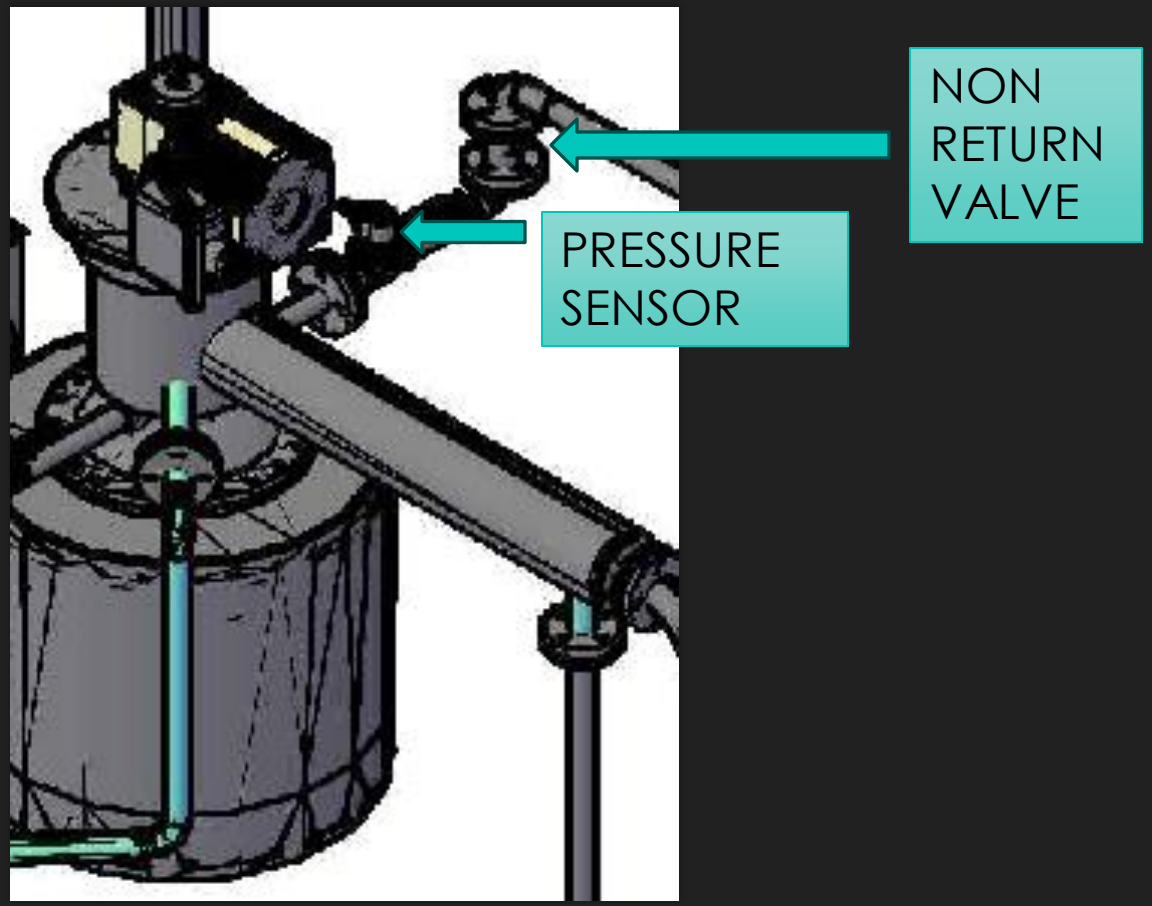
- The gaps mentioned are closed by using **Carbon Powdered Asbestos** and **Seal Bush** in order to prevent exposure to the environment during the Thermal decomposition process.
- The Self Lubricating Bushes in the boiler are protected from the damage due to heat by using a **Bush Cooling System**.

EQUIPMENTS USED FOR HEATING



The Heating inside the boiler is done by using an induction coil. There is an outer glass wool that works as an insulator. There are cool air inlet holes on the bottom of the induction heating chamber covering the boiler and also there is a hot air outlet. Hence the flow of air takes place from bottom to top.

PRESSURE SENSORS AND NRV

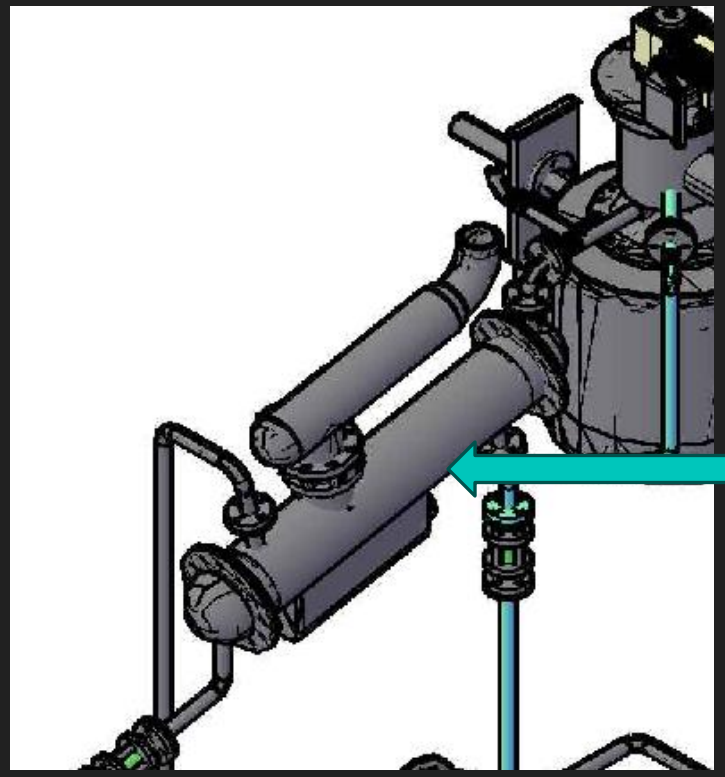


- There are **Pressure Sensors** that detects excess pressure which is connected to a bar pressure gauge.
- When excess pressure is sensed the **Non Return Valve (NRV)**, which ensures unidirectional flow, is opened which is in turn connected to the water tank.

4 TYPES OF CONDENSER USED

- The basic function of the condenser is to convert the gas/liquid entering into it to liquid/solid respectively. The condensers are maintained at 1-5°C. This Process uses a total of 4 condensers. The **first condenser** condenses the carbon fumes which exits from the hollow shaft and moves it into a water tank.
- The **second condenser** condenses the hydrocarbons obtained from simple distillation into pyrolysis oil (wax).
- The **third condenser** is used for the condensation of the ga fumes which were not fully condensed from the 2nd condenser. The third one is called a Glass ball condenser. The liquid entering from the cooling chamber is converted to pyrolysis oil (wax) inside this condenser.
- The **fourth condenser** is used for the condensation of the products of fractional distillation. This finally produces liquid petrol.

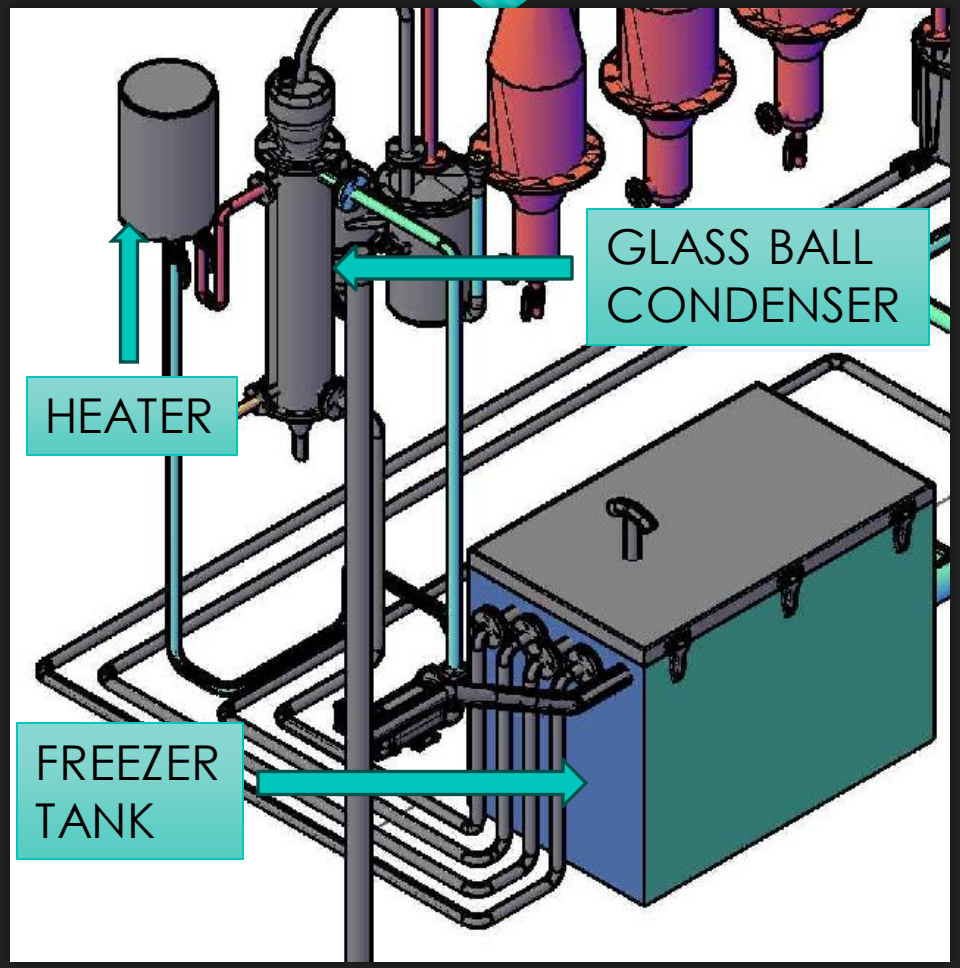
EACH CONDENSER HAVE DIFFERENT STRUCTURE ACCORDING TO THERE USE



SIMPLE DISTILLATION CONDENSER

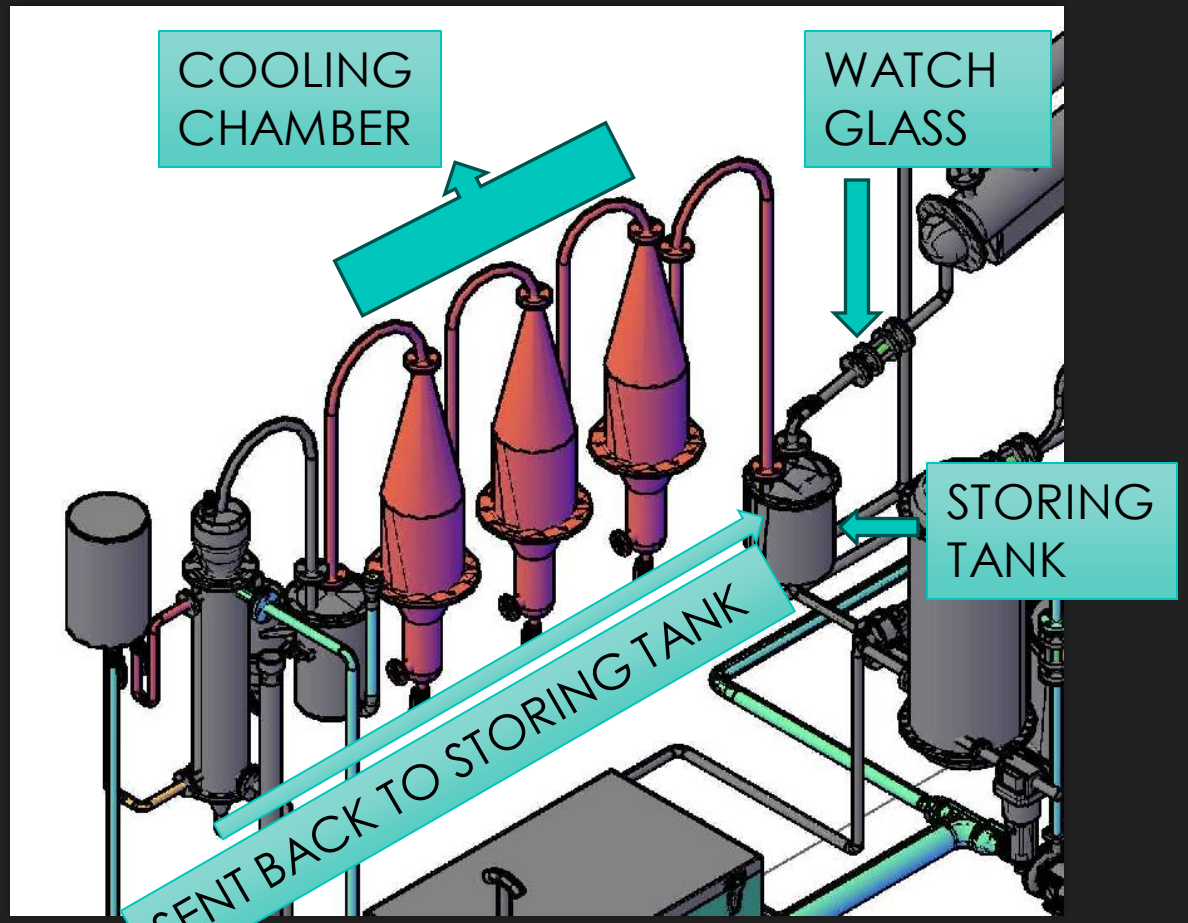
- The **Simple Distillation Condenser** has several this straight pipes surrounding a main pipe. Cool water passes through the main pipe and the gas fumes passes through this glass tubes. The cool water ensures that the temperature condition is met for the condensation to take place.

GLASS BALL CONDENSER



- The **Glass Ball Condenser** gets the liquid from cooling chamber. The inside of this condenser is filled with many glass balls which makes the flow of liquid through it slower. This ensures gradual and full condensation of the liquid into wax.
- The outer frame of the condenser has many pipes. One of the pipes connects to the freezer tank where cold water flows into the outer frame with help of a pump.
- The **Freezer tank** has a connection to a heater which heats the cool water and inputs it onto the outer frame of the glass ball condenser.
- The water from the **Heater** is provided to ensure gradual heating if the liquid so that the condensation does not happen midway.
- This water circulates around the outside and goes back to the freezer tank through an outlet forming a continues process.

STORING TANK

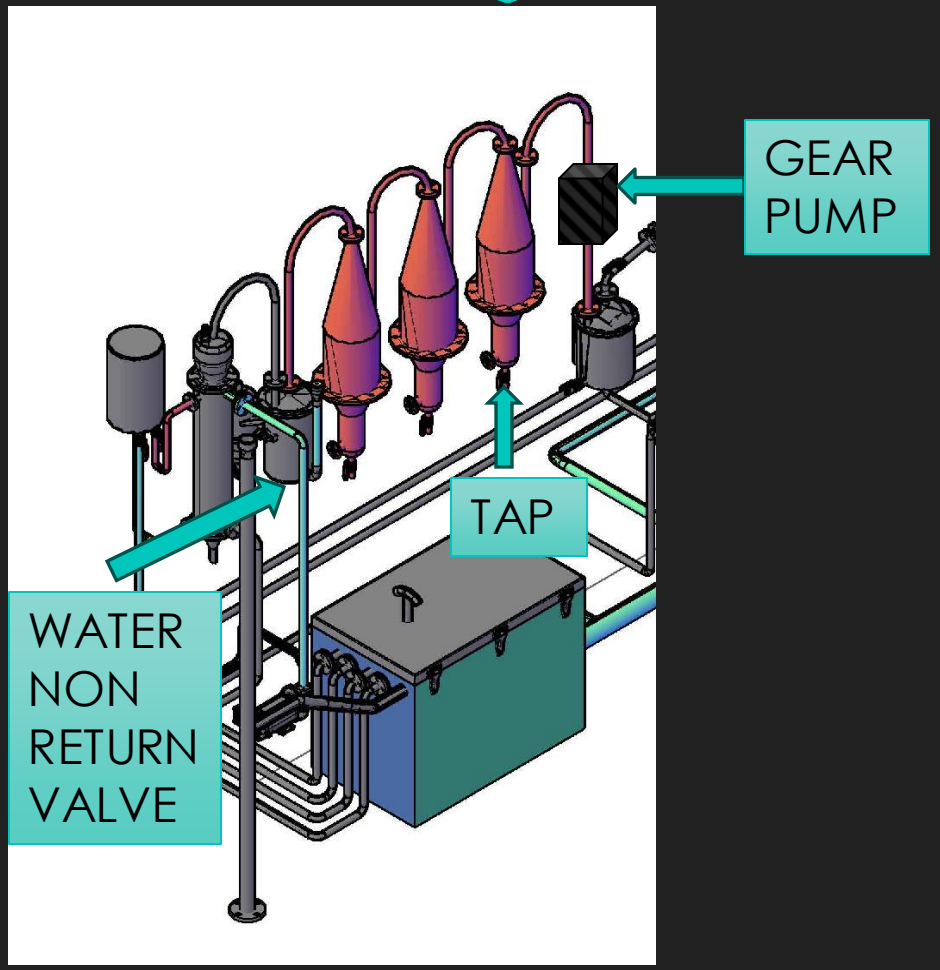


- The pyrolysis oil after condensation is stored inside a **Storing tank**. The pipe connecting the condenser to the storing tank has a **watch glass** to ensure that the wax is indeed passing into the tank.

- The storing tank will have some gas fumes which were not condensed. These fumes pass through **Cooling chamber** and then through glass ball condenser and forms pyrolysis oil which is sent back to the storing tank.
- There is a pipe present at the bottom of the condenser which is connected to the storing tank.
- Hence we get pyrolysis oil from the leftover gas fumes after continuous processing.

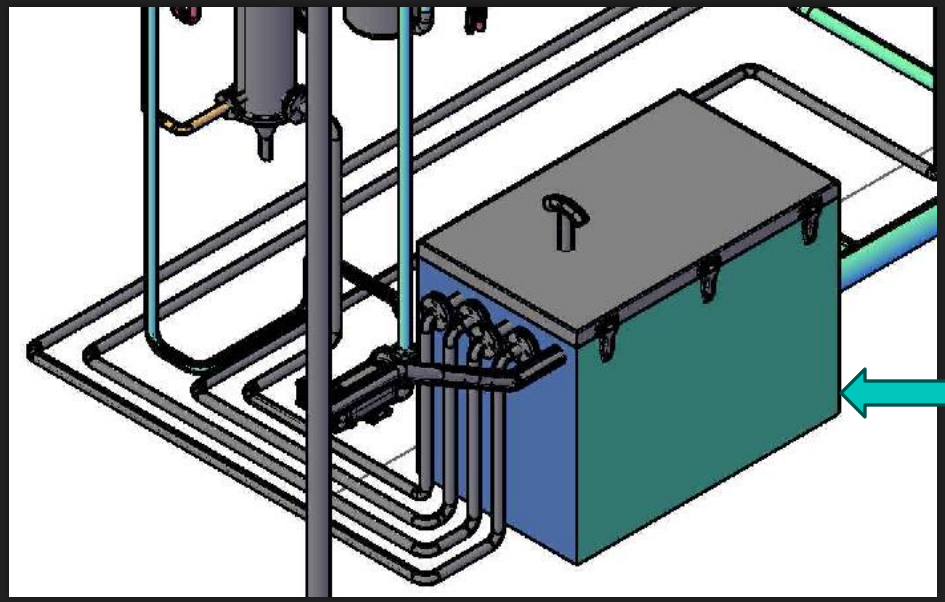
- The pyrolysis oil stored in the tank is further sent to a boiler for fractional distillation.

COOLING CHAMBER



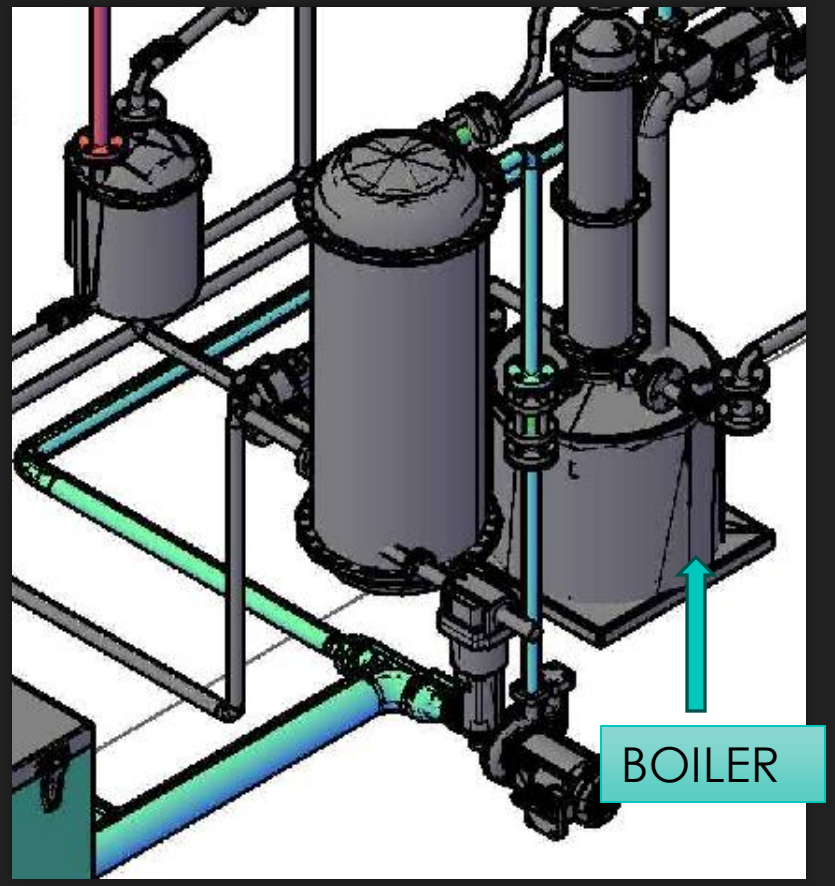
- There are 3 cooling chambers that converts the gas fumes which were not fully condensed during the condensation process after simple distillation. These gas fumes goes to the storing tank from where they travel to the 1st cooling chamber with the help of a **gear pump.**
- The bottom side of the cooling chamber has low pressure and the top part has high pressure over here. Additionally there is a **tap** at the bottom to collect samples for testing purpose in the lab. There is a **water non return valve** for the excess pressure to be released from the cooling chamber. This gas after passing through the cooling chambers turns to liquid and enters the glass ball condenser.

FREEZER TANK

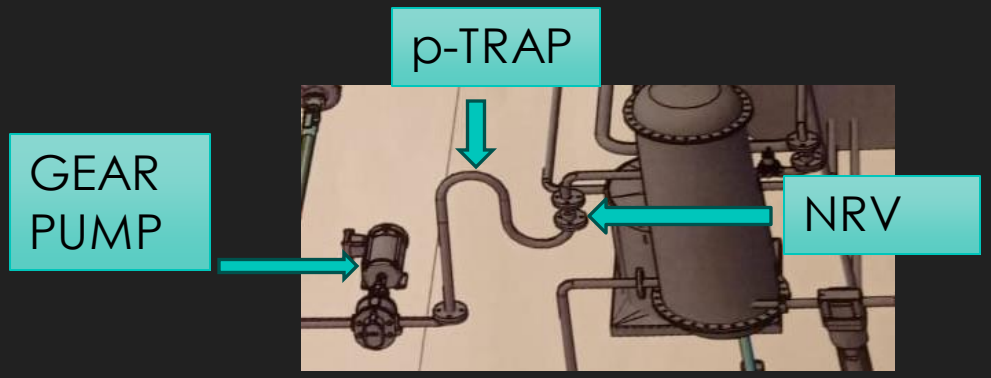


- The freezer tank is used to provide cold water to various parts. It provides cold water for condensation.
- The glass ball condenser uses the freezer tank to maintain the temperature and it ensures a continuous flow of water on the condenser. Similarly it is connected to all the other 3 condensers for maintaining the temperature for condensation.

FRACTIONAL DISTILLATION



- The pyrolysis oil from the storing tank goes to a boiler for fractional distillation. The wax from the storing tank is moved through a pipe with help of a **gear pump.**



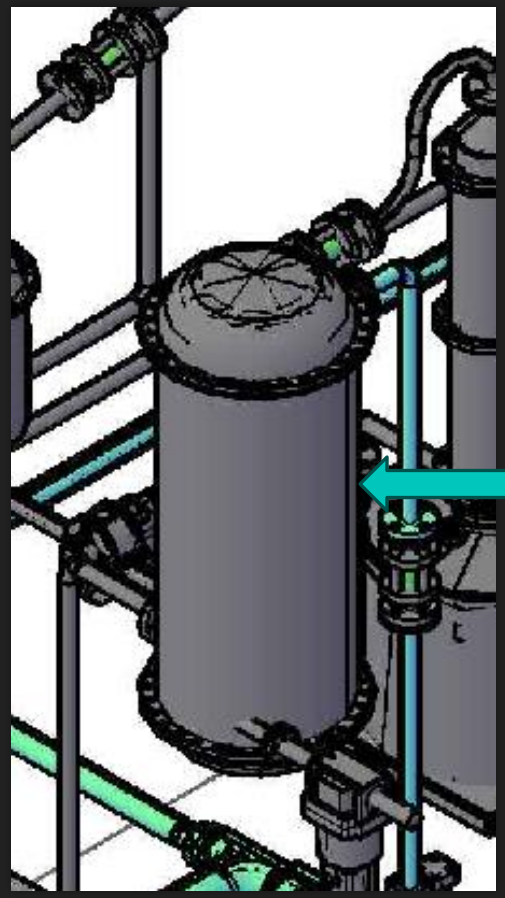
- There are **p-trap** and Non Return Valve (NRV) to ensure the unidirectional flow of wax into the **boiler**.

- The pipe through which the wax flows contained heating coil wounded over it to melt the wax to ensure easier flow. Additionally the storing tank also has a heater to melt the wax.

- Inside the boiler the temperature is maintained at 300-500°C. This heats the wax producing gas fumes.
- These gas fumes pass through the fractional distillation column where they gets separated by boiling point difference. After fractional distillation the fumes that is extracted then moves to a condenser where the gas gets condensed to liquid petrol. The condenser has thin and long helical pipe wound around a main pipe.

- The fumes pass through the main pipe. The longer helical pipe ensures that the gas fumes stay inside the condenser long enough so as to obtain high octane petroleum.

FRACTIONAL DISTILLATION CONDENSER



- The **Fractional Distillation Condenser** has a similar structure to that of the simple distillation condenser but instead of this straight tubes, it has longer helical tubes. This ensures that the gas fumes stay inside the condenser for a longer period of time for proper condensation and also to obtain **higher octane petroleum.**

OCTANE RATING OF GASOLINE

- Gasoline with an octane rating of 91 contains a mixture of hydrocarbons and additives that perform similarly to a blend of 91% iso-octane and 9% heptane in this test.
- Qatar typically used gasoline with different octane ratings, similar to many other countries. The common octane ratings for gasoline available in Qatar were 91 octane and 95 octane. (Based on September 2021 study)
- Gasoline with an octane rating of 95 contains a mixture that performs similarly to a blend of 95% iso-octane and 5% heptane in the same test.
- In our method we get 97.6% iso-octane fuel and is suitable for consumption in Automobiles after adding Additives(catalyst) to increase its efficiency.

3	Specific Gravity@15.5°C	----	ASTM D4052	0.7203
4	Research Octane Number , RON	----	FTIR	97.6
5	Motor Octane Number , MON	----		88.5
6	Total Sulfur Content	wt ppm	ASTM D4294	48
7	Vapor Pressure at 37.8 °C	Kpa	ASTM D6378	

TREATMENT TRACE GASES AND TOXIC COMPOUNDS

1. The various trace gases formed are mainly CO due to incomplete combustion, SO2 due to the presence of Sulphur additives in plastics, various nitrogen oxides like nitrogen dioxide and some particulate matter.

2. In these the CO,SO2 and NO2 are separated using ORSAT analyzer



FINAL PRODUCT



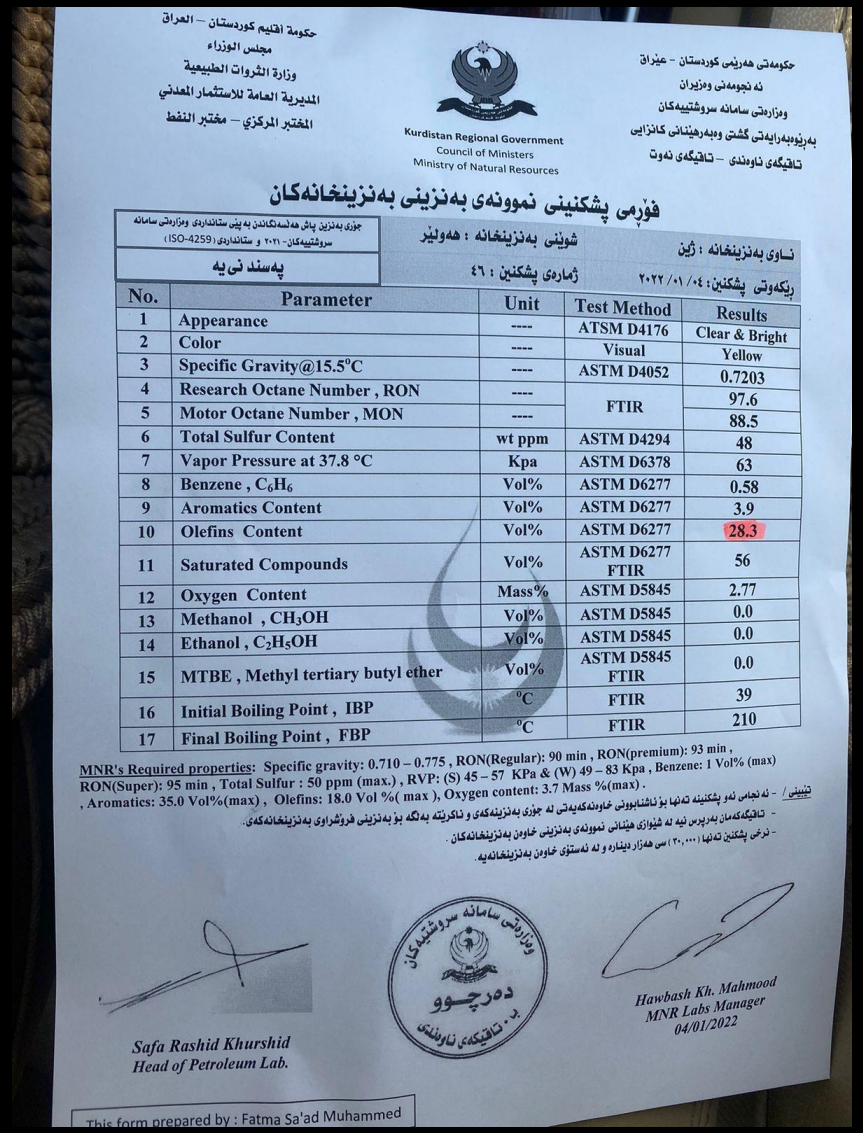


BENEFIT OF THIS SETUP

- The above experiments mentioned (1 kg waste plastic into 820mg fuel) is just a small scale production. This small quantity production is just done in order to obtain the exact value of every resources used in this process.
- The whole process is done in of plastic waste can produce a huge amount of fuel) and this can bring a huge profit. This would be the most selling factor of the product.



PHYSICAL PROPERTIES OF PETROL GRADE OF WASTE PLASTIC



حكومة اقليم كوردستان – العراق
مجلس الوزراء
وزارة الثروات الطبيعية
المديرية العامة للاستثمار المعدني
المختبر المركزي – مختبر النفط

Kurdistan Regional Government
Council of Ministers
Ministry of Natural Resources

حکومەتی هەرێمی کوردستان - عێراق
ئەنجومەنی وەزیران
وەزارەتی سامانە سروشتییەکان
بەڕێوەبەرایەتی گشتی وەبەرهێنانی کانزایی
تاقیگەی ناوەندی – تاقیگەی نەوت

فۆرمی پشکنینی نموونەی بەنزینی بەنزینخانەکان

جۆری بەنزین پاش هەڵسەنگاندن بە پێی ستانداردی وەزارەتی سامانە سروشتییەکان- ٢٠٢١ و ستانداردی (ISO-4259)

پەسند نی یە

شوێنی بەنزینخانە : هەولێر

ژمارەی پشکنین : ٤٦

ناوی بەنزینخانە : ژین

ڕێکەوتی پشکنین: ٠٤/ ٠١/ ٢٠٢٢

No.	Parameter	Unit	Test Method	Results
1	Appearance	----	ATSM D4176	Clear & Bright
2	Color	----	Visual	Yellow
3	Specific Gravity@15.5°C	----	ASTM D4052	0.7203
4	Research Octane Number , RON	----	FTIR	97.6
5	Motor Octane Number , MON	----		88.5
6	Total Sulfur Content	wt ppm	ASTM D4294	48
7	Vapor Pressure at 37.8 °C	Kpa	ASTM D6378	63
8	Benzene , C_6H_6	Vol%	ASTM D6277	0.58
9	Aromatics Content	Vol%	ASTM D6277	3.9
10	Olefins Content	Vol%	ASTM D6277	28.3
11	Saturated Compounds	Vol%	ASTM D6277 FTIR	56
12	Oxygen Content	Mass%	ASTM D5845	2.77
13	Methanol , CH_3OH	Vol%	ASTM D5845	0.0
14	Ethanol , C_2H_5OH	Vol%	ASTM D5845	0.0
15	MTBE , Methyl tertiary butyl ether	Vol%	ASTM D5845 FTIR	0.0
16	Initial Boiling Point , IBP	°C	FTIR	39
17	Final Boiling Point , FBP	°C	FTIR	210

MNR's Required properties: Specific gravity: 0.710 – 0.775 , RON(Regular): 90 min , RON(premium): 93 min , RON(Super): 95 min , Total Sulfur : 50 ppm (max.) , RVP: (S) 45 – 57 KPa & (W) 49 – 83 Kpa , Benzene: 1 Vol% (max) , Aromatics: 35.0 Vol%(max) , Olefins: 18.0 Vol %(max), Oxygen content: 3.7 Mass %(max) .

تێبینی / - نەنجامی ئەو پشکنینە تەنها بۆ ئاشنابوونی خاوەنەکەیەتی لە جۆری بەنزینەکەی و ناکرێتە بەڵگە بۆ بەنزینی فرۆشراوی بەنزینخانەکەی.
- تاقیگەکەمان بەرپرس نیە لە شێوازی هێنانی نموونەی بەنزینی خاوەن بەنزینخانەکان.
- نرخی پشکنین تەنها (٢٠,٠٠٠) سی هەزار دینارە و لە ئەستۆی خاوەن بەنزینخانەیە.

Safa Rashid Khurshid
Head of Petroleum Lab.

وەزارەتی سامانە سروشتییەکان
دەرچوو
بەڕێوەبەرایەتی تاقیگەی ناوەندی

Hawbash Kh. Mahmood
MNR Labs Manager
04/01/2022

This form prepared by : Fatma Sa'ad Muhammed

- The petrol produced by this method underwent several chemical tests and studies and have been sanctioned by the Council of ministers, Ministry of Natural resources (Kurdistan Regional Government)

[The various properties of the product, listed in the slip, is shown in the next slide for better visibility]

NO.	PARAMETER	UNIT	TEST METHOD	RESULT
1	Appearance	…….	ATSM D416	Clear & Bright
2	Color	…….	Visual	Yellow
3	Specific Gravity at 15.5 Degree Celsius	…….	ASTM D7039	0.7541
4	Research Octane Number, RON	…….	FTIR	95.4
5	Motor Octane Number, MON	…….		82.6
6	Total Sulfur Content	wt ppm	ASTM D4294	25
7	Vapor Pressure at 37.8 Degree Celsius	Kpa	ASTM D6378	28
8	Benzene, C6H6	Vol%	ASTM D6277	0.1
9	Aromatics Content	Vol%	ASTM D6277	3.3
10	Olefins Content	Vol%	ASTM D6277	27
11	Saturated Compounds	Vol%	ASTM D6277, FTIR	67
12	Oxygen Conetnt		ASTM D5845	0.83
13	Methanol, CH3OH	Vol%	ASTM D5845	0
14	Ethanol, C2H5OH	Vol%	ASTM D5845	0
15	MTBE, Methyl teritiary butyl ether	Vol%	ASTM D5845, FTIR	0
16	Initial Boiling Point, IBP	Degree Celsius	FTIR	33
17	Final Boiling Point, FBP	Degree Celsius	FTIR	207

APPLICATION OF PROJECT & FUTURE WORK



The obtained fuel could be utilized in vehicles.



The fuel has to be refined at the industrial establishments, based on the results of which small scale industry can be established.



As there is a demand of crude oil and we could take up this project to setup large or small industries and produce the fuel locally at much cheaper rates directly benefiting National economy.



CONCLUSION

- The implementation of this project can develop so many opportunities in the city. It can be a solution to control waste plastic, develop a new technique or idea, and detect the source of fuel for the country.


THANK
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