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Solid & Liquid Hydrocarbons Wastes Recycling into Diesel Fuel & Natural Gas Processing Plant

Collection, Transfer, Treatment and Recycling of Hydrocarbon Sludge and Slurries,
Preliminary Design & Engineering Study

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Contents

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1. Preface

Egypt, among many countries is suffering serious environmental problems due to liquid and solid hydrocarbon wastes L&SHCW discharge to the air, soil and waterways. Burning L&SHCW is releasing huge amounts of hazardous substance, for instance, Burning 1 ton of used tires, produces about 450 kg toxic gases. By treating same ton of tires in a pyrolysis reactor, 350-500 kg of oil can be produced. Carbon black (300-350 kg) and Steel wire (100-150 kg) can also be produced. The remaining pure gas (100-120 kg) is also produced and normally utilized as energy source within the process. Pyrolysis of one tone of waste PE & PP may yield 900 kg of oil which can be re-refined up to nearly virgin oil quality.

The pyrolysis treatment of L&SHCW is an eco-friendly process. All outputs are fully monitored and controlled and no release of any substance to the air, soil or waterways.

The pyrolysis treatment of L&SHCW will help the authorities in solving the non-degradable waste plastic dump areas or burning and the related hazardous impacts.

Simply, let's protect the environment while concerting the "protection" work into profit source.

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2. Acronyms

CC, Cubic Centimeter
Deg C Degree Celcius
CU M, Cubic Meters
GM. Gram
KCAL, Kilo calorie
KG, Kilogram
L&SHCW, Liquid & Solid Hydrocarbon Waste.
LHW, Liquid Hydrocarbon Wastes
Max, Maximum
SHCW, Slurry Hydrocarbon Wastes
VOL, Volume
WT, Weight

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3. Hydrocarbon Waste Recycling,….Why?

- Recycles Liquid & Solid Hydrocarbon L&SHCW into usable fuel.
- L&SHCW , by definition is a renewable energy source.
- Part of product fuels of L&SHCW recycling can be used as an energy source for the recycling plant.
- Recycling L&SHCW into energy products eliminates the hazards of burning or discharging into water ways and soil.
- Recycling L&SHCW clears dumping yards and environment of non bio-degradable plastic and tire waste.

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4. Liquid & Slurry Hydrocarbon Wastes

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4.1 Sources

4.1.1 Liquid Hydrocarbon Wastes LHW

- Oil Refineries Slop Oil & API Separator Oily Water Mixture .
- Oil Polluted Wastewater.
- Ship Ballasts Oil-Water Mixtures .
- Discarded Lubricant Oils and Emulsions.
- Industrial Oil /Water and Emulsion Waste Streams

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4.1.2 Slurry Hydrocarbon Wastes SHCW

- Oil Refineries Sludge & Residues
- Edible Oil Refineries Sludge
- Oil Tank “bottom” Slurries.
- Oil Sludge Lagoons
- API separator sludge
- Oilfield and Drilling Mud Waste

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4.2 Treatment

Liquid & Slurry Hydrocarbon Wastes L&SHCW is collected in an under ground via coarse screen and macerating pumps which liquefy the feed stock. L&SHCW is pumped in controlled patch mode to the pyrolysis reactor where the L&SHCW is heated up to certain temperature limited for a preset time to allow evaporation of waste oil, diesel oil and light oil fuel contents.

Combined contents pass through catalytic reactor prior to cooling and separation “individually” in diesel oil and waste oil separators. In the waste oil separator, waste oil is discharged to the waste oil tank for further recycling or final discharge.

Lighter contents is extracted, cooled and further classified in a diesel oil separator where diesel oil is discharged to the diesel oil tank while light oil fuel is discharged to the light oil fuel tank.

Solid remains in the pyrolysis reactor is discharged frequently to the sludge thickener/filter press, while liquid is returned to the under ground collection tank.

Flue gases and ash from the pyrolysis reactior is further treated in an electrostatic precipitator/dust scrubber where clean gas is discharged via long stack, while ash is discharged as final product.

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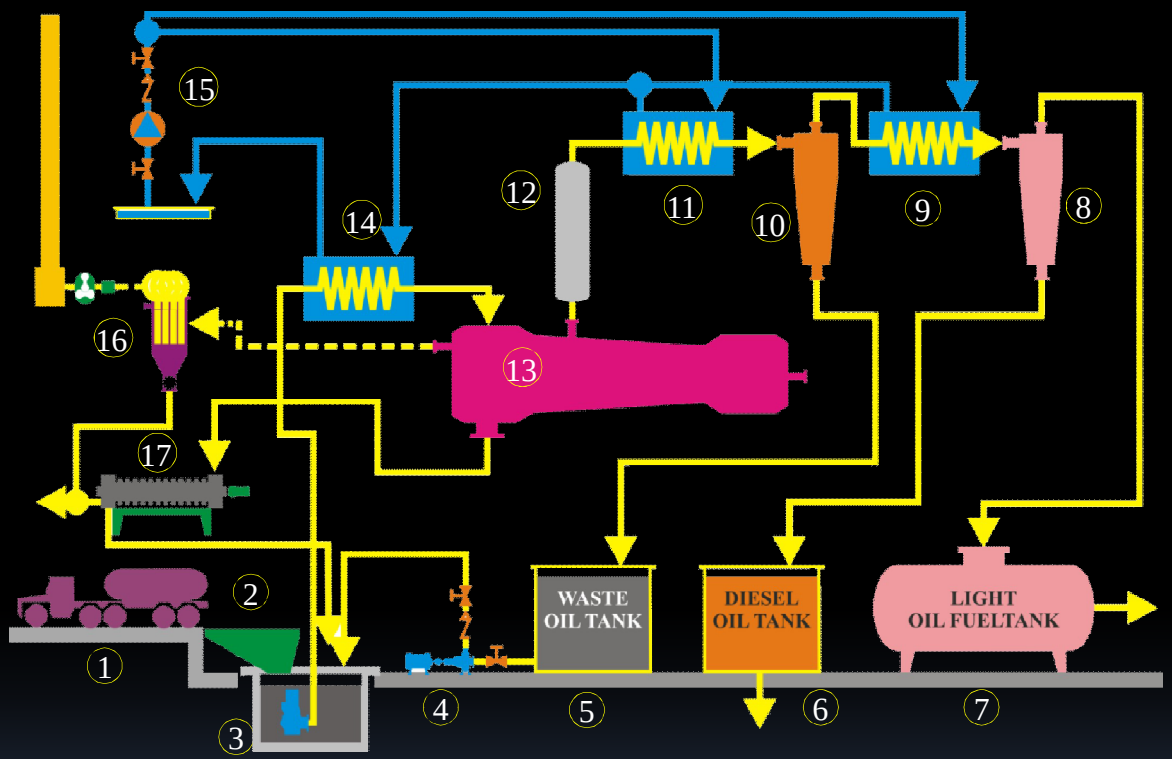
Liquid & Slurry Hydrocarbon Waste Pyrolysis Process



1. loading platform
2. macerating feeder
3. feed pump/collection tank
4. waste oil return pump
5. waste oil tank
6. diesel oil tank
7. light oil fuel tank
8. diesel oil separator
9. heat exchanger I
10. waste oil separator
11. heat exchanger II
12. catalytic reactor
13. pyrolysis reactor
14. heat exchanger III
15. heat exchange pump
16. dust scrubber & stack
17. filter press

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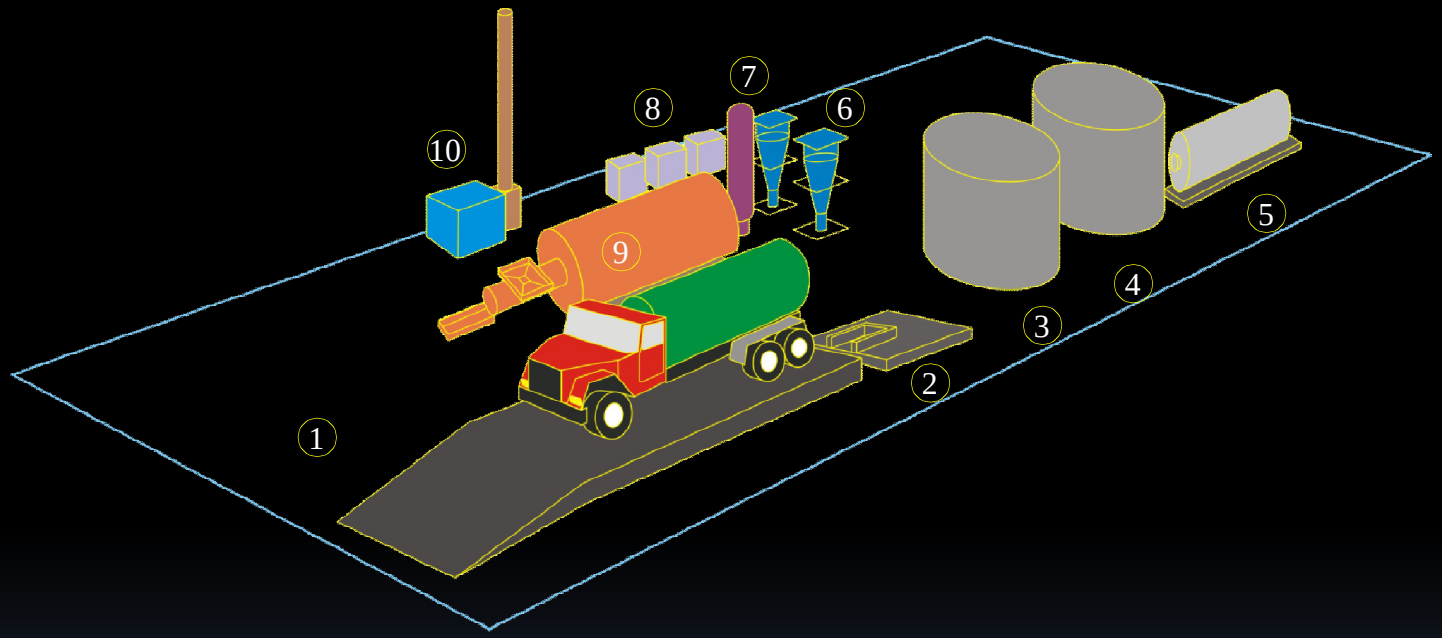
Liquid & Slurry Hydrocarbon Waste Pyrolysis Process

Bird's Eye View



1. loading platform
2. feed stock storage tank
3. waste oil tank
4. diesel oil tank
5. light fuel oil tank
6. oil separators
7. catalyst reactor
8. heat exchangers
9. pyrolysis reactor
10. dust scrubber

5. Solid Hydrocarbon Wastes

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5.1 Sources

- Plastic Waste

- Used Tiers

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5.2 Treatment

Solid Hydrocarbon Wastes SHCW , mainly plastic waste and used tire pyrolysis process involves heating up SHCW to high temperature , 400 to 450 degree Celsius, in absence of oxygen. During pyrolysis SHCW breaks down into smaller molecules of pyrolysis oil, pyrolysis gas and carbon black.

Solid Hydrocarbon Wastes SHCW, mainly used tires and plastic wastes are disintegrated in a macerating system, then conveyed to the pyrolysis reactor

In the pyrolysis reactor the SHCW is heated up to certain temperature limited for a preset time to allow evaporation of oil, while steel scrape and carbon black is settled.

Oil is cooled-condensed and discharged to the oil tank.

Steel scrap is discharged via magnetic separator, where solids are collected in steel scrape tank, while dust is diverted to the dust collector.

Gas from pyrolysis reactor is compressed and stored in an uncondensed gas tank, ready for use as an energy source for the plant.

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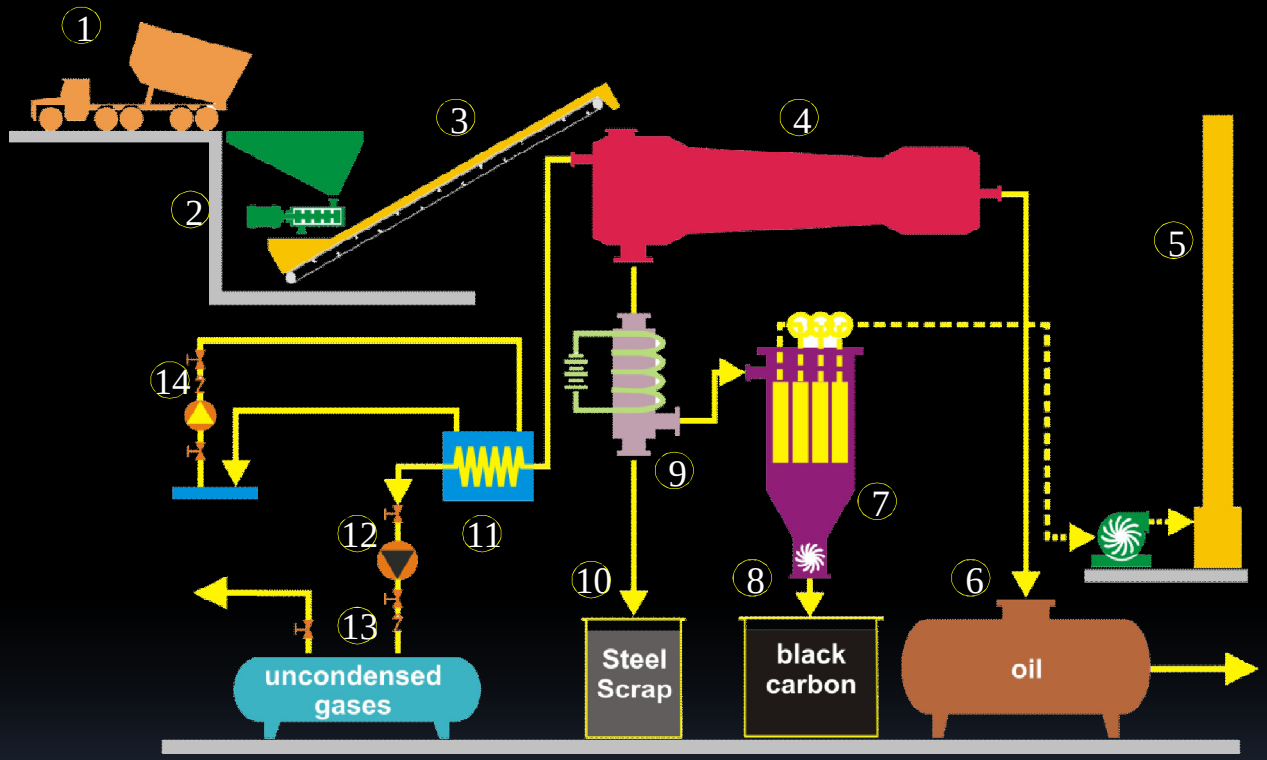
Solid Hydrocarbon Waste Pyrolysis Process



1. loading platform
2. macerating feeder
3. feed conveyor
4. pyrolysis reactor
5. flue gases exhaust stack
6. oil tank
7. dust scrubber
8. black carbon tank
9. magnetic separator
10. steel scrap tank
11. heat exchanger
12. gas compressor
13. uncondensed gas
14. cooling system

6. Technical Data

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6.1 Used Tiers Pyrolysis

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6.1.1 Used Tiers Oil Yield

Raw Material	
truck tires	45-50%
small tires	35-40%

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6.1.2 Oil Characteristics

CHARACTERISTICS	
ASH, % WT. MAX.	0.01
DENSITY AT GM/CC,	0.9612
FLASHPOINT,(PMCC) 0C, MIN.	70
KINEMATICS VISCOSITY IN CENTISTOKES AT 40C, MAX	36.06
SEDIMENT, % WT. MAX.	0.02
SULPHUR, TOTAL, % WT, MAX.	1.17
WATER CONTENT, %BY VOL, MAX	<0.05
POUR POINT, 0C, MAX	+3
GROSS CALORIFIC VALUE, KCAL/KG	10101

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6.1.3 Carbon Black Characteristics

PROPERTIES	
DBP ABSORPTION, CM3/100G	78
CTAB SURFACE AREA, M2/G	68
pH-VALUE	9
HEATING LOSS, % MAX	1.5
ASH CONTENT, % MAX	10
AVERAGE PARTICLE SIZE, NM	200 :400 MESH

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6.1.4 Steel Wire

Tiers contain steel wires of 10% to 15% of the total used tire weight.
Upon completion of pyrolysis process, total steel wire content can be detached and prior to recycling into steel making.

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6.1.5 Non-Condensable Gas

Non-Condensable gases arise during the pyrolysis process. The amount of gas is 12% to 15% of the total amount of recycled tiers. As an example, pyrolysis of 10 ton used tiers/day, may generate 1200:1500 cu m/day of gas, which is a good source of energy for the pyrolysis process itself..

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6.2 Waste Plastic Pyrolysis

6.2.1 Waste Plastic Oil Yield

Raw Material	
PE	95%
PP	90%
PS	90%
ABS	40%
Plastic cable	80%
Plastic bag	50%
Rubber cable	35%
PVC	NA
PET	N

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7. Economics

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Solid Hydrocarbon Waste Recycling Economics

Pyrolysis of used tiers, normally yields the following products:

1. Fuel Oil (40 to 45%)
2. Carbon Black (30 to 35%)
3. Steel Wire (10 to 15%)
4. Gas (10 to 12%)

An average tier pyrolysis plant may treat 10 tons /day of used tiers, producing 1200-1500 cu m of gas (worth 1200 USD) which can be either sold as high quality combustion gas or it can be fired as clean energy source for the pyrolysis plant, saving standard hydrocarbon fuel,

The 10 tons /day pyrolysis plant may produce 4 tons of oil, which worth 1600 USD, and it can be re-refined to produce nearly virgin oil.

Same plant produces an average 1 : 1 ½ tons/day of steel scrap worth 400:600 USD.

The produced carbon black, 3-3 ½ tons/day can be recycled into road finishing manufacturers or can be used in medium or low quality carbon applications (300-350 USD/day)

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Solid Hydrocarbon Waste Recycling Economics “cont’d”

Pyrolysis of plastic wastes , normally yields the following products:

1. Oil (50 to 50%)
2. Gas (10 to 12%)

The oil content depends on the material, for instance the PE plastic wastes may yield 95% oil, and negligible gas, while ABS plastic wastes may yield 40% oil with higher content of gas.

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8. Environment

The pyrolysis of L&SHCW is an eco-friendly process……

- Gas emissions is to the minimum and the quality is fully controlled and monitored.
- All gas, liquid and solid products are of high economical value and it's recycled into existing energy systems.
- No chemical treatment….environmentally clean.
- Efficient process, with low external energy consumption (if any). The process allows for product fuel oil & gas to be used in thermal operations.

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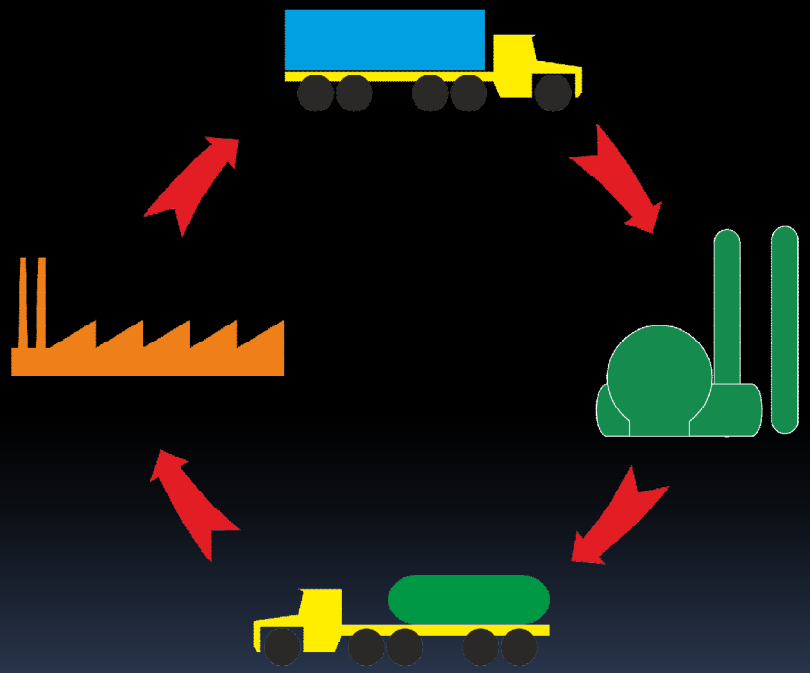
8. Environment, cont'd

The pyrolysis of L&SHCW is an effective tool for environmental protection ……



- Hazardous non degradable wastes such as tiers & plastic wastes are treated in an eco-friendly process protecting the environment (air, water & soil) from the negative impacts of direct firing of these wastes.
- Converting waste into energy products is a typical sustainable energy application, necessary to protect the energy sources.

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9. Logistics

9.1 The Collection &Transport of Wastes

The project will allow for collection of solid & liquid hydrocarbon wastes at the customer's facilities. Special handling equipment, transportation vehicles and trained staff are the necessary tools for safe collection and transfer of wastes.

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