

Petroleum Waste Product and Emission Environmental Impacts

Name- Rekha
M.Sc. 2nd year
21001556009

Submitted To- Dr. Jyoti Rani
Dept. of CEEES



Petroleum

- Petroleum or crude oil is a naturally occurring flammable liquid consisting of a complex mixture of hydrocarbons of various molecular weights and other liquid organic compounds found in geologic formations beneath the Earth's surface.
- Most petroleum is a fossil fuel. Fossil fuel is formed, when large quantities of dead organisms, usually zooplankton and algae, are buried underneath sedimentary rock and undergo intense heat and pressure.

Composition of Petroleum

- Petroleum comprises crude oil but all liquid, gaseous, and solid (e.g., paraffin) hydrocarbons in common usage.
- Under surface pressure and temperature conditions, lighter hydrocarbons methane, ethane, propane, and butane occur as gases, while pentane and heavier ones are in the form of liquids or solids. However, gas, liquid, and solid proportions depend on subsurface conditions in an underground oil reservoir.

Use of Petroleum

- Petroleum is used mostly, by volume, for producing fuel oil and petrol, both important "primary energy" sources.
- 84% by volume of the hydrocarbons present in petroleum is converted into energy-rich fuels (petroleum-based fuels), including petrol, diesel, jet, heating, and other fuel oils, and liquefied petroleum gas.
- Due to its high energy density, easy transportability, and relative abundance, oil has become the world's most important source of energy since the mid-1950s.
- Petroleum is also the raw material for many chemical products, including pharmaceuticals, solvents, fertilizers, pesticides, and plastics.

Petroleum Waste Product Composition

- The composition of oily sludge is very complex. It comprises oil in water, water in oil emulsion, and suspended solids.
- Oily sludge contains toxic substances like aromatic hydrocarbons, polyaromatic hydrocarbons, and high total hydrocarbons content.
- The sludge basically comprises about 55.13% of water, 9.246% of sediments, 1.9173% of asphaltenes, 10.514% of wax, and 23.19% of light hydrocarbons.
- Also has a high concentration of heavy metals, for instance, vanadium is 204 ppm, Fe is 0.6% and nickel is 506 ppm, which makes the oily sludge harmful to the environment and organisms, which needs to be dealt with, for environmental protection.

General Issues by PETROLEUM

Toxic Compound

- Petroleum is a complex mixture of many components. These components include straight-chained, branched, cyclic, monocyclic aromatic, and polycyclic aromatic hydrocarbons.
- **Benzene** is the petroleum-related product with the highest level of toxicity. Other substances other than benzene which are highly toxic are **toluene**, **methylbenzene**, and **xylene**. Substances with the lowest toxicity are **crude oil** and **motor oil**.

Greenhouse gases

- Petroleum extraction disrupts the equilibrium of the earth's **carbon cycle** by transporting sequestered geologic carbon into the biosphere. The carbon is used by consumers in various forms and a large fraction is combusted into the atmosphere; thus creating massive amounts of the greenhouse gas, carbon dioxide, as a waste product.
- The atmospheric concentration of **carbon dioxide** and **methane** have increased by about **50%** and **150%**, respectively.
- Each is currently increasing at a rate of about **1%** every year since about half of the added carbon has been absorbed by Earth's land vegetation and ocean sinks

Microplastics

- Petroleum has enabled plastics to be used to create a wide range and massive quantity of consumer items at extremely low production costs.
- Annual growth rates in production have been near **10%**, and are driven largely by **single-use** plastics for which improper disposal is common.
- The majority of plastic is not recycled, and it fragments into smaller and smaller pieces over time. Microplastics are particles that are smaller than **5 mm** in size.
- When particles are ingested by marine organisms they usually end up in tissues such as the digestive glands, circulatory system, gills, and guts.

The [International Energy Agency](#) and others report that oil & gas use comprised over **55%** (18 Billion Tons) of the record **32.8** Billion Tons (BT) of **CO₂** released into the atmosphere from all energy sources during the year **2017**.

The petroleum industry directly contributed about **8%** (2.7 BT) of the **32.8 BT** in **2017**.

Global and Local Impacts

- Some harmful impacts of petroleum can be limited to the geographic locations where it is produced, consumed, and/or disposed of.

AIR POLLUTION

Exhaust Emission

- Emissions from the petroleum industry occur in every chain of the oil-producing process from the extraction to the consumption phase in the extraction phase, [gas venting](#) and [flaring](#) release not only [methane](#) and [carbon dioxide](#) but various other pollutants like [nitrous oxides](#) and [aerosols](#). Certain by-products include [carbon monoxide](#) and [methanol](#).
- A study investigating the effects of oil refineries in Taiwan. The study found an increased occurrence of premature births in mothers that lived in close proximity to oil refineries than in mothers who lived away from oil refineries. There were also differences observed in sex ratios and the [birth weight](#) of the children.
- Also, fine [particulates](#) of [soot](#) blacken humans' and other animals' lungs and cause heart problems or death. Soot is [cancer-causing](#) ([carcinogenic](#)).



Petroleum **diesel exhaust** from a truck

Acid Rain

- The combustion process of [petroleum](#), [coal](#), and [wood](#) is responsible for the increased occurrence of acid rain.
- Combustion causes an increased amount of [nitrous oxide](#), along with [sulfur dioxide](#) from the sulfur in the oil. These by-products combine with water in the atmosphere to create acid rain.
- The increased concentrations of nitrates and other acidic substances have significant effects on the [pH levels](#) of rainfall. Data samples analyzed from the [United States](#) and [Europe](#) from the past 100 years showed an increase in nitrous oxide emissions from combustion.

For example:

- Acid rain can kill trees and can kill fish by acidifying lakes.
- [Coral reefs](#) are also destroyed by acid rain.
- Acid rain also leads to the corrosion of machinery and structures (large amounts of capital) and to the slow destruction of archeological structures like the marble ruins of [Rome](#) and [Greece](#).



Trees killed by [acid rain](#), an unwanted side effect of burning petroleum

Oil Spills

- An oil spill is the release of a [liquid petroleum hydrocarbon](#) into the environment, especially marine areas, due to human activity, and is a form of pollution.
- Oil spills may be due to releases of [crude oil](#) from [tankers](#), pipelines, railcars, [offshore platforms](#), [drilling rigs](#), and [wells](#), as well as spills of [refined petroleum products](#) (such as [gasoline](#), [diesel](#)) and their by-products, heavier fuels used by large ships such as [bunker fuel](#), or the spill of any oily refuse or [waste oil](#).



Waste Oil

- Waste oil is an oil containing not only breakdown products but also impurities from use.
- Waste oil is used oils such as [hydraulic oil](#), transmission oil, brake fluids, [motor oil](#), [crankcase oil](#), [gear box oil](#), and [synthetic oil](#).
- When waste oil from vehicles drips out engines over streets and roads, the oil travels into the water table bringing with it such toxins as [benzene](#).
- This poisons both soil and drinking water. Runoff from storms carries waste oil into rivers and oceans, poisoning them as well.

Effect on Human Health

- Several health issues like respiratory system disorders, miscarriages and infertility in women, birth defects, skin rashes, and childhood leukemia are associated with petroleum hydrocarbon contamination.
- Besides, there are high chances of carcinogenic, mutagenic, and teratogenic disorders, in most cases, it can damage deoxyribonucleic acid
- International Program on Chemical Safety (IPCS) 2000 suggested that some chronic symptoms like vomiting, diarrhea, abdominal pain, nausea, confusion, and headache can be experienced by a person when exposed shortly to organic pollutants.

Effects on Aquatic Ecosystem

- Petroleum seepage in surface water causes an adverse impact on the aquatic ecosystem
- Groundwater gets contaminated with petroleum hydrocarbons when oil percolates into the soil and reaches the groundwater aquifers.
- Produced waste (PW) discharges from petroleum extraction result in PAH ([Poly-aromatic Hydrocarbon](#)) emissions in the ocean.
- PAHs released by PW were responsible for biological changes in mussels and Atlantic cod.
- Long-term exposure to PAHs has been linked to a series of health problems such as [lung](#), [skin](#), [bladder](#), and [gastrointestinal cancer](#).

Effects of petroleum hydrocarbons on soil microbiota

- Petroleum waste hydrocarbons contaminated soils may lose their functions i.e., **soil fertility, porosity, regulation of water supply, degradation of decayed material, and providing habitat** to microorganisms.
- Contaminated soils may lose or threaten several microbial species, which will ultimately affect the biodiversity of soil microorganisms.

Land degradation

- Quite numerous incidents happened in the world because of the **flushing/dumping** of petroleum wastes in an open environment. However, the release of **PWHCs'** may also occur because of **accidental leakage** of the storage tank and pipelines. Due to this, several fertile agricultural lands were converted to **unfertile** and **degraded soil fertility**.
- In **2003**, an oil spillage accident occurred in Karachi, Pakistan, where about **15,000 tons** of oil spilled into the marine environment from a crude oil tanker. The land was badly affected, which ultimately affected **flora** and **fauna**. Moreover, **marine** and **wildlife** were also affected.