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PETROL & DIESEL POLLUTION CONTROL BY POTASSIUM ALUM

By Ammineni Shyam Sundar, B.B.M, P.G.D.B.A, Junior Assistant (Outsourcing),

Jawaharlal Nehru Technological University, Anantapur – 515002, A.P, INDIA.

E-mail: a_shyamsundhar@yahoo.com

ABSTRACT

To control petrol & diesel pollution the world need of different cost effective sources. Potassium Alum usage in petrol and diesel found to be one among them. In order to get easy access about Potassium Alum effect on Petrol & Diesel, there is a need to analyze Potassium Alum, Petrol, and Diesel.

INTRODUCTION

The use of fossil fuels such as petroleum can have a negative impact on Earth's biosphere, releasing pollutants and greenhouse gases into the air and damaging ecosystems through events such as oil spills. Because petroleum is a naturally occurring substance, its presence in the environment need not be the result of human causes such as accidents and routine activities (seismic exploration, drilling, extraction, refining and combustion). Phenomena such as seeps and tar pits are examples of areas that petroleum affects without man's involvement. Regardless of source, petroleum's effects when released into the environment are similar.

In India in general, Potassium Alum is used for water purification. This is the origin of this experiment. Potassium Alum effect have been proven to play a vital role in development of non pollutant Petrol and Diesel.

MATERIALS

1. POTASSIUM ALUM
2. PETROL
3. DIESEL

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1. **POTASSIUM ALUM,** potash alum or Tawas is the potassium double sulfate of aluminium. Its chemical formula is $KAl(SO_4)_2$ and it is commonly found in its dodecahydrate form as $KAl(SO_4)_2 \cdot 12(H_2O)$. Alum is the common name for this chemical compound, given the nomenclature of potassium aluminum sulfate dodecahydrate. It is commonly used in water purification, leather tanning, dyeing, fireproof textiles, and baking powder. It also has cosmetic uses as a deodorant, as an aftershave treatment and as a styptic for minor bleeding from shaving.

Characteristics

Potassium alum crystallizes in regular octahedra with flattened corners, and is very soluble in water. The solution reddens litmus and is an astringent. When heated to nearly a red heat it gives a porous, friable mass which is known as "burnt alum." It fuses at 92 °C in its own water of crystallization. "Neutral alum" is obtained by the addition of as much sodium carbonate to a solution of alum as will begin to cause the separation of alumina. Alum finds application as a mordant, in the preparation of lakes for sizing handmade paper and in the clarifying of turbid liquids. It can also be used as fire proof material and in preparation of many fire proof clothing . Molar Mass is 258.21 g/mol. Boiling Point is 200 °C. Melting Point is 92-93 °C. Density is 1.76 g/cm^3. Odorless. Solubility in Water is 14.00 g/100 mL (20 °C), 36.80 g/100 mL (50 °C). Refractive Index (n_D): 1.4564.

Mineral form and occurrence

Potassium alum or alum-(K) is a naturally occurring sulfate mineral which typically occurs as encrustations on rocks in areas of weathering and oxidation of sulfide minerals and potassium-bearing minerals. In the past, alum was obtained from alunite, a mineral mined from sulfur-containing volcanic sediments source. Alunite is an associate and likely potassium and aluminium source. It has been reported at Vesuvius, Italy, east of Springsure, Queensland, Alum Cave, Tennessee, Alum Gulch, Santa Cruz County, Arizona and the Philippine island of Cebu. A related mineral is *kalinite*, a fibrous mineral with formula $KAl(SO_4)_2 \cdot 11(H_2O)$.

Uses

Potassium alum is an astringent/styptic and antiseptic. For this reason, it can be used as a natural deodorant by inhibiting the growth of the bacteria responsible for body odor. Use of mineral salts in such a fashion does not prevent perspiration. Its astringent/styptic properties are often employed after shaving and to reduce bleeding in minor cuts and abrasions, nosebleeds, and hemorrhoids. It

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is frequently used topically and internally in traditional systems of medicine including Ayurveda, where it is called phitkari or saurashtri, and Traditional Chinese Medicine, where it is called *ming fan*. It is also used as a hardener for photographic emulsions (films and papers), usually as part of the fixer, although modern materials are adequately hardened and this practice has fallen out of favor. It is also used in tanning of leather. Aftershave: In rock form, alum is used as an aftershave, due to its astringent property. It can be rubbed on freshly shaved face, and its astringent property helps in preventing and reducing bleeding caused due to minor cuts.

2. 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, that are found in geologic formations beneath the Earth's surface. A fossil fuel, it is formed when large quantities of dead organisms, usually zooplankton and algae, are buried underneath sedimentary rock and undergo intense heat and pressure.

The proportion of light hydrocarbons in the petroleum mixture varies greatly among different oil fields, ranging from as much as 97 percent by weight in the lighter oils to as little as 50 percent in the heavier oils and bitumens.

The hydrocarbons in crude oil are mostly alkanes, cycloalkanes and various aromatic hydrocarbons while the other organic compounds contain nitrogen, oxygen and sulfur, and trace amounts of metals such as iron, nickel, copper and vanadium. The exact molecular composition varies widely from formation to formation but the proportion of chemical elements vary over fairly narrow limits as follows:

Composition by weight

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Element	Percent range
Carbon	83 to 87%
Hydrogen	10 to 14%
Nitrogen	0.1 to 2%
Oxygen	0.05 to 1.5%
Sulfur	0.05 to 6.0%
Metals	< 0.1%

Four different types of hydrocarbon molecules appear in crude oil. The relative percentage of each varies from oil to oil, determining the properties of each oil.

Composition by weight		
Hydrocarbon	**Average**	**Range**
Paraffins	30%	15 to 60%
Naphthenes	49%	30 to 60%
Aromatics	15%	3 to 30%
Asphaltics	6%	remainder

Petroleum is used mostly, by volume, for producing fuel oil and petrol, both important *"primary energy"* sources. 84 per cent 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. The lighter grades of crude oil produce the best yields of these products, but as the world's reserves of light and medium oil are depleted, oil refineries increasingly have to process heavy oil and bitumen, and use more complex and expensive methods to produce the products required. Because heavier crude oils have too much carbon and not enough hydrogen, these processes generally involve removing carbon from or adding hydrogen to the molecules, and using

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fluid catalytic cracking to convert the longer, more complex molecules in the oil to the shorter, simpler ones in the fuels.

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; the 16 per cent not used for energy production is converted into these other materials. Petroleum is found in porous rock formations in the upper strata of some areas of the Earth's crust. There is also petroleum in oil sands (tar sands). Known oil reserves are typically estimated at around 190 km^3 (1.2 trillion (short scale) barrels) without oil sands, or 595 km^3 (3.74 trillion barrels) with oil sands. Consumption is currently around 84 million barrels (13.4×10^6 m^3) per day, or 4.9 km^3 per year. This in turn yields a remaining oil supply of only about 120 years, if current demand remains static.

Petroleum is a mixture of a very large number of different hydrocarbons; the most commonly found molecules are alkanes (linear or branched), cycloalkanes, aromatic hydrocarbons, or more complicated chemicals like asphaltenes. Each petroleum variety has a unique mix of molecules, which define its physical and chemical properties, like color and viscosity.

These different molecules are separated by fractional distillation at an oil refinery to produce petrol, jet fuel, kerosene, and other hydrocarbons. For example, 2,2,4-trimethylpentane (isooctane), widely used in petrol, has a chemical formula of C_8H_{18} and it reacts with oxygen exothermically:

$$2\ C_8H_{18(l)} + 25\ O_{2(g)} \rightarrow 16\ CO_{2(g)} + 18\ H_2O_{(g)}\ (\Delta H = -10.86\ \text{MJ/mol of octane})$$

Incomplete combustion of petroleum or petrol results in production of toxic byproducts. Too little oxygen results in carbon monoxide. Due to the high temperatures and high pressures involved, exhaust gases from petrol combustion in car engines usually include nitrogen oxides which are responsible for creation of photochemical smog.

The petroleum industry generally classifies crude oil by the geographic location it is produced in (e.g. West Texas Intermediate, Brent, or Oman), its API gravity (an oil industry measure of density), and its sulfur content. Crude oil may be considered *light* if it has low density or *heavy* if it has high density; and it may be referred to as sweet if it contains relatively little sulfur or *sour* if it contains substantial amounts of sulfur.

The geographic location is important because it affects transportation costs to the refinery. *Light* crude oil is more desirable than *heavy* oil since it produces a higher yield of petrol, while *sweet* oil commands a higher price than *sour* oil because it

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has fewer environmental problems and requires less refining to meet sulfur standards imposed on fuels in consuming countries. Each crude oil has unique molecular characteristics which are understood by the use of crude oil assay analysis in petroleum laboratories.

Petroleum is vital to many industries, and is of importance to the maintenance of industrialized civilization itself, and thus is critical concern to many nations. Oil accounts for a large percentage of the world's energy consumption, ranging from a low of 32 per cent for Europe and Asia, up to a high of 53 per cent for the Middle East. Other geographic regions' consumption patterns are as follows: South and Central America (44%), Africa (41%), and North America (40%). The world at large consumes 30 billion barrels (4.8 km^3) of oil per year, and the top oil consumers largely consist of developed nations.

Today, about 90 per cent of vehicular fuel needs are met by oil. Petroleum's worth as a portable, dense energy source powering the vast majority of vehicles and as the base of many industrial chemicals makes it one of the world's most important commodities. Viability of the oil commodity is controlled by several key parameters, number of vehicles in the world competing for fuel, quantity of oil exported to the world market (Export Land Model), Net Energy Gain (economically useful energy provided minus energy consumed), political stability of oil exporting nations and ability to defend oil supply lines.

The top three oil producing countries are Saudi Arabia, Russia, and the United States. About 80 per cent of the world's readily accessible reserves are located in the Middle East, with 62.5 per cent coming from the Arab 5: Saudi Arabia, UAE, Iraq, Qatar and Kuwait.

The most common distillation fractions of Petroleum are (by increasing boiling temperature range)

Common fractions of petroleum as fuels	
Fraction	**Boiling Range ^{o}C**
Liquefied petroleum gas (LPG)	−40
Butane	−12 to −1
Petrol	−1 to 180
Jet fuel	150 to 205

Kerosene	205 to 260
Fuel oil	205 to 290
Diesel fuel	260 to 315

Global warming

When burned, petroleum releases carbon dioxide; a greenhouse gas. Along with the burning of coal, petroleum combustion is the largest contributor to the increase in atmospheric CO_2. Atmospheric CO_2 has risen steadily since the industrial revolution to current levels of over 380ppmv, from the 180 – 300ppmv of the prior 800 thousand years, driving global warming. The unbridled use of petroleum could potentially cause a runaway greenhouse effect on Earth. So far, the Earth's temperature has been raised by almost an entire degree Celsius. This raise in temperature has reduced the Arctic ice cap to 1.1 million square miles smaller than ever recorded, a size merely twelve times that of Great Britain. Because of this melt, more oil reserves have been revealed. It is estimated by the International Energy Agency that about 13 per cent of the world's undiscovered oil resides in the Arctic.

Though crude oil is predominantly composed of various hydrocarbons, certain nitrogen heterocylic compounds, such as pyridine, picoline, and quinoline are reported as contaminants associated with crude oil, as well as facilities processing oil shale or coal, and have also been found at legacy wood treatment sites. These compounds have a very high water solubility, and thus tend to dissolve and move with water. Certain naturally occurring bacteria, such as Micrococcus, Arthrobacter, and Rhodococcus and have been shown to degrade these contaminants.

3. **DIESEL FUEL** in general is any liquid fuel used in diesel engines. The most common is a specific fractional distillate of petroleum fuel oil. Petroleum-derived diesel is also called **petro diesel**. Ultra-low sulfur diesel (ULSD) is a standard for defining diesel fuel with substantially lowered sulfur contents. The word "diesel" is derived from the family name of German inventor Rudolf Diesel who in 1892 invented the diesel engine. Diesel engines are a type of internal combustion engine. **Petroleum diesel**, also called **petro diesel**, or fossil diesel is produced from the fractional distillation of crude oil between 200 °C (392 °F) and 350 °C (662 °F) at atmospheric pressure, resulting in a mixture of carbon chains that typically contain between 8 and 21 carbon atoms per molecule. Petroleum-derived diesel is composed of

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about 75% saturated hydrocarbons (primarily paraffins including *n*, *iso*, and cycloparaffins), and 25% aromatic hydrocarbons (including naphthalenes and alkylbenzenes). The average chemical formula for common diesel fuel is $C_{12}H_{23}$, ranging approximately from $C_{10}H_{20}$ to $C_{15}H_{28}$.

Cetane number

The principal measure of diesel fuel quality is its cetane number. A higher cetane number indicates that the fuel ignites more readily when sprayed into hot compressed air. European (EN 590 standard) road diesel has a minimum cetane number of 51. Fuels with higher cetane numbers, normally "premium" diesel fuels with additional cleaning agents and some synthetic content, are available in some markets. As of 2010, the density of petroleum diesel is about 0.832 kg/l (6.943 lb/US gal), about 12% more than ethanol-free petrol (gasoline), which has a density of about 0.745 kg/l (6.217 lb/US gal). About 86.1% of the fuel mass is carbon, and when burned, it offers a net heating value of 43.1 MJ/kg as opposed to 43.2 MJ/kg for gasoline. However, due to the higher density, diesel offers a higher volumetric energy density at 35.86 MJ/L (128 700 BTU/US gal) vs. 32.18 MJ/L (115 500 BTU/US gal) for gasoline, some 11% higher, which should be considered when comparing the fuel efficiency by volume. The CO_2 emissions from diesel are 73.25 g/MJ, just slightly lower than for gasoline at 73.38 g/MJ. Diesel is generally simpler to refine from petroleum than gasoline, and contains hydrocarbons having a boiling point in the range of 180–360°C (360–680°F). Because of recent changes in fuel quality regulations, additional refining is required to remove sulfur, which contributes to a sometimes higher cost. In many countries diesel may be priced higher than petrol. Reasons for higher-priced diesel include the shutdown of some refineries in the world, diversion of mass refining capacity to gasoline production, and a recent transfer to ultra-low sulfur diesel (ULSD), which causes infrastructural complications. In Sweden, a diesel fuel designated as MK-1 (class 1 environmental diesel) is also being sold; this is a ULSD that also has a lower aromatics content, with a limit of 5%.This fuel is slightly more expensive to produce than regular ULSD.

Use as vehicle fuel

Unlike petroleum ether and liquefied petroleum gas engines, diesel engines do not use high-voltage spark ignition (spark plugs). An engine running on diesel compresses the air inside the cylinder to high pressures and temperatures (compression ratios from 14:1 to 18:1 are common in current diesel engines); the engine generally injects the diesel fuel directly into the cylinder, starting a few degrees before top dead center (TDC) and continuing during the combustion event. The high temperatures inside the cylinder cause the diesel fuel to react

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with the oxygen in the mix (burn or oxidize), heating and expanding the burning mixture to convert the thermal/pressure difference into mechanical work, i.e., to move the piston. Engines have glow plugs to help start the engine by preheating the cylinders to a minimum operating temperature. Diesel engines are **lean burn** engines, burning the fuel in more air than is required for the chemical reaction. They thus use less fuel than **rich burn** spark ignition engines which use a Stoichiometric air-fuel ratio (just enough air to react with the fuel). Because they have high compression ratios and no throttle, diesel engines are more efficient than many spark-ignited engines. Gas turbine internal combustion engines can also take diesel fuel, as can some other types of internal combustion. External combustion engines can easily use diesel fuel as well.

This efficiency and its lower flammability than gasoline are the two main reasons for military use of diesel in armored fighting vehicles. Engines running on diesel also provide more torque, and are less likely to stall, as they are controlled by a mechanical or electronic governor. A disadvantage of diesel as a vehicle fuel in cold climates, compared to gasoline or other petroleum-derived fuels, is that its viscosity increases quickly as the fuel's temperature decreases, turning into a non-flowing gel at temperatures as high as −19 °C (−2.2 °F) or −15 °C (5 °F), which cannot be pumped by regular fuel pumps. Special low-temperature diesel contains additives to keep it in a more liquid state at lower temperatures, but starting a diesel engine in very cold weather may still pose considerable difficulties. Another disadvantage of diesel engines compared to petrol/gasoline engines is the possibility of runaway failure. Since diesel engines do not require spark ignition, they can sustain operation as long as diesel fuel is supplied. Fuel is typically supplied via a fuel pump. If the pump breaks down in an "open" position, the supply of fuel will be unrestricted, and the engine will runaway and risk terminal failure. (In vehicles or installations that use both diesel engines and bottled gas, a gas leak into the engine room could also provide fuel for a runaway, via the engine air intake.). Diesel-powered cars generally have a better fuel economy than equivalent gasoline engines and produce less greenhouse gas emission. Their greater economy is due to the higher energy per-litre content of diesel fuel and the intrinsic efficiency of the diesel engine. While petro diesel's higher density results in higher greenhouse gas emissions per litre compared to gasoline, the 20–40% better fuel economy achieved by modern diesel-engine automobiles offsets the higher per-litre emissions of greenhouse gases, and a diesel-powered vehicle emits 10–20 percent less greenhouse gas than comparable gasoline vehicles. However, the increased compression ratios mean there are increased emissions of oxides of nitrogen (NO_x) from diesel engines. This is compounded by biological nitrogen in biodiesel to make NO_x emissions the main drawback of diesel versus gasoline engines.

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Environment hazards of sulfur

High levels of sulfur in diesel are harmful for the environment because they prevent the use of catalytic diesel particulate filters to control diesel particulate emissions, as well as more advanced technologies, such as nitrogen oxide (NO_x) absorbers (still under development), to reduce emissions. Moreover, sulfur in the fuel is oxidized during combustion, producing sulfur dioxide and sulfur trioxide, that in presence of water rapidly convert to sulfuric acid, one of the chemical processes that results in acid rain. However, the process for lowering sulfur also reduces the lubricity of the fuel, meaning that additives must be put into the fuel to help lubricate engines.

Road hazard

Petrodiesel spilled on a road will stay there until washed away by sufficiently heavy rain, whereas gasoline will quickly evaporate. After the light fractions have evaporated, a greasy slick is left on the road which can destabilize moving vehicles. Diesel spills severely reduce tire grip and traction, and have been implicated in many accidents. The loss of traction is similar to that encountered on black ice. Diesel slicks are especially dangerous for two-wheeled vehicles such as motorcycles.

Diesel fuel is also often used as the main ingredient in oil-base mud drilling fluid. The advantage of using diesel is its low cost and that it delivers excellent results when drilling a wide variety of difficult strata including shale, salt and gypsum formations. Diesel-oil mud is typically mixed with up to 40% brine water. Due to health, safety and environmental concerns, Diesel-oil mud is often replaced with vegetable, mineral, or synthetic food-grade oil-base drilling fluids, although diesel-oil mud is still in widespread use in certain regions.

In some countries, such as Germany and Belgium, diesel fuel is taxed lower than petrol (gasoline) (typically around 20% lower), but the annual vehicle tax is higher for diesel vehicles than for petrol vehicles. This gives an advantage to vehicles that travel longer distances (which is the case for trucks and utility vehicles) because the annual vehicle tax depends only on engine displacement, not on distance driven. The point at which a diesel vehicle becomes less expensive than a comparable petro vehicle is around 20,000 km a year (12,500 miles per year) for an average car. However, due to a rise in oil prices from about 2009, the advantage point started to drop, causing more people opting to buy a diesel car where they would have opted for a gasoline car a few years ago. Such an increased interest in diesel has resulted in slow but steady "dieseling" of the automobile fleet in the countries affected, sparking concerns in certain authorities about the harmful effects of diesel.

PROJECT EXPERIMENT

TAKE TWO ONE LITRE CAPACITY EMPTY BOTTLES. TAKE ONE LITRE PETROL & ONE LITRE DIESEL. NOTE DOWN THE FOLLOWING READINGS OF SAMPLE PETROL AND DIESEL.

1. NOTE DOWN THE AUTO IGINITON TEMPERATURE OF THE SAMPLE PETROL AND DIESEL. (THE NORMAL AUTO IGNITION TEMPERATURE OF PETROL IS 246°C AND IS 210°C).
2. NOTE DOWN THE CARBON PERCENTAGE OF SAMPLE PETROL & DIESEL.
3. NOTE DOWN THE HYDEROGEN PERCENTAGE OF SAMPLE PETROL & DIESEL.
4. NOTE DOWN THE NITROGEN PERCENTAGE OF SAMPLE PETROL & DIESEL.
5. NOTE DOWN THE OXYGEN PERCENTAGE OF SAMPLE PETROL & DIESEL.
6. NOTE DOWN THE SULFUR PERCENTAGE OF SAMPLE PETROL & DIESEL.

LATER ON TAKE THE SAMPLES AND PUT THEM IN THOSE EMPTY BOTTLES. PUT IN THAT EACH BOTTLE 250 GRAMS OF POTASSIUM ALUM. KEPT THE BOTTLE UPTO 48 HOURS. LATER ON TAKE THE SAMPLES, REMOVE THE ALUM AND CHECK THE ABOVE NOTED POINTS. WE GET CONSIDERABLE CHANGE IN ALL THE NOTED POINTS.

RESULTS

BY USING POTASSIUM ALUM IN PETROL AND DIESEL WE GET THE FOLLOWING RESULTS

1. IT REDUCES THE PETROL & DIESEL FUELS EXHAUST EMISSIONS.
2. IT REDUCES THE AUTO IGNITION TEMPERATURE OF PETROL & DIESEL THAN THE NORMAL.
3. IT GIVES MORE MILEAGE AND MORE ENGINE EFFICIENCY.
4. IT AFFECTS THE CETANE NUMBER IN DIESEL. HIGHER CETANE NUMBER INDICATES THAT THE FUEL IGNITES MORE READILY WHEN SPRAYED INTO HOT COMPRESSED AIR.

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5. THE COMPLETE COMBUSTION OF PETROL AND DIESEL IS POSSIBLE.

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