GREEN DIESEL BY POTASSIUM ALUM

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ABSTRACT

The world needs Transportation. Transportation needs fuel. One of the Fuels for Transportation is Diesel. Heavy usage of transportation by that heavy usage of diesel occurring and by that automobile exhaust emissions and by that air pollution. To control diesel pollution the world need of different cost effective sources. Potassium Alum usage in diesel found to be one among them. Just by keeping 50 grams (by using up to 37 grams (may be critical point) changes occurred in flash point, fire point etc. in the properties of diesel after that quantity of alum no change is there in one liter diesel) of Potassium Alum in one liter diesel is enough to change the normal diesel to green diesel. Green diesel in the sense, lower auto ignition temperature, lower flash point (previously it is 63⁰ c , after 50 grams of potassium alum it is 53⁰ c) , lower fire point (previously it is 73⁰ c , after 50 grams of potassium alum it is 63⁰ c), higher calorific value, more mileage, less carbon dioxide and carbon monoxide emissions. Now a days, the Ultra Low Sulfur Diesel (USLD – S15), sulfur content of 15 parts per million (ppm) is using to reduce the pollution. But the refining process used to attain the sulfur ratio of USLD is expensive and affects the naturally occurring paraffins (wax) inherent in diesel fuel in such a way that can cause the fuel to gel more readily in cold temperatures. As Sulfur in the fuel enhances lubricity, by decreasing the sulfur, lubrication problem and to attain the same lubrication, additives are being used to improve fuel fluidity at low temperatures. As the diesel fuel is cooled it will reach the cloud point. This is the temperature at which paraffin wax falls out of solution and starts to form wax crystals in the fuel. As the fuel is cooled further, it will eventually reach its pour point. This is the temperature at which fuels will no longer flow or the point at which fuel gels or turns solid. Another key property of diesel fuel is the Cold Filter Plug Point (CFPP). This is the temperature where fuel can no longer flow freely through a fuel filter, it is approximately halfway the cloud point and the pour point. To solve this problem we are using the fuel additives, known as wax crystal modifiers, can result in satisfactory fuel flow on average of 9⁰ c to -27⁰ c. All this process is expensive and by that increasing the diesel fuel price. Rather than thinking of alternatives fuels and adding common diesel fuel additives, here the fuel is altered by Potassium Alum. By the Potassium Alum we
can change the diesel in cheap and best way into Nano Sulfur Diesel (NSD-S5) with sulfur content of 5 parts per million (ppm) and the fuel is also called ATFD, Any Temperature Flow Diesel (no gel). This cheap and best method is more useful to Road and Transport Corporation (R.T.C) and Railway Department in India. In order to get easy access about Potassium Alum effect on Diesel, there is a need to analyze Potassium Alum, Diesel.

**INTRODUCTION**

The use of fossil fuels such as Diesel 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 Diesel is a naturally occurring substance by crude oil, 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). 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 Diesel or Green Diesel.

**TECHNICAL TERMS**

1. **CALORIFIC VALUE:** The calorific value of fuel is the quantity of heat produced by its combustion at constant pressure and under normal or standard conditions that means to 0°C and under pressure of 1,013 mbar. The diesel higher calorific value is 44,800 kJ/kg, lower calorific value is 43,400 kJ/kg.

2. **AUTO IGNITION TEMPERATURE:** The auto ignition temperature or kindling point of a substance is the lowest temperature at which it will spontaneously ignite in a normal atmosphere without an external source of ignition, such as flame or spark. Diesel auto ignition temperature is 210°C.

3. **FLASH POINT:** The flash point of a volatile material is the lowest temperature at which it can vaporize to form an ignitable mixture in air. At flash point, a lower temperature, a substance will ignite briefly, but vapor might not be produced at a rate to sustain the fire. Diesel flash point is >62°C.

4. **FIRE POINT:** The fire point of a fuel is the temperature at which it will continue to burn for at least 5 seconds after ignition by an open flame. Diesel fire point is >72°C.
MATERIALS

1. POTASSIUM ALUM

2. DIESEL

1. POTASSIUM ALUM, potash alum or Tawas is the potassium double sulfate of aluminium. Its chemical formula is KAl(SO₄)₂ and it is commonly found in its dodecahydrate form as KAl(SO₄)₂·12(H₂O). 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/cm³. Odorless. Solubility in Water is 14.00 g/100 mL (20 °C), 36.80 g/100 mL (50 °C). Refractive Index (nD): 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 $\text{KAl(SO}_4\text{)}_2\cdot 11(\text{H}_2\text{O})$.

**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 is frequently used topically and internally in traditional systems of medicine including *Ayurveda*, where it is called *phitkari* or *saurashtri*, patika in *Telugu* language 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.

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**2. 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 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 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-liter 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 liter compared to gasoline, the 20–40% better fuel economy achieved by modern diesel-engine automobiles offsets the higher per-liter 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 (NOx) from diesel engines.
This is compounded by biological nitrogen in biodiesel to make NO\textsubscript{x} emissions the main drawback of diesel versus gasoline engines.

**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\textsubscript{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**

IN A TWO LITER CAPACITY PLASTIC BOTTLES WE KEPT THE ONE LITER DIESEL WITH 50 GRAMS OF POTASSIUM ALUM FOR SEVEN DAYS. TEN SAMPLES TAKEN. BEFORE PUTTING THE ALUM IN THE DIESEL WE TOOK THE PREVIOUS READINGS. AFTER SEVEN DAYS WE REMOVED THE ALUM. THE FOLLOWING ARE THE RESULTS. THE CALORIFIC VALUE OF DIESEL IS INCREASED.

**RESULTS**

<table>
<thead>
<tr>
<th>READINGS</th>
<th>DIESEL BEFORE POTASSIUM ALUM</th>
<th>DIESEL AFTER POTASSIUM ALUM (50 grams per liter)</th>
</tr>
</thead>
<tbody>
<tr>
<td>FLASH POINT</td>
<td>63°c</td>
<td>53°c</td>
</tr>
<tr>
<td>FIRE POINT</td>
<td>73°c</td>
<td>63°c</td>
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<tr>
<td>SPECIFIC GRAVITY/DENSITY</td>
<td>0.8 to 0.82 kg/l</td>
<td>0.8272 kg/l</td>
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<td>REFRACTIVE INDEX</td>
<td>1.4679</td>
<td>1.317005</td>
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<tr>
<td>CARBON MONOXIDE EMISSION</td>
<td>1.1 km/l</td>
<td>0.023 km/l</td>
</tr>
</tbody>
</table>

BY USING POTASSIUM ALUM IN DIESEL WE GET THE FOLLOWING RESULTS

1. IT REDUCES THE DIESEL FUEL EXHAUST EMISSIONS.
2. IT GIVES MORE MILEAGE AND MORE ENGINE EFFICIENCY.
3. IT AFFECTS THE CETANE NUMBER IN DIESEL. HIGHER CETANE NUMBER INDICATES THAT THE FUEL IGNITES MORE READILY WHEN SPRAYED INTO HOT COMPRESSED AIR.
4. IN GENERAL DIESEL VISCOSITY INCREASES QUICKLY AS THE FUEL'S TEMPERATURE DECREASES, TURNING INTO A NON-FLOWING GEL AT TEMPERATURES AS LOW AS −19 °C (−2.2 °F) OR −15 °C (5 °F), WHICH CANNOT BE PUMPED BY REGULAR FUEL PUMPS. THE ALAMISED DIESEL MAY SOLVE THIS PROBLEM.
ACKNOWLEDGEMENTS

I, the Author dedicate my sincere gratitude to Jawaharlal Nehru Technological University, Anantapur and Oil and Technology Research Institute, Anantapur and Government Polytechnic College, Ananatapur.

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