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Comparison of Corrosion Resistance of Brass and Copper for Petroleum Products

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ABSTRACT: This test method covers the determination of the corrosiveness of copper and brass using the petroleum products. Brass offers much better thermal conductivity and corrosion resistance than carbon or even stainless steel. Copper is a chemical element. It is a soft, malleable, and ductile metal with very high thermal and electrical conductivity. This study was carried out to investigate and evaluate the influence of fossil fuel like petrol, diesel, kerosene and grease on the corrosion performance of brass and copper. The samples were prepared for the study by cutting into 1 cm² coupons and soaking them in different containers containing petrol, kerosene, grease and diesel. The corrosion rate of each sample for a specific period of immersion (24, 48, 72, 96 and 120 hours) was determined on average of three samples exposed under the same condition and test media in different container. The finding showed that brass is resistant to corrosion after long hours of contact in chosen liquid fossil fuels.

KEYWORDS: Corrosion performance, fossil fuels, thermal and electrical conductivities.

I. INTRODUCTION

Fossil fuels are fuels formed by natural processes such as anaerobic decomposition of buried dead organisms, containing energy originating in ancient photosynthesis. The age of the organisms and their resulting fossil fuels is typically millions of years, and sometimes exceeds 650 million years. Fossil fuels contain high percentages of carbon and include petroleum, coal, and natural gas. Petroleum (from Greek: *petra*: "rock" + *oleum*: "oil") is a naturally occurring, yellow-to-black liquid found in geological formations beneath the Earth's surface, which is commonly refined into various types of fuels. Components of petroleum are separated using a technique called distillation. It consists of hydrocarbons of various molecular weights and other organic compounds. The name "petroleum" covers both naturally occurring unprocessed crude oil and petroleum products that are made up of refined crude oil. A fossil fuel, petroleum is formed when large quantities of dead organisms, usually zooplankton and algae, are buried underneath sedimentary rock and subjected to both intense heat and pressure. Petroleum has mostly been recovered by oil drilling (natural petroleum springs are rare). Drilling is carried out after studies of structural geology (at the reservoir scale), sedimentary basin analysis, and reservoir characterization (mainly in terms of the porosity and permeability of geologic reservoir structures) have been completed. It is refined and separated, most easily by distillation, into a large number of consumer products, from gasoline (petrol) and kerosene to asphalt and chemical

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reagents used to make plastics and pharmaceuticals. Petroleum is used in manufacturing a wide variety of materials. The main uses of petroleum products are as follows,

- 1) Transportation for running the vehicles,
- 2) In power stations where diesel is used to produce electricity,
- 3) For smooth running of machines, in which lubricating oil is used,
- 4) For domestic and lightning purposes in which kerosene is used,
- 5) For the construction of metal roads in which tar is used,
- 6) For the manufacturing of candles and pharmaceuticals in which paraffin and Vaseline are used
- 7) In chemical industry naphtha is used to produce fertilizers, explosives, polythene plastics, synthetic rubber, nylon, paints, pesticides etc.

Most of the petroleum and petrochemical industry depend on carbon steel alloys as primary backbone and skeletons. Corrosion of metal is a common problem across many industries. Corrosion of steel is an “electrochemical process,” involving the transfer of electrons from iron atoms in the metal to hydrogen ions.

1.1.1 PETROL

Gasoline known as petrol outside North America is a transparent, petroleum-derived liquid that is used primarily as a fuel in internal combustion engines. It consists mostly of organic compounds obtained by the fractional distillation of petroleum, enhanced with a variety of additives. On average, a 42-gallon barrel of crude oil (159 L) yields about 19 US gallons (72 L) of gasoline when processed in an oil refinery, though this varies based on the crude oil source's assay.

The characteristic of a particular gasoline blend to resist igniting too early (which causes knocking and reduces efficiency in reciprocating engines) is measured by its octane rating. Gasoline is produced in several grades of octane rating. Tetraethyl lead and other lead compounds are no longer used in most areas to regulate and increase octane-rating, but many other additives are put into gasoline to improve its chemical stability, control corrosiveness and provide fuel system 'cleaning,' and determine performance characteristics under intended use. Sometimes, gasoline also contains ethanol as an alternative fuel, for economic or environmental reasons.

1.1.2 DIESEL

Diesel fuel in general is any liquid fuel used in diesel engines, whose fuel ignition takes place, without any spark, as a result of compression of the inlet air mixture and then injection of fuel. (Glow plugs, grid heaters and heater blocks help achieve high temperatures for combustion during engine startup in cold weather.) Diesel engines have found broad use as a result of higher thermodynamic efficiency and thus fuel efficiency. This is particularly noted where diesel engines are run at part-load; as their air supply is not throttled as in a petrol engine, their efficiency still remains very high. The most common type of diesel fuel is a specific fractional distillate of petroleum fuel oil, but alternatives that are not derived from petroleum, such as biodiesel, biomass to liquid (BTL) or gas to liquid (GTL) diesel, are increasingly being developed and adopted. To distinguish these types, petroleum-derived diesel is increasingly called petrodiesel. Ultra-low-sulfur diesel (ULSD) is a standard for defining diesel fuel with substantially lowered sulfur contents. As of 2016, almost all of the petroleum-based diesel fuel available in UK, Europe and North America is of a ULSD type. In the UK, diesel fuel for on-road use is commonly abbreviated DERV, standing for diesel-engine road vehicle, which carries a tax premium over equivalent fuel for non-road use. In Australia diesel fuel is also known as distillate, and in Indonesia, it is known as Solar, a trademarked name by the local oil company Pertamina.

1.1.3 KEROSENE

Kerosene, also known as paraffin, lamp oil and coal oil (an obsolete term), is a combustible hydrocarbon liquid which is derived from petroleum, widely used as a fuel in industry as well as households. Its name derives from Greek, meaning wax, and was registered as a trademark by Abraham Gesner in 1854 before evolving into a genericized trademark.

The term kerosene is common in much of India, Canada, the United States, Argentina, Australia and New Zealand and the term paraffin is used in the United Kingdom, Southeast Asia, East Africa and South Africa. Liquid paraffin (called mineral oil in the US) is a more viscous and highly refined product which is used as a laxative. Paraffin

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Vol. 6, Issue 4, April 2017

wax is a waxy solid extracted from petroleum. Kerosene is widely used to power jet engines of aircraft (jet fuel) and some rocket engines, and is also commonly used as a cooking and lighting fuel and for fire toys such as poi. In parts of Asia, where the price of kerosene is subsidized, it fuels outboard motors on small fishing boats. World total kerosene consumption for all purposes is equivalent to about 1.2 million barrels per day

1.1.4 GREASE

Grease is a semisolid lubricant. Grease generally consists of a soap emulsified with mineral or vegetable oil. The characteristic feature of greases is that they possess a high initial viscosity, which upon the application of shear, drops to give the effect of an oil-lubricated bearing of approximately the same viscosity as the base oil used in the grease. This change in viscosity is called shear thinning. Grease is sometimes used to describe lubricating materials that are simply soft solids or high viscosity liquids, but these materials do not exhibit the shear-thinning properties characteristic of the classical grease. For example, petroleum jellies such as Vaseline are not generally classified as greases. Greases are applied to mechanisms that can only be lubricated infrequently and where lubricating oil would not stay in position. They also act as sealants to prevent ingress of water and incompressible materials. Grease-lubricated bearings have greater frictional characteristics due to their high viscosity.



Figure 1: Grease sample

1.2. BRASS

The most common brass is nominal brass which contains 70% copper and 30% zinc. It is also known as “cartridge brass” this brass is subjected to dezincification if left for long times in water, the zinc disappears and the metal has a dull copper color as copper is all that is left on the surface.

Brass with less than 15% zinc is supposed not to dezincification if left for long times in water. Brass should not be used in ammonia or nitrogen compound because of corrosive product form by brass in this environment and when it comes to machining, brass is much easier to cut than most ferrous materials. Brass is an excellent material choice for use in most industrial and agricultural application. Brass offers much better thermal conductivity and corrosion resistance than carbon or even stainless steel. Brass is an excellent material for use in both hot and cold water industrial and residential system including those carry portable water. Brass provides excellent resistance to corrosion in contact with petroleum products. Brass can be nickel plated to further reduce tarnishing and corrosion or to simply provide a silver finish. Nickel finishes may also be useful if a hard ware surface is required. Some examples of applications that are nickel plated for these purposes are door knobs, plumbing fixtures, gears and bearings.



Figure 2: Brass wires

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Vol. 6, Issue 4, April 2017

1.3. COPPER

Pure copper is a reddish, highly malleable metal, and was one of the first to be found and utilized. Copper and its alloys are widely used because of their excellent electrical, thermal conductivities, outstanding resistance to corrosion, ease fabrication and broad ranges of obtainable strength and special properties. Copper and copper alloys comprise one of the broadest and most versatile groups of engineering materials. Almost 500 copper alloys are currently recognized and are classified under international standard. Copper alloys are produced in all common forms. Choosing the correct alloy is simplified by the fact that copper metals are normally chosen for particular physical or mechanical properties and alloys with the desired properties can easily be sorted out. The main reason why copper and its alloys are so widely used is that they offer a better combination of useful properties that cannot be found in other material.

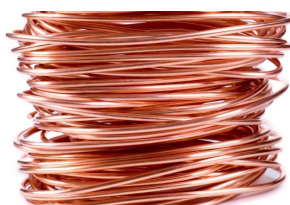


Figure 3: Copper wire

II. COPPER STRIP APPARATUS DESCRIPTION

The apparatus we used is copper strip corrosion test apparatus. It is actually an Owen where we can change the temperature for the experiment. The apparatus consists of a boiling bath (100°C only) without stainless steel bomb and copper strips of definite size 6 bombs or 18 test tubes can be accommodate in each type of bath with different temperature regulation system to operate on 220 volts AC mains.



Figure 4: Copper strip apparatus



Figure 5: Copper strip

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Vol. 6, Issue 4, April 2017



Figure 6: Brass strip

III. PROCEDURE

- 1) Take the oil samples to be tested without filtering.
- 2) Weigh the strips using for the test.
- 3) Place the strip (brass or copper) in a clean 250 ml bottle in which 250ml of oil to be added.
- 4) Place the copper strip standing on its long edge.
- 5) Lubricate the ground glass stopper with a small amount of sample
- 6) Place the stopper bottle in the oven at 90°C.
- 7) Remove the bottle after heating for 24hrs at 90°C.
- 8) Carefully take the copper strip from flask and wash with acetone.
- 9) Measure the final weight of the strip.

IV. OBSERVATION

Initial Weight of copper strip: 2.45g

Table 1: Corrosion performance of Copper in fossil fuels

Time [h]	W _f [g] of Petrol in Copper	W _f [g] of Diesel in Copper	W _f [g] of Kerosene in Copper	W _f [g] of Grease in Copper
24	2.1847	2.3558	1.6991	1.2301
48	2.5283	2.4412	2.3985	1.4523
72	1.851	1.8842	2.4825	1.5263
96	2.3029	1.8465	1.8901	1.58
120	2.1572	1.6416	1.9623	1.625

Initial Weight of Brass strip: 2.98g

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Vol. 6, Issue 4, April 2017

Table 2: Corrosion performance of brass in Fossil fuels

Time [h]	W _f [g] of Petrol in Brass	W _f [g] of Diesel in Brass	W _f [g] of Kerosene in Brass	W _f [g] of Grease in Brass
24	1.847	1.358	0.6911	1.55
48	2.83	1.4412	1.398	1.386
72	1.851	1.6832	1.455	0.5263
96	1.302	1.046	1.485	0.586
120	1.523	1.8416	0.9623	0.625

V. CALCULATIONS

Corrosion Efficiency= {(Initial Weight-Final Weight) / (Initial Weight)} * 100

Corrosion performance of Copper in Different Products

Table 3: Corrosion performance of Copper in Different products

Time [Hrs]	P ^H of Petrol	P ^H of Diesel	P ^H of Kerosene	P ^H of Grease	CR [mm/yr] of Petrol	CR [mm/yr] of Diesel	CR [mm/yr] of Kerosene	CR [mm/yr] of Grease
24	6.42	5.85	6.97	5.23	2.85	3.252	2.15	0.98
48	6.52	5.92	7.01	5.98	2.65	3.12	2.013	0.78
72	6.88	5.99	7.50	5.985	2.47	2.98	2.001	0.254
96	7.12	6.21	7.65	6.01	2.011	1.65	1.65	0.252
120	7.31	6.25	7.78	6.21	1.89	1.15	1.232	0.015

Corrosion performance of Brass in Different Products

Table 4: Corrosion performance of Brass in Different products

Time [Hrs]	P ^H of Petrol	P ^H of Diesel	P ^H of Kerosene	P ^H of Grease	CR [mm/yr] of Petrol	CR [mm/yr] of Diesel	CR [mm/yr] of Kerosene	CR [mm/yr] of Grease
24	6.015	5.53	6.97	5.02	4.66	0.4946	2.6522	0.356
48	7.01	5.42	6.98	5.15	2.06	0.2644	1.2579	0.258
72	7.055	5.60	6.985	5.28	0.312	0.1194	0.2118	0.255
96	7.065	5.65	6.99	5.42	0.275	0.079	0.2143	0.234
120	7.083	5.82	6.997	5.43	0.128	0.0273	0.1685	0.145

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(An ISO 3297: 2007 Certified Organization)

Website: www.ijirset.com

Vol. 6, Issue 4, April 2017

VI. CONCLUSION

In conclusion, the influence of liquid petroleum products on the corrosion rate of brass and copper was investigated and the following findings were deduced from the study.

- The corrosion rates of brass in petrol, kerosene, diesel and grease were low after a long period of contact.
- Corrosion rate was highest for brass in petrol than in kerosene, and the rate was least in grease at early hours of immersion.
- Corrosion rate was highest for copper in diesel than in kerosene, and the rate was least in grease at early hours of immersion.
- Finally comparison is done for copper and brass and concluded that brass is more resistant to corrosion than copper.

REFERENCES

- [1] Paul Mann, Lisa Gahagan, and Mark B. Gordon, "Tectonic setting of the world's giant oil and gas fields," in Michel T. Halbouty (ed.) Giant Oil and Gas Fields of the Decade, 1990–1999, Tulsa, Okla.: American Association of Petroleum Geologists, p. 50, accessed 22 June 2009.
- [2] oil - late 12c., "olive oil," from Anglo-French and Old North French olie, from Old French oile, uile "oil" (12c., Modern French huile), from Latin oleum "oil, olive oil" (source of Spanish, Italian olio), Medieval Latin: literally, rock oil = Latin petr (a) rock (< Greek pétra + oleum oil (<http://www.thefreedictionary.com/petroleum>)).
- [3] "Evaluation of the Influence of Fossil Fuel on Corrosion Resistance of Brass" Olayide Rasaan Adetunji, Peter Olaitan Aiyedun, Sidikat Ibiyemi Kuye, Dauda Adewale Lateef, Mechanical Engineering Department, Federal University of Agriculture, Abeokuta, Nigeria
- [4] Brondel, D. et al. 1994. "Corrosion in the Oil Industry". Oilfield Review (April): 4.
- [5] Treseder, R. and Tuttle, R. 1998. "Corrosion Control in Oil and Gas Production". Item No. 37741.