

A Prospective analysis on Minimization of Mechanical Friction of Fuel Engine Using Chemical Reagents

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Abstract

Chemical reagents such as Lithium base grease, Calcium base grease, Aluminum base grease which are reduced the mechanical friction and increase the performance of machines with adding various additives molybdenum disulphide (MoS_2), Graphite, Boron Nitrite. Dropping point is an indicator of heat resistance of the grease. The dropping point indicates the upper temperature limit at which grease retains its structure. If, failure the grease against high temperature then occurs friction and increase load. When load is increase then the fuel engine does not give the satisfy output. The paper estimated the dropping point of those grease. A.S.T.M standard D-566 used for estimated dropping of the greases. The dropping point of Lithium base grease, Calcium base grease, Aluminum base grease are estimated 195°C, 95°C, and 110°C respectively. The dropping point of mixed base grease i.e., Calcium 50% + Lithium 50%, Lithium 50% + Aluminum 50% and Calcium 50% + Aluminum 50% are 140°C, 158°C and 152°C respectively. The dropping of mixed base grease is higher than the individuals of the greases. The use of the calcium base grease also act is a water and repellent and corrosion protective. This paper represents that Aluminum 50% + Calcium 50% mixed base grease is showing the best performance against high temperature with protects the corrosion.

Keywords: Grease; Dropping point; Friction; Lubrication; Fuel engine

Introduction

Chemical reagent such as grease is a solid or semi-solid combination of petroleum products and soap or mixtures of soaps with or without fillers, suitable for certain type of lubrication. Grease is a lubricant of higher initial viscosity than oil, consisting originally of a Calcium, Lithium, soap jelly emulsified with oil [1-5]. The manufacturing of grease involves dispersion of a thickener in the oil. The thickener or jelling agent in over 90% of grease is a metallic soap. The usual method by which a metallic soap thickener is formed (fat + metal hydroxide). This reaction is carried out by cooking the fatty material and alkali with normally some oil in order to get the soap well dispersed and also to make it softer and easier to stir [6,7].

The Lithium base grease is high water resistance and high temperature properties. The use of Lithium base grease is to increase of mechanical stability. But the disadvantage is pump ability at low temperatures. It can present a difficulty in centralized lubrication systems at temperatures below -10°C [8-10]. The Calcium base grease is high operational temperature and it is water resistance with mechanically stable. Aluminum base grease is excellent oxidation and water resistance but tends to have poor mechanical stability [11].

Friction and lubrication play a vital role in energy conservation. Low friction and suitable lubrication are related with engine integrity and good performance. The lubricant influences the lubrication regimes of the lubricated parts. Additives maintain temperature sensitivity; reduce solid to solid friction [12-14]. Friction is the force that opposes the motion of an object. Another friction is the resistance to the sliding of one solid body over or along another, as solid bodies are ordinarily understood in the macroscopic world [15].

When the temperature is high in the part of engine then it is so necessary to maintenance the lubricant system otherwise, create friction and failure the satisfy output due to increase high load. Corrosion is high if friction is increase so, it is most important to use of proper lubricant in the part of engine [16-18]. Where, Calcium base grease is

used to the point of wet condition in pump area. Aluminum base grease is used plain bearing; low shear point and lithium base grease is used long supply area. To use of individual greases in the individual's area is so complexity and high cost. Again, there is no need to add corrosion inhibitor to Calcium base grease [19] and Calcium and Aluminum mixed base grease is show high dropping point which is indicates best performance against high temperature in the fuel engine [20-22].

Materials and Methods

The materials used in this test (Dropping point measurement) are lithium base grease, calcium base grease and aluminum base grease. All of those materials are collected in the local market. Compositions of materials are lithium base grease (Metal of Lithium + Lithium's Fatty acid + Base oil), Calcium base grease (Metal of Calcium + Calcium's Fatty acid + Base oil) and aluminum base grease (Metal of Aluminum + Aluminums Fatty acid + Base oil) [23-25]. All are tested on the Institute of Fuel Research and Development in the Bangladesh Council of Scientific and Industrial Research (B.C.S.I.R).

Place the cork on one of the thermometers so that the tip of the thermometer build will be about 1/8" above the bottom of the grease cup when the apparatus is assembled the other cork is placed equidistant between the lower end of upper cork and the grease cup as per the Figure 1. This cork will have to be worked cut to fit inside the

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test tube. Suspend the other thermometer into the oil bath so that its bulb will about the same level of the test tube [26].

Fill the grease cup with a sample of grease and gently press the grease into the cup until a small amount is extruded at the small opening. Using metal rod cut a wedge of grease from the cup by revolving the cup against the rod and simultaneously pushing the upward. A smooth film of grease shall remain in the cup.

Assemble the apparatus, start the stirrer and heat at a rate of 8-12°F per minute until the bath reaches a temperature approximately 30°F below the expected dropping point. Reduce the rate of heating so that the temperature in the test tube will be within 4°F or less of the bath temperature. As the temperature increases the grease will slowly protrude through the orifice of the cup. The temperature at which a drop of grease falls to the bottom of the cup is the dropping point. If the drop has a tailing thread, the test is continued until it breaks completely [27,28].

The dropping point calculated as following equation,

$$DP = ODP + \left[\frac{BT - ODP}{3} \right]$$

Where,

DP = Dropping point.

ODP = Thermometer reading when first drop reaches the bottom of the test tube, and

BT = Block temperature when the drop fall.

Results and Discussion

The study estimated the dropping point of grease both as mixed and individually. The individual grease is A (calcium) base, B (Lithium) base, C (Aluminum) base which are tested in B.C.S.I.R. The dropping

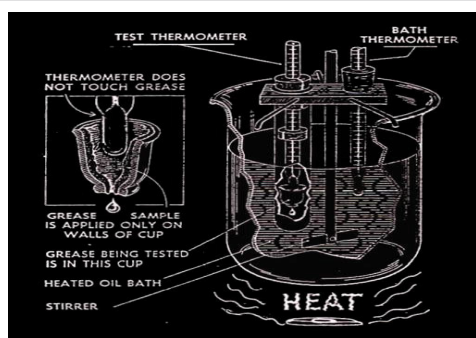


Figure 1: Test procedure dropping point grease [36].

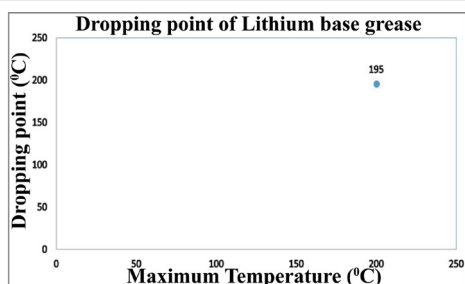


Figure 2: Dropping point of lithium base grease.

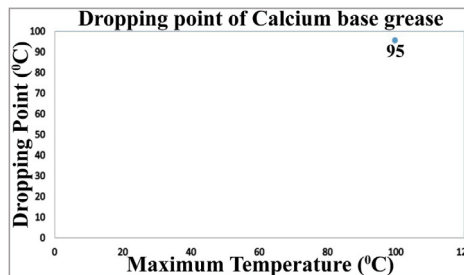


Figure 3: Dropping point calcium base grease.

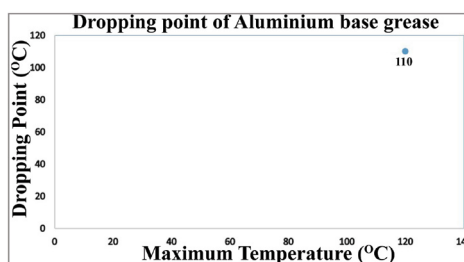


Figure 4: Dropping point aluminum base grease.

Grease	Dropping Point
A (Calcium)	95°C
B (Lithium)	195°C
C (Aluminum)	110°C

Table 1: Dropping point of individuals grease.

Grease	Dropping Point
A + B (Calcium 50% + Lithium 50%)	140°C
A + C (Calcium 50% + Aluminum 50%)	158°C
B + C (Lithium 50% + Aluminum 50%)	152°C

Table 2: Dropping point of mixed grease.

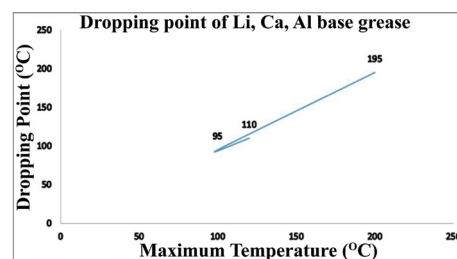


Figure 5: Dropping points of Li, Ca, Al base greases with scatter line diagram.

point of A (calcium), B (Lithium), C (Aluminum) are estimated 95°C, 195°C and 110°C respectively that shows in Figures 2-4 and Tables 1 and 2.

The lithium grease trend to be liquid at the actual point of 195°C when the temperature at the point of 200°C or above. The dropping point of Lithium base grease shows by scatter diagram in Figure 2 and Table 1. The Lithium base grease dropping point is high (195°C) but have to some demerits that is metal effects on the mechanical parch.

The calcium grease trend to be liquid at the actual point of 95°C that show in Figure 3. This dropping point consider as moderately high. The maximum temperature trend to be liquid at 120°C for aluminum based grease. The actual dropping point at 110°C (high) that is shown in Figure 4. At that point grease fall-down.

The ascending and descending curve of scatter line diagram is shown in Figure 5 for Li, Ca and Al base greases. The maximum temperature is applying at 200°C. Dropping points of Li, Ca, Al base greases are represented by scatter diagram shows in Figure 6 and Table 2. To show the tested results and curve analysis of the individuals greases Li is high and it has to metal effects. Other none they are have moderately high and have to corrosive solution.

Mixed grease are A + B (Calcium 50% + Lithium 50%) base grease, A + C (Calcium 50% + Aluminum 50%) base grease and B + C (Lithium 50%+ Aluminum 50%) base grease. The dropping point of AB, AC, BC is 140°C, 150°C and 152°C respectively that shows in Figure 7. The bearable maximum temperature grease is 158°C of the AC (Calcium and Aluminum base greases).

It is clear that the Lithium base grease is shown the maximum

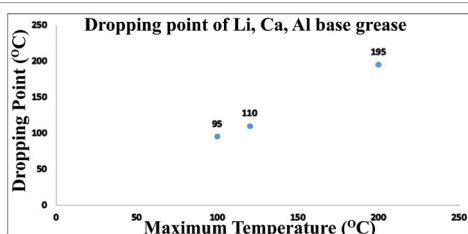


Figure 6: Dropping points of Li, Ca, Al base greases with scatter diagram.

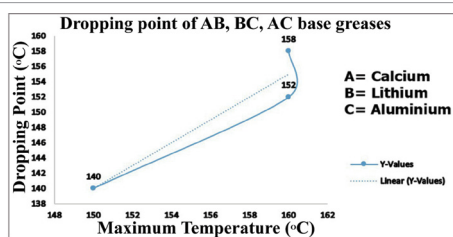


Figure 7: Dropping points of mixed greases. AB (140°C), BC (152°C), AC (158°C).

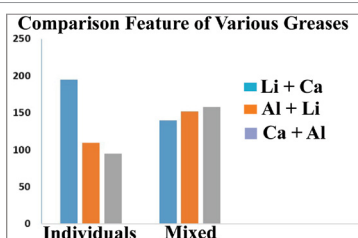


Figure 8: View of the dropping points of two group greases.

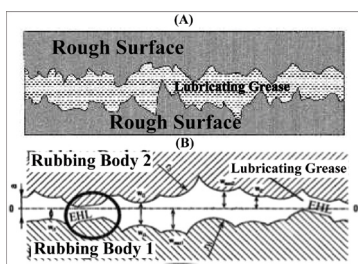


Figure 9: (A) Grease lubricated contact with two rough surfaces; (B) Modeled mixed friction contact of a grease lubricated gap [22].

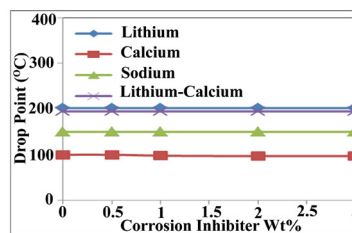


Figure 10: Effect of corrosion inhibitor additive on drop point test [27].

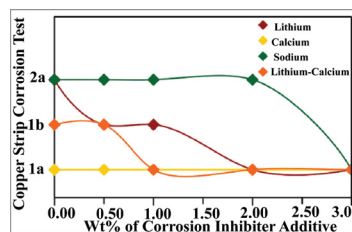


Figure 11: Effect of corrosion inhibitor additive on copper strip corrosion test [27].

dropping point temperature (195°C) of the individuals grease group and Calcium + Aluminum base grease is show maximum dropping point temperature(158°C) of the mixed grease group in Figure 8.

Dropping point is an indicator of the heat resistance of grease. As grease temperature raises penetration increase until the grease liquefies and the desired consistency is lost [29]. Dropping point the temperature which grease becomes fluid enough to drip. The dropping point indicates the upper temperature limit which a grease retains structure [30]. There are hundreds of moving parts of engine and others so, every one of these things Russ against something else as it moves making noise, losing energy to friction and gradually wearing out, wood ford, Chris lubricants [31,32]. Grease lubricated contract are often working in mixed friction. That means liquid friction (grease film) and solid friction (asperity deformation) have to be considered [33-35] that shows in Figure 9.

A common way to reduce friction is by using a lubricant, such as grease which is placed between the two surfaces, often dramatically lessening the coefficient of friction. Lubricants to overcome friction need not always be thin. Lubricated friction is a case of fluid friction where a fluid separates two solid surfaces. When lubrication breaks down, metal or other components can rub destructively over each other [36,37].

The drop point temperature remained constant despite the increase in additive in Lithium grease but except for Calcium grease which shows in Figure 10. Again, Calcium base grease no needs additives for corrosion protect due to the curve (Calcium) shows that straight line to the Corrosion Inhibitor additive shows in Figure 11. In the fuel engine is occur the spark as a result need to high resistance grease withstand against high temperature. If, failure the grease against high temperature then occurs friction and increase load. On the other hand, seen that calcium base grease is a water repellent and corrosion protective that shown in Figures 10 and 11 [38,39].

Conclusion

A modern internal combustion engine is comprised of dozens of moving components. Without appropriate oiling, these parts run against each other with incredible speed, creating friction which then

leads to heat. This heat can wear the mechanical parts of an engine and lead to bad performance under the hood. Worn parts due to friction cause have with gas mileage and emissions since the engine is pushed to work harder. Wear on the engine's vehicle is a primary known cause of less efficient burning of fuel. It is clear that AC (Aluminum+ Calcium) base grease show the maximum dropping point (158°C) against temperature. Also, to see from the mixed base grease comparison AC (Aluminum+ Calcium) show maximum dropping point temperature (158°C). Where the dropping point is useful to assist in identifying the grease as type and for establishing and maintaining bench marks with quality control and service performance.

Dropping point is a qualitative indicator of the heat resistance of grease on application semi-solid lubricant is essential on the other hand corrosion problem is most significance in the fuel engine component. If to use of Calcium base grease it is not importance to use of the additives due to Calcium base grease is auto water repellent with fiber length. So, if it is possible to use of the mixed grease (Calcium + Aluminium) of the fuel engine part, it gives two supports the one is sustainable against to the high temperature and two is protect the corrosion problem.

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