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REDUCTION OF WEAR IN VEHICLE PISTONS WITH COPPER OXIDE EFFECT AND EXTENSION OF MOTOR LIFE

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ABSTRACT:

Our vehicles equipped with internal combustion engines facilitate a significant part of our lives and are used in every area from transportation to industry, from trade to health. However, increasing the efficiency of these engines will contribute both economically and to the environment positively.

The frequent maintenance periods of the internal combustion engines increase the operating costs and shorten the service life. The heat caused by friction causes the gap between the metal atoms of the piston and the oxygen molecules that fill the cavities prevent the closure of cracks and disrupt the integrity of the metal. This distortion leads to fracture cracking and this leads to abrasion. Wear is a major problem in the engine and the revision costs of the engine increase due to wear.

In order to prevent erosion during the literature review of our project, we concluded that we should first prevent oxygen atoms from entering the piston. Many oils and additives are now used to prevent the introduction of oxygen molecules between metal atoms. Increasing the efficiency of these additives and finding new additives, increasing the efficiency of internal combustion engines or wherever the friction effect is seen means lowering the cost.

Thanks to the copper oxide solution in our school laboratory, our new lubricating liquid covers the pistons or the metals exposed to the friction and prevents the filling of the gaps during expansion by filling with oxygen atoms, thus preventing the onset of abrasion. The results of the surface roughness tests we conducted before and after the experiments support our idea and show that our experience was successful. Our lubricating fluid, which is more efficient than other oils, can be used in all metals and does not damage metals in the long term and its cost is lower than other oils and additives.

Key words: friction, metal wear, copper oxide, piston

Introduction

Friction exists in every aspect of our lives. Thanks to friction, heat energy sometimes presents with positive results and sometimes with negative results. The abrasion caused by friction is encountered in all mechanical systems and the mechanical systems are not working properly.

We aimed to reduce friction and wear effects with our project.

Corrosion is a natural process that converts a refined metal into a chemically more stable form such as oxide, hydroxide or sulfide. It is the gradual destruction of materials (usually metals) due to their chemical and / or electrochemical reaction with their environment. Corrosion engineering is the area dedicated to controlling and stopping corrosion.

Passivation is an ultra-thin corrosion products film, known as a passive film, there is no one interested in the barrier to further oxidation on the surface of the metal. The chemical composition and microstructure of a passive film are different from the underlying metal. Typical passive film types in aluminum, stainless steel and alloys are within 10 nanometers. The passive film differs from the cleaning layers on heating and is micrometer-thick - the passive film improves if it is removed or damaged when there is no oxide layer. Materials such as aluminum, stainless steel, titanium and silicon are passivated in air, soil and natural environments at moderate pH. [6]

Passivation is primarily determined by metallurgical and environmental factors. The effect of PH is summarized using Pourbaix diagrams, but many other factors are effective. Some conditions that prevent passivation include high pH for aluminum and zinc, the presence of chloride ions for low pH or stainless steel, high temperature for titanium (in this case dissolves into metal instead of oxide, electrolyte) and fluoride ions.

On the other hand, unusual conditions can cause passivation of materials that are not normally protected, as the alkaline environment of the concrete does for steel rebar. Exposure to a liquid metal, such as a mercury or hot solder, may frequently affect passivation mechanisms.

A piston is a component of piston engines, piston pumps, gas compressors and pneumatic cylinders as well as other similar mechanisms. It is a movable component located by the cylinder and gas sealed by piston rings. In an engine, the purpose is to transfer force from the expanding gas in the cylinder to the piston rod and / or the connecting rod to the crankshaft. In a pump, the function is reversed and the force is transferred from the crankshaft to the piston to compress or remove the liquid in the cylinder. In some engines, the piston also acts as a valve by closing and opening the ports in the cylinder. [8], [9], [10]

Materials

- Arduino Uno
- Stepper Motor (1200 Step)
- Steel Parts (1% Carbon)
- Copper Oxide (Chemical)
- Oleic Acid (Chemical)
- Centrifuge (3000 rpm)
- Magnetic Stirrer
- Laser Thermometer
- Table clamp: used to position the elements in the layout.
- Extension Clamp: Used to position the elements in the layout.
- 100 cm ruler: It was used to calculate the distance between the elements.

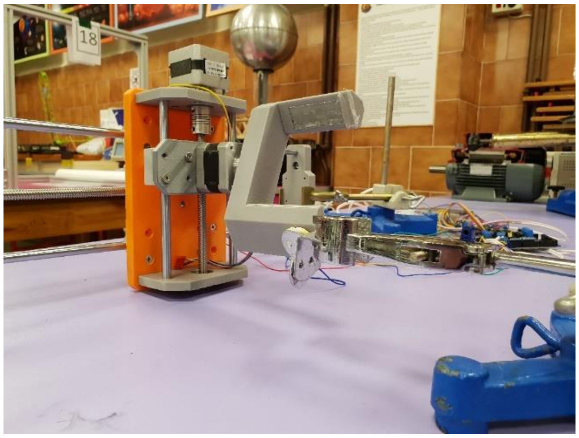
Method

The Set-Up

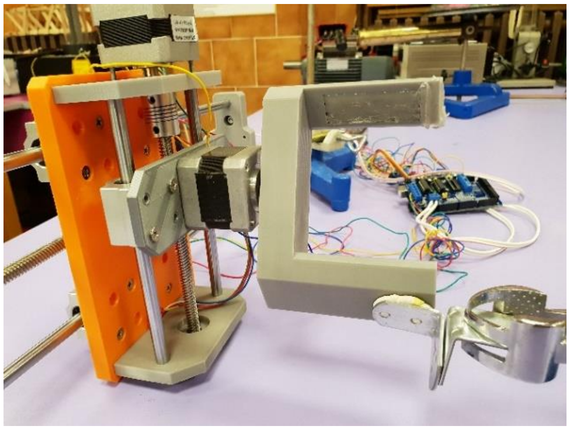
In order for the steel samples to rub against each other, a mechanism was set up to move back and forth with stepper motor, arduino and 3d printer. The steel samples are connected to the device so that they remain in the lubrication tank. Copper Oxide and Oleic Acid 50% copper oxide solution was prepared. The prepared solution was left at 24° C for 24 hours at 100 rpm. The prepared solution was left at 24° C for 100 hours at 100 rpm centrifuge. Specimens were first treated dry without any additives, then in copper oxide solution we prepared and in the market with boron doped and ceramic doped oil samples, each with 100,000 friction. Before the test, the samples were sent to the surface roughness test.

Our experiment was conducted in closed laboratory environment. Because our laboratory environment was under the ground, it was far from weather and was isolated. The working environment has been standardized in every trial by reducing all external factors that could cause data errors to a minimum.

The Process and Mechanisms



(Friction Test Assembly)



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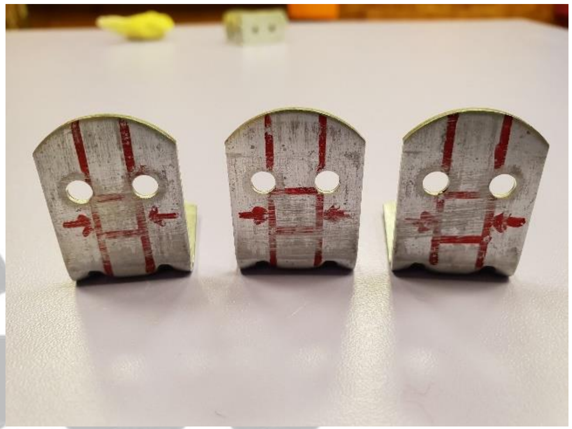


(Samples)

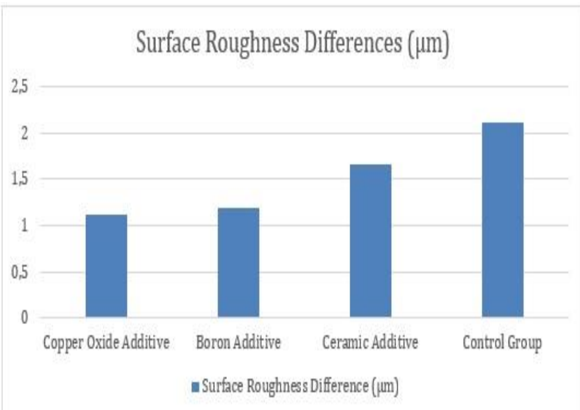
The Collection of Data

	Surface Roughness Before Experiment (µm)	Surface Roughness After Experiment (µm)	Difference
Control Group	0,574	2,688	2,114
Copper Oxide Additive	0,608	1,718	1,110
Boron Additive	0,566	1,748	1,182
Ceramic Additive	0,524	2,184	1,660

(Surface Roughness Measurement Values Before and After Experiments)

The values shown in the table are average values and the data in all experiments were taken and the data was averaged for each data 5 times. In this way, we have tried to find the right results by minimizing the possibility of errors.

As it is understood from the table, the control group showed a very large wear and the least wear value was added to the Copper Oxide. The best result in the commercially available additives was Boron doped oils with 32.4% protection, while ceramic doped oils remained at 24.0%. The copper doped solution we created was cheaper with 30.4% than the boron additive.



(Surface Roughness Quantities According to Additive Types)

Results and Discussion

The results of our experiment can be summarized as follows.

1. In order to reduce friction and wear, oxygen should not be in contact with friction or heat.

2. It has been found that the best coating material on the pistons is the copper oxide solution and the oils added to this solution have higher yields.

3. Boron doped oil is more efficient than ceramic doped oil and the pipe is attached to the steel to form a more permanent film.

4. It has been concluded that the rate of film formation on each steel is different and that the maximum protection of copper oxide is the highest protection and that the oxygen effect of metal wear is reduced.

In our project, the steel samples were chosen as the same material used in the vehicle pistons and the number of piston friction was imitated. In this way, our error in the experiment was achieved to a minimum. In the evaluations made according to the results of surface roughness measurements, we have seen that the most additive of the boron additive and ceramic additives in the copper oxide additive of the least abrasion is in our dry additive experiment.

The cost of the copper oxide solution we made was much lower and the efficiency was much higher than the additives in the market. In this way, we have produced a domestic and cheap solution against friction and abrasion.

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