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INVESTIGATION OF PERFORMANCE IMPROVEMENT OF INTERNAL COMBUSTION ENGINES USING NEW OIL ADDITIVES.

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ABSTRACT

A new oil additive is tested to justify its influences on the performance of the Internal Combustion Engines (ICE). This additive belongs to the fluoroplastics group. It contains polytetrafluoroethylene (PTFE), Some forms of which were developed before in USA under the brand names Teflon, Fluon or Hostaflon. Also a high-polymer form of PTFE was used for years in advanced bearing, clutch disk and valve stem packing design in the automotive industry, however its use was limited to components of racing engines. In this research low polymer PTFE is tried as an additive to ICE oils, to produce a self-lubricating coating on the concerned engine components. Tests are carried out to investigate the effects of PTFE on the behavior of ICE. The results reflected an increase of about 9% in the compression pressure, 6% in the oil pressure, 8% in the engine power. The results also showed a decrease in fuel consumption of about 4%, a noticeable reduction in engine noise, no contamination effects and no change in oil viscosity. It is concluded that the PTFE low polymers are deposited on the metal surface of the internal parts of the engine forming a durable slippery coat which significantly reduces the friction, consequently the wear, and improve the tolerances.

1.INTRODUCTION

Wear of the cylinder-piston assembly is an important factor which is seriously deteriorating the ICE technical state. It appears as a result of the severe operating conditions of the working space inside the cylinder (Temperature, pressure, corrosion, rubbing, knocking, burnt deposits and oil, overheating and mismatch of the thermal expansion coefficients of piston and cylinder,....). As the wear increases, leakage of oil and gases take place,affecting the performance and engine rebuilding will be a must. Several attempts were made to avoid rebuilding costs by diminishing the wear to the minimum value.

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This was accomplished by some kinds of oil treatment, the effect of which expires by the oil changing. With the increasing demands of the application of polymers, fluoroplastics group was introduced and have a proven record of success in practically all branches of industry due to their remarkable properties. From this group, polytetrafluoroethylene (PTFE) was developed more than 40 years ago in the USA and has since become known under the brand names "Teflon", "Fluon" or "Hostaflon". High-polymer PTFE has been used for years in advanced bearing, clutch disk and valve stem packing design in the automotive industry. The practice of coating certain engine components is also many years old. However, these material improvements are mainly limited to components of racing engines. In this process the coating must be stoved after application. PTFE was developed for spacecraft. It is used for instance for space shuttle COLUMBIA, especially in its engine and on its outer hull for decrease of friction. In this research low molecular PTFE is used as an additive to motor oils to produce a self-lubricating coating on the parts of the engine, transmission and differential simply by reason of the pressure and temperature existing in the engine when running, thus obviating the need for any work to be done on the engine for this purpose. Interest in these additives as a means of making better use of available energy has been sparked by recent petrol price hikes. Tests [1] were conducted to measure the consumption of oil and fuel afterusing the additive. These tests showed a considerable reduction in oil and fuel consumption. Other tests [2] used the scanning electron microscope to demonstrate the coating, micro analytical determination of fluorine to demonstrate the PTFE and the radio isotopes to demonstrate the reduction in wear. The reduction in wear of the piston ring friction surface was reported to be 54%.

2.THE OIL ADDITIVE

The oil additive contains solid PTFE particles as well as liquid cleansing substances which dissolve the deposited dirts and give rise to a shiny metallic surface before a solid, long-lasting PTFE coating can form. The PTFE particles have the size of 0.2 to 0.3 micron, and can agglomerate up to 5 microns. The dry coating in the engine reaches up to that thickness. Long-time micro filters have an average permeability of 10 to 15 microns. Hence there is no danger that PTFE gets filtered out or that the filter chokes up. For old or dirty engines, a filter change is recommended once more after the application of the additive during the cleaning period, in order to get the dissolved dirt removed out of the engine. The application of the additive is recommended at the moment when the engine performance start to deteriorate. The additive then has the value of an engine overhaul.

3. DEMONSTRATIVE TESTS AND RESULTS.

A Fiat-128 GLS, 5 speed, model 1991 car with about 30,000 Kilometers covered distance was used to conduct the demonstrative tests in the Automobile department of the Military Technical College. Each test was performed twice, once before adding the oil additive and another after 2500 kilometers covered with the oil additive added. The additive is mixed with engine oil during oil change in a ratio of 1:4 with the engine warm and the oil filter replaced (It has not to be added in each oil change, only when performance decrease). The engine should be run at least 20 minutes after adding the additive. The following tests were performed to investigate the effect of the oil additive on the engine behavior. Each test was done at the same operating conditions before and after adding the oil additive. These tests are standard [3],[4],[5],[6],[7].

3.1. Compression Pressure Test.

The compression pressure test measure the amount of pressure that is formed by the piston moving up on its compression stroke and how well the cylinder is sealed. The device used for this purpose is shown in figure (1), and the results are shown in figure (2). Before using the additive, the recorded pressure in the cylinders is : 7.6, 7.6, 7.6 and 7.8 Kp/cm^2. After using the additive, the recorded pressure in the cylinders is : 8.45, 8.6, 8.4, and 8.4 Kp/cm^2 respectively. These results reflect an increase in the compression pressure of a maximum value of 9%. This is due to the deposited layer of PTFE on the cylinder wall which increase the tightness of the cylinders.

3.2. Oil Pressure Test.

This test measures the value of pressure of oil after passing through the filter and before entering the main gallery. It is performed when there is a reason to believe that the oil pressure is not correct. The pressure gauge used for this purpose is shown in figure (3), and the results are given by figure(4). The results show an increase in the oil pressure of a maximum value of 6% after adding the oil additive. This is due to the deposited layer of PTFE on the walls of the oil passage.

3.3.Checking The Engine Noise.

Each of the moving parts in the engine has a unique sound. Change of the sound of any part is an indication of some trouble. The purpose of this test is to hear the different sounds of the moving parts, and to notice the change in the level of noise after adding the oil additive. For this purpose, the stethoscope shown in figure(5) and a tape recorder were used. Places of moving parts (piston, bearings, crankshaft and camshaft) were checked. It was noticed that the noise level is relatively reduced after adding the oil additive. This is due to the decease in friction between the moving parts brought by the slippery coating deposited on the internal surfaces covered by the engine oil.

3.4.Checking of CO and HC Contents in Exhaust Gases.

This test is performed using the exhaust gas analyzer to measure any change in the CO (Carbon monoxide) and HC (Hydrocarbons) contents brought by the addition of the oil additive. The CO and HC levels should be within the range permitted by the government legislation and consistent with good engine performance. The results are given in table (1), which indicate that the oil additive has no influence on the CO and HC levels, hence no contribution to air pollution.

3.5.Fuel Consumption Test.

The fuel consumption before and after adding the oil additive was measured. The results are given in figure (6). The results show a decrease of fuel consumption of a maximum value of 4% after adding the oil additive. This is due to the decrease of fuel lost in the mixture leakage to the crank case. This effect is mainly due to the tightening of the cylinder working space brought by the deposition of PTFE layer on the cylinder wall.

3.6.Engine Performance Test.

This test was done to investigate the effect of the oil additive on the power. The brake dynamometer HPA 107 was used for this purpose. The results are given in figure (7). These results show an increase of a maximum value of 8% in the engine power. This results from the increase in compression pressure [8], decrease of friction of moving parts and better utilization of fuel energy. These of course are due to the tightening effect and the slippery property of the oil additive.

3.7.Heat of Engine Test.

This is to measure the rate of temperature increase for fixed operating conditions. The time elapsed for the pointer to reach the middle of the temperature scale was measured while fixing the engine speed. Before adding the oil additive the time measured was 7 minutes, while that measured after adding the additive was 7 minutes and 20 seconds. This is due to the deposited coating of PTFE on the cylinder wall, slightly decreasing the heat transfer from inside to outside the cylinder.

3.8.Checking of Engine Oil.

Due to the tightening effect of the PTFE layer, the leakage of oil and gases through the piston rings is expected to be diminished. A specimen of engine oil, after adding the oil additive and before the oil change, was tested for acidity and was found to be neutral. This proves that the additive has no harmfull effects on the engine. Two specimens were tested for viscosity, for the same operating conditions, before and after using the additive. the viscosity was found to be approximately the same. Thus the oil viscosity is not affected by the oil additive.

4.CONCLUSIONS.

The PTFE low polymers contained in the additive and mixed with engine oil are deposited on the internal surface of the engine due to the high specific gravity, in the form of minute particles similar to a consistent coating. As the metal surface is microscopically uneven and constituting hills and valleys, the PTFE particles nest in the valley (forming a solid durable slippery coating which is not washed away at the next oil change). The particle size of an average 0.004 (mm) is suitable for the roughness prevalent for stick slip surfaces. This PTFE coating improves the tolerances and thus the running properties of the engine, while the anti-stick feature of PTFE prevents deposits such as burnt oil. At the same time PTFE behaves absolutely neutral towards all substances such as fuel, oil, water and carbon dioxide. Engine motion is improved and abrasion is considerably reduced accordingly. Tests were conducted at the same operating conditions, before and after adding the oil additive, to demonstrate its influence on the engine behavior. The compression pressure was found to increase by a maximum of 9% due to the tightening effect of PTFE layer. The oil pressure is increased by a maximum of 6% due to the deposited PTFE layer on the walls of the oil passage. The noise level is relatively reduced due to the decrease in friction between moving parts. The additive was found to have no contribution to air pollution.

The fuel consumption is reduced by a maximum of 4% due to the decrease of fuel lost in leakage because of the tightening effect. The engine power is increased by a maximum of 8% due to the increase of the compression pressure and decrease of friction. The heat transfer through the cylinder is slightly reduced by the PTFE deposited layer. The additive was found to have no harmfull effect on the engine parts and no effect on oil viscosity.

5. REFERENCES.

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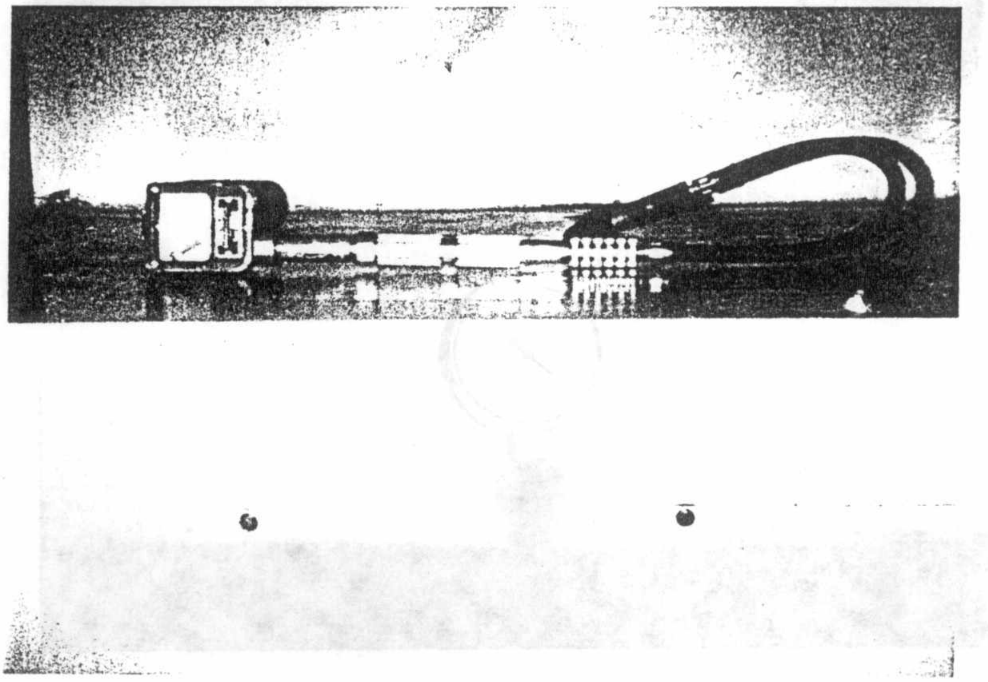
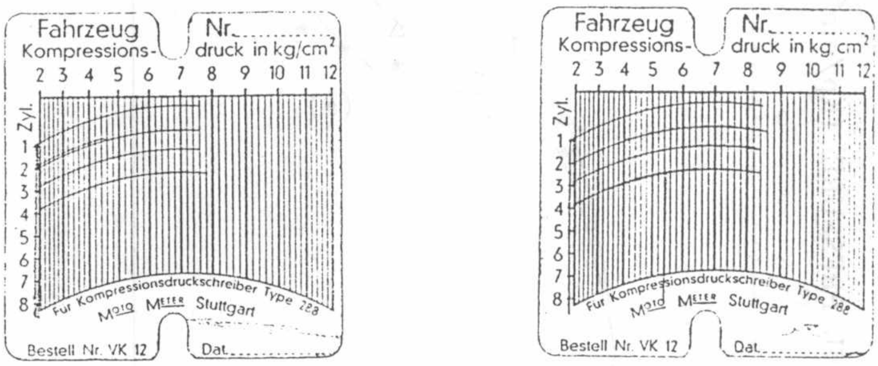


Fig.(1): The Recording Device Used in
Compression Pressure Test.



(a)

(b)

Fig.(2): Results of Compression Pressure Test:-
(a). Without Additives (b). With Additives

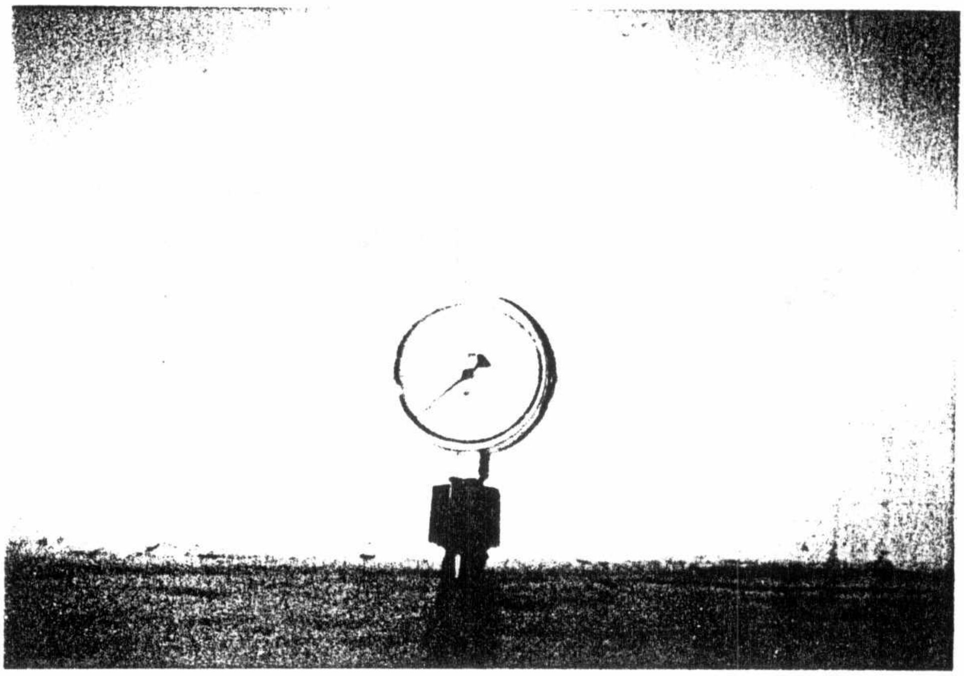
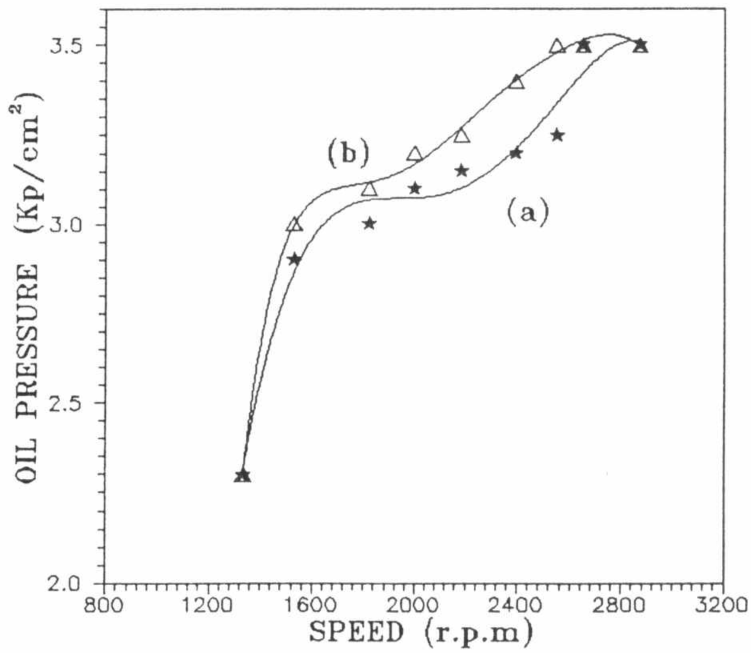


Fig.(3): Pressure Gauge For Oil Pressure Test.



Fig(4) Results of oil pressure test:
(a)-Without additive. (b)-With additive.

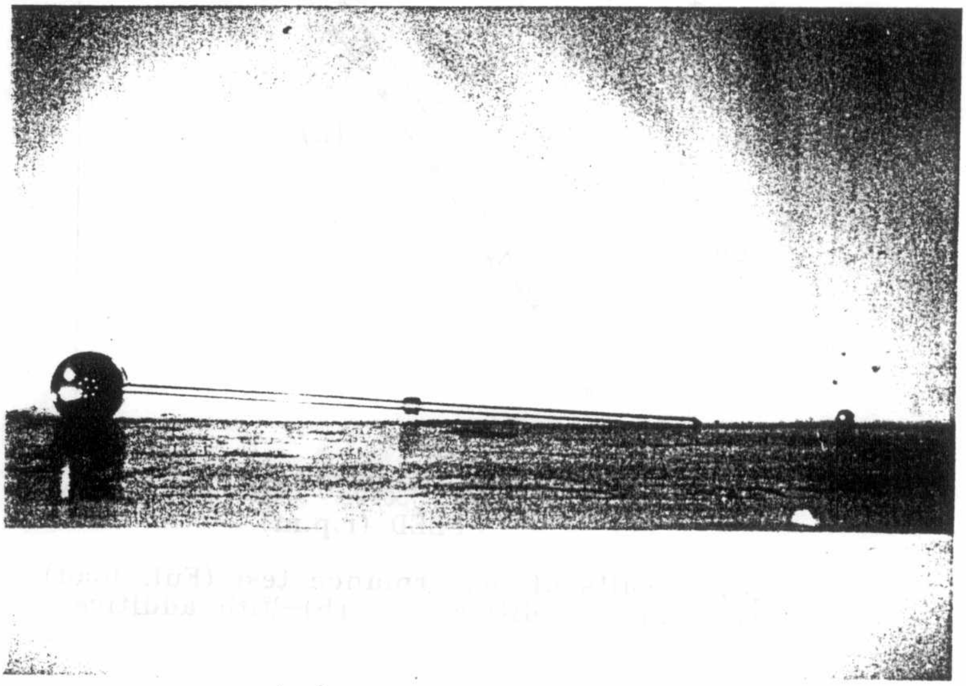
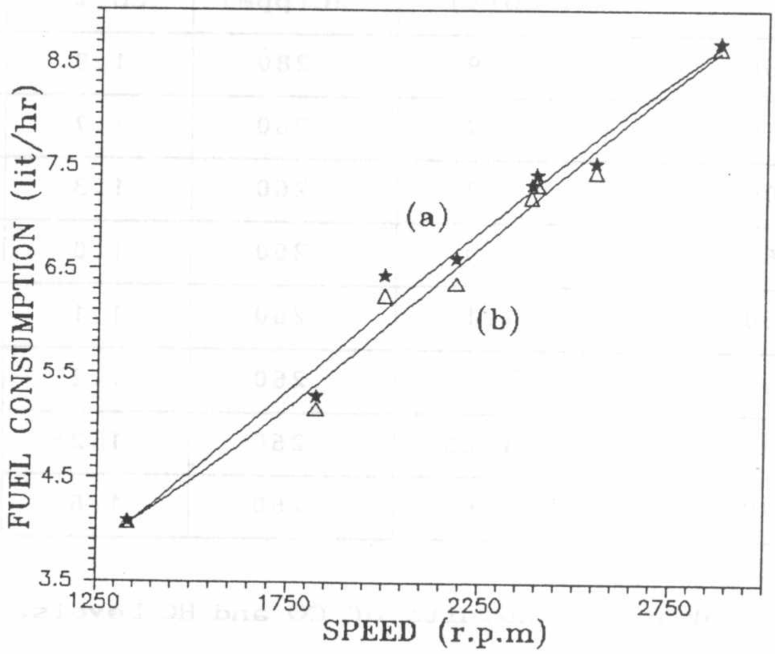
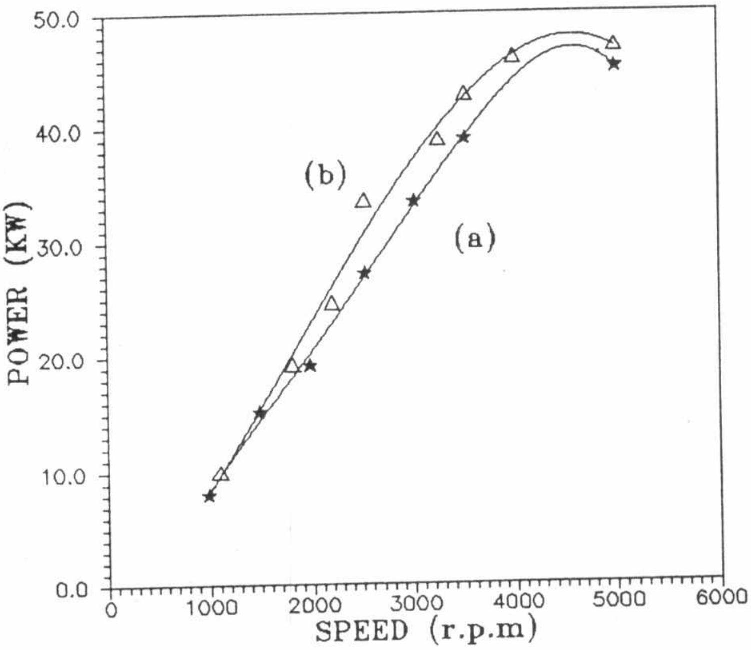


Fig.(5): Stethoscope For Checking of Engine Noise.



Fig(6) Results of fuel consumption test:
(a)-Without additive. (b)-With additive.



Fig(7) Results of performance test (Full load)
(a)-Without additive. (b)-With additive.

Engine Speed r.p.m.	Without Additives		With Additives	
	CO(%)	HC(ppm)	CO(%)	HC(ppm)
660	1.9	280	1.9	280
670	1.7	260	1.7	260
1500	1.3	260	1.3	260
2160	1.0	260	1.0	260
1860	1.1	260	1.1	260
1710	1.2	260	1.2	260
1570	1.25	260	1.25	260
970	1.6	260	1.6	260

Table (1): Results of CO and HC Levels.