Evaluation Of Internal Combustion Engine Parts Wear By Mechanical Contamination Contained In The Engine Oil

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***Abstract*— The working resources of the machinery operating in agricultural and mining site of field work in Mongolia are changed in the wide ranges of utilization condition and there are various factors that affect them. The produced technology, fuel used, engine oil quality, terms of use and environment conditions are important role for internal combustion engine parts wear. In this paper presented are experimental results on evaluating wear contamination particles (Fe, Al, Cu, Pb, Sn, Cr, Ni) in the internal combustion engine oil using the atomic emission spectrometer analysis.**

***Keywords*— wear elements; engine oil analysis; particle contamination and regression analysis;**

I. INTRODUCTION

In my country, machine and equipment, their spare parts, lubricating oils get to import from abroad. Recently, all of the kind of auto motive's numbers increase high. In regarding my country that has a dry and arctic climate, machine technics with high price.

Due to that, analysis of oils, based on properly defined program, represents a very effective method for monitoring the state of technical systems, which ensures early warning signals of potential problems that could lead to failure and break down of the technical systems. Using Oil Analysis programs for engine oils has several benefits: reduction of unscheduled vehicle downtime, improvement of vehicle reliability, help in organizing effectiveness of maintenance schedules, extension of engine life, optimization of oil change intervals and reduction of cost of vehicle maintenance.

II. MATERIAL AND METHOD OF RESEARCH STUDY

Aim of our research study is appreciate for wear rating of spare parts by content of metal particles in the internal combustion engine oil.

A. *Inductively Coupled Plasma-Atomic Emission Spectrometry*

As an engine oil analysis technique used spectrometric investigation. This method can determine the elemental content of oil samples, including wear debris. There are several methods for the quantitative and qualitative analysis of elements in new and used engine oils: inductively coupled plasma atomic/optical emission spectroscopy or mass spectroscopy (ICP-AES/OES, ICP-MS), flame or graphite furnace atomic absorption spectroscopy (FF-AAS/GF-AAS) or energy/wavelength dispersive X-ray fluorescence spectroscopy (ED/WDXRFS).

We should emphasize the ICP spectrometer analysis. Inductively Coupled Plasma-Atomic Emission Spectrometry (ICP-AES) is one of the most common techniques for elemental analysis. Its high specificity, multi-element capability and good detection limits result in the use of the technique in a large variety of applications.

III. RESULTS OF THE RESEARCH STUDIES

Analysis of the contents of different metals that are in the lubricant is very important. Metal particles are abrasive, and act as catalysts in the oxidation of oils. In motor oils, the origin of the elements may be from the additives, the wear, the fuel, air, and liquid for cooling.

The engine oil samples were collected from the diesel engine operated in mining field excavator of Bucyrus RH340. Tested oil is Mobile 15W-40. The experiments were analyzed 9 times per hour for approximately 250-300 hours. Table 1. shows results of experimental expressed in ppm.

Table 1. Result of experimental, ppm

№	Equipment meter	Metal elements					
		Cu (copper)	Fe (iron)	Cr (chromium)	Al (aluminum)	Pb (lead)	Sn (tin)
1	2381	0	7	0	0	0	0
2	2667	1	9	0	2	1	1
3	2985	1	9	0	2	1	1
4	3420	0	3	0	1	0	1
5	3607	0	5	0	1	0	2
6	4148	22	15	0	3	1	1
7	4268	32	35	0	6	0	3
8	4736	11	23	0	2	0	4
9	4832	12	24	2	2	3	4

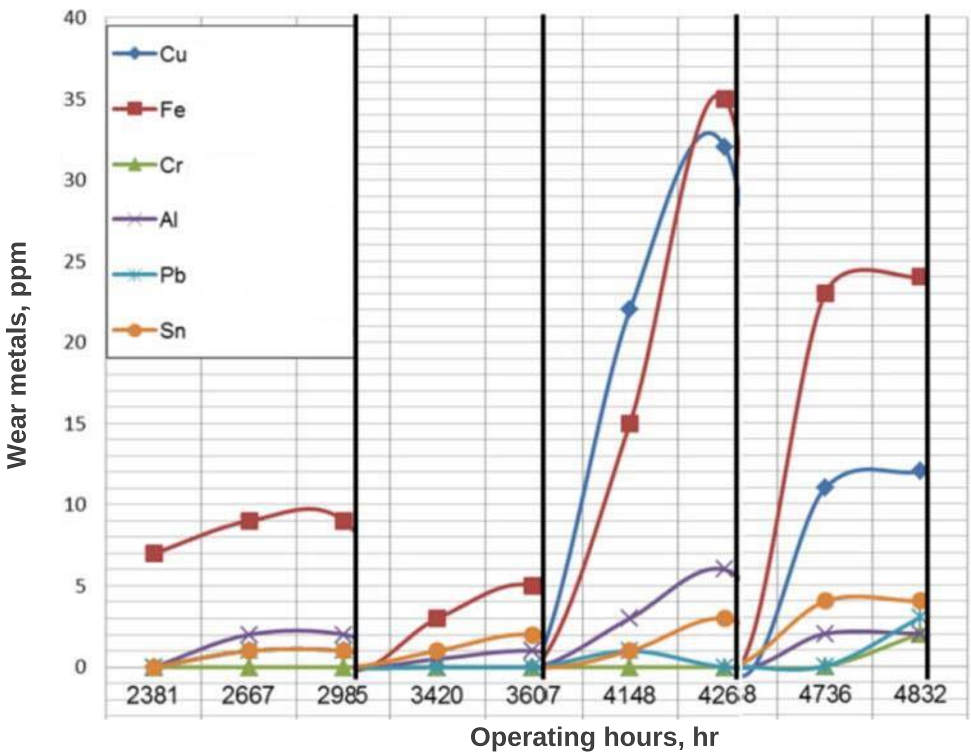

Figure 1. Content of wear metals in the used oil of diesel engine of Bucyrus RH340 excavator

As shown in Figure 1, black line is drawn the time for oil changed period, and it was increasing that Iron and Copper contents rather than other elements. These elements contain in most parts of the engine and indicative of components wear such as piston rings, connecting rods, crankshaft, engine block and bearing.

The following graph is a representation of the relationship between iron levels and operating hours of engine in one interval for changing the oil (Figure 2). This graph has confirmed that iron content in the engine oil was as dependence of operating hours of engine and it will be expressed as y=0.555x+6.465, and the linear fit has a coefficient of determination value of 0,91.

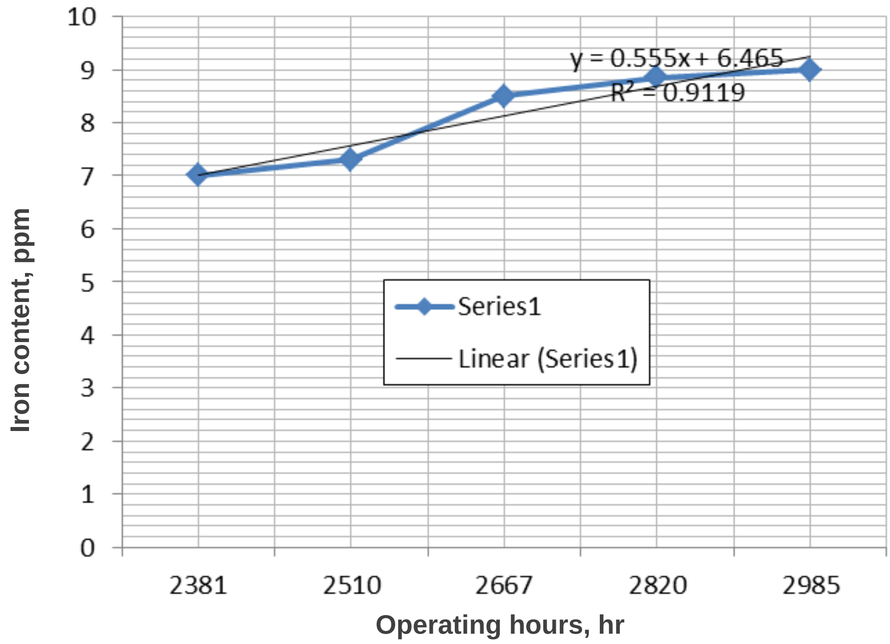

Figure 2. Content of Iron in the used oil of diesel engine of Bucyrus RH340 excavator

Iron (Fe): In engines, the cylinder liners and the crankshaft are the major wearing components along with timing gears, shafts and valves. In gearboxes and drive train components, iron is the major constituent of the gears, shafts and antifriction (rolling element) bearings. Finally, iron can also be a contaminant. When iron reacts with water (which contains oxygen) and atmospheric oxygen, rust can form, which may indicate contamination or component degradation. Rust, containing iron, can be formed in cooling systems. If an internal coolant leak occurs whereby the coolant comes into contact with the lubricating oil then the coolant may evaporate at working temperature and pressure whilst leaving coolant additives and contaminants behind in the oil. This will be covered in more detail under sodium.

The following graph is a representation of the relationship between copper levels and operating hours of engine in one interval for changing the oil (Figure 3). This graph has confirmed that copper content in the engine oil was as dependence of operating hours of engine and it will be expressed as $y=0.49x-0.57$, and the linear fit has a coefficient of determination value of 0,97.

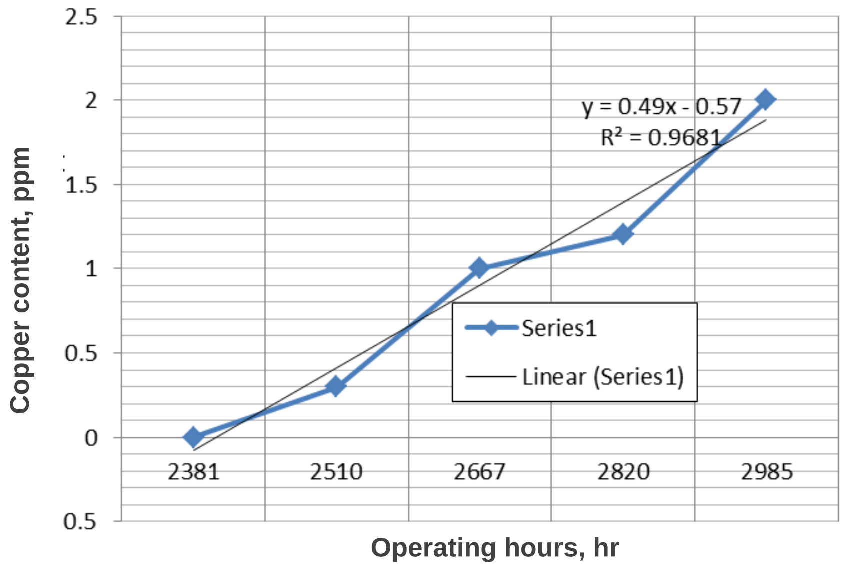

Figure 3. Content of Copper in the used oil of diesel engine of Bucyrus RH340 excavator

Copper (Cu): Copper has many wear metal sources although it, too, can be a contaminant and occasionally an additive. Copper comes from plain bearings, bushes, thrust washers, worm gears, sintered clutch packs and brakes. Anything with a 'yellow' metal component will contain copper. The alloy of copper and tin is called bronze whilst copper and zinc make brass. Bronze gears are frequently used as worm gears in worm drive gearboxes. Very high levels of copper can leach from oil coolers and radiators as a contaminant. Cooling system components are frequently made of copper and this can leach directly into the oil. This does not mean that the cooler is dissolving and it is not an indication of a problem. However, it can be a little disturbing to see several hundred ppm of copper in a sample suddenly appear in an oil analysis report. Copper can also leach into the water side of the cooler and if this water gets into the oil it can evaporate off leaving the copper behind which is an indication of a problem.

CONCLUSIONS:

We have evaluated the contamination of the wear products of the engine oil samples collected from the engines mounted to the excavators Bucyrus RH340.

We have confirmed that iron content in the engine oil was as dependence of operating hours of engine and it will be expressed as y=0.555x+6.465, and the linear fit has a coefficient of determination value of 0,91

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