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Evaluation of wear metals levels in engine oil recycled by composite solvents and cashew bark activated carbon extraction technology

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ABSTRACT

The experimental method adopted for the determination of wear metals in the 6 months used engine oil, and the recycled engine oil, was activated carbon extraction technology using activated carbon from *Anacardium occidental* bark. The research began with samples collection and preparation. The engine oil was then recycled and analysis on the wear metals of the recycled engine oil such as Iron (Fe), Copper (Cu), and Lead (Pb), were determined using atomic adsorption spectrometry (AAS) and compared with a fresh engine oil using ASTM specifications.

Keywords - Anacardium occidental, atomic adsorption spectrometry (AAS), recycled engine oil, wear metals

1. INTRODUCTION

Engine oil is made from petroleum, it is a viscous liquid used in lubrication of mobile parts of engines and machines. They are used to reduce friction of mobile parts of machinery by a process of inter-positioning a thin film between the surfaces. They keep the machine clean, prevent rust and remove heat. They help to protect rubbing surfaces and promote smooth motion of machine parts, reduce friction, protection against wear and tear, and removing contamination from engines, act as a cleansing agent, and act like a cooling agent, and an anticorrosion agent, also as a medium to eliminate high accumulation of temperature on the moving surfaces. Metal parts worn-out from the surfaces and dirt are dump into the oil, with more time of usage, it loses its lubricating properties due to over-reduction of the wanted properties and so should be evacuated and a fresh engine oil replaced [1].Engine oil is petroleum products that lubricates the metal parts of engines, reduction of frictions and keep it fresh. The oil is for lubrication of engine to avoid wear and overheating [2]. It is a substance added between two surfaces in relative motion to reduce friction, improve efficiency and decrease wear. It prevents direct contact of gliding surfaces and hence reduces wear of the surfaces [3]

Analysis of wear metals levels in engine oil was introduced to check the failure of the engine parts prior to total damage. Wear metals such as Fe, Cu, and Pb in engine oil, indicate wear and tear of the engine parts. Used engine oil may contain wear metals particles of different concentrations of the dissolved metals[4].

Trace metals and metallic fragments found in used engine oil possibly comes from wear and tear of mobile parts of machines, Sand and dirt may be introduced into used engine oil during transit [5]. Road dust contaminants in engine oil passes into the engine via the air cleaner. It composes of tiny particles of silicate [6]

The machine parts are made of iron, lead, copper, etc. During friction of the machine parts, the wear of these metals in parts per million (ppm), are found in the used engine oil [7].Tetraethyl Lead that is added as an anti-knock in fuel, passes into the engine oil. Lead also comes from wearing of bearings. Copper, Iron and Aluminum released due to engine wear are also contaminants found in used engine oil [6].

The study aimed to determine the wear metals in used engine oil, and compared with recycled used engine oil.

2. MATERIALS AND METHODS

2.1. Sample collection

Anacardium occidental bark, the source of the activated carbon was obtained from *Anacardium occidental* tree and was identified in the department of Animal and Environmental Biology, University of Port Harcourt.

The 6 months used engine oil which was recycled and the new engine oil used for value comparison were both obtained from a mechanic shop at Choba Park in Rivers state, and identified in the department of Pure and Industrial Chemistry, University of Port Harcourt.

2.2. Sample preparation

The used engine oil was filtered using a funnel with a filter paper placed in it to remove impurities. The *Anacardium occidental* bark was sun dried for 72 hours, and ground to smaller particles, sieved with a mesh of size 500×10-6m. 200g of the sample was made into slurry with 80cm. 3 of distilled water and followed by the addition of 60ml of 0.35M solution of H_2SO_4. The slurry was left for 48 hours and then washed several times with distilled water. The washed sample was then dried in an oven for one hour at 45 °C. The sample now activated is then carbonized at 600 °C, to get activated charcoal.

100 ml of the used engine oil samples was mixed with composite solvents of methanol and nHexane (70% of methanol and 30% of nHexane made up the solvent) in the ratio of 5:1 with KOH (3g). The mixtures were thoroughly stirred for 30 minutes and heated in the mantle at 60 °C and at an atmospheric pressure to remove light hydrocarbons. The mixture was then settled in a separation flask for 24 hours. The oil-solvent mixture of the used engine oil was separated, and heated at 120 °C to remove any remaining solvent in the mixture.

The engine oil collected from the oil-solvent mixture was mixed with of *Anacardium occidental* activated carbon, and then heated at 150 °C for 1 hour 30 minutes. The heated mixtures were left for 2 hours for gravity settling. It was thereafter filtered with a filter paper to recover base oil.

2.3. Test Analysis

Metal content analysis was done by Atomic Absorption Spectrometry (AAS). Lead (Pb), iron (Fe), and copper (Cu) metal fragments concentrations were identified from the calibration that was obtained. All analysis was conducted at Olembe Research Laboratory Asaba, Nigeria.

3. RESULTS AND DISCUSSION

The activation of *Anacardium occidental* was done successfully. The *Anacardium occidental* activated carbon absorbent is used to absorb any trace metals found in the used engine oil due to wear and tear of machine parts from friction. It is also used to remove colour and odour in the recycled engine oil.

The results of the research shows a very high concentration of wear metals in 6 months used engine oil which can pose as environmental pollutants. From the research, the reduction in the level of wear metals from the recycled engine oil was very high, using activated carbon from *Anacardium occidental* bark. The wear metals levels of the used engine oils were compared with the recycled engine oil using Atomic Absorption Spectrum (AAS). This showed a reduction in the wear metals levels in the recycled engine oil, and by this, the recycled engine oil could be reused.

The iron (Fe) content was reduced from 88.68 to 10.32 ppm; copper (Cu) was reduced from 42.84 to 3.20 ppm and the lead (Pb) was reduced from 0.93 to <0.01 ppm (figure 1 a, b, c). The machine parts are made of iron, lead, copper, etc. During friction of the machine parts,

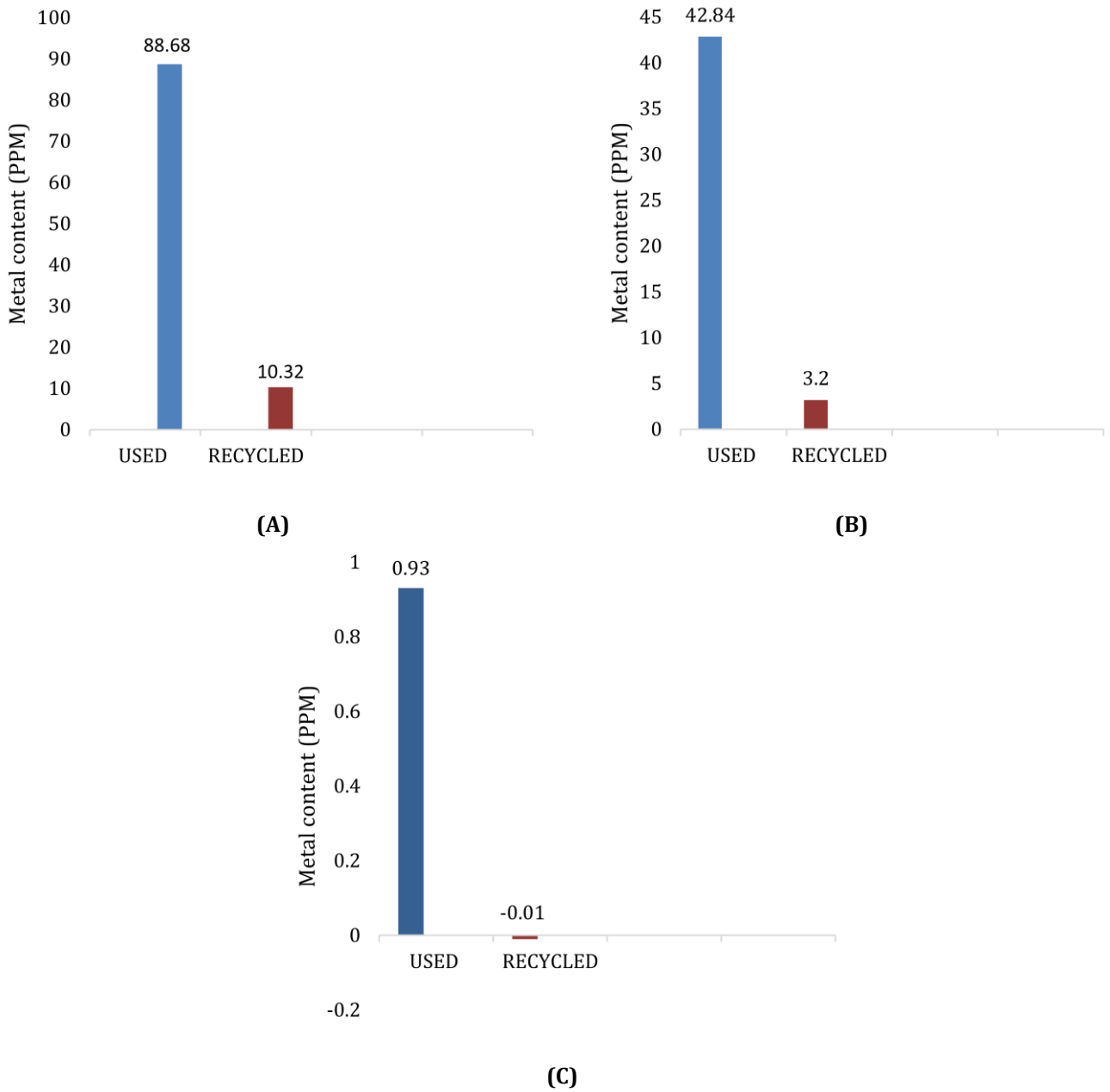

Figure 1. (A) Fe absorption on the 6 months used engine oil; **(B)** Cu absorption on the 6 monthsused engine oil; **(C)** Pb absorption on the 6 months used engine oil

Table 1. The metal content absorption on theused engine oil

Metal content (PPM)	Used engine oil	Recycled engine oil
Fe	88.86	10.32
Cu	42.84	3.20
Pb	0.93	<0.01

the wear of these metals in parts per million (ppm), are found in the used engine oil [5].

This result is consistent with the previous works. The wear metals for contaminants waste and recovered oil showed indistinct distribution [7-8]. The management of used engine oil is particularly better for use because the potential for direct re-use, reprocessing, regeneration and detrimental effects on the environment. Recycling of waste lubricants could result in both environmental and economic benefits [9-10].

4. CONCLUSION

The wear metals levels determination process, has shown the possibility of recovery good quality engine oil from used engine oil. The recycling of used engine oil is cost effective, which is relatively low compared to its production from crude oil. The source and collection of used engine oil was highlighted and indicated.

5. ACKNOWLEDGEMENT

NA

6. CONFLICT OF INTEREST

The authors have declared that there is no conflict of interest.

7. SOURCE/S OF FUNDING

NA

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