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|  <p>ISSN NO. 2320-5407</p> | <p>Journal Homepage: - <a href="http://www.journalijar.com">www.journalijar.com</a></p> <h2 style="text-align: center;">INTERNATIONAL JOURNAL OF<br/>ADVANCED RESEARCH (IJAR)</h2> <p style="text-align: center;">Article DOI: 10.21474/IJAR01/10054<br/>DOI URL: <a href="http://dx.doi.org/10.21474/IJAR01/10054">http://dx.doi.org/10.21474/IJAR01/10054</a></p> |  <p>INTERNATIONAL JOURNAL OF<br/>ADVANCED RESEARCH (IJAR)<br/>ISSN 2320-5407<br/>Journal Homepage: <a href="http://www.journalijar.com">http://www.journalijar.com</a><br/>Article DOI: 10.21474/IJAR01/10054</p> |
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### RESEARCH ARTICLE

#### MANAGEMENT OF USED ENGINE OIL IN AUTO AND MOTOR REPAIR GARAGES IN OUAGADOUGOU, BURKINA FASO.

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#### Manuscript Info

##### Manuscript History

Received: 12 September 2019

Final Accepted: 14 October 2019

Published: November 2019

##### Key words:-

Awareness, Developing countries, Education, Management, Used engine oil.

#### Abstract

Environmental contamination by used engine oil is common in developing countries, causing various occupational health hazards. In this study, a structured questionnaire was administered through personal interviews on the common practices of disposal of used engine oil among motor and auto garage workers in Ouagadougou, Burkina Faso.

Results showed that the majority (30%) of the garage workers have never had any form of formal education. While most of them (93.33%) have never had a training on handling and disposal of used engine oil. Among the respondents, 96.7% indicated they do not use any personal protective equipment when handling the used engine oil, and 93.33% do not change their clothes after handling used engine oil. The awareness among garage workers regarding the health and environmental impacts of used engine oil is very primitive. Only 64.17% of respondents are aware that used engine oil could adversely affect human health, but are not aware of its carcinogenic and mutagenic potentials.

Results obtained from this survey emphasize the need to take garage workers' education as priority. Furthermore, there is a need to encourage research into the occupational health risk and the impacts of used engine oil on soil microorganisms.

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#### Introduction:-

Lubricating oils are used in many types of machines to minimize friction, heating and wearing by preventing metal to metal contact between moving parts, especially in internal combustion engines and gears. Lubricating oils minimize needed repairs and maintenance, and extend machine life. Annually, the modern world's demand for lubricants is about 40 million metric tonnes [1] and this is expected to grow approximately 0.5% per year. Lubricating oil must be removed and changed from vehicles at the maximum number of driven miles, given by the car manufacturer. This generates used oil that is also called used engine oil, spent lubricant or waste engine oil.

Used engine oil can be recycled to base lube oil by proper recycling process. The recycling of used engine oil involves removing impurities, such as polycyclic aromatic hydrocarbon (PAH), heavy metals (HMs), and total

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petroleum hydrocarbon (TPH), and bringing the oil back to its original state. The presence of these impurities qualify the waste oil as environmentally hazardous [2] and unacceptable for landfills, thus should be collected and treated for reuse. The recycling of used engine oil is a great source of energy. For example, 1 liter of used engine oil re-processed as fuel contains about 8000 kJ of energy, which is sufficient to light a 100 W bulb for 1 day, or to operate a 1000 W electric heater for 2 h [3] However, less than 45% of used engine oil is available for collection and the remaining 55% are dominated by either misuse or improper set-up in the field [4].

Despite the benefits derived from their recycling, used engine oil and their degradation products can enter into the environment through runoffs [5], thus posing a risk to aquatic organisms; human beings may also be affected through direct contact or the consumption of contaminated vegetables and animals from such polluted environment. Many researchers have identified different adverse effects of used engine oil on health of garage workers' in developing countries. These include hematological disorders and decreased erythrocyte, hemoglobin, hematocrit, and platelet levels, and increased blood pressure [6], [7]. These cases have been reported in Egypt and Nigeria. Environmental contamination by used engine oil has been reported in many developing countries. For example in Nigeria, pollution arising from the disposal of used engine oil is one of the important environmental problems. [8] reported severe soil contamination caused by indiscriminate dumping of engine oil at the Abakaliki Auto-Mechanic Village, Nigeria. The soil analysis revealed high concentrations of PAHs. In India, water pollution by lead and cadmium at the vicinity of auto garages has been reported [9]. The major factors leading to the environment contamination by used engine oil include mishandling, deliberate disposal, spilling and leakage [4].

In Burkina Faso, a total number of motorcycles was estimated at 1,525,000 in 2014 with an increase of 238,342 new motorcycles per year [10]. In Ouagadougou, Burkina Faso, a great quantity of used engine oil is generated in the motor and auto garages. However, there is limited information on how these wastes are handled and disposed of, such that the environment is not adversely impacted. Such information, particularly in Burkina Faso, can be important to finding out critical points of intervention to promote safety in garages and limit exposures. Therefore, the objective of this study was to assess the management of used engine oil among motor and auto garage workers in Ouagadougou, Burkina Faso. Such information obtained may be relevant to all sectors in sub-Saharan African countries where used engine oil is generated.

### **Materials and Methods:-**

The study was conducted from July to September 2018 among auto and motor repair garages in the 12 districts of Ouagadougou, Burkina Faso. Ouagadougou is the capital city of Burkina Faso. The last population survey, in 2006, estimated that Ouagadougou has a population of 1,475,223, and 308,380 households. This population was projected to reach 2,388,725 in 2017 [11]. The population is spread across 12 local government areas. A total number of motorcycles was estimated at 1,525,000 in 2014 with an increase of 238,342 new motorcycles per year in the traffic [10]. Ouagadougou can be considered as the city with the largest engine oil consumers in the country according to the great number of cars and motorcycles.

#### **Data acquisition**

Data were collected by means of a structured questionnaire administered via personal interviews. This method was used because most of the respondents did not have formal education and many of those who had some education might not be familiar with the terminologies used in the questionnaire. The questionnaire contained both fix-response and open-ended questions about the knowledge, attitude and common practices among garage workers. The questionnaire contained a number of multiple choice tests from which respondents were asked to choose the answer which they thought best described their attitude for each particular case. Besides closed questions, free space for alternative answers was also included in all questions. The questions and the possible alternative answers were read to interviewees by the interviewers who ticked the given answer(s). The interviews were conducted in a friendly way and there was very good cooperation.

To avoid any potential bias, the auto and motors garage workers were informed that the study was only for academic research. All auto and motors mechanics who participated in the survey were full-time auto and motors mechanics earning off their income mainly from this activity.

The questionnaire was designed to collect information of respondents such as age, sex level of awareness, precautionary mode and factors that will improve the health factors of auto-mechanics.

**Statistical analysis:-**

The raw data from the questionnaires were entered into the statistical package R version 64 3.3.3. The frequencies of answers were calculated for each question. Relative frequencies were compared using the chi-square test to determine significant differences in the proportions of given answers. Mean differences were declared significant at the 95% confidence level.

**Results:-**

The respondents' ages were between 18 and 57 years with an average of  $29.18 \pm 7.66$  years and a coefficient of variation (CV) of 0.26%. (Table 1). The largest group of respondents was within the age group of 18-30 (55.8%), followed by those within the age group of 31-40 years old (39.1%). The two groups together comprised 94.9% of the respondents. The survey also revealed that 30% of respondents have never attended school (Table 2). While a proportion of 35.83% have a secondary education, and 31.67% have a primary education, only 2.50% have a tertiary education. Irrespective of their levels of education, 93.33% of respondents never had a training on handling and disposal of used engine oil (Table 2).

After collection, 55.84% of respondents reported storing the used engine oil for a maximum of 1 month. But 40% of them are unsure of the length of the storage period. Storage could be in plastic tanks (81.67%) or metal tanks (16.67%) for later reselling (88.33%), dumping (1.67%) or other purposes (3.33%). Up to 67.50% of respondents are aware that the used engine oil could be recycled (Table 3). The survey further revealed that the majority of the respondents (80.83%) are aware that the used engine oil could have some effects on the soil (Table 4). All garage soils were contaminated by used engine oil at high (33.33%), moderate (35.00%) or low (31.67%) levels.

Only 3.3% of the respondents used personal protective equipment when handling the used engine oil. Majority (93.33%) do not change their clothes after handling used engine oil. After handling used engine oil, 94.17% of the respondents wash their hands before meals, mostly using water and soap (92.50%). The survey further revealed that 64.17% of respondents are aware of the impact of used engine oil on human health. But only few are aware that the used engine oil could get in the body through ingestion (35%), breathing (50.83%) or skin contact (36.67%) (Table 5).

**Discussion:-****Effect of farmers' age and educational levels on management of used engine oil**

A survey was carried out to investigate the management strategies of used engine oil among auto and motor repair garages in the 12 districts of Ouagadougou, Burkina Faso. The survey showed that majority of auto and motor repair activities are performed by younger (18 to 40 years old) than older individuals. This could be because activities involved in the mechanic garages require high labor that is easily performed by young people. [12] found that most of garage workers in Nigeria were from 30 years old and above. This was explained to be caused by the high rate of unemployment. Also in Ethiopia, the majority (43%) of garage workers were found to be about 28-37 years old [5]. Poor education among the auto and motor garage workers in Ouagadougou could be due to the availability of a number of casual jobs that do not necessitate any formal education. Interestingly, exposure to used engine oil has been found to limit academic achievement among children and adolescents [13], with the later affected more. In the present study, only 2.5% of respondents have a tertiary education. In the survey by [12], about 73.2% of garage workers did not complete secondary school education. In general, informal sectors in Africa is occupied by people that did not or partly completed formal education.

**Effect of garage workers' attitudes on handling and disposal of used engine oil**

Findings in this survey showed that most of the garage workers collected and sold the used engine oil. The selling of used engine oil should facilitate the implementation of used engine oil recycling facilities in this region, since used engine oil can be easily collected from the garage workers. In most cases, the sale of used engine oil usually serves as supplementary source of income for the garage owners. In Lebanon, 200 liters of used engine oil is sold for about 12 US dollars to a local waste-oil collection contractor who is responsible for re-processing the waste to fuel oil [4]. Prior to selling out, the used engine oil is usually collected and stored in plastic or metal tank. Storing of used oil creates a fire hazard. It is also dangerous to store used oil in containers for long periods of time. Many materials can degrade when in contact with used oil, increasing the risk of a spill. In our survey, very few garage workers reported dumping the used oil. Inappropriate disposal into open dumpsites, sewers, or drains as well as uncontrolled burning

and low-grade recycling [4] suggests potential entry routes into the environment causing soil, surface and ground-water contaminations.

#### **Awareness of garage workers on the impacts of used engine oil on environment and human health**

The awareness of garage workers regarding potential impacts of used engine oil on the environment is very primitive. The used oil is reused in many other ways which include spraying on roads as a dust suppressant, protecting timber posts and fences from termites, reduction of bad odor from pit latrines, for fuel in kitchen and industry, and cleaning tools, with little to no knowledge of its potential adverse environmental impacts. Majority are not aware of the possibility to recycle the use oil, but they are aware that the used engine oil can affect the soil. According to [14], the used engine oil increased soil bulk density and reduced gravimetric moisture content, total porosity and hydraulic conductivity; organic carbon and nitrogen were increased but available P, exchangeable K, Mg, Na and Ca were decreased.

Garage workers are less informed of the potential hazards of used engine oil on human health. This could justify the lack of a healthy attitude in the management of used engine oil. Most garage workers do not use protective equipment while handling the used engine oil, also they do not change their cloth after coming in contact with the used oil, thus increasing their chance of contact with the used oil. In Ethiopia, majority of the workers (80%) do not use any kind of personal protective equipment and did not follow safety measures [5]. According to the same study, 46.67% of garage workers had a habit of smoking, drinking, and eating at the garage where the used oil is kept, further increasing their chance of ingesting the used oil. Possible entry routes of chemical entry into the body are inhalation, ingestion and contact [15]. In Ethiopia, risk analyses revealed that more frequent and greater exposure was strongly associated with a higher occurrence of symptoms, and that lack of protective equipment and safety education was positively associated with acute adverse health effects [15]. The manifestations most frequently reported in people exposed to engine oil are respiratory defects, back pain, headache, and neurovestibular disorders [15].

#### **Conclusion:-**

The results of this study shows that management of used engine oil in Ouagadougou does not comply with environmental sustainable procedures. This can have negative impacts on the environment and cause occupational health risk. Garage workers in developing countries are not aware of the impacts used engine oil have on human health and do not use any protective equipment while handling the used engine oil. Therefore, there is an urgent need to address used engine oil related activities and regulate its handling, collection and re-cycling for human health protection, resources conservation and environment protection. In the long run, the issue of waste-oil management and recycling should be included in the environmental educational program. This will lead to an early exposure and more willingness to participate in order to protect public health and the environment.

**Table 1:-Age of respondents (n =120)**

| Age     | No    | %    |
|---------|-------|------|
| 18-30   | 66    | 55.8 |
| 31-40   | 47    | 39.1 |
| >40     | 6     | 5    |
| Minimum | 13    |      |
| Maximum | 57    |      |
| Average | 29.18 |      |
| SD      | 7.66  |      |
| CV (%)  | 0.26  |      |

**Table 2:-Educational levels of respondents**

|                                                | Response  | No  | %     | Chi <sup>2</sup> | p-value                |
|------------------------------------------------|-----------|-----|-------|------------------|------------------------|
| Educational level                              | None      | 36  | 30    | 58.67            | 5.53×10 <sup>-12</sup> |
|                                                | Primary   | 38  | 31.67 |                  |                        |
|                                                | Secondary | 43  | 35.83 |                  |                        |
|                                                | Tertiary  | 3   | 2.50  |                  |                        |
| I have been trained on the used oil management | Yes       | 8   | 6.67  | 90.13            | 2.20×10 <sup>-16</sup> |
|                                                | No        | 112 | 93.33 |                  |                        |

**Table 3:-**Management strategies of used engine oil

| Variable                                | Answers          | No  | %     | Chi <sup>2</sup> | p-value               |
|-----------------------------------------|------------------|-----|-------|------------------|-----------------------|
| I store the used oil for                | <1 month         | 47  | 39.17 | 85.25            | $2.2 \times 10^{-16}$ |
|                                         | 1 month          | 20  | 16.67 |                  |                       |
|                                         | 2 months         | 3   | 2.5   |                  |                       |
|                                         | >2 months        | 2   | 1.67  |                  |                       |
|                                         | Unknown duration | 48  | 40    |                  |                       |
| The kind of containers used for storage | Metal tank       | 20  | 16.67 | 213.53           | $2.2 \times 10^{-16}$ |
|                                         | Plastic tank     | 98  | 81.67 |                  |                       |
|                                         | Other containers | 2   | 1.66  |                  |                       |
| Disposal of used engine oil             | Sale             | 106 | 88.33 | 539.63           | $2.2 \times 10^{-16}$ |
|                                         | Offer            | 8   | 6.67  |                  |                       |
|                                         | dump             | 2   | 1.67  |                  |                       |
|                                         | Other            | 4   | 3.33  |                  |                       |
| I know the used oil can be recycled     | Yes              | 39  | 32.5  | 14.7             | $1.26 \times 10^{-4}$ |
|                                         | No               | 81  | 67.5  |                  |                       |

**Table 4:-**Awareness of garage workers on the impact of used engine oil on the environment

| Variable                                              | Answers | No | %     | Chi <sup>2</sup> | P value                |
|-------------------------------------------------------|---------|----|-------|------------------|------------------------|
| I think the used oil has an effect on the soil        | Yes     | 97 | 80.83 | 45.63            | $1.42 \times 10^{-11}$ |
|                                                       | No      | 23 | 19.17 |                  |                        |
| Level of soil contamination in auto and motor garages | Low     | 38 | 31.67 | 0.20             | $9 \times 10^{-1}$     |
|                                                       | Middle  | 42 | 35.00 |                  |                        |
|                                                       | High    | 40 | 33.33 |                  |                        |

**Table 5:-**Awareness of garage workers on the impacts of used engine oil on human health

| Variable                                                            | Answer          | No  | %     | Chi <sup>2</sup> | p-value                |
|---------------------------------------------------------------------|-----------------|-----|-------|------------------|------------------------|
| I wash my hands before a meal                                       | Yes             | 113 | 94.17 | 93.63            | $2.2 \times 10^{-16}$  |
|                                                                     | No              | 7   | 5.83  |                  |                        |
| I wash my hands with                                                | Water + soap    | 111 | 92.50 | 189.35           | $2.2 \times 10^{-16}$  |
|                                                                     | Water+soap+fuel | 2   | 1.87  |                  |                        |
| I use a personal protective equipment when I handle used oil        | Yes             | 4   | 3.3   | 93.63            | $2.2 \times 10^{-16}$  |
|                                                                     | No              | 116 | 96.7  |                  |                        |
| I change my clothes after handling used oil                         | Yes             | 8   | 6.67  | 90.13            | $2.2 \times 10^{-16}$  |
|                                                                     | No              | 112 | 93.33 |                  |                        |
| I think used oil has an effect on human health                      | Yes             | 77  | 64.17 | 9.63             | $1.91 \times 10^{-3}$  |
|                                                                     | No              | 43  | 35.83 |                  |                        |
| I have some health complaints                                       | Yes             | 20  | 16.67 | 53.33            | $2.81 \times 10^{-13}$ |
|                                                                     | No              | 100 | 83.33 |                  |                        |
| I think the used oil can get in the body through ingestion          | Yes             | 42  | 35    | 10.80            | $1.01 \times 10^{-3}$  |
|                                                                     | No              | 78  | 65    |                  |                        |
| I think the used oil can get in the body through the breathing ways | Yes             | 61  | 50.83 | 0.03             | $8.55 \times 10^{-1}$  |
|                                                                     | No              | 59  | 49.17 |                  |                        |
| I think the used oil can get in the body through the skin           | Yes             | 44  | 36.67 | 8.53             | $3.48 \times 10^{-3}$  |
|                                                                     | No              | 76  | 63.33 |                  |                        |

**Table 6:-**Impact of the repeated usage of used engine oil on the environment and human health

| Area of re-use | Environmental impact | Impact on human health |
|----------------|----------------------|------------------------|
|----------------|----------------------|------------------------|

|                                              |                                                                                                                                                                                                        |                                                                                                                                                                       |
|----------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Fuel                                         | Air pollution and human contamination                                                                                                                                                                  | PAHs which are toxic, mutagenic and carcinogenic (Cerniglia and Sutherland, 2001)                                                                                     |
|                                              | Air and human contamination by polycyclic aromatic hydrocarbons (PAHs)                                                                                                                                 |                                                                                                                                                                       |
| Mud construction (mud block conception)      | Cause of environmental pollution, the most serious current problem in the world, especially in developing countries (Sawadogo et al., 2016)                                                            | Accumulation of hydrocarbons within animals and plants resulting in death and mutation (Ilyina et al., 2003)                                                          |
| Fuel for wood or charcoal burning in kitchen | Air pollution, human breathing problem (PNUE/PAM, 2015)                                                                                                                                                | Hydrocarbons and their products from combustion are toxic pollutants, sometimes mutagenic or carcinogenic for human (Vandermeer & Daugulis, 2007; Bouda et al., 2008) |
| Reduce odour from pit latrines               | Reduction of gaseous exchanges between microorganisms and ambient air and the massive death of aerobic microorganisms responsible for the degradation of faecal matter (Abdou Karim et Gbaguidi, 2004) | Soil and water contamination by used oil when human faecal is used as organic amendment                                                                               |

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