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Investigating the Quantity of Used Oil Produced by Motor Vehicles in Iran and Providing Management Solutions Based on Health and Environmental Principles

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Abstract

Background. Used oil is a problematic waste containing hazardous and toxic components. This study aimed to investigate the quantity of used oil produced by motor vehicles in Iran and offer management solutions based on health and environmental principles.

Methods. First, the conversion ratio of motor oil into used oil was determined. The mass balance method and the conversion ratio were used to estimate the used oil produced in the past 14 years. The amount of used oil produced over the following 15 years was also predicted using an artificial neural network. The current status of used oil management in Iran was assessed through checklists, observations, field visits, and interviews. Finally, an appropriate management solution was provided for it.

Results. According to the results, 151.2 to 315.2 kilotons (kt) of used oil were produced annually in Iran between 2003 to 2017, and it would reach 250 kt by 2031 according to prediction. In Iran, approximately 77% of the used oil was collected and recycled, about 5% was used in construction, and the rest was disposed and managed without following the scientific principles.

Conclusion. The lack of principled management of used oil may have had a significant adverse impact on the environment. Taking into account the fact that about 55% of used oil was produced by vehicles, and assuming that the remaining 45% of used oil was produced by other sources, it was concluded that the overall percentage of used oil production in Iran was probably two-fold approximately. Therefore, it was recommended that the current situation and its principled management should be minitored.

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Extended Abstract

Background

Petroleum oils are byproducts of crude oil composed of base oils and additives. These oils have general and specialized uses. The general uses include the lubrication of vehicle engines or other mechanical parts. The specialized uses of petroleum oils include the application as hydraulic oil, turbine oil, cooling oil, compressor oil, metalworking oil, transformer oil, insulating oil, etc. The global oil demanded in 2015 was reported to be between 35-36 million tons. Petroleum oils deteriorate after exposure to physical and chemical contaminants, and become used oil at the end of their service life. Used oil is a problematic waste containing hazardous and toxic components. Lack of management causes serious damage to the environment. Given the above discussion, this study aimed to investigate the quantity of used oil produced by motor vehicles in Iran, and offer management solutions based on health and environmental principles.

Methods

This study was conducted in Tabriz, Iran (as a pilot). First, the total demand for motor oil (MO) in Tabriz was obtained. Since the demanded motor oil was not compeletly converted into used oil (UO), the conversion rate (CR) of the demanded motor oil into used oil was determined.

Equation (1) $CR = UO/MO$

To directly measure the amount of used oil produced in Tabriz, 20 oil change centers were first randomly selected based on Tabriz Oil Change Association report, and the average amount of used oil produced by 60 different vehicles receiving services from the given centers was determined. Based on the opinions shared by the owners of a number of oil change centers, the average annual oil change frequency of the vehicles was determined to be three. Then, the amount of used oil collected for recycling was acquired in collaboration with Tabriz Oil Change Association and private companies involved in the collection and recycling of used oil. The used oil production in the following 15 years was estimated using the artificial neural network (ANN) model. The management of used oils was assessed and practical management strategies were proposed. Afterwards, the current management status of used oil was determined through the prepared checklist, field visit to used oil production centers managing and disposing of it, interviews, review of laws and regulations, and by-laws. Finally, the practical management strategies were proposed to improve the management and disposal of used oil in Iran based on the findings of this study, the current status of waste management in Iran, and the successful experiences of other countries.

Results

The results showed that the amount of motor oil consumed in Tabriz was equal to 9600 tons/year, and the used oil produced was equal to 6154 tons/year. Therefore, the conversion rate of motor oil into used oil was 0.641. In other studies, the conversion ratio of motor oil into used oil was determined at 0.5-0.6, which was slightly different from our study results in this redgard. The per capita of used oil produced based on the population and per vehicle in Iran in 2017 was obtained 3 Kg/person/year and 12.8 Kg/number of vehicles/year, respectively.

Estimating the used oil collected for recycling in Tabriz indicated that approximately 2000 barrels of used oil (each barrel is 220 liters) were collected every month by the private sector. Assuming that the density of used oil was 0.9 g/cm^3, the annual used oil collected in Tabriz was estimated at 4752 tons. Comparing the used oil produced and collected revealed that the latter was 22.8% lower than the former. About 5% of used oil was sold to construction contractors. The larger part of the remaining used oil in Iran was found to pollute the water and soil resources in the environment. A small amount was detected to be illegally used by do-it-yourselfers as fuel to heat outdoor environments, contributing to air pollution.

According to the results, the per capita and total used oil produced in different countried were different. This difference was most likely due to the engine and vehicle type and make, vehicle model year, engine power, driving etiquette and style, road conditions, distance traveled, oil change frequency, motor oil type and quality, fuel type and quality, popularity of public transportation, weather conditions, etc. It was predicted that there would be an increasing trend in used oil

production during the upcoming years. However, it was also found that the predicted per vehicle used oil production (per road vehicle according to the above Table) would decrease over time (It will be about 9.6 Kg/number of vehicles/year for 2033). Reviewing the current status of used oil management in Iran demonstrated that there was no particular ministry, administration, or agency in charge of collection, transportation, recycling, and treatment of used oil in Iran. Furthermore, the government was unprepared for reducing the quantity of used oil produced in the coming years, and had proposed no particular budgetary plan or policy for sound management and proper recycling of the produced waste oil.

Conclusion

Used oil production in Iran was on the rise, and most of it (77.2%) was managed and recycled by the private sector. In order to improve and enhance the efficiency of used oil disposal and management in Iran, however, it was recommended that a government agency should be established. Finally, some other measures were also recommended including the supervision of the quality of the motor oil on the market; collection and transportation of used oil produced by tankers and special vehicles (in order to prevent leakage and discharge of used oil on the road); storage of used oil in Iran and adoption of the law and regulations concerning its implementation; application of modern and advanced refinement technologies (to reduce sludge production); and allocation of funds for used oil management and recycling equipment and facilities.