Material Science Research India Vol. **7**(1), 245-248 (2010)

Environmental impacts of used oil

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(Received: May 29, 2010; Accepted: June 15, 2010)

ABSTRACT

Lubricating oil is an important resource and a petroleum base product. The high price of oil and objective of saving valuable foreign exchange has resulted in efforts for regeneration of used lube oil. Mismanagement of waste lube oil is a serious environmental problem. Almost all types of waste oil have the potential to be recycled safely, saving a precious non-renewable source and at the same time minimizing environmental pollution. Unfortunately, most of used oil is handled improperly. Some is emptied in to sewers for going directly into water waste, adversely affecting water treatment plants. Some is dumped directly on to the ground to kill weeds or is poured on to dirty roads or is dumped in deserts, where it can contaminate surface and ground water. Disposal of used lubricating oil into the eco system creates environmental hazards. Tough laws are being enacted throughout the world for the disposal of waste petroleum products and every genuine effort should be made for it's re-use. In most cases, used oil can be re-used after reconditioning with or without the addition of any additives resulting in huge saving and conservation of precious oil. Thus regeneration, reclamation or recycling of spent lubricating oils has become an important process industry, adopting various techniques for oil purification.

Key words: Environment, petroleum products, used oil.

INTRODUCTION

Used automotive lubricating oils are re-refined by a process that effectively removes contaminants and returns the oils to an equivalent to oil produced from virgin stocks. Motor oil picks up a variety of contaminants its use that pose significant risks to human health and the environment. Oil is also a pollutant, it takes only one litre of oil to contaminate one million litres of water and a single automotive oil change produces four to five litres of used oi[1-4]. The collected oils are treated in few refineries or used as fuel in cement industry. Regarding ecology and economy, both paths of disposal are unsatisfying. The refinery process causes a high logistical and infrastructural effort and has a high energy demand for purification of the used oils. The combustion of used oils in the cement and heavy industry without any pre-treatment of the oils may result in uncontrolled pollution. The heavy metals, which are found in used oils, stay in the product (e.g. cement) or are to be found in the exhaust gas. Due to the disadvantages of the classical disposal of used oils, different research groups have investigated new possibilities to purify and recycle oils. A very promising method is the extraction of the oil components using supercritical gases[5-7].

Contaminants in Used oil

Used oil is made up primarily of hydrocarbons, but also contains various additives, which boost its performance in particular applications. The amount and type of additives vary with the intended use of the oil. Hydraulic oils, for example, contain very few additives, whereas lubricating oils typically contain 10 to 20 percent by volume. Some of these additives can be harmful to human health and the environment, while others are harmless. Used oil also contains physical and

chemical impurities due to physical contamination, chemical reactions and wears occurring during its use. For example, the additive lead tetraethyl decomposes to lead, polycyclic aromatic hydrocarbons (PAHs) are formed by incomplete combustion of organic matter, such as oils, and heavy metal particles are introduced through wear. It is these contaminants, rather than the oil itself, which are of concern when oil is burned in particular ways or used on roads. When used oil is re-refined or reprocessed, the contaminants are not destroyed, but accumulate in the waste sludge. The contaminants render this oily sludge highly toxic. There is wide variation in the properties of and contaminants in, used oil. The Principal contaminants in used oil are Aluminium Dichlorodifluoromethane, Benzene, Antimony Trichclorotrifluorethane, Toluene Arsenic, 1,1,1-Trichloroethane Xylenes, Barium Trichloroethylene, Chromium Polychlorinated biphenyls Other PAHs, Cobalt Sulphur, Copper Nitrogen, Lead, Magnesium, Manganese. Mercury, Nickel, Phosphorus, Silicon, Sulphur and Zinc[8-9].

Human health effects

The contaminants in used oil can induce a variety of illnesses and diseases in humans and other mammals through inhalation, ingestion or skin contact. Observed effects include lipid pneumonia, lipid granuloma in the lung, eczematous and contact dermatitis, folliculitis, oil acne, and melanosis. Used oil can induce cancer, principally squamous cell cancer of the skin and scrotum, bladder and liver cancer. These effects can be attributed largely to the presence of PAHs in used oil; benzene, toluene, and chlorinated solvents can also contribute to this toxicity. PAHs are formed by incomplete combustion of organic matter, such as oils. Seven PAHs have been classified as probable human carcinogens. PAHs are generally rapidly absorbed upon inhalation, ingestion or exposure through the skin. Heavy metals tend to concentrate in the environment (eg, in plants, animals and aquatic species), and humans may come into contact with them, causing a wide range of illnesses such as cancer, anemia, skin ulcerations and cardiovascular disease. Considerable concern about the health effects of lead, which was present in worrying quantities in some parts of the India environment, led to it being phased out of petroleum in 1996. As lead levels in petrol have declined to trace amounts, so too have the quantities usually found in used lubricating oil. Particularly harmful metals that remain, to varying degrees; in used oil include arsenic, cadmium and chromium. Particulates produced by burning used oil can aggravate and cause respiratory problems, and can result in the loss of lung function, loss of ability to resist infection, and death. Sulphur dioxide and nitrogen dioxide are also produced by burning used oil, and can have serious adverse respiratory effects. Combustion of fuel containing carbon and chlorine can produce a wide range of organochlorine compounds. These can include dioxins and furans, which pose a risk to human and environmental health. Toxic responses include skin toxicity, immunotoxicity, carcinogenicity, and adverse effects on reproduction, development and endocrine functions. Polychlorinated biphenyls (PCBs) are principally found in used transformer oils, but it is believed that

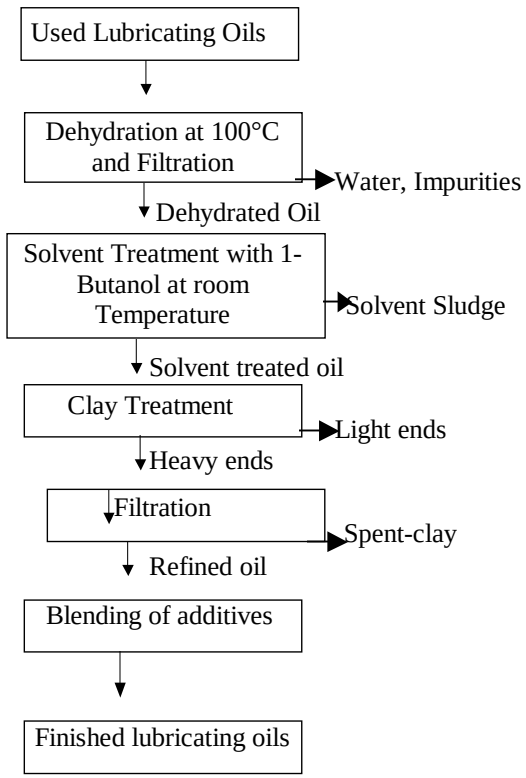

Chart 1: Flow diagram of regeneration of used lubricating oils

there are now very low levels of PCBs remaining in oils. Although the incidence of PCBs in used oil is low, the health effects from exposure are very serious. PCBs are highly persistent and can accumulate to high levels in human tissue. This can cause serious health effects, including liver damage, respiratory problems, cancer promotion, endocrine disruption and neurotoxicity[10].

Ecotoxic effects

Animals and aquatic organisms will share some of the human health effects caused by used oil contaminants. Observed effects include acute toxicity in aquatic organisms as a result of poisoning by arsenic, cadmium, chromium and zinc; acute toxicity in fish, and tumours, caused by mixtures of PAHs; and a range of illnesses affecting fertility, reproduction, the immune system and growth caused by PCBs and dioxins. For some substances found in used oil, such as mercury, PCBs and organ chlorines, the main issue of concern when released into the environment is not their short-term toxic effect but the risks associated with their bioaccumulation in organisms and the potential for secondary poisoning. Oil contaminants also have a range of properties poisonous to plants. Heavy metals, such as cadmium, arsenic and chromium have been shown to cause direct toxicity to plants. Deterioration of foliage and plant growth are caused by nitrogen dioxide and sulphur dioxide, as well as physical smothering by oil or by the particulates generated by the burning of oil. Oil floating on the top of water can prevent the penetration of oxygen into water, adversely affecting aquatic life [11-12].

How does used oil damage the environment?

Once lubricating oil is drained from engines, gearboxes, and hydraulic systems, turbines and air compressors:

- The oil is contaminated with wear debris
- The lubricating base oil has deteriorated and degraded to acids
- The additives have decomposed into other chemical species
- Process fluids, degreasers and solvents have mixed into the used oil

Used oil contains wear metals such as iron, tin and copper as well as lead from leaded petrol used by motorists. Zinc arises from the additives packages in lube oils[13].

Method of treatment

Dehydration

The used lubricating oil was heated at 100°C for 1 h to remove water and then filtered.

Solvent Treatment

Dehydrated oil thus obtained was then solvent treated with 1-butanol.

Clay Treatment and Filtration

Solvent treated oil were heated under vacuum with constant stirring to 100°C and the fuller's earth was added in 8 to 10 percent (w/v) for 50 and 60 percent solvent treated oil and filtered.

Blending of additives

Mono and multi grades of engine oils available in the market for various purposes require different base stocks depending upon their characteristics. Further, a specific amount of suitable additives is needed for a particular grade of oil.

CONCLUSION

Used oil is a pollutant, and by re-refining, the pollution is reduced. Hence, it should get the status of eco-friendly technology and get grants and incentives from the Ministry of Environment. The quality of thoroughly re-refined oil is comparable with nascent base oils. Hence, it should be awarded import-substitute status. The re-refining of lubricating oil enables the repeated use of these used oils, thus improving the trade balance through supplementing reclaimed oil and thus augmenting the indigenous oil. Therefore, the most important route to conserve lubricants is that of recycling. Recycling is a generic term for processing used lubes oils to regain useful material through reclamation and re-refining.

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