CHAPTER 1

INTRODUCTION

1.1 Motivation

From an environmental point of view, used lubricating oil (ULO) has potential to create serious environmental problems due to their persistence and toxic properties. They may also contain contaminants, such as heavy metals, which are detrimental to the environment. Lack of proper handling practice often leads to a large quantity of ULOs being released into the environment, e.g. oil spilled from equipment, direct disposal of ULOs to the storm drains, etc. To elucidate the effect of the ULO contamination, consider the following examples. If 1 gallon of ULO is disposed of into a natural watercourse, it will contaminate at least a million gallons of fresh water. Oil films on the water surface will block sunlight, impair photosynthesis and prevent the replenishment of dissolved oxygen, which can finally lead to the decay in aquatic lives. Moreover, oil spilled on land will reduce soil productivity and may also contaminate underground water. It is worth noting that ULO is not easily destroyed using conventional wastewater treatment plants [1]. Often, oil users feed their ULO into the furnace as an additional fuel without knowing that burning untreated ULO usually ends up with a generation of harmful air pollutants. Besides, some constituents in ULO such as polynuclear aromatic hydrocarbons (PAHs) (formed during the combustion cycle in engines) are recognized as a carcinogenic risk to human beings. Hence, using ULO as fuel poses environmental concerns due to their highly toxic flue gas components such as PCBs, PAHs, dioxins, and heavy metals. The disposal of ULO requires that they be incinerated at high temperature to ensure complete oxidation of PAHs, PCBs [2]

Used lubricating oil is hazardous according to the Hazardous Substance B.E.2535 of Thailand. It is classified as a hazardous substance type 3, which means that production, import, export, or possession in large quantity (more than 20 litres) must obtain a permit [3]. During the use of lubrication oil, the conditions and contaminants deteriorate the quality of the oil and after some time it loses the ability to lubricate and needs to be replaced.

Used lubricating oil can become a serious threat or a valuable resource, depending on how it is managed. ULO that is properly handled can be re-refined into lubricants, processed into fuel oils, and used as raw materials in the refining petrochemical industries. However, it was found that collection systems as well as treatment technologies currently used might not always be technically viable or acceptable, not to mention that illegal dumping was still regularly found. In Thailand, only ULO generated from major sources could be sold to small entrepreneurs at a price of 1-5 Bath/liter. It was then sold to re-refinery plants or other factories to be used as fuel oil. At present acid/clay techniques are used to treat ULO in these re-refinery plants. Acid clay technique produce great amounts of hazardous waste, which are dumped in backyards of the plants, and the quality of re-refined products, is generally poor. In addition, there are no control measures regarding the environmental impact of the use of ULO as fuel oil [4]

The National Energy Policy Office (NEPO) and the Pollution Control Department (PCD), and General Environmental Conservation Public CO., LTD (GENCO) created the Guideline for Collecting Used Lubricating Oil Pilot Project in 1997, in order to determine a suitable collection strategy for ULO as a supplementary fuel in cement kilns. It was found that extreme temperatures (1500-2000^{o}C) in the cement kiln will help in the combustion of ULO, and this method would provide an economically attractive alternative for the management of ULO. According to the pilot project, the automotive sector was the most important source of ULO. It produced 223 million liters from a total of 329 million liters or 67.78% of the total amount of the ULO generated in 1997. The second most important source was the industrial sector, which produced 73 million liters (22.19%). In this report, it was anticipated that the generation of ULO would increase to 330 and 348 million liters in 1999 and 2001,

respectively. This quantity was consumed in the engine process about 30 % or 120 million liter, the 70 % remaining or 280 million liter is used lubricating oil (ULO). Which 50 % or 137 million liter of ULO quantity will be recycled or reused in further activities [5].

It appears from literature that there are other alternatives for managing ULO, each of which has its pros and cons depending on many factors, particularly properties of ULO and composting applications of the treated ULO. It is the aim of this work to provide a comprehensive database regarding available technologies for the management of ULO, which can then be used as a decision-making tool for the future management of ULO.

1.2 Objectives

1.2.1 Propose potential alternative options of available technologies for the management of used automotive lubricating oil.

1.2.2 Provide a comparative evaluation of the proposed managing technologies in terms of feasibility and environmental impacts.

1.2.3 Prepare information database regarding the various uses of available managing technologies for used automotive lubricating oil.

1.3 Scope of Work

1.3.1 Review available technologies for managing used automotive lubricating oil. The information will be gathered primarily from the commercially available techniques and also from related journals, theses, and proceedings. Note that only mature technologies will be given more attention. The newborn laboratory scale technologies might be included for the sake of completeness of this work.

1.3.2 Evaluate available managing technologies based on

- Environmental impacts
- Cost-effectiveness

1.3.3 Establish the database and construct a simple mathematical procedure as a decision-making tool for the selection of a suitable technology for managing used automotive lubricating oil.

1.4 Methodology

1.4.1 Collection of data, in this work the main information is secondary data from textbooks, research journals, patents, theses, proceedings, as well as data on related technologies from the Internet. Some primary data come from Thai commercially enterprise through interviews. These published data come from reliable sources, such as government officials, Cement Company and GENCO.

1.4.2 Classification of data in to two management technologies approaches for used lubricating oils: regeneration as lubricating oil or recovery as fuel or valuable product.

1.4.3 Process analysis of each technology option

1.4.4 Evaluation of appropriate technologies and also proposal of pollution control mitigation based on

1.4.4.1 Environmental impact criteria.

- Concentrations of heavy metals contaminated in the waste oil The heavy metals of concerns are: Lead, Cadmium, Chromium, Zinc, Barium, Nickel etc.
- Concentrations of air pollutants including: Particulate, Sulfur oxide: SO_x, Oxides of nitrogen: NO_x, etc
- Other waste streams such as final residual, ash deposit, oily sludges and wastewater.

1.4.4.2 Cost effectiveness criteria.

- Average present cost of treatment one unit of ULO
- Average present revenue of treatment one unit of ULO
- Revenue per cost is estimated by: Net Present Value
- Feasibility of option is estimated by Benefit Cost analysis

1.4.4.3 Preparation of database by Microsoft Access and establish ULO management computer program by Visual basic.

1.5 Advantage of this work

To provide a comprehensive database regarding available technologies for the management of Used Lubricating Oil, resulting in ways that bring together technical, environmental and economical feasibility, which can then be used as a decision-making tool for the future management of ULO.