CHAPTER I
INTRODUCTION

Nowadays, Thailand used 3.8 million vehicles. Quality of used lubricating oil assumed to 40 million liters per year, excluding other engine. Although used lubricating oil must be waste in enormous residue chemical waste, if it has not managed. So that idea to recycled the used lubricating oil by uses in heavy industrial such as fuel for smelt industry, cement industry. And reprocess for new grade lubricant return to industrial again. But recycle processes are little points of method to get rid of used lubricating oil waste. High portion of lubricant waste must effect to environment. Now have law to control lubricating oil. Factory must to have responsible about management residue, by product, waste, for not effect to environment. By the way is the reason to researcher wanted to develop process to change heavy oil become light oil for value added by hydrocracking and 2 kinds of catalysts Ni-Mo/Al_2O_3 and HZSM-5 are the compared point in this research. Determination to compare mechanism of hydrocracking reaction on Ni-Mo/Al_2O_3 metal catalyst and HZSM-5 high acid catalyst.

Apparatus for uses in research is small reactor capacity 70 ml that ability to reacts at high pressure and high temperature. The end product of this research depends on adjust vary of temperature, pressure, retention time, and ratio of percentage catalyst by weight of used lubricating oil.

Generally, the used lubricating oil was drained into ground and channels or distributes cheaply to customers. These are causes of many problems, especially in the considerations of environmental and low-grade lubricating oil distributions.

In order to perform properly, used lubricating oil were usually disposed in three ways:

1. Disposal as toxic/ hazardous waste
2. Re-refining to produce base oils
3. Use as fuel

Almost all of base oil was imported from several countries such as Taiwan, China, Singapore, England, Korea, Hongkong, Malaysia, Australia, Kuwaiy, etc.,. Thus to minimize the trade deficit and to reduce the environment pollution, used lubricating oils are the choices to be considered [1].

There are many researches, which have the same objective of improving, or recycling used oils. In following contents, the recycling processes were described.

In 1972, Brownawell Darrell W., Renard Remi H. [2], had reclaimed and refined used lubricating oils by preliminary treated used lubricating oils with C_4-C_5 alcools, separated and brought the desludged oils to refining step such as treatment with fuming sulric acid followed by neutralizing, washing, clay treating step and hydrogenation treatment step.

In 1972, Biswas A. *et al.* [3], had regenerated used lubricating oil by settling and decantation used motor oils at 60-70 ^{0}C, dehydration at 120-150 ^{0}C followed by acid treatment, clay treatment and blending with additives.

In 1974, M.L. Whisman *et al.* [4], they worked in improving the used oil quality by the folowing processes:

- acid/clay treatment
- caustic treatment
- aliphatic alcohol-acid treatment
- caustic/peroxide/aluminium chloride treatment

In 1976, Khaltaeve T.S. [5], studied the hydrogeneration of an asphalt-free lubricating oil at 400 ^{0}C, 4.05 Mpa (40 atm), liquid space velocity 1.5 hr^{-1} in the presence of a catalyst. After hydrotreating, they reported that a viscosity index of the oil increased from 55 to 104 and 65 %wt of sulfur was removed.

In 1979, Salusinszky A.L. [6], had recycled used lubricating oils by mixed used oils with aqueous treating solution then passed through a self-cleaning centrifuge, separated and stripped of light hydrocarbons and brought the pretreated oils charged to refinery stream.

In 1981, Tirtaatmadja V., Agnew J.B. [7], had refined used lubricating oils by treated used oils with MEK followed by acid treating and separation.

In 1981, Marvin M. Johnson *et al.* [8], they reclaimed used motor oil by reacted with with aq. Ammonium salt followed by separation and filtration step.

In 1982, Fletcher Laired C., Beard Harold J. [9], had refined used lubricating oil by distillation to remove a volatile forecourt and distillation to obtain the lubricating oil fractions.

In 1983, Fletcher Laird C. *et al.* [10], had refined used lubricating oils by distillation into light and heavy fractions followed by extraction with tetrahydrofurfuryl alcohol and separation.

In 1983, Wood William E. *et al.* [11], had reclaimed used lubricating oils by treated used oils with aqueous ammonium salt followed by dehydration, filtration and vacuum distillation.

In 1984, Mead Theodore C. *et al.* [12], had reclaimed used lubricating oils by vacuum distillation.

In 1985, Tabler Donald C. [13], had reclaimed used lubricating oils by filtration, acid treatment and clay treatment.

In 1986, Bhan O.K. *et al.* [14], who tested activity of several commercial catalysts in hydrotreating of used lubricating oil. Light and heavy hydrocarbon compounds were removed from feedstock by vacuum distillation. A viscosity at 38 ^{0}C a ASTM color, a sulfur content of distillation oil were 29.18 cst, 8.0 and 0.3 %wt respectively.

In 1986, Strahorn David A.,Forester Allen R. [15], had purified used lubricating by distillation and mixing with NH_4OH followed by settling and separation.

In 1989, Langhoff Josef *et al.* [16], had improved used oil by solid content separation and hydrogenation.

In 1994, Charles W. Harrison, Arthur G. Gorneau, Robert M. Steinberg, Bruce R. Bond [17], had reclaimed zinc dithiophosphate from used lubricating oil by vacuum distillation.

In 1994, Edward C. and Shurtleff R.R. [18], had reclaimed waste oil by evaporation and condensation.

In 1994, Somsak Sriwanichanichapoom [19], studied the catalytic hydrotreatment of used lubricating oil by Ni-Mo/Al_2O_3 and Co-Mo/Al_2O_3 catalyst .

In 1995, Kanite Rongsawad [20], had reclaimed used industrial lubricating oil by acid/clay treatment and hydrogenation.

In 1996, Rangsun Chaosuwannakij [21], had recycled of used marine lube oil by hydrotreating catalyst (NiO/WO_3/Al_3O_3).

In 1998, Jirsak Tscheikuna. and Sasithorn Boon-Long [22], had regenerated of used lubricating oil by CoMo/Al_2O_3, NiMo/Al_2O_3 and NiW/Al_2O_3. catalytic hydrotreatment.

In 1999, Prawpring Chaiprasert [23], studied the one-step catalytic hydrotreatment of used automotive lubricating oil by hydrotreating catalysts.

The objectives of this study

1. To convert the used lubricating oil to light oil by using catalysts.
2. To investigate the effects of variables on % yield and % composition of oil product.
3. To search for optimum conditions of catalytic conversion used lubricating oil into light oil product.

The scope of study

To investigate the suitable conditions of reaction for the conversion of used lubricating oil to light oil by hydrocracking process as following conditions;

1. To find optimum conditions of reaction by 2 types of catalysts Ni-Mo/Al_2O_3 and HZSM-5 catalyst.

- Temperature range from 400 °C to 470 °C
- Pressure of hydrogen gas range from 0 to 200 psi
- Reaction time:
  - Range from 30 to 120 minutes in case of Ni-Mo/Al_2O_3.
  - Range from 30 to 90 minutes in case of HZSM-5.
- Quantity of catalyst as percent by weight:
  - Range from 0 to 5% in case of Ni-Mo/Al_2O_3.
  - Range from 0 to 0.6% in case of HZSM-5.

The experimental schemes of two catalysts were shown in figures 3.5 and 3.6, respectively.

2. To determine % yield of light oil and product compositions by Simulate distillation Gas chromatography (DGC).

3. To compare efficiency of 2 types of catalysts in hydrocracking.