

CHAPTER 5

COMPUTER PROGRAM

ULO MANAGEMENT TECH computer program is established as a decision-making facility for selecting a suitable technology for managing used automotive lubricating oil. The available managing technologies evaluated based on environmental impact and economic indicators. Quantities and also major constituents contaminants in products and waste streams along with the associated cost are calculated from this program.

Figure 5.1 presents the steps in the program and there are three main calculation steps from this program as follows:

1. Calculation of output product from the process, those are quantity of treated oil, permeated flux, energy recovery and also waste streams e.g. residue, acid sludge, spent clay or etc.
2. Calculation of toxic heavy metals constituents in the waste streams or emission of air pollutants.
3. Determination of economic indicators: average unit cost of treatment per one unit of ULO, average unit cost per one unit of product, Net Present Value (NPV) and Pay back period.

The program begins with starting page (Figure 5.2) and goes to input data page (Figure5.3).

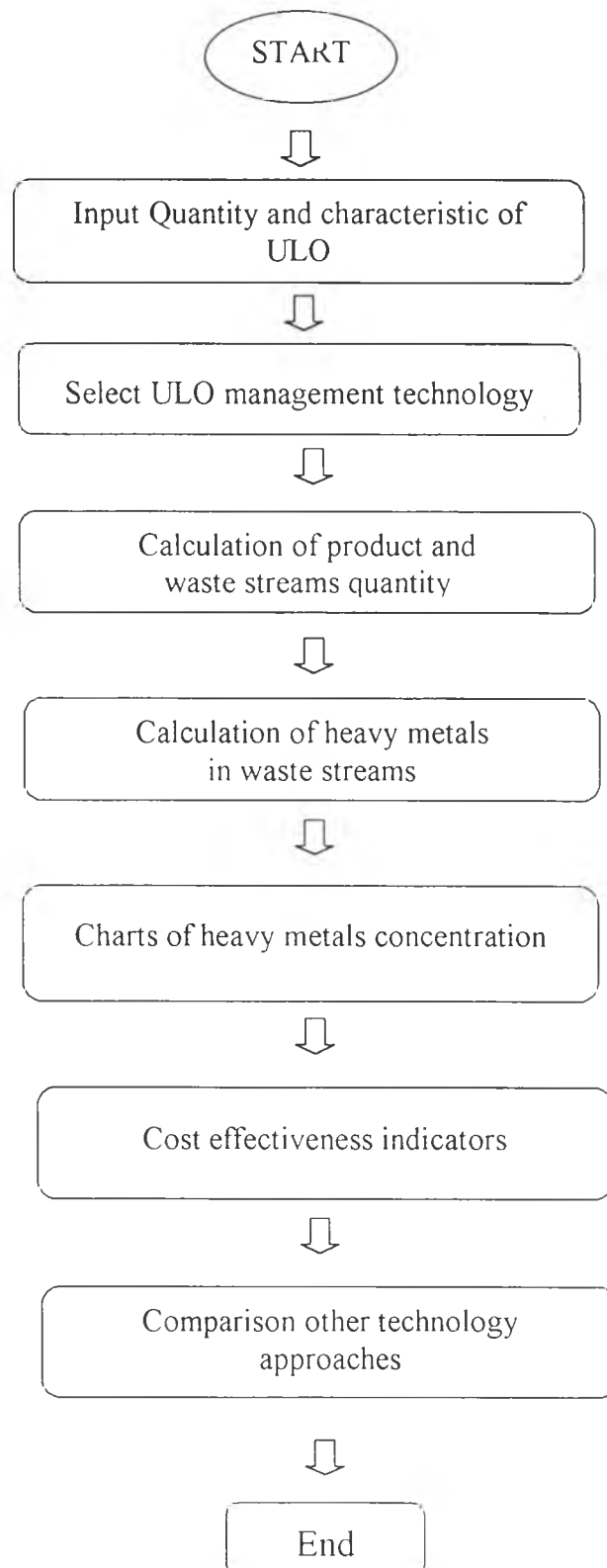


Figure 5.1 Main steps of the ULO management Program



Figure 5.2 Starting page

Characteristic		Conc. of Heavy Metal in ULO, ppm	
Viscosity @ 40 Celcius	70 cSt	<input checked="" type="checkbox"/> Al	10
Viscosity @ 100 Celcius	65 cSt	<input checked="" type="checkbox"/> As	65
Flash Point	95 Celcius	<input checked="" type="checkbox"/> Ba	30
		<input checked="" type="checkbox"/> Ca	180
		<input checked="" type="checkbox"/> Cd	20
		<input checked="" type="checkbox"/> Cr	200
		<input checked="" type="checkbox"/> Cu	30
		<input checked="" type="checkbox"/> Fe	655
		<input checked="" type="checkbox"/> Pb	176
		<input checked="" type="checkbox"/> Zn	860

Mass: 10 ton

Next >>

Figure 5.3 Input data page

Input data page is divided in to 3 part as below:

- Characteristics of used lubricating oil, viscosity and flash point are the important items to specified used lubricating oil
- Quantity of used lubricating oil input (ton)
- Concentration of toxic heavy metal in used lubricating oil (ppm)

After that one can select management technology just by clicking the button

next

and the “ select technology ” page appears as shown in Figure 5.4

Figure 5.4 Select technology page

In this page, a desired technology is selected then the default of waste stream quantity in each technology appears. These can be easily changed by altering the numbers in the boxes on the right hand side. Then, one can click next button and the simulation result will be shown as illustrated in Figure 5.5.

Figure 5.5 Management technology results page

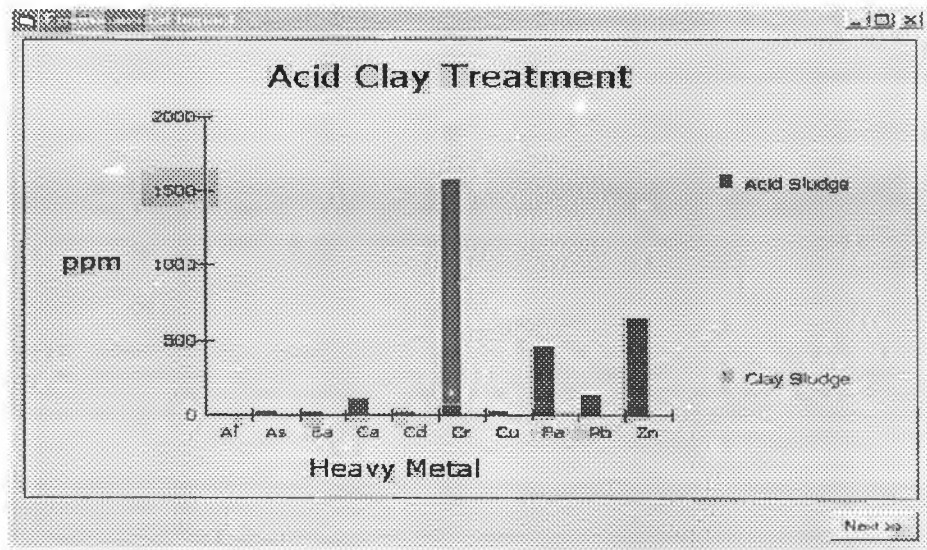


Figure 5.6 Concentration of heavy metals in waste streams from acid clay process

The bar chart of heavy metals concentration in waste streams is provided as present in Figure 5.6. Cost effective indicators page will be shown to summarise the results. Figure 5.7 shows when the next button is selected, and resulting the cost effectiveness indicators results.

process name	Cost per ton ULO	Revenue per t.	NPV	Benefi
Combustion in boiler	216680	31890	9.9	.15
Direct burning in	1460	6620	2888	4.53
Acid Clay Treatment	145590	404000	411	73
Chemical and Cla	145590	404000	1896	4.84
Solvent extraction	456920	616000	124	1.35
Distillation Clay Fil	99980	393000	58	3.93
Membrane techn	101140	844800	53	8.35

Note: NPV, million Baht

Compare with other Tech Exit

Figure 5.7 Cost effectiveness indicators page

Finally, the comparison of ULO regeneration technologies page can be obtained from this program if one chooses the “ Compare with other tech ” option and the results from this comparison is shown in Figure 5.8.

Parameter	Value	Unit	or	Value	Unit
Treated Oil	4.30	ton			
% Recover	43				
Organic phase	30	ton	or	17	%
Aqueous phase	1.70	ton	or	3	%
Fuel cut	1.40	ton	or	14	%
Bottom residue	1.30	ton	or	13	%
Heavy Lube	80	ton	or	8	%
Spent Clay	60	ton	or	6	%

Heavy Metal	Concentration
Al in Organic phase	1.656667 ppm
Al in Aqueous phase	1.176471E-02 ppm
Al in Fuel cut	5 ppm
Al in Bottom	10.30769 ppm
Al in Heavy lube oil	.0375 ppm
Al in Spent clay	3.333333E-02 ppm
Al in Light oil Product	2.093023E-02 ppm
As in Organic phase	6.5 ppm
As in Aqueous phase	4.205882 ppm
As in Fuel cut	10.21429 ppm

Figure 5.8 Regeneration approaches comparison