CHAPTER 5

Model and Actual Work verification

This chapter presents the results of petroleum quantity calculation from developed simulation to also show the comparison of petroleum quantity calculation from currently used program and manual report from actual plant. The simulation included correction for the effect of temperature on the steel shell of the tank for analysts. All data for simulation running are gathered from data records of each storing terminal in each distributed location in Thailand.

5.1 Developed Program Characteristic

The simulation program developed herein is helpful for calculation petroleum quantity and use analyst effect of temperature on the steel shell. Petroleum quantity calculated from the program can indicate some situation of operation such as size of tank and material used setup tanks. The program for calculating petroleum quantity (herein called currently used program) is used to run to obtain results for calculating actual petroleum quantity in tanks which it not consider effect of temperature on steel shell. Although the object of both programs, the developed and the currently used program is to calculate petroleum quantity in tanks, they have some different characteristics. The developed program is written in Delphi language run on Windows but the currently program is modified in SAP system. The main principle of calculation is the same concept but the calculated equations for the developed program based on updated version API petroleum measurement standard and ISO standard 7507. Therefore, some variables and factors used for calculation in both program are different.

These difference was due to an awareness of more factors in actual petroleum quantity occurring. Calculation equations in developed program cover the effect of temperature on the steel shell and can calculate value of API gravity @ 60°F from

sampling of product. The developed program can use replace manual table as used in present. It shows value of volume correction factor at 60 $^\circ$F and 86 $^\circ$F in the screen for check values.

The currently used program does not provide these kinds of input database. It isn't has these value in the database. Besides the developed program has provided database, user can save calculation results and can check value of correct calculated.

In this work, petroleum quantity value in tanks was calculated from the developed program in order to compare with the calculated value of the currently used program and reported manual. The four of kinds product types; fuel oil, gas oil, unleaded gasoline octane 91 and octane 95 were used in calculation.

After input necessary data such as location of terminal, tank, product, level of oil, free water level, API gravity at observed temperature, temperature in tank and hydrometer temperature data for calculation, the developed program was used to calculation petroleum quantity by consider effect of temperature on steel shell. Calculation results and comparison of calculation petroleum quantity are presented in programming report and shown in Tables 5.1 and 5.2.

5.2 Comparison of Calculation Petroleum Quantity to Reported Data

Comparison data of petroleum quantity calculated from two programs are shown in Table 5.1.

In this study, the developed program is aimed to calculation quantity of petroleum by use effect of temperature on the steel shell of tank for analyst actual quantity in tank. In order to different value GOV and GSV to compare with the currently used program calculated data, the value of GOV and GSV is calculated from the currently used program should be adjust value.

Table 5-1 Use CTSh for Calculation Quantity of Petroleum

Terminal	Tank no.	Product	Calculation from Developed Program		Calculation from Currently Used Program		Different Value (%)	
			GOV (L'/Quart.)	GSV (L'86/Quart.)	GOV (L'/Quart.)	GSV (L'86/Quart.)	GOV (L'/Quart.)	GSV (L'86/Quart.)
Bangkok	TH05	FOD	246,285,618	244,450,029	246,336,613	244,500,631	0.021	0.021
	TH06	FOA	102,802,391	102,228,137	102,787,120	102,212,957	0.015	0.015
	TH16	FOC	257,092,573	255,387,489	257,046,160	255,341,405	0.018	0.018
	TH17	Diesel	835,902,897	835,832,073	835,900,652	835,829,852	0.000	0.000
	TH26	Diesel	685,743,016	685,832,073	685,745,576	685,892,354	0.000	0.000
	TH09	ULG	299,092,338	299,200,987	299,093,952	299,202,607	0.000	0.000
	TH25	ULG	225,004,314	225,136,659	225,006,187	225,138,535	0.000	0.000
	TH14	ULR	118,475,913	118,556,019	118,477,173	118,557,280	0.000	0.000
	TH21	ULR	346,443,274	346,672,072	346,446,618	346,675,420	0.000	0.000

Table 5-1 Use CTSh for Calculation Quantity of Petroleum (continues)

Terminal	Tank no.	Produc.	Calculation from Developed Program		Calculation from Currently Used Program		Different Value (%)	
			GOV (L/Quart.)	GSV (L/Quart.)	GOV (L/Quart.)	GSV (L/Quart.)	GOV (L/Quart.)	GSV (L/Quart.)
Surattani	TH01	ULG	20,478,461	20,550,322	20,479,567	20,551,432	(0.005)	(0.005)
	TH02	ULG	17,161,852	17,210,708	17,162,600	17,211,462	(0.004)	(0.004)
	TH03	ULG	16,511,532	16,557,899	16,512,241	16,558,615	(0.004)	(0.004)
	TH09	ULR	81,327,483	81,579,497	81,331,275	81,583,301	(0.005)	(0.005)
	TH05	Diesel	28,914,693	28,974,361	28,916,008	28,975,681	(0.005)	(0.005)
	TH06	Diesel	87,311,296	87,411523	87,313,392	87,413,622	(0.002)	(0.002)
	TH08	Diesel	330,910,164	331,632,662	330,925,690	331,648,224	(0.005)	(0.005)
Chieng mai	TH05	ULG	13,561,541	13,596,240	13,562,052	13,596,757	(0.004)	(0.004)
	TH04	ULR	13,296,512	13,327,498	13,296,989	13,327,971	(0.004)	(0.004)
	TH01	Diesel	233,285,178	233,438,160	233,287,594	233,440,610	(0.001)	(0.001)

Table 5-1 Use CTSh for Calculation Quantity of Petroleum (continues)

Terminal	Tank no.	Produc.	Calculation from Developed Program		Calculation from Currently Used Program		Different Value (%)	
			GOV (L/Quart.)	GSV (L/Quart.)	GOV (L/Quart.)	GSV (L/Quart.)	GOV (L/Quart.)	GSV (L/Quart.)
Khonkhaen	TH03	ULR	9,552,675	9,583,248	9,553,139	9,583,712	(0.005)	(0.005)
	TH04	ULR	9,706,888	9,738,068	9,707,367	9,738,549	(0.005)	(0.005)
	TH01	ULG	25,159,671	25,242,116	25,160,942	25,243,388	(0.005)	(0.005)
	TH02	Diesel	20,882,262	20,928,141	20,883,273	20,929,155	(0.005)	(0.005)
	TH05	Diesel	23,419,411	23,477,068	23,420,656	23,478,317	(0.005)	(0.005)
Pitsanuloke	TH07	ULR	22,534,273	22,544,953	22,534,458	22,545,137	(0.001)	(0.001)
	TH06	ULG	35,064,235	35,101,649	35,064,797	35,102,217	(0.002)	(0.002)
	TH08	Disel	86,299,879	86,303,541	86,300,097	86,303,759	(0.000)	(0.000)

Many location show high different value because effect of temperature of petroleum product in tanks. These effects are included in API standard but not consider in currently program.

The additional factor to cause more or less than actual petroleum quantity in some location is mentioned in this section. Temperature of product in tank has direct causes wrong calculation petroleum quantity. Another factor which relation with temperature of product in tank is quantity of product in tanks.

5.3 Accuracy of Developed Program

Table 5.2 show the comparison of results of petroleum quantity calculation by not use effect of temperature on the steel shell of tanks.

Table 5-2 Calculation Quantity of Petroleum by not use CTSh

Terminal	Tank No.	Product	Calculation from Developed Program GSV (L'86/ Quart.)	Calculation from Currently Used Program GSV (L'86/ Quart.)	Diff.
Bangkok	TH05	FOD	244,450,029.00	244,450,029.00	0.00
	TH06	FOA	102,212,957.00	102,212,957.00	0.00
	TH16	FOC	255,341,405.00	255,341,405.00	0.00
	TH17	Diesel	835,829,852.00	835,829,852.00	0.00
	TH26	Diesel	685,892,354.00	685,892,354.00	0.00
	TH09	ULG	299,202,607.00	299,202,607.00	0.00
	TH25	ULG	225,138,535.00	225,138,535.00	0.00
	TH14	ULR	118,557,280.00	118,557,280.00	0.00
	TH21	ULR	346,675,420.00	346,675,420.00	0.00

Table 5-2 Calculation Quantity of Petroleum by not use CTSh (continues)

Terminal	Tank No.	Product	Calculation from Developed Program GSV (L'86/ Quart.)	Calculation from Currently Used Program GSV (L'86/ Quart.)	Diff.
Surattani	TH01	ULG	20,551,432.00	20,551,432.00	0.00
	TH02	ULG	17,211,462.00	17,211,462.00	0.00
	TH03	ULG	16,558,615.00	16,558,615.00	0.00
	TH09	ULR	81,583,301.00	81,583,301.00	0.00
	TH05	Diesel	28,975,681.00	28,975,681.00	0.00
	TH06	Diesel	87,413,622.00	87,413,622.00	0.00
	TH08	Diesel	331,648,224.00	331,648,224.00	0.00
Chiengmai	TH05	ULG	13,596,757.00	13,596,757.00	0.00
	TH04	ULR	13,327,971.00	13,327,971.00	0.00
	TH01	Diesel	233,440,610.00	233,440,610.00	0.00
Pitsanuloke	TH07	ULG	22,545,137.00	22,545,137.00	0.00
	TH06	ULR	35,102,217.00	35,102,217.00	0.00
	TH08	Diesel	86,303,759.00	86,303,759.00	0.00
Khonkhean	TH03	ULG	9,583,712.00	9,583,712.00	0.00
	TH04	ULR	9,738,549.00	9,738,549.00	0.00
	TH01	ULR	25,243,388.00	25,243,388.00	0.00
	TH02	Diesel	20,929,155.00	20,929,155.00	0.00
	TH05	Diesel	23,478,317.00	23,478,317.00	0.00

Table 5.2 shows difference zero between developed program and currently used program by not consider effect of temperature on the steel of tanks. Object of comparison value by not use CTSh will help user clarify process calculation inventory between manual calculate with automatic calculate.

Results of comparison currently used program with developed program give same value so this result can clarify process calculate inventory with user which both currently used program and manual calculation basis from same fundamentals.

NOTE: Reader can study program calculation inventory by contact direct to Dr. Jirdsak Tscheikuna, Faculty of Chemical Engineering, Chulalongkorn University.