CHAPTER 4

Oil Inventory Simulation and Example

Oil inventory simulation program is a developed simulator for calculating statistic liquid quantities, at atmospheric conditions, in upright cylindrical tanks. The information needed is oil level, FW level, product temperature, ambient temperature, density. It will also be necessary to have the capacity table and applicable correction factor tables or subroutines. Any deduction that is inappropriate for a particular application will be a zero deduction, and any correction that is inappropriate will be held at 1.00000.

4.1 Simulation Volume Based Calculation Procedure

The calculation sequence follows that of the preceding section. The flow is as follows (see appendix A ,Figure A-1):

$$TOV \longrightarrow GOV \longrightarrow GSV$$

a) With the oil level or gauge, enter the capacity table and records the TOV, as recorded in the table.

b) Subtract any gauged FW volumes. The FW volume is obtained by entering the capacity table with the gauged FW level.

c) Apply the CTSh to arrive at the GOV.

d) Correct this quantity for any applicable FRA.

e) Calculate API gravity @ 60 $^\circ$F for finds value of CTL. The API gravity @ 60 $^\circ$F is calculated by entering the API gravity observed temperature and temperature in hydrometer.

f) Correct the GOV to standard temperature. This is done by multiplying and dividing the GOV with the CTL at 60 $^\circ$F and the CTL at 86 $^\circ$F to arrive at the GSV.

The mathematical formulae for the various required values can be expressed as follows:

$$GSV = \left\{ \left[(TOV - FW) \times (CTSh) \right] \pm FRA \right\} \times CTL$$

4.2   Simulation Data

The first of data is table quantity of upright cylindrical, the calibration of vertical cylindrical tanks has been used and is a recognized method of determining the capacity of storage tanks from measurements of the circumference of a tank at various heights. These table calibration by reference ISO 7507. Oil level and FW level will be converted to quantity from table quantity of tanks.

The second of data is tank data such as weight of roof and material of tank (coefficient of expansion of material used 0.0000062 for mild steel tanks). Floating roof adjustment (FRA) and correction for the effect of temperature on the steel shell of the tank (CTSh) which will be calculated by this data.

The third of data is sampling of product such as API gravity observed temperature, hydrometer temperature and temperature of product in tanks. API gravity @ $60^{\circ}F$, volume correction factor (VCF or CTL) will be calculated by this data.

These data input are useful for calculating quantity petroleum in tanks which will be using equation from Chapter 3.

4.3   Simulation Flow Diagram

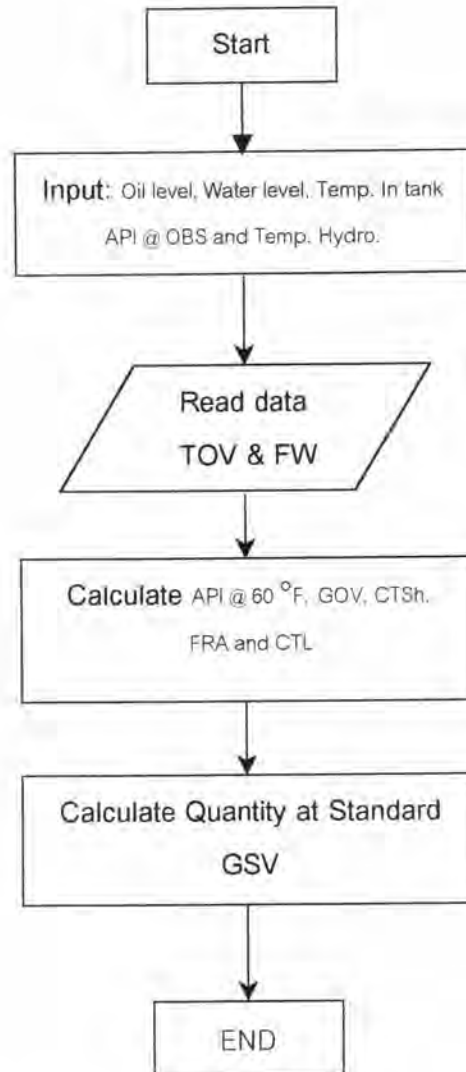### 4.3.1   Calculation Overall Petroleum Quantity

Figure 4-1 Flow Diagram for Calculation Overall Petroleum Quantity
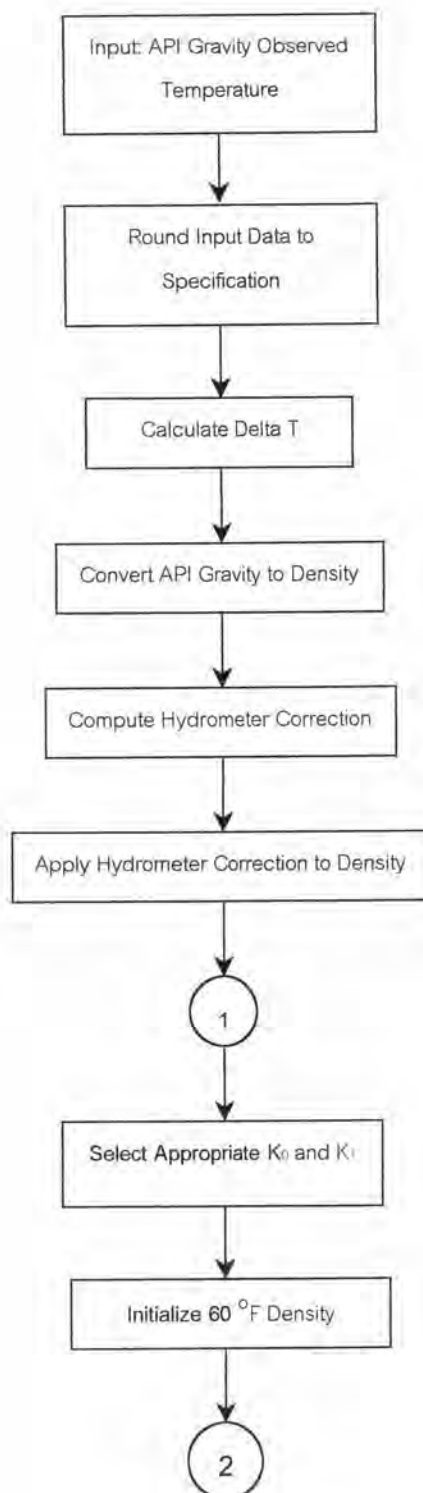
4.3.2 API Gravity @ 60°F

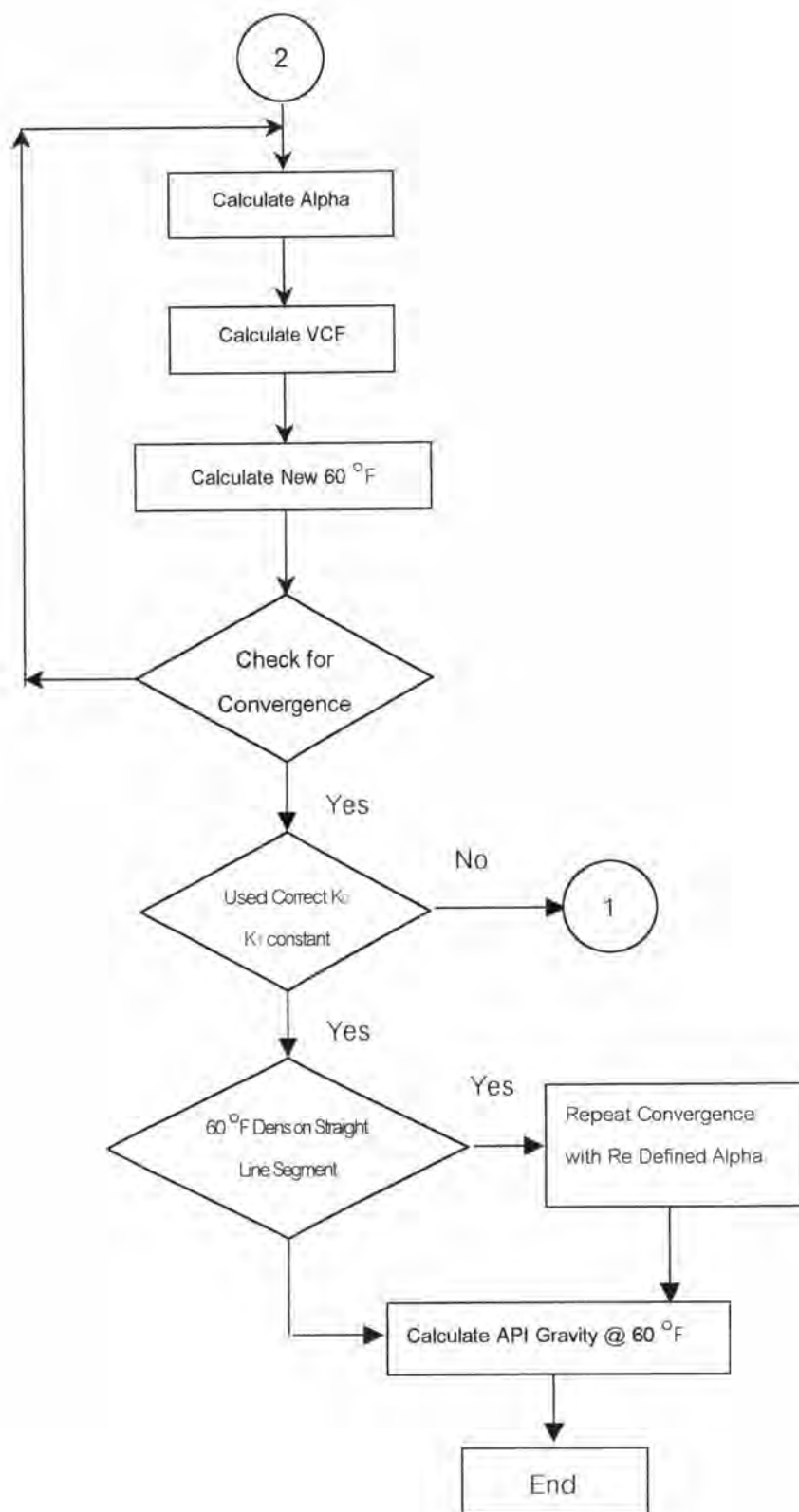Figure 4-2 Flow Diagram for Calculation API Gravity @ 60 °F

Figure 4-2 Flow Diagram for Calculation API Gravity @ 60 $^{\circ}$F (continue)
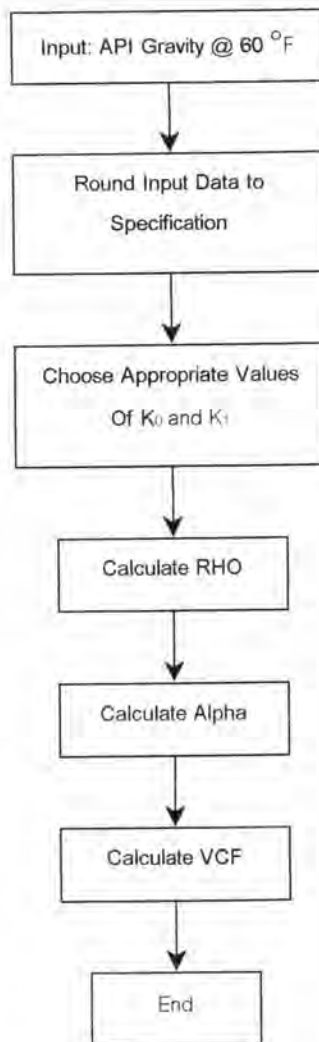
4.3.3 Volume Correction Factor

```
┌─────────────────────────────┐
│  Input: API Gravity @ 60 °F  │
└─────────────────────────────┘
              │
              ▼
┌─────────────────────────────┐
│     Round Input Data to      │
│        Specification         │
└─────────────────────────────┘
              │
              ▼
┌─────────────────────────────┐
│   Choose Appropriate Values  │
│       Of $K_0$ and $K_1$     │
└─────────────────────────────┘
              │
              ▼
┌─────────────────────────────┐
│        Calculate RHO         │
└─────────────────────────────┘
              │
              ▼
┌─────────────────────────────┐
│       Calculate Alpha        │
└─────────────────────────────┘
              │
              ▼
┌─────────────────────────────┐
│        Calculate VCF         │
└─────────────────────────────┘
              │
              ▼
┌─────────────────────────────┐
│             End              │
└─────────────────────────────┘
```

Figure 4-3 Flow Diagram for Calculation VCF

c)   Tank data

d)   Type of product

e)   Relation of Product
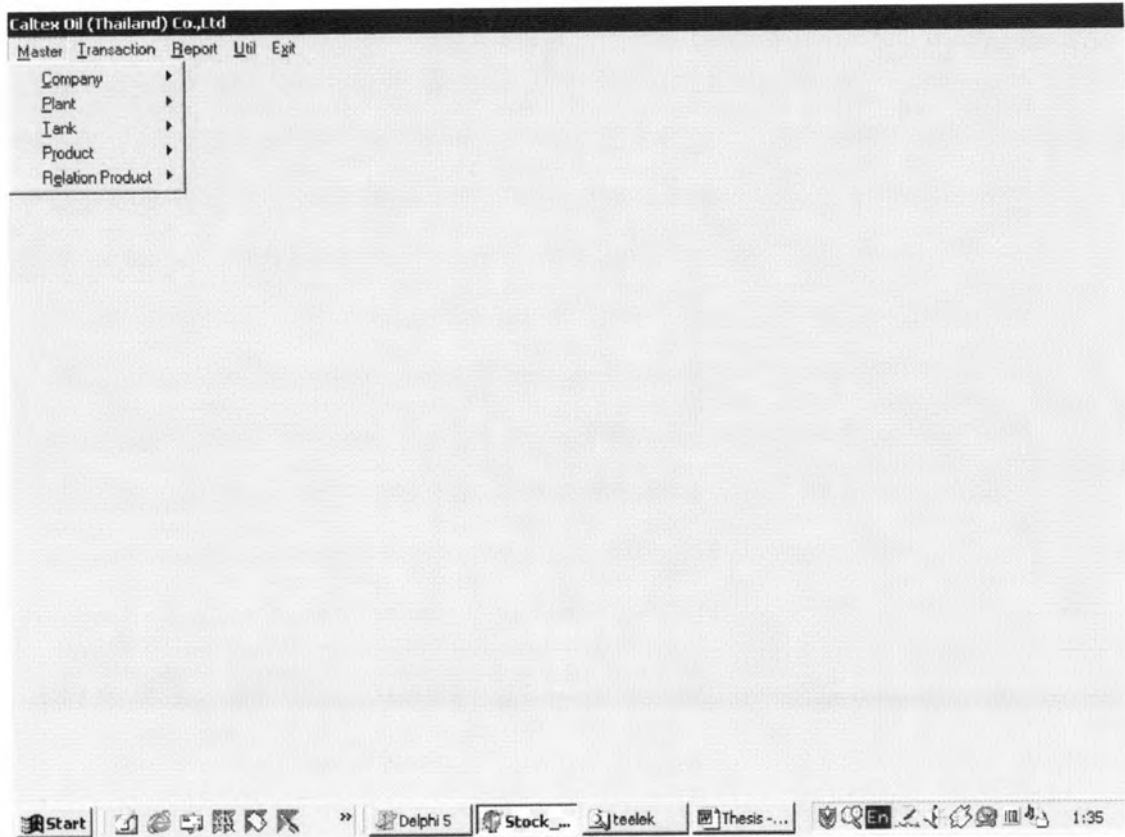
Figure 4-5 Master Data Menu

The calculation of this simulation will be started from database of quantity table, company name, plant name, Tank number, Type of products, displacement volume table and remain volume table.

4.4.2.1 Company Data Menu

a) Add company data (see figure 4.6)

- Use menu path: Master ──➤ Company ──➤ Add Company
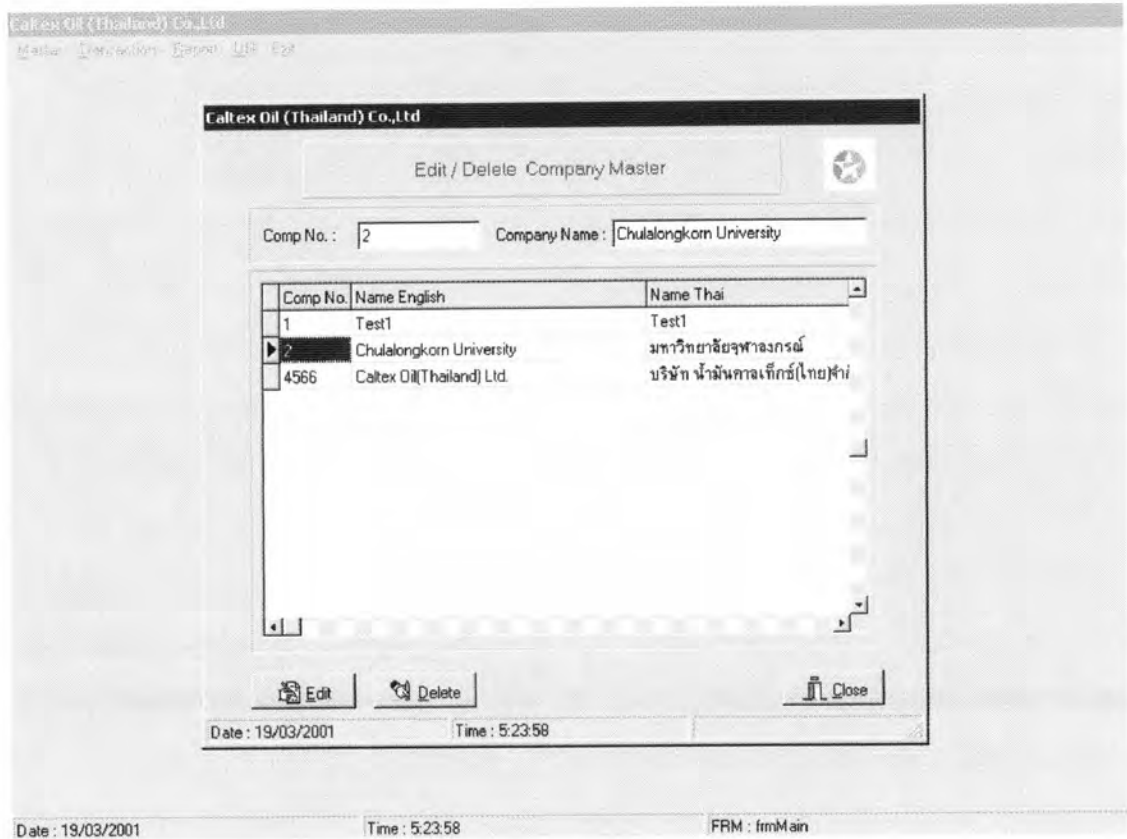
Choose Add company menu next screen will be appears.

4.4   Simulation Program Menu

4.4.1   Main Menu

The program starts from Main menu as shown in Figure 4.4. There are five menus in this screen.
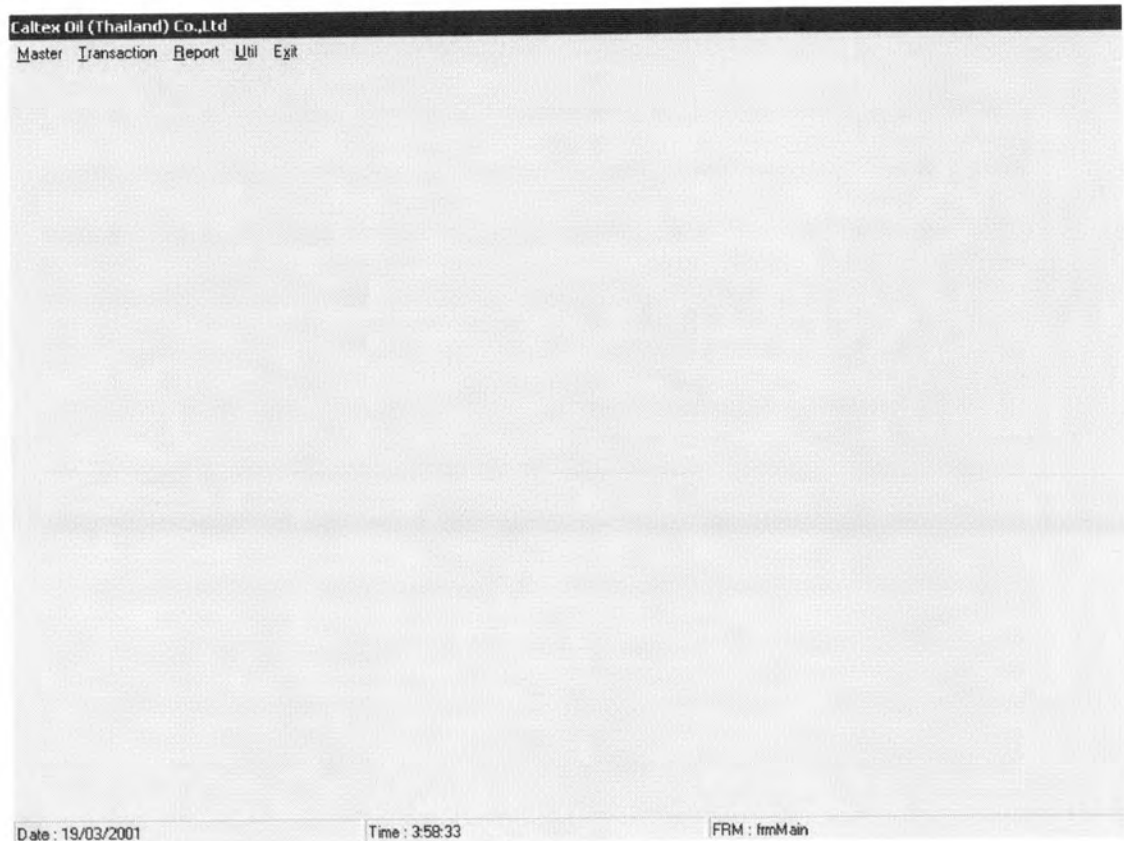
Figure 4-4 Main Menu

4.4.2   Master Data Menu

This menu consists of the following items of data for selection and input. (see Figure 4.5)

a)   Company data

b)   Plant data

Figure 4-6 Add Company Menu

Follow in action click button " Save " and click button " Yes " the data will be kept in database table.

b) Edit company data (see figure 4.7)

- Use menu path: Master ⟶Company⟶ Edit / Delete Company

Choose Edit / Delete Company menu next screen will be appears.

Figure 4-7 Edit / Delete Company Menu

In this screen user can be edit or delete data as show wrong data. Follow in action click button " Edit " next screen will be appears.
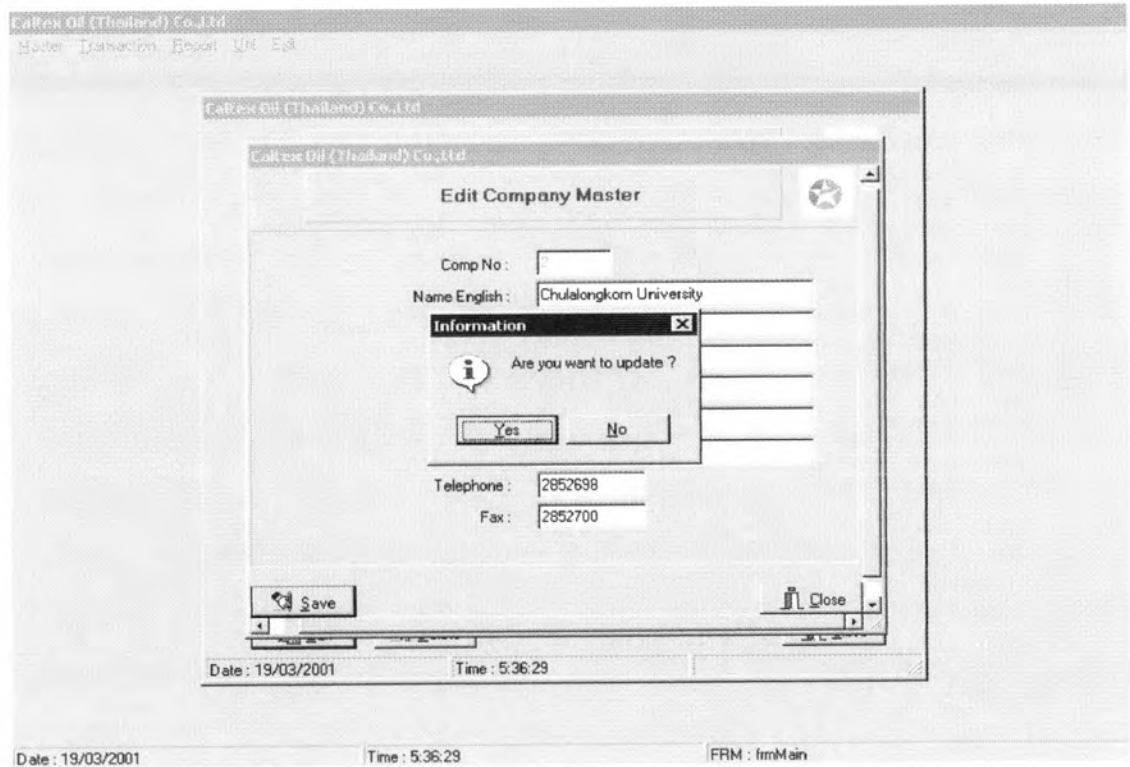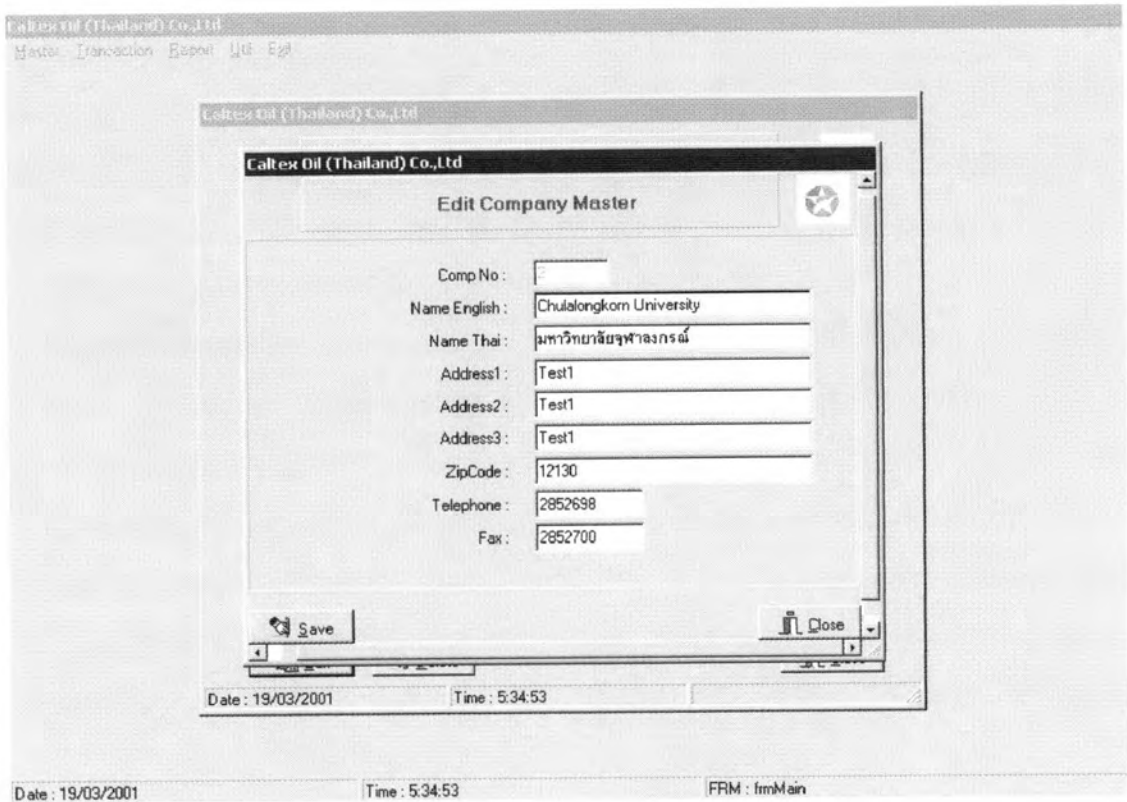
Figure 4-8 Edit Company Screen

Follow in action click button " Save " and click button " Yes " the data will be changed and update in database table.

c) Inquiry company data (see figure 4.9)

- Use menu path: Master ──→ Company ──→ Inquiry Company

Choose Inquiry Company menu next screen will be appears. In this menu use for display data only.
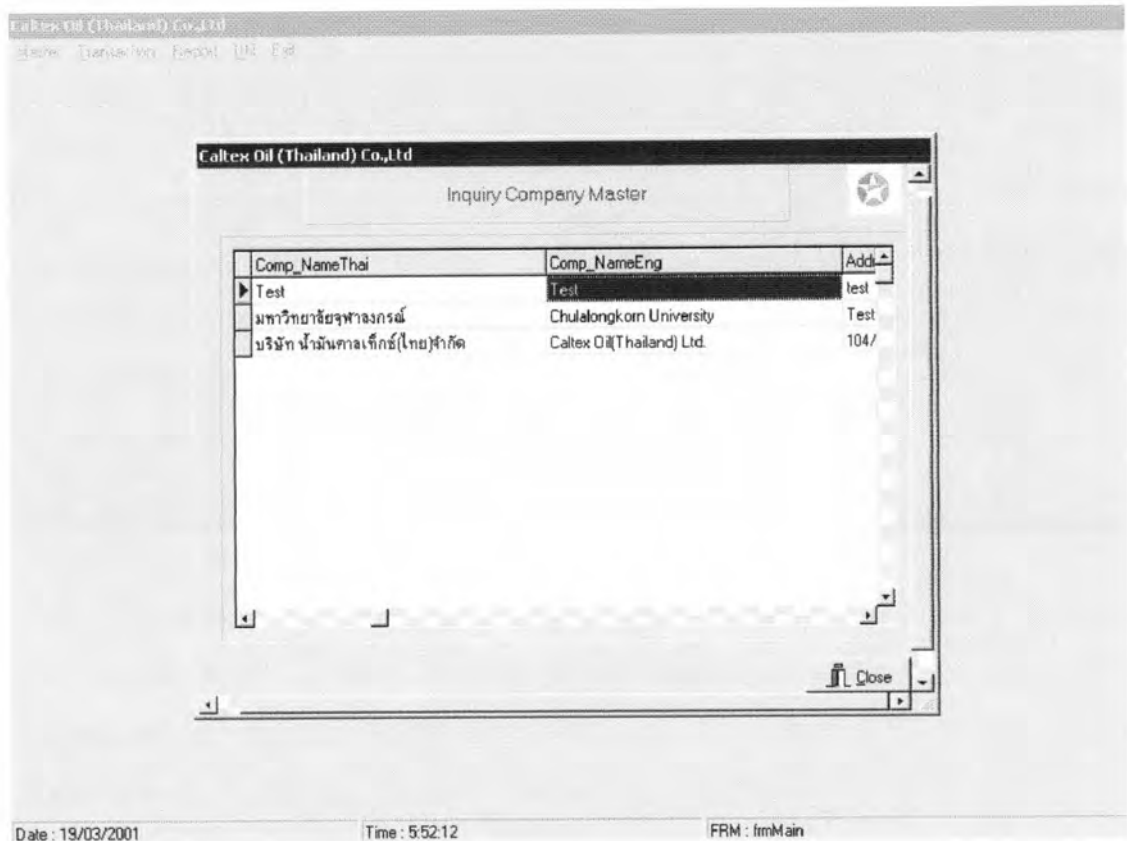
Figure 4-9 Inquiry Company Menu

4.4.2.2 Plant Data Menu

a) Add plant data (see figure 4.10)

- Use menu path: Master ──→ Plant ──→ Add Plant

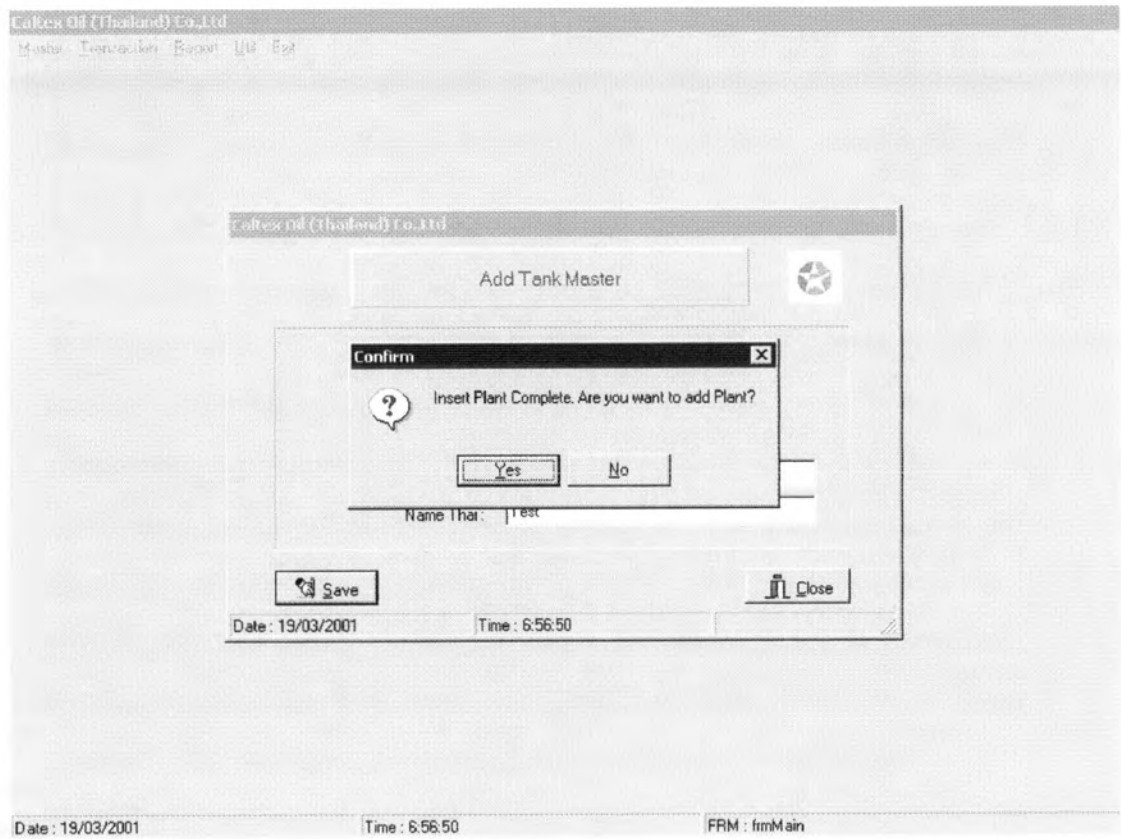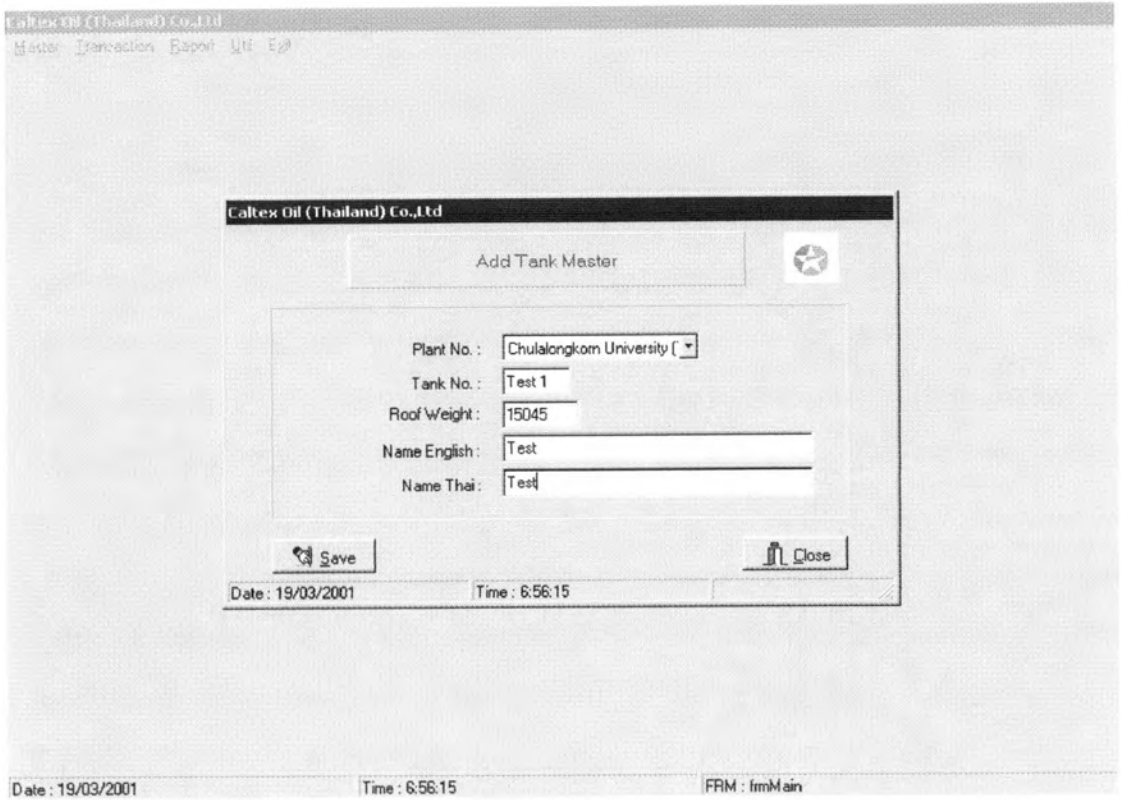Choose Add Plant menu next screen will be appears. In this menu used update plant name in database.
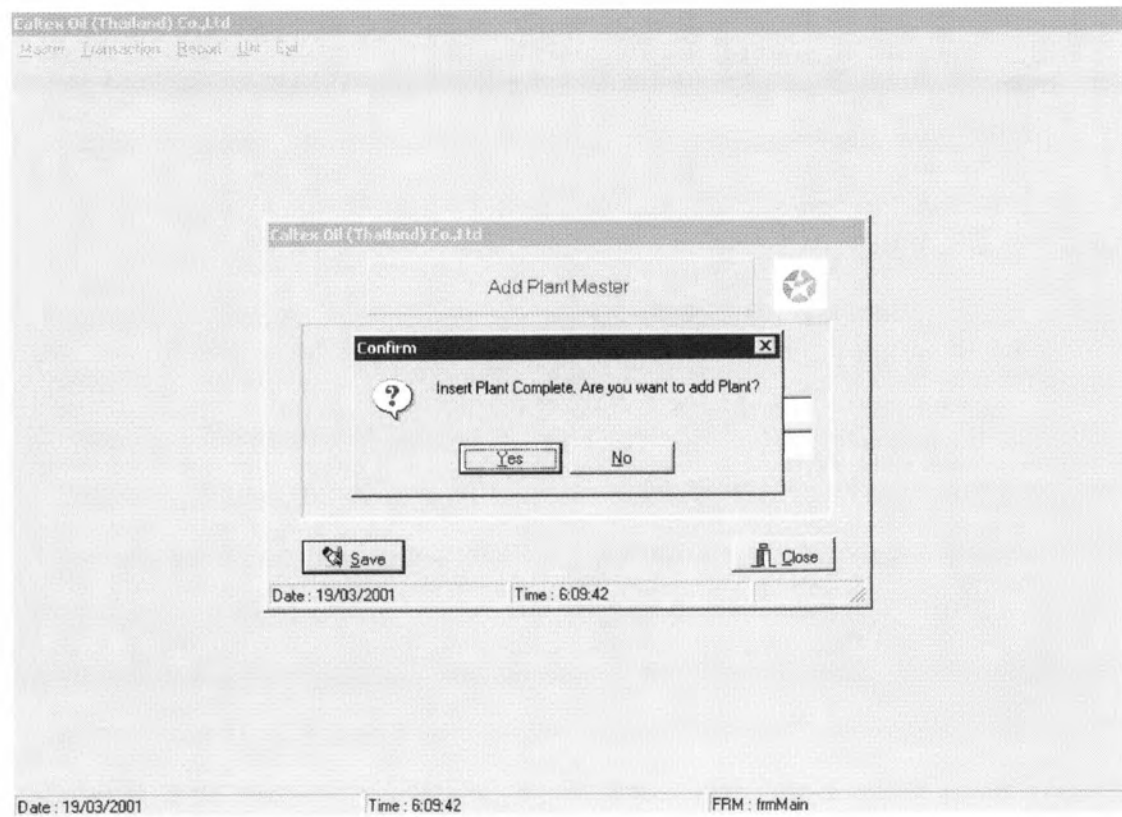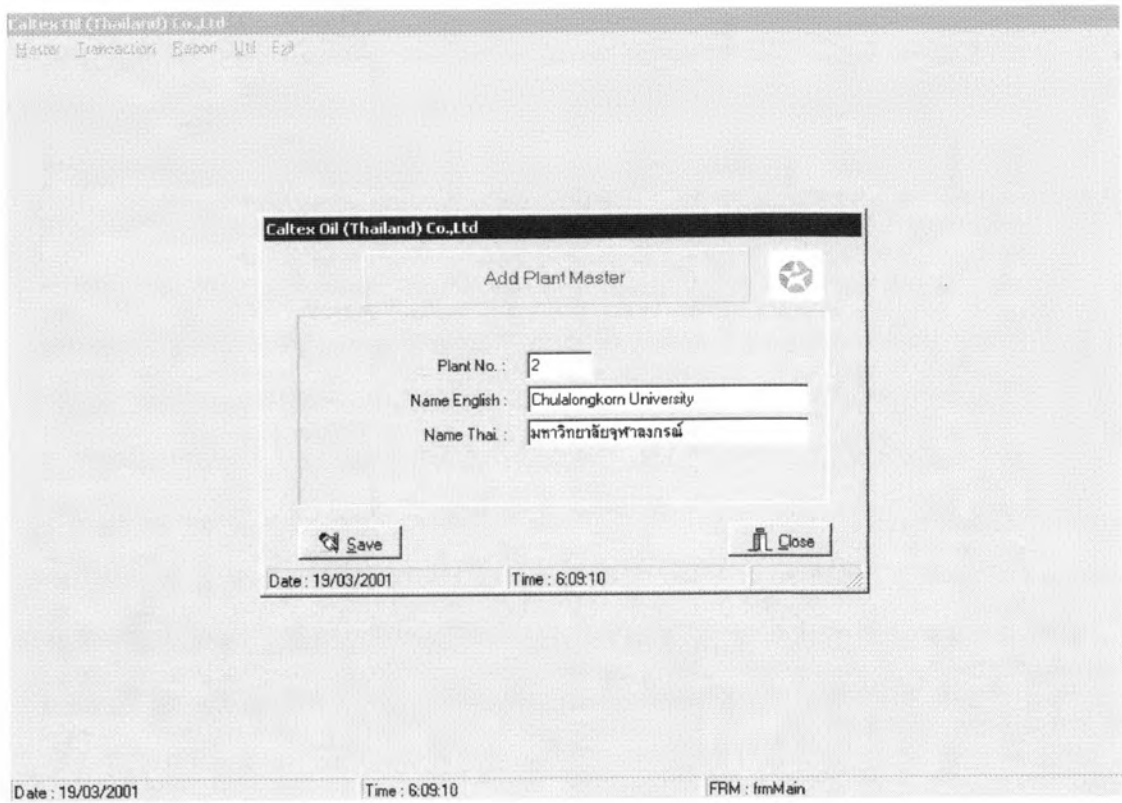
Figure 4-10 Add Plant Menu

b) Edit / Delete plant data (see figure 4.11)

- Use menu path: Master ⟶ Plant ⟶ Edit / Delete Plant

Choose Edit / Delete Plant menu next screen will be appears. In this

menu used change plant data and update plant data in database.
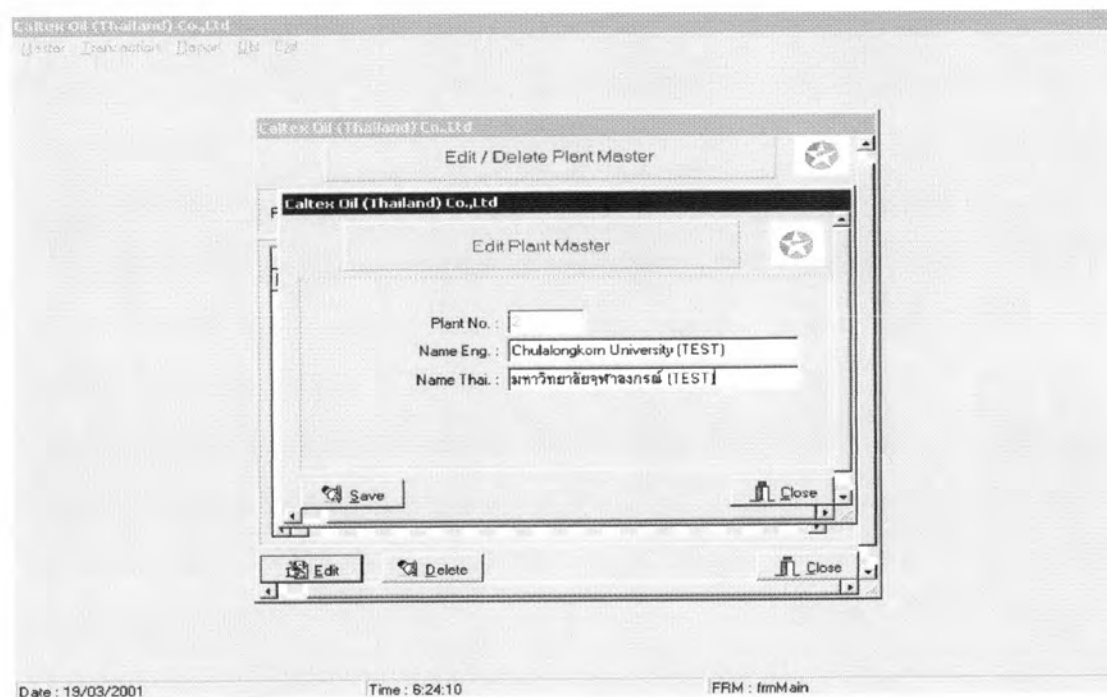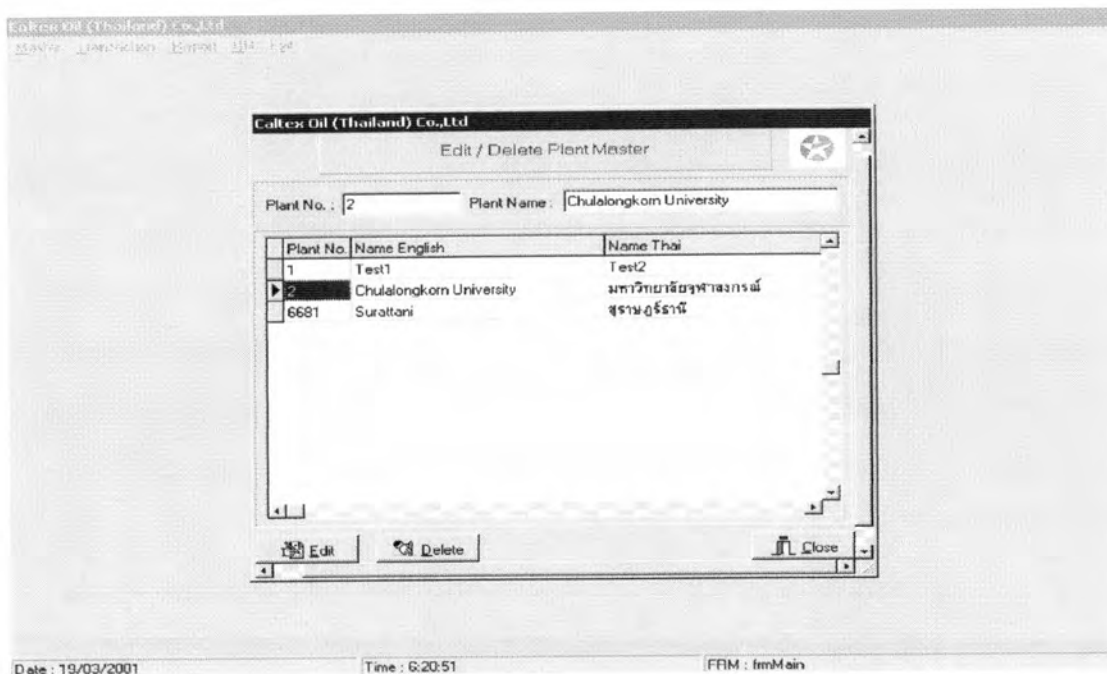
Figure 4-11 Edit / Delete Plant Menu

c) Inquiry plant data (see figure 4.12)

- Use menu path: Master ⟶ Plant ⟶Inquiry Plant

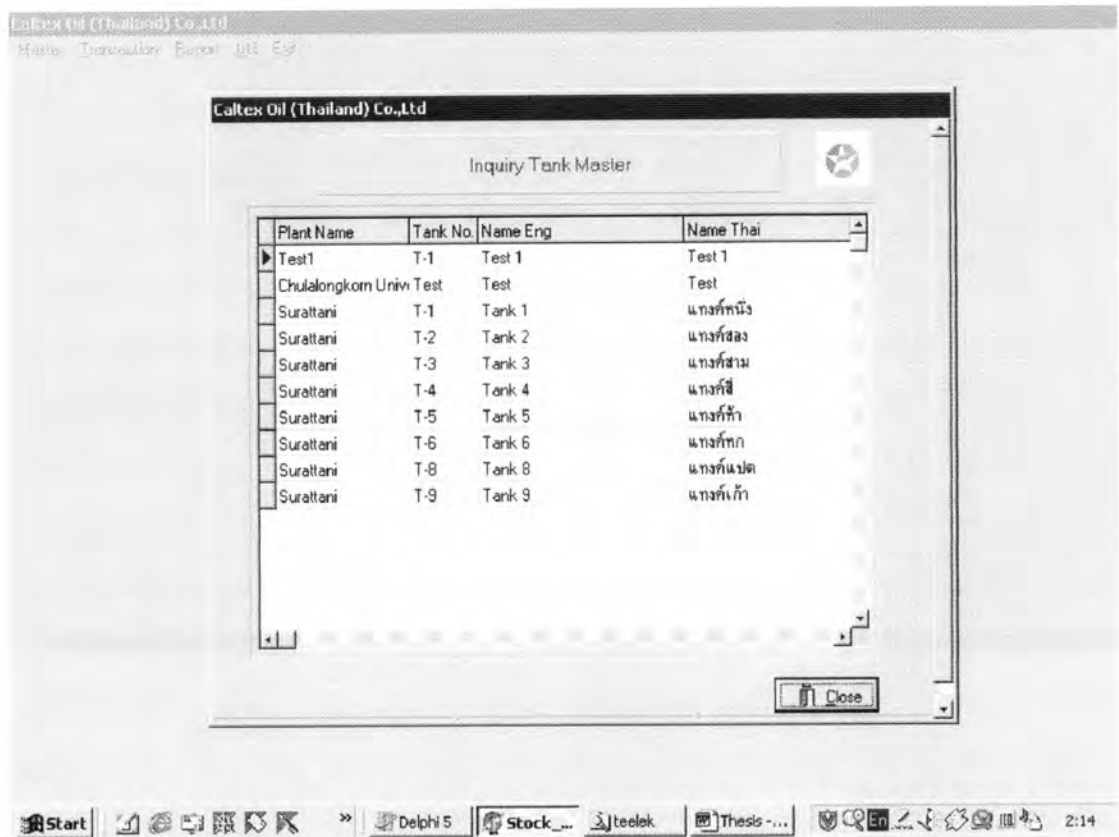Choose Inquiry Plant menu next screen will be appears. In this menu used display plant name in database only.
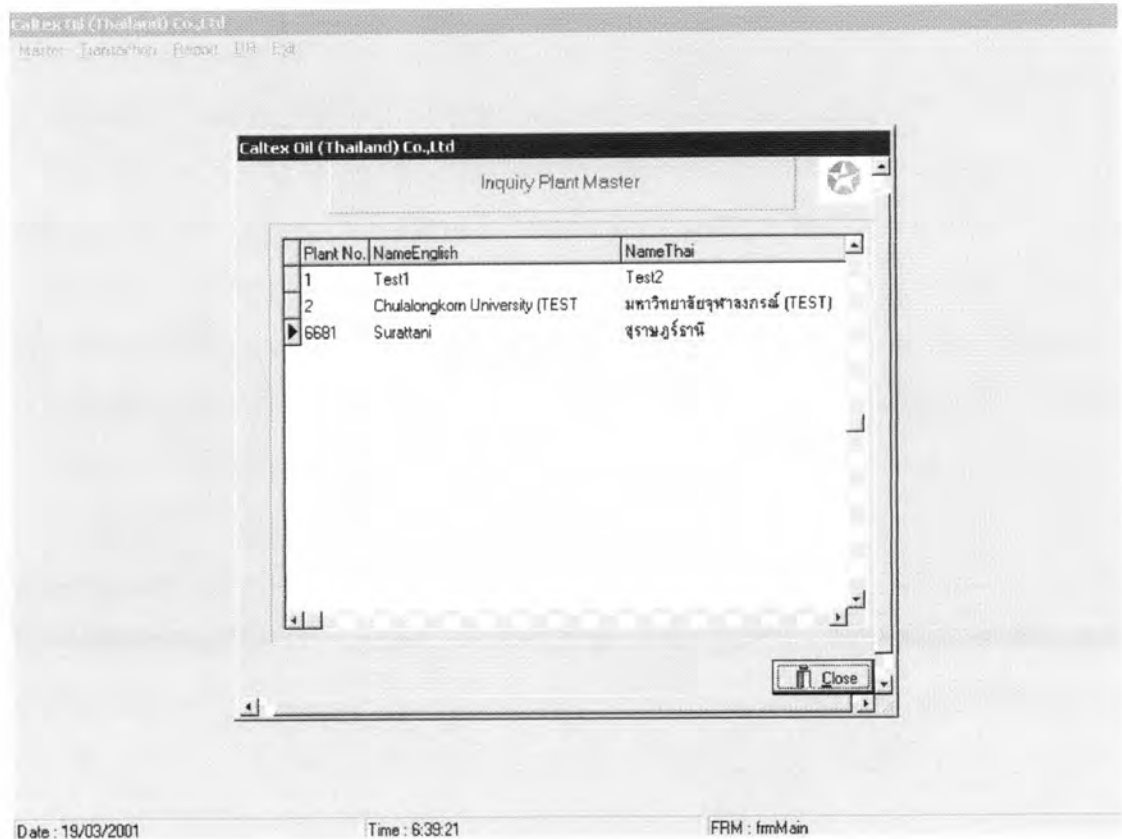
Figure 4-12 Inquiry Plant Menu

4.4.2.3 Tank Data Menu

a) Add Tank data (see figure 4.13)

- Use menu path: Master ⟶ Tank ⟶Add Tank

Choose Add Tank menu next screen will be appears. In this menu used update Tank name and weight of roof in database.

Figure 4-13 Add Tank Menu

b) Edit / Delete Tank data (see figure 4.14)

- Use menu path: Master ⟶ Tank ⟶ Edit / Delete Tank

Choose Edit / Delete Tank menu next screen will be appears. In this menu used change Tank name and weight of roof in database.
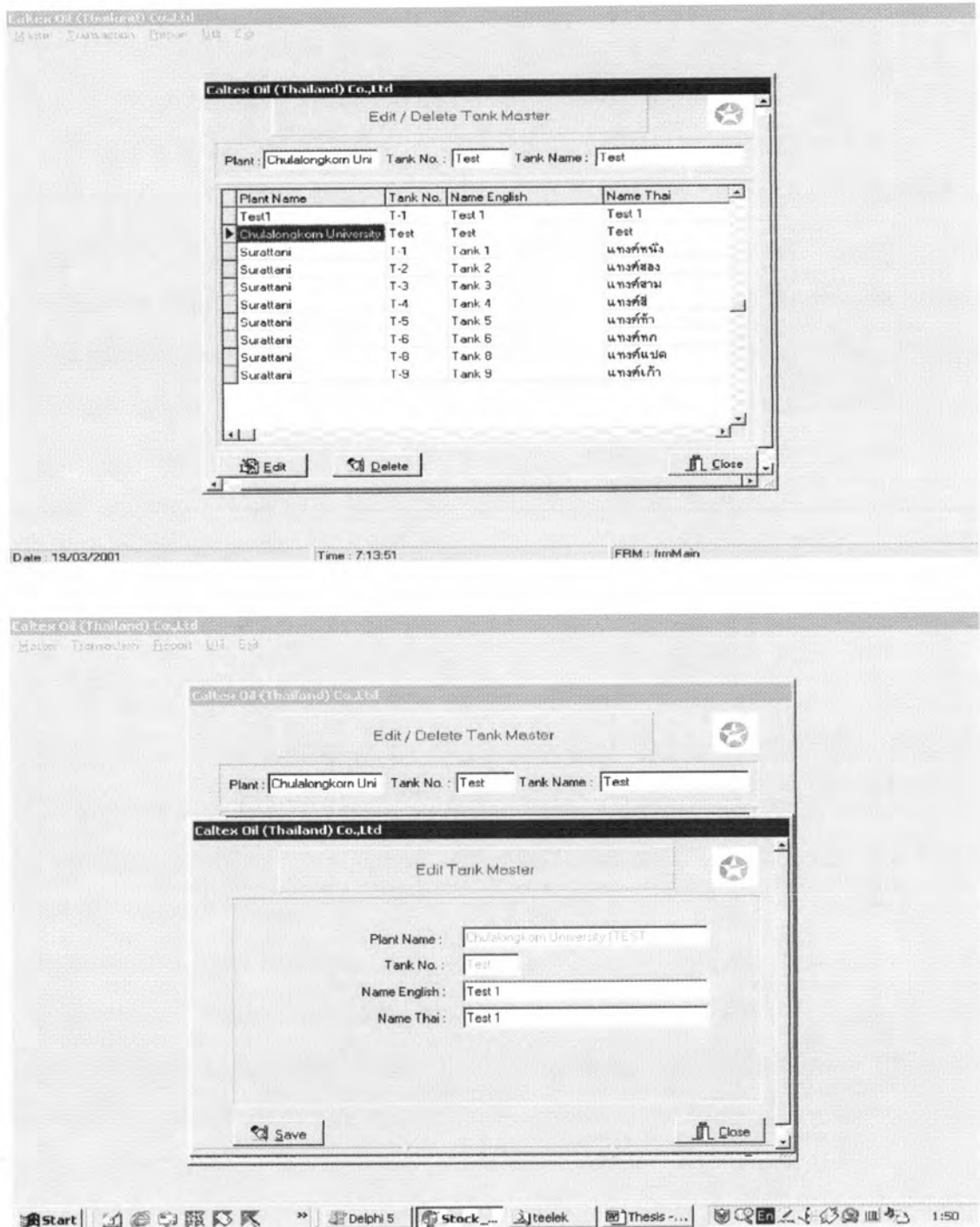
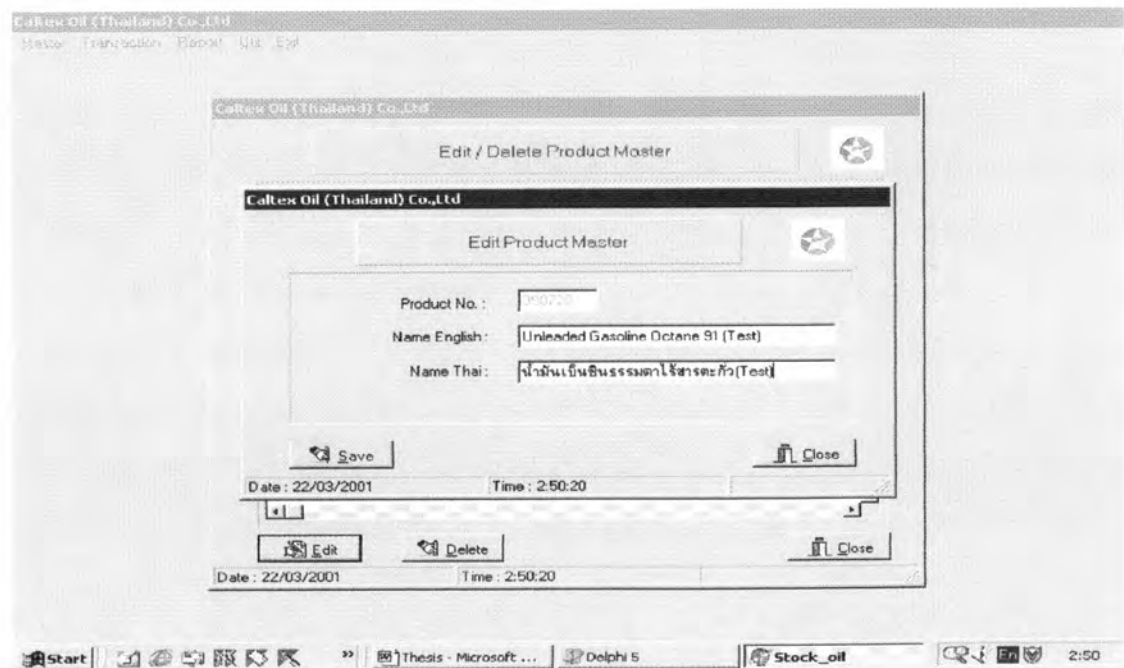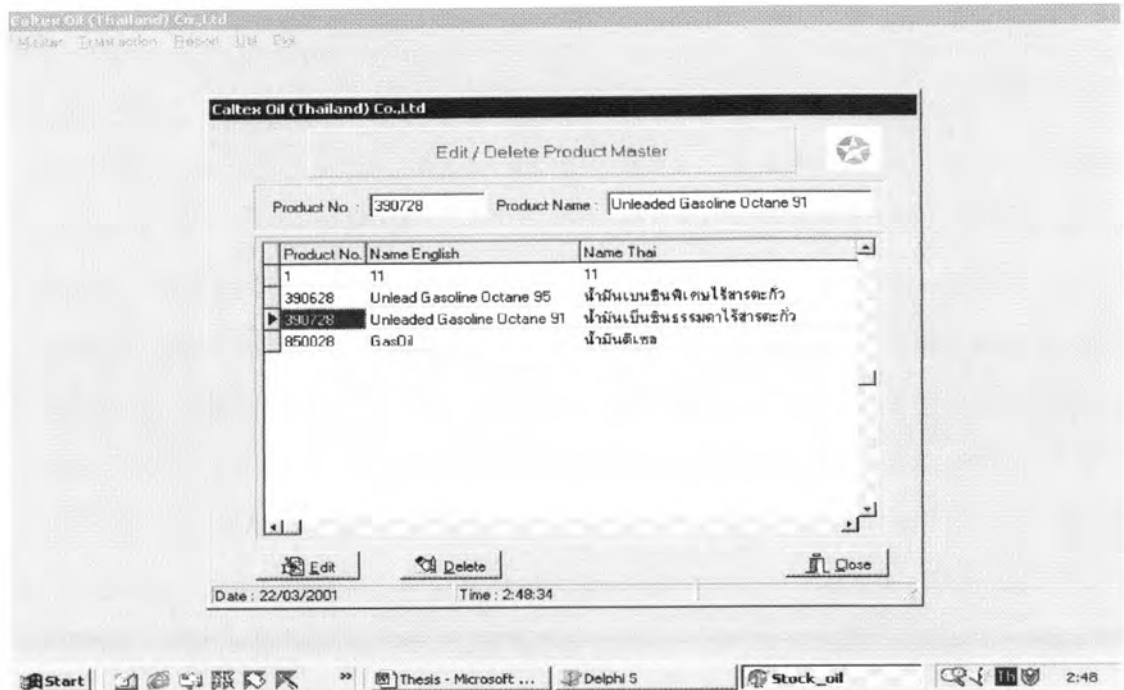Figure 4-14 Edit / Delete Tank Menu

c) Inquiry plant data (see figure 4.15)

- Use menu path: Master ⟶ Tank ⟶ Inquiry Tank

Choose Inquiry Plant menu next screen will be appears. In this menu used display plant name and tank name in database only.

Figure 4-15 Inquiry Tank Menu

4.4.2.4 Type of product Menu

a) Add Product Menu (see figure 4.16)

- Use menu path: Master ⟶ Product ⟶ Add Product

Choose Add Product menu next screen will be appears. In this menu used update product number and product name in database.
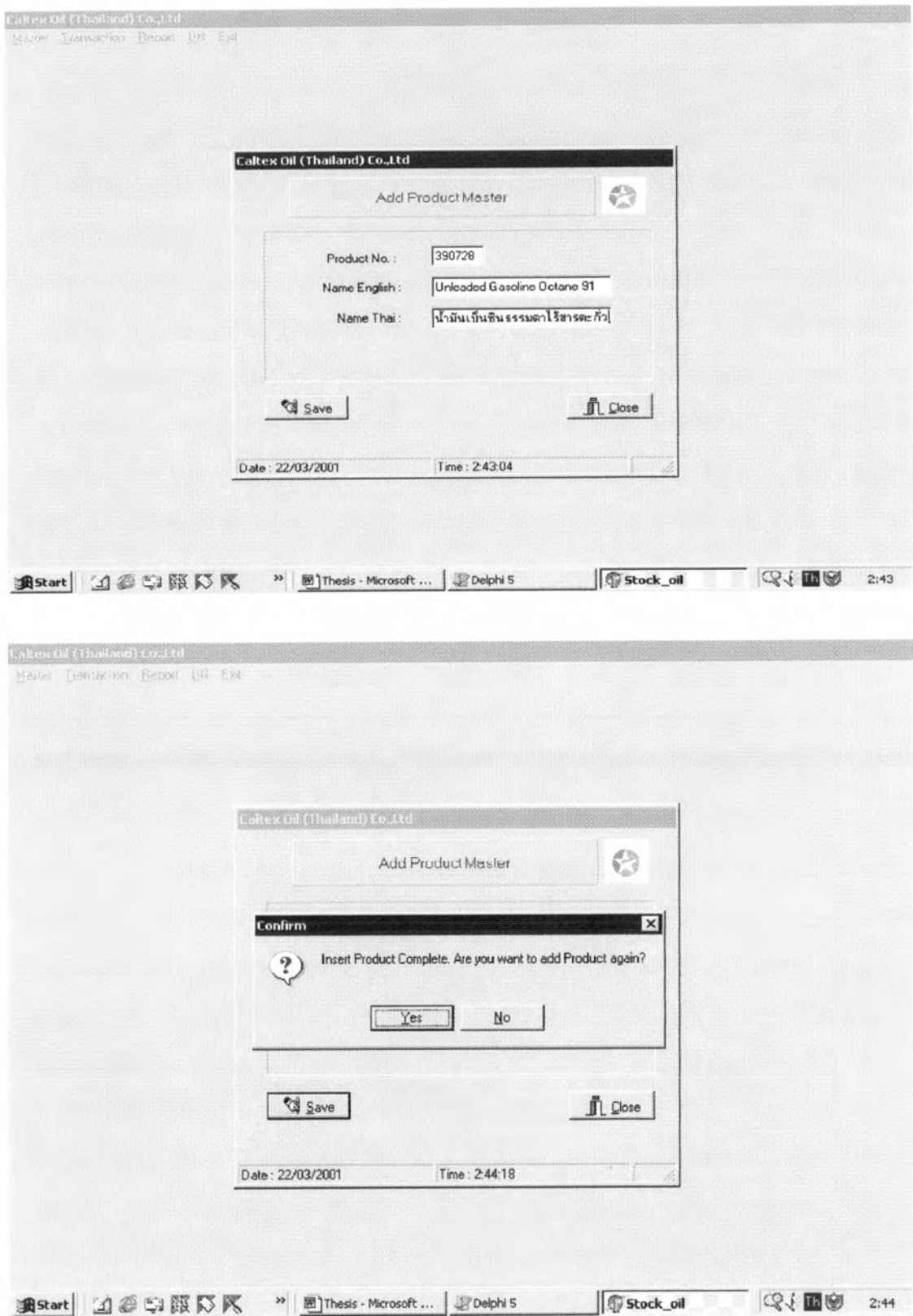
Figure 4-16 Add Product Menu
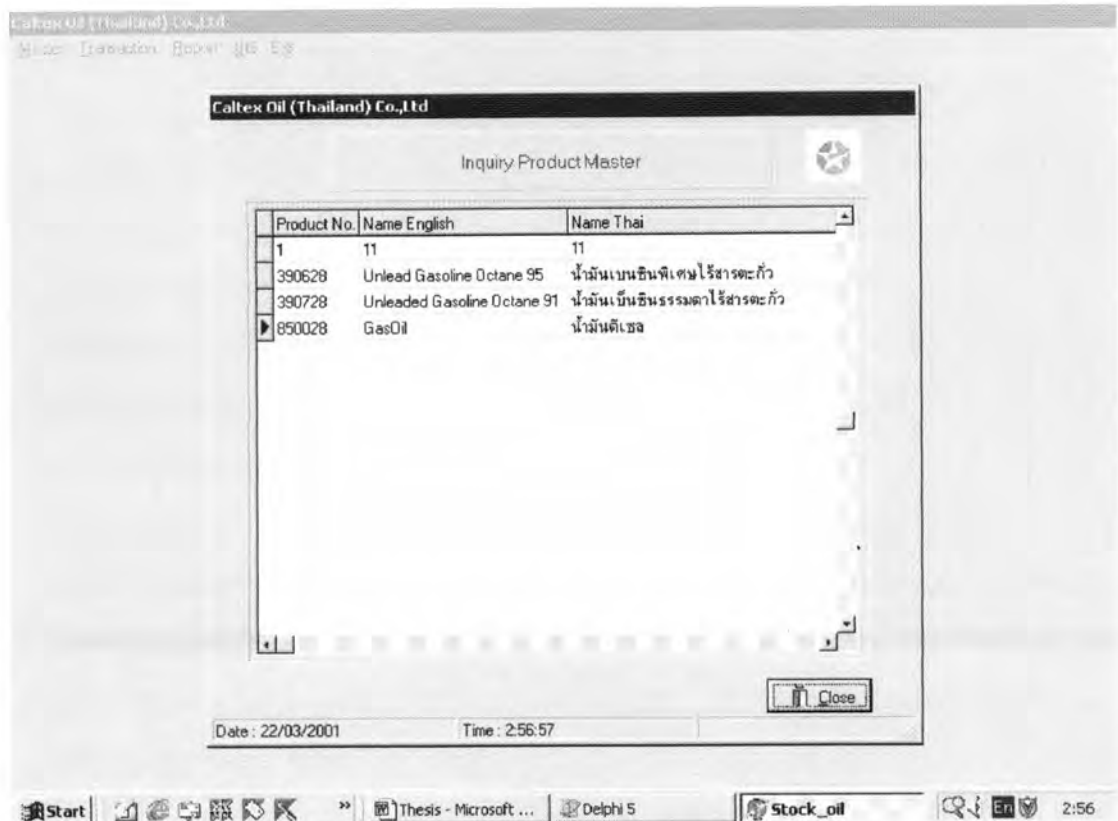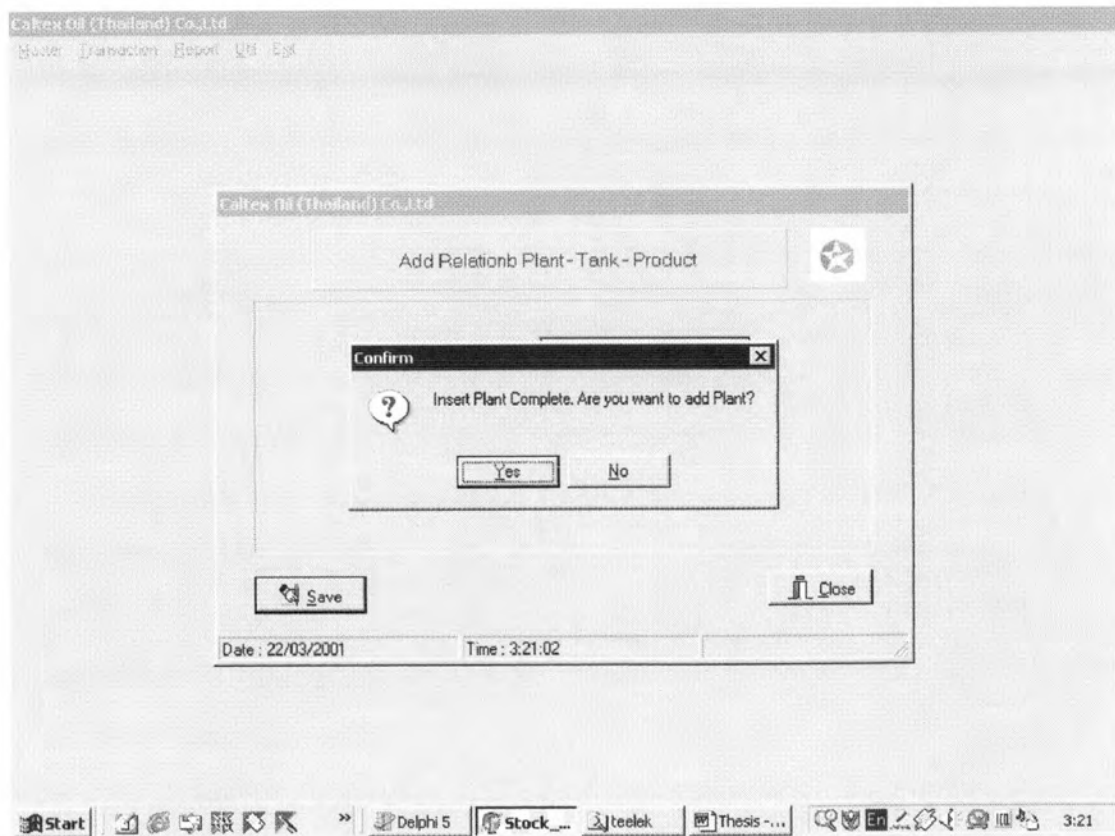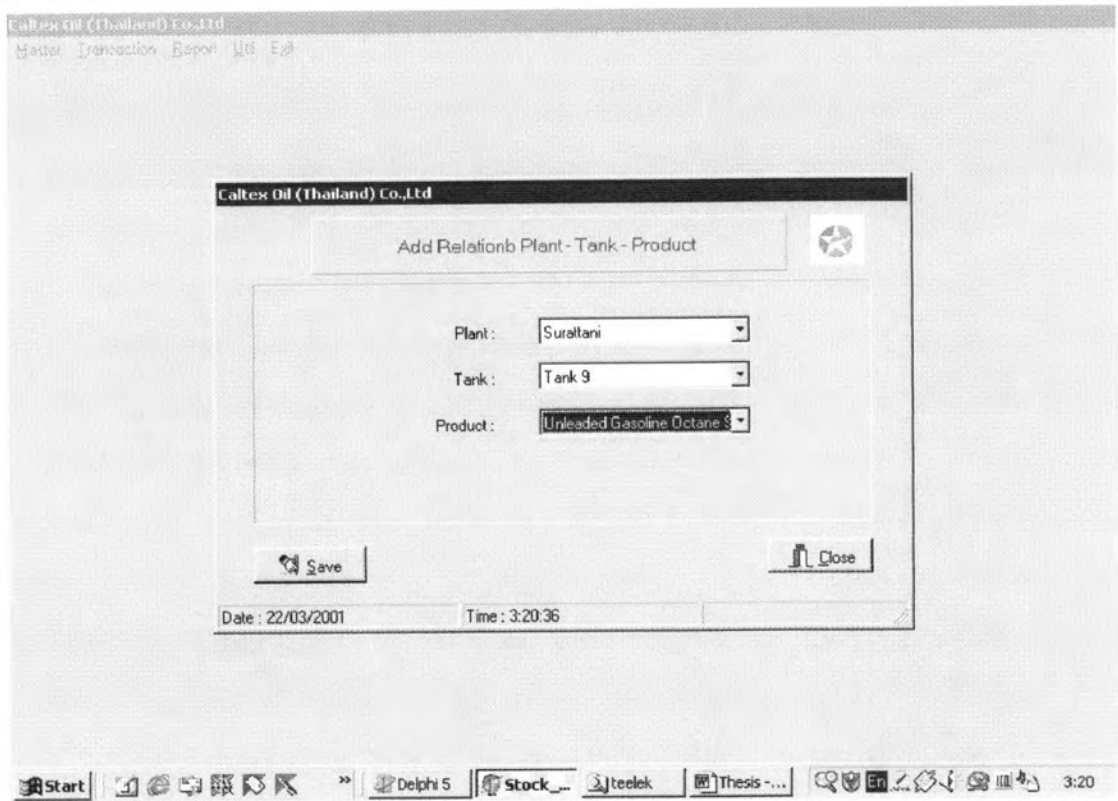
b) Edit / Delete Product data (see figure 4.17)

- Use menu path: Master —→ Product —→ Edit / Delete Product

Choose Edit / Delete Tank menu next screen will be appears. In this menu used change product number and product name in database.

Figure 4-17 Edit / Delete Product Menu

c) Inquiry Product data (see figure 4.18)

- Use menu path: Master ⟶ Product ⟶ Inquiry Product

Choose Inquiry Product menu next screen will be appears. In this menu used display product number and product name in database only.

Figure 4-18 Inquiry Product Menu

4.4.2.5 Relation of product Menu

a) Add Relation Product Menu (see figure 4.19)

- Use menu path: Master ⟶ Relation Product ⟶ Relation Product

Choose Add Relation Product menu next screen will be appears. In this menu used integrate plant name, tank number and type of product when user update relation of these data in database, program will show plant name relate with tank number and type of product.

Figure 4-19 Add Product Menu

b) Edit / Delete Relation Product data (see figure 4.20)

- Use menu path: Master ⟶ Relation Product ⟶ Delete

Relation Product

Choose Delete Relation Product menu next screen will be appears. In this menu used change integrate plant name, tank number and type of product in database.
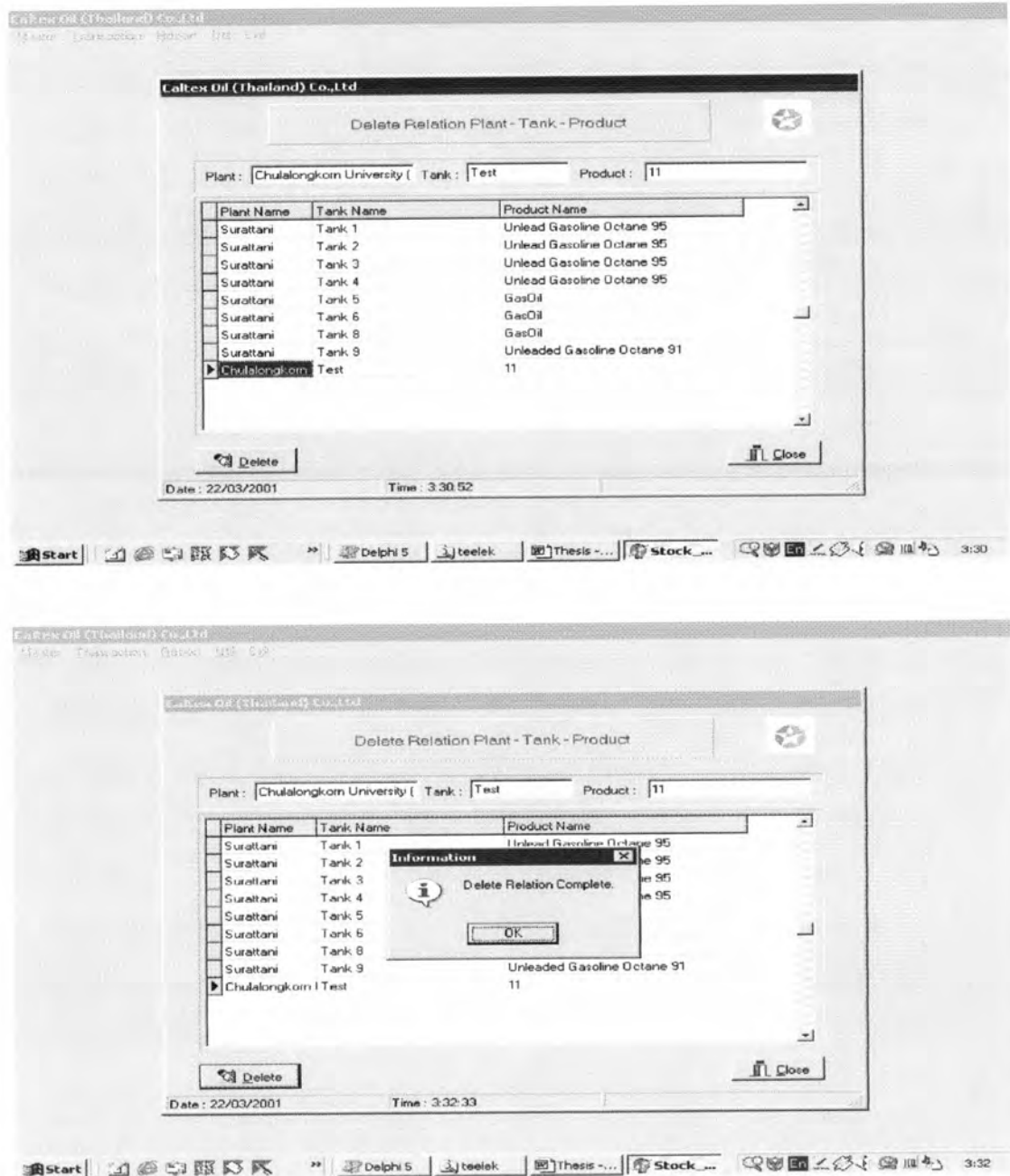

Figure 4-20 Delete Relation Product Menu

c) Inquiry Product data (see figure 4.21)

- Use menu path: Master $\longrightarrow$ Relation Product $\longrightarrow$ Inquiry Relation Product

Choose Inquiry Relation Product menu next screen will be appears. In this menu used display integration of plant name, tank number and product name in database only.
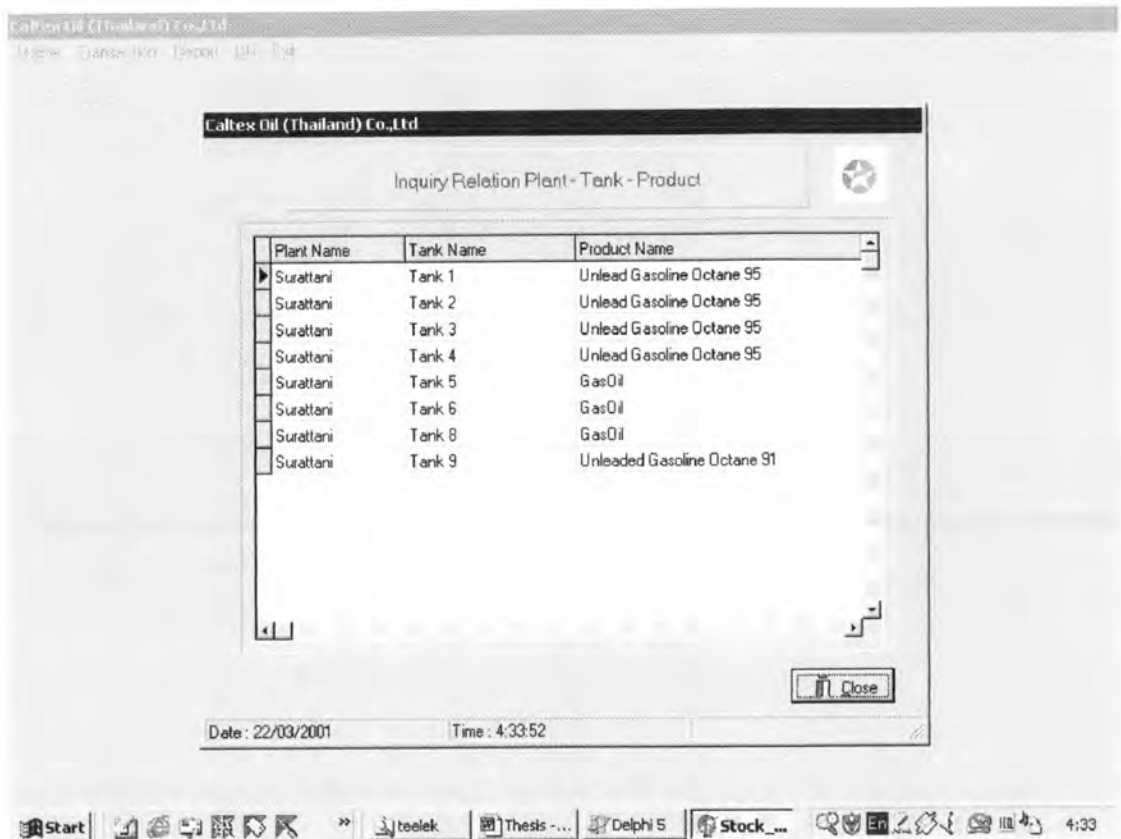
Figure 4-21 Inquiry Relation Product Menu

4.5 Simulation Inventory of Petroleum in Tank

When the transaction menu is selected to calculate inventory of petroleum, the following menu of data entry will appear consecutively.

The program has run from selection add tank gauging from **Transaction** menu, followed with updated data in database as mentioned in 4.4.2. This menu has five data necessary to input as follow in action:

4.5.1 Add Gauging Menu

-Use menu path: Transaction $\longrightarrow$ Tank Gauging $\longrightarrow$ Add Gauging

Choose Add Gauging menu next screen will be appears. In this screen input data entry Oil level, Water level, Temp in tank (temperature of products in tanks), API @ OBS and Temp Hydro. When user input all data in this screen program will be calculation value of API @ 60 $^{\circ}$ F, CTSh (effect of temperature on steel shell of tanks), GOV, VCF @ 60 $^{\circ}$F, VCF @ 86 $^{\circ}$F and GSV.

Follow in action click button " Save " the data as updated in database for run report in next step.

Figure 4-22 Add Gauging Menu

4.5.2   Edit/Delete Gauging Menu

-Use menu path: Transaction ⟶ Tank Gauging ⟶ Edit/Delete Gauging

Choose Edit/Delete Gauging menu next screen will be appears. In this screen user can change data entry Oil level, Water level, Temp in tank (temperature of products in tanks), API @ OBS and Temp Hydro.
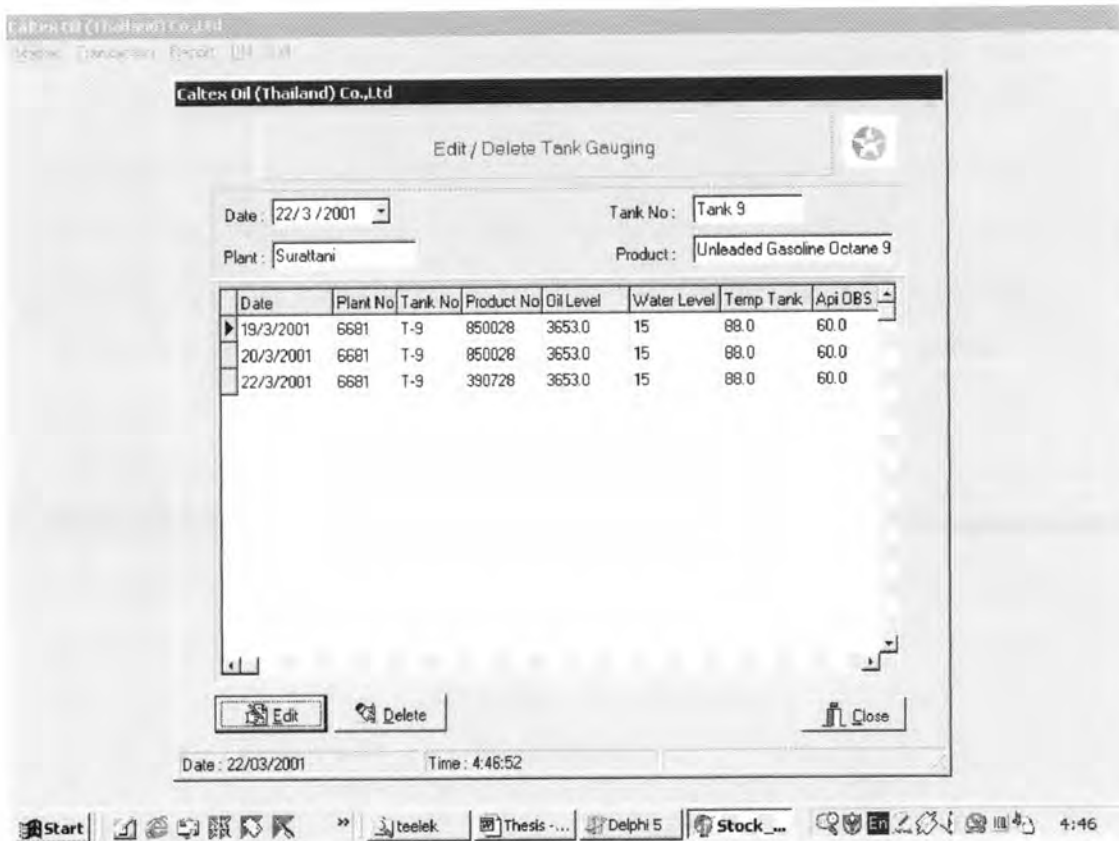

Figure 4-23 Edit / Delete Gauging Menu

Follow in action click button " Edit " next screen will be appear. When user input all data in this screen program will be recalculation value of API @ 60 $^{\circ}$ F, CTSh (effect of temperature on steel shell of tanks), GOV, VCF @ 60 $^{\circ}$F, VCF @ 86 $^{\circ}$F and GSV.

Follow in action click button " Save " the data as updated in database for run report in next step.

Figure 4-23 Change Data Gauging Menu

4.5.3   Inquiry Gauging Menu (See Figure 4.24)

-Use menu path: Transaction —→ Tank Gauging —→ Inq Gauging

Choose Inquiry Gauging menu next screen will be appears. In this menu used display data of API @ 60 $^{\circ}$ F, CTSh (effect of temperature on steel shell of tanks), GOV, VCF @ 60 $^{\circ}$F, VCF @ 86 $^{\circ}$F and GSV as updated in database.
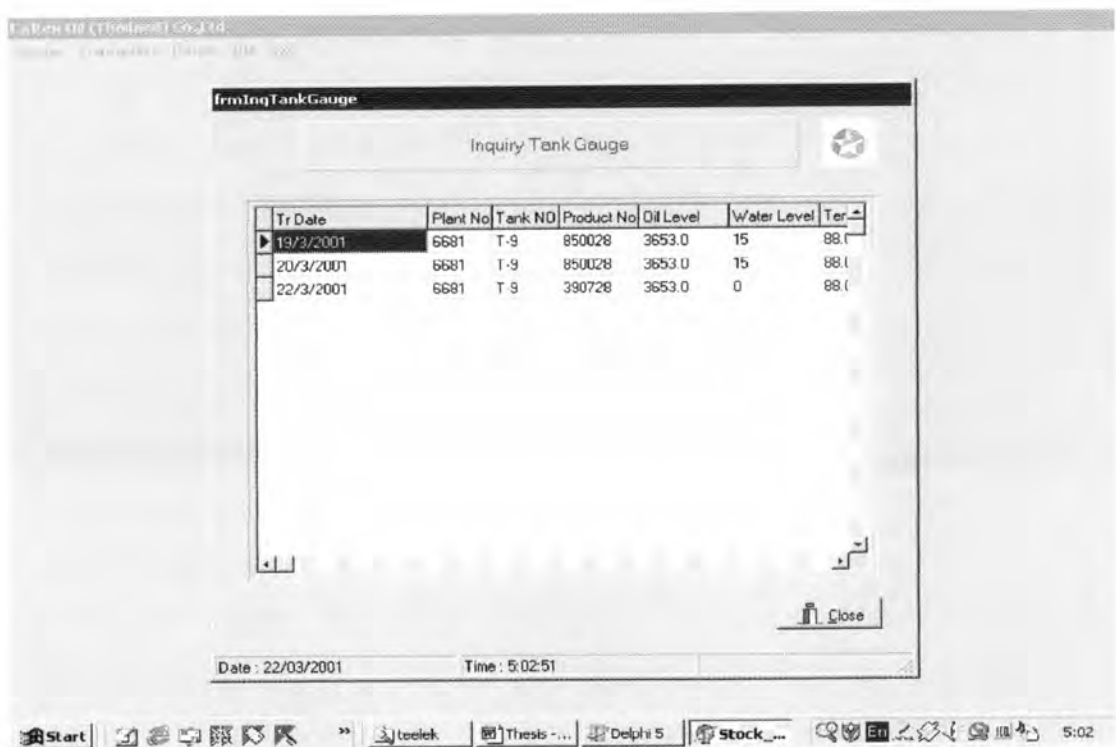
Figure 4-24 Inquiry Gauging Menu

4.6   Simulation Reported

When the Report menu is selected to calculate inventory of petroleum, the following menu of data entry will appear consecutively.

-Use menu path: Report —→ Oil inventory Report

Choose Oil inventory Report menu next screen will be appears. In this screen program will bring value from database show in this reports.
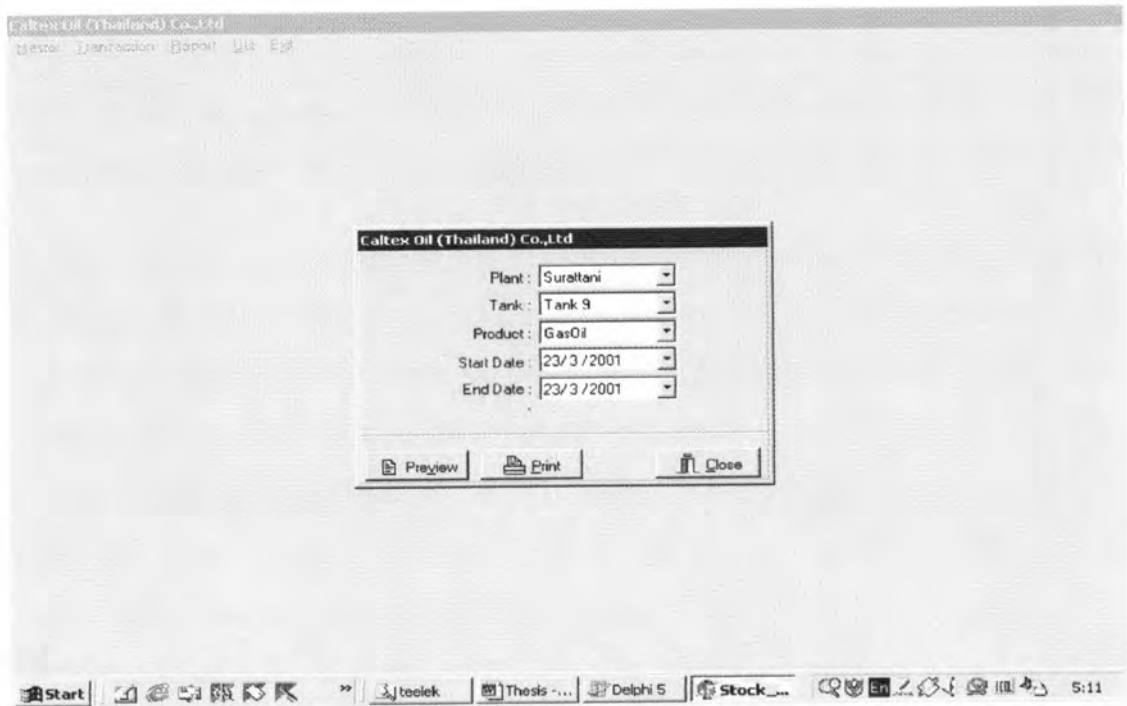
Figure 4-25 Oil Inventory Report Menu

Follow in action click button " Print " next screen will be appears.

Figure 4-26 Oil Inventory Report