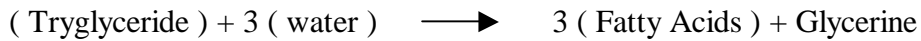


## MATERIAL BALANCE

### OVERALL MASS BALANCE



98% yield

One mole of fat gives three moles of Stearic acid. Therefore to produce  $(5000/284.47 =)$  17.58 Kmoles of Stearic acid, we require  $(17.58/3=)$  5.86 Kmoles of fat.

But yield =98%

$$\begin{aligned} \text{Fat required} &= 5.86/0.98 \\ &= 5.98 \text{ Kmoles} \end{aligned}$$

From literature,

5000 kg of Stearic acid is associated with

6100 kg of Oleic acid

793.8 kg of Glycerine.

The fat associated with this is 12.3 Kmoles.

### WATER BALANCE

One mole of fat requires three moles of water.

$$\begin{aligned} 12.3 \text{ Kmoles of fat require} &= 12.3 * 3 \\ &= 36.9 \text{ Kmoles of water.} \end{aligned}$$

25% of glycerine is removed.

$$\begin{aligned}\text{Water associated with 25\% of Glycerine} &= [793.8/0.25 - 793.8]/18 \\ &= 132.3 \text{ Kmoles of water.}\end{aligned}$$

$$\begin{aligned}\text{Total water required} &= 36.9 + 132.3 \\ &= 169.2 \text{ kmoles.}\end{aligned}$$

Taking 10% extra = 186.12 kmoles.

## **EQUIPMENT MATERIAL BALANCE**

### **FAT SPLITTER**

Stearic acid is produced in batches of 4 hours each. Therefore to produce 5000 kg of stearic acid / day ( $24/4 = 6$ ) 6 batches of ( $5000/6 = 833.33$  kg each is produced. Doing calculations for one single batch, we have

From literature

833.33 kg of Stearic acid is associated with

1016.66 kg of Oleic acid

132.3 kg of Glycerol.

$(833.33/284.47 = )$  2.93 kmoles of Stearic acid require 2 kmoles of fat.

But yield is 98%

$$\begin{aligned}\text{Therefore fat required} &= 2/0.98 \\ &= 2.05 \text{ kmoles}\end{aligned}$$

Conversion of fat = 99%

$$\text{Fat reacting} = 2.05/0.99$$

$$= 2.03 \text{ kmoles}$$

Stearic acid formed = 2.958 kmoles

$$= 841.47 \text{ kg}$$

Water reacting =  $(2.03 * 3 * 18 + \{132.3/0.25\} - 132.3)$

$$= 508.662 \text{ kg}$$

Taking 10% excess water = 559.52 kg

### FAT SPLITTER

INLET	OUTLET
1826.06 KG OF FAT	841.47 KG OF STEARIC ACID
559.52 KG OF WATER	1025.3 KG OF OLEIC ACID
	45.51 KG OF WATER
	18.26 KG OF UNREACTED FAT

Table 2.1 Inlets And Outlets For Fat Splitter

Sweet water required = 25 % Glycerine

$$= 400.76 \text{ kg of water} + 133.6 \text{ kg of Glycerol.}$$

### STILL

INLET	OUTLET
18.26 KG OF UNREACTED FAT	841.47 KG OF STEARIC ACID
841.47 KG OF STEARIC ACID	1025.3 KG OF OLEIC ACID
1025.3 KG OF OLEIC ACID	
45.51 KG OF EXCESS WATER	

Table 2.2 Inlets And Outlets Of Still

PITCH contains

18.26 KG OF UNREACTED FAT

45.5 KG OF EXCESS WATER.

## CHILLER

### CALCULATING AMOUNT OF METHANOL REQUIRED

Solubility of Fatty acids at  $-10^{\circ}\text{C}$

Stearic acid = 0.48g/100g of Methanol

Oleic acid = 31.6g/100g of Methanol

Solubility of Stearic acid at  $30^{\circ}\text{C}$  = 1820g/100g of Methanol.

To ensure complete crystallization of Stearic acid at and complete solubility of Oleic acid at  $-10^{\circ}\text{C}$ ,

$$\begin{aligned}\text{Methanol required} &= 1025.3 * (100/31.6) + 841.47 * (100/1820) \\ &= 3290.86 \text{ kg of Methanol.}\end{aligned}$$

Taking 10% excess = 3619.94 kg of Methanol.

INLET	OUTLET
3619.94 KG OF METHANOL	MOTHER LIQUOR + 841.25 KG OF STEARIC ACID CRYSTALS.
841.47 KG OF STEARIC ACID	
1025.3 KG OF OLEIC ACID	

Table 2.3 Inlets And Outlets Of Chiller

MOTHER LIQUOR has

3619.94 KG OF METHANOL

1025.3 KG OF OLEIC ACID

0.22 KG OF STEARIC ACID

### **FILTER**

INLET	OUTLET
MOTHER LIQUOR + 841.25 KG OF STEARIC ACID CRYSTALS	837.27 KG OF STEARIC ACID CRYSTALS +FILTRATE.

**Table 2.4 Inlets And Outlets Of Filter**

Loss of Stearic acid crystals during separation = 5%

### **STRIPPING STILL 1**

FOR THE FILTER CAKE

Loss of Stearic acid = 5%

Outlet = 833.33 kg of Stearic acid crystals.

### **STRIPPING STILL 2**

FOR THE FILTRATE

INLET	OUTLET
1025.3 KG OF OLEIC ACID	FROM TOP → 3619.94 KG OF METHANOL 0.22 KG OF STEARIC ACID 10.25 KG OF OLEIC ACID
3619.94 KG OF METHANOL	FROM BOTTOM → 1016.7 KG OF OLEIC ACID
0.22KG OF STEARIC ACID	

Table 2.5 Inlets And Outlets Of Stripping Still 2

LOSS OF OLEIC ACID =1%