CHAPTER VI
CALCULATIONS

6.1 Calculation of Enthalpy Change from % Composition of the products

The thermodynamic equilibrium constant K^u is related to the standard Gibbs energy change for the process by

$$\Delta G^\circ = - RT \ln K^u \tag{6.1}$$

The thermodynamic equilibrium constant K^u is a dimensionless quantity. If the standard state for delta G° is 1 atm pressure, K^u is $K^u{}_p$, which is the dimensionless form of K_p in which pressures are in atmospheres; if the standard state is 1 mol dm^{-3} the K^u is $K^u{}_c$, which is the dimensionless form of K_c in which concentrations are expressed in mol dm^{-3}.

$$\ln K^u{}_p = - \Delta G^\circ / RT = - (\Delta H^\circ / RT) + (\Delta S^\circ / R) \tag{6.2}$$

$$\ln K_2 - \ln K_1 = - (\Delta H^\circ / RT_2) + (\Delta H^\circ / RT_1) \tag{6.3}$$

$$\ln (K_2 / K_1) = (\Delta H^\circ / R) [(1/T_1) - (1/T_2)] \tag{6.4}$$

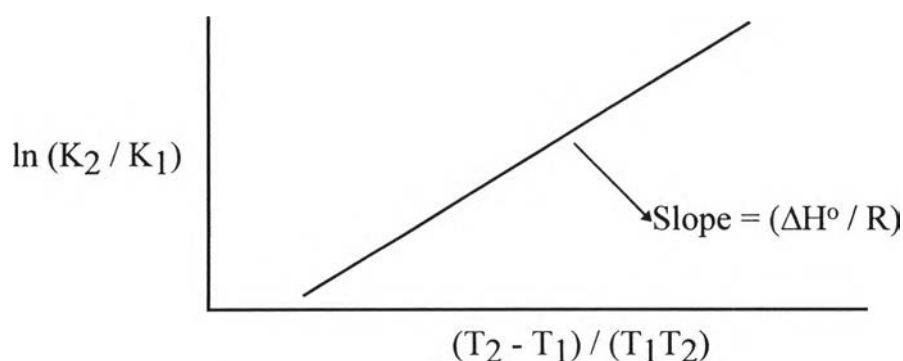$$= (\Delta H^\circ / R) [(T_2 - T_1) / (T_1 T_2)] \tag{6.5}$$

Figure 6.1 Plots of $\ln (K_2 / K_1)$ against $(T_2 - T_1) / (T_1 T_2)$.

6.1.1 Enthalpy Change of Rubber Solvent

Table 6.1 Rubber Solvent by GC PIONA Method

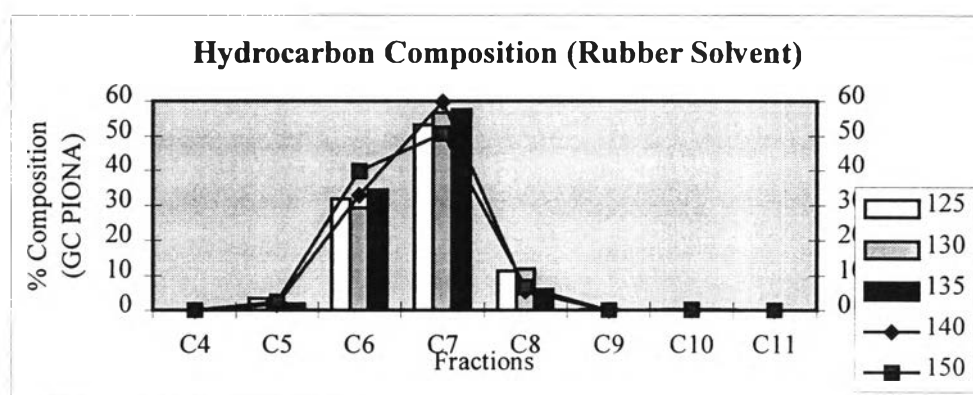| Fractions	Temperature (^{O}C)					Mean Values
	125	130	135	140	150	
C_4	0.03	0	0	0	0	0.006
C_5	3.45	2.00	1.81	1.75	2.48	2.298
C_6	31.76	29.08	34.30	32.90	39.82	33.572
C_7	53.10	56.65	57.65	59.77	50.71	55.576
C_8	11.17	11.77	6.01	5.34	6.72	8.202
C_9	0.23	0.20	0	0	0.05	0.096
C_{10}	0.16	0.18	0.18	0.19	0.15	0.172
C_{11}	0.04	0.04	0	0	0	0.016
					Total	99.938

Figure 6.2 Plot of % composition by GC PIONA against temperature.

From the GC PIONA method, we found that Rubber solvent is C_5 to C_8 dominant. Therefore, use the data C_5 to C_8 % composition to calculate the enthalpy of the product.

Table 6.2 Enthalpy change of Rubber solvent (based on C_5 to C_8)

(a) Enthalpy Change Calculation Based on C_5 ($K_{1,C5}$@140°C = 1.75, R = 8.314 J/Mol K)

T2 (°C)	T2 (K)	K_2	K_2/K	ln (K_2/K_1)	($T_2 - T_1$)/T_1T_2	$T_1T_2/(T_2-T_1)$	ln (K_2/K_1)*[$T_1T_2/(T_2-T_1$)], $\Delta H^O/R$	$\Delta H^O_{,C5}$
125	398	3.45	1.971	0.678758	-9.12553E-05	-10958.27	-7438.016022	-61839.67
130	403	2.00	1.143	0.133531	-6.00821E-05	-16643.90	-2222.483146	-18477.72
135	408	1.81	1.034	0.033711	-2.96729E-05	-33700.80	-1136.089601	-9445.45
150	423	2.48	1.417	0.348643	5.72413E-05	17469.90	6090.754367	50638.53

(b) Enthalpy Change Calculation Based on C_6 ($K_{1,C6}$@140°C = 32.90, R = 8.314 J/Mol K)

T2 (°C)	T2 (K)	K_2	K_2/K	ln (K_2/K_1)	($T_2 - T_1$)/T_1T_2	$T_1T_2/(T_2-T_1)$	ln (K_2/K_1)*[$T_1T_2/(T_2-T_1$)], $\Delta H^O/R$	$\Delta H^O_{,C6}$
125	398	31.76	0.965	-0.035265	-9.12553E-05	-10958.27	386.4435084	3212.89
130	403	29.08	0.884	-0.123422	-6.00821E-05	-16643.90	2054.223511	17078.81
135	408	34.30	1.043	0.041673	-2.96729E-05	-33700.80	-1404.403207	-11676.21
150	423	39.82	1.210	0.190897	5.72413E-05	17469.90	3334.945226	27726.73

(c) Enthalpy Change Calculation Based on $C_7 (K_{1,C7} @ 140°C = 59.77, R = 8.314$ J/Mol K)

T2 (°C)	T2 (K)	K_2	K_2 / K	$\ln (K_2 / K_1)$	$(T_2 - T_1) / T_1 T_2$	$T_1 T_2 / (T_2 - T_1)$	$\ln (K_2/K_1)*[T_1 T_2/(T_2-T_1)], \Delta H^0/R$	$\Delta H^0_{,C7}$
125	398	53.10	0.888	-0.118327	-9.12553E-05	-10958.27	1296.658103	10780.42
130	403	56.65	0.948	-0.053612	-6.00821E-05	-16643.90	892.3106923	7418.67
135	408	57.65	0.965	-0.036114	-2.96729E-05	-33700.80	1217.057754	10118.62
150	423	50.71	0.848	-0.164381	5.72413E-05	17469.90	-2871.714968	-23875.44

(d) Enthalpy Change Calculation Based on $C_8 (K_{1,C8} @ 140°C = 5.34, R = 8.314$ J/Mol K)

T2 (°C)	T2 (K)	K_2	K_2 / K	$\ln (K_2 / K_1)$	$(T_2 - T_1) / T_1 T_2$	$T_1 T_2 / (T_2 - T_1)$	$\ln (K_2/K_1)*[T_1 T_2/(T_2-T_1)], \Delta H^0/R$	$\Delta H^0_{,C10}$
125	398	11.17	2.092	0.738006	-9.12553E-05	-10958.27	-8087.266112	-67237.53
130	403	11.77	2.204	0.790328	-6.00821E-05	-16643.90	-13154.14466	-109363.56
135	408	6.01	1.125	0.118199	-2.96729E-05	-33700.80	-3983.40408	-33118.02
150	423	6.72	1.258	0.229863	5.72413E-05	17469.90	4015.674916	33386.32

(e) Enthalpy Change Calculation Based on C_5 to C_8

Temperature,°C	Percent	$\Delta H^0_{,C5}$	Percent	$\Delta H^0_{,C6}$	Percent	$\Delta H^0_{,C7}$	Percent	$\Delta H^0_{,C8}$	$\Delta H^0_{,Total}$
125	3.45	61839.7	31.76	3212.89	53.10	10780.4	11.17	67237.53	16388.72
130	2.00	18477.7	29.08	17078.8	56.65	7418.67	11.77	109363.56	22410.84
135	1.81	9445.45	34.30	11676.2	57.65	10118.6	6.01	33118.02	11999.68
150	2.48	50638.5	39.82	27726.7	50.71	23875.4	6.72	33386.32	26647.42

6.1.2 Enthalpy Change of Straight Run Light Hydrocarbon

Table 6.3 Straight Run Light Hydrocarbon by GC PIONA method

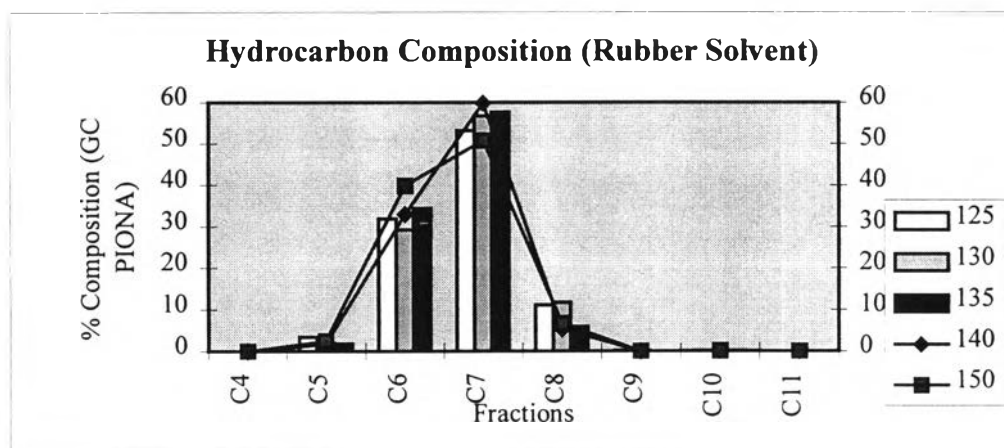| Fractions	Temperature (^{O}C)					Mean Values
	125	130	135	140	150	
C_4	0.04	0.04	0.03	0.02	0.04	0.034
C_5	0.84	0.85	0.65	0.53	0.76	0.726
C_6	9.12	8.83	8.04	6.92	7.88	8.158
C_7	30.44	28.68	32.25	31.29	29.17	30.366
C_8	43.33	42.73	46.48	47.75	47.12	45.482
C_9	11.49	16.04	9.42	12.00	13.51	12.492
C_{10}	4.41	2.49	2.77	1.08	1.18	2.396
C_{11}	0.23	0.24	0.29	0.33	0.26	0.270
					Total	99.914

Figure 6.3 Plot of % composition by GC PIONA against temperature.

From the GC PIONA method, we found that Straight Run Light Hydrocarbon is C_6 to C_{10} dominant. Therefore, use the data of the C_6 to C_{10} % composition to calculate the enthalpy of the product.

Table 6.4 Enthalpy Change Calculation Based on C_6 to C_{10}

Temperature,$^\circ$C	Percent	$\Delta H^O_{,C6}$	Percent	$\Delta H^O_{,C7}$	Percent	$\Delta H^O_{,C8}$	Percent	$\Delta H^O_{,C9}$	Percent	$\Delta H^O_{,C10}$	$\Delta H^O_{,Total}$
125	9.12	25150.5	30.44	2509.18	43.33	8849.57	11.49	3956.74	4.41	128179.72	7346.66
130	8.83	33728.00	28.68	12052.5	42.73	15370.7	16.04	40154.20	2.49	115589.63	19443.45
135	8.04	42032.00	32.25	8467.15	46.48	7553.03	9.42	67825.66	2.77	263905.66	16009.85
150	7.88	18869.1	29.17	10190.1	47.12	1929.07	13.51	17214.92	1.18	12861.92	7694.03

6.1.3 Enthalpy Change of Spirit

Table 6.5 Spirit by GC PIONA method

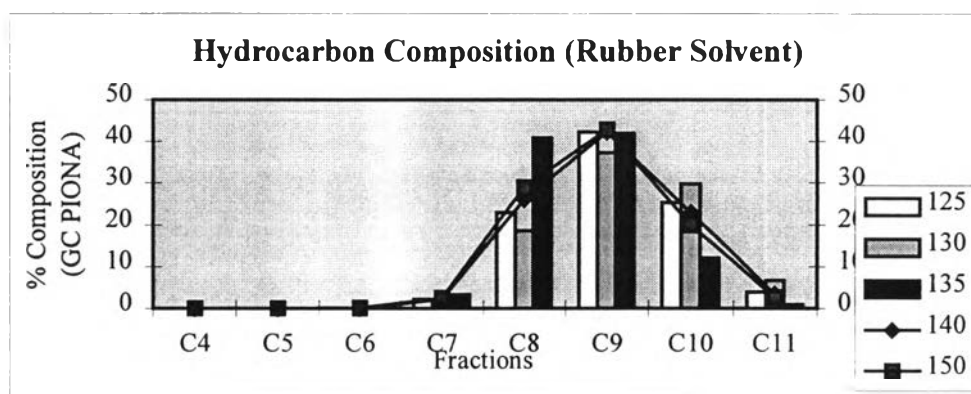| Fractions	Temperature (°C)					Mean Values
	125	130	135	140	150	
C_4	0	0	0	0	0	0
C_5	0	0	0	0	0	0
C_6	0.05	0.06	0.18	0.04	0.16	0.098
C_7	2.17	2.02	3.31	2.21	2.55	2.452
C_8	22.90	18.58	40.76	25.98	28.99	27.442
C_9	42.20	37.23	41.95	42.14	42.85	41.274
C_{10}	25.20	29.73	11.96	22.89	19.96	21.948
C_{11}	3.86	6.63	0.89	3.48	2.64	3.500
					Total	96.714

Figure 6.4 Plot of % composition by GC PIONA against temperature.

From the GC PIONA method, we found that Spirit is C7 to C11 dominant. Therefore, use the data of the C7 to C11 % composition to calculate the enthalpy of the product.

Table 6.6 Enthalpy Change Calculation Based on C_7 to C_{11}

Temperature, $^{\circ}$C	Percent	$\Delta H^{O}_{,C7}$	Percent	$\Delta H^{O}_{,C8}$	Percent	$\Delta H^{O}_{,C9}$	Percent	$\Delta H^{O}_{,C10}$	Percent	$\Delta H^{O}_{,C11}$	$\Delta H^{O}_{,Total}$
125	2.17	1664.10	22.9	11496.81	42.20	129.63	25.2	8759.38	3.86	9441.87	4930.95
130	2.02	12439.44	18.58	46389.81	37.23	17142.5	29.73	36179.67	6.63	89194.26	26008.89
135	3.31	113183.71	40.76	126189.65	41.95	1266.16	11.96	181879.40	0.89	382055.48	77465.21
150	2.55	20784.65	28.99	15922.3	42.85	2426.78	19.96	19894.15	2.64	40124.35	10156.63

6.1.4 Enthalpy Change of Distillate

Table 6.7 Distillate by GC PIONA method

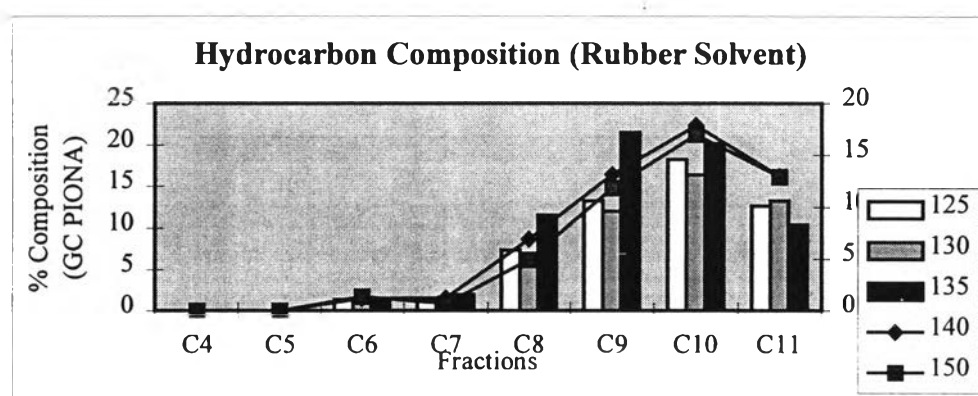| Fractions	Temperature (^{0}C)					Mean Values
	125	130	135	140	150	
C_4	0	0	0	0	0	0
C_5	0	0	0	0	0	0
C_6	1.31	1.38	1.07	1.18	1.34	1.256
C_7	1.38	1.39	1.98	1.25	0.71	1.342
C_8	7.32	6.43	11.55	6.89	4.91	7.420
C_9	13.25	11.97	21.49	13.17	11.83	14.342
C_{10}	18.22	16.33	20.19	17.88	17.03	17.930
C_{11}	12.63	13.21	10.33	12.93	12.92	12.404
					Total	54.694

Figure 6.5 Plot of % composition by GC PIONA against temperature.

From the GC PIONA method, we found that Spirit is C_6 to C_{11} dominant, use the data of the C_6 to C_{11} % composition to calculate the enthalpy of the product.

Table 6.8 Enthalpy Change Calculation Based on C_6 to C_{11}

Temperature, °C	%	$\Delta H^O_{,C6}$	%	$\Delta H^O_{,C7}$	%	$\Delta H^O_{,C8}$	%	$\Delta H^O_{,C9}$	%	$\Delta H^O_{,C10}$	%	$\Delta H^O_{,C11}$	$\Delta H^O_{,Total}$
125	1.31	9521.84	1.38	9014.12	7.3	5515.55	13.3	551.75	18.2	1716.19	12.6	2138.76	**725.98**
130	1.38	21665.62	1.39	14690.17	6.4	9561.40	12.0	13220.30	16.3	12547.90	13.2	2964.59	**2700.45**
135	1.07	27418.06	1.98	128873.6	11.6	144749	21.5	137193.2	20.2	34044.2	10.3	62901.72	**49046.44**
150	1.34	18468.62	0.71	82155.35	4.9	49208.5	11.8	15585.17	17.0	9074.33	12.9	112.38	**5090.65**

6.2 Calculation of Enthalpy Change from the First Law of Thermodynamics

The first law of a steady-flow process is expressed by;

$$\Delta H = Q - W_s \qquad (6.6)$$

In this experiment, no shaft work is accomplished between state1 ($140^\circ C$) and state2 (125, 130, 135, 150 $^\circ C$). Hence equation 6.6 reduces to

$$\Delta H = H_2 - H_1 = Q \qquad (6.7)$$

ΔH of Raw Material Calculation

From experiment; Raw material feed rate   = 45 GPM

Steady - state time   = 120 minutes

C_p / R $= A + BT + CT^2 + DT^{-2}$

R   = 8.314 J/mol K

Table 6.9 Percent Composition of Raw Material

PIONA Analysis	% Volume	Percent Composition
C_4	0.07	0.0192
C_5	4.29	1.177
C_6	36.35	9.973
C_7	87.09	23.890
C_8	84.72	23.244
C_9	67.21	18.439
C_{10}	67.99	18.654
C_{11}	16.76	4.598

Note : All carbon compositions in raw material are paraffin dominant.

$$C_p(\text{Total}) = 0.0002C_{p,C4} + 0.0117C_{p,C5} + 0.099C_{p,C6} + 0.238C_{p,C7}$$
$$+ 0.2324C_{p,C8} + 0.184C_{p,C9} + 0.186C_{p,C10} + 0.045C_{p,C11} \quad (6.8)$$

Table 6.10 Heat Capacities Calculation

Composition	C_p (Ideal Gas, 60^OF, 14.696 psia)	C_p	
		$\dfrac{\text{Btu}}{\text{lbmol F}}$	$\dfrac{\text{J}}{\text{mol K}}$
C_4	0.3970	0.0000794	0.000084
C_5	0.3972	0.0046472	0.004903
C_6	0.3984	0.0394416	0.041614
C_7	0.3992	0.0950096	0.100244
C_8	0.3998	0.0929135	0.098033
C_9	0.3850	0.0708400	0.074743
C_{10}	0.3870	0.0719820	0.075948
C_{11}	-	-	-
Total		0.3749133	0.395569

Note : 1 Btu   = 1055.1 Joules

1 lbmol F   = 1000 mol K

Table 6.11 Heat of Vaporization Calculation

Composition	Heat of Vaporization (Cal./g)	Heat of Vaporization (Cal./g)
C_4	86.63	0.0173
C_5	87.54	1.024
C_6	87.50	8.662
C_7	87.18	20.748
C_8	86.80	20.172
C_9	94.90	17.462
C_{10}	56.14	10.442
C_{11}	58.05	2.612
	Total	81.1393

Raw Material (Feed) :

Heat capacities	=	C_p	=	0.395569	J/mol K
Heat of vaporization	=	L	=	81.1393	Cal./g
			=	339.714	J/g

$$= \frac{339.714 \text{ J}}{\text{g}} * \frac{116.642 \text{ g}}{\text{mol}}$$

$$= 39{,}624.92 \quad \text{J/mol}$$

Specific Gravity $=$ 0.7535 $=$ $\dfrac{\text{Density of oil} \quad (Kg/Gal.)}{\text{Density of water} \quad (Kg/Gal.)}$

Density of feed	=	0.7535		
Flow rate	=	45	Gal./min	
Steady state time	=	120	min.	
Volume	=	45	Gal. =	0.170325 m³
Mass	=	m	=	0.7535*0.170325 Kg

	=	0.12833	Kg
	=	128.33	g

Molecular Weight of feed = $(0.0002 M.W._{C4H10}) + (0.0117 M.W._{C5H12})$
$+ (0.099 M.W._{C6H14}) + (0.238 M.W._{C7H16})$
$+ (0.2324 M.W._{C8H18}) + (0.184 M.W._{C9H20})$
$+ (0.186 M.W._{C10H22}) + (0.045 M.W._{C11H24})$

= $(0.0002*58) + (0.0117*72) + (0.099*86)$
$+ (0.238*100) + (0.2324*114) + (0.184*128)$
$+ (0.186*142) + (0.045*156)$

= $0.0116 + 0.8424 + 8.514 + 23.8 + 26.49 + 23.552$
$+ 26.412 + 7.02$

= 116.642   g/mol

Mass = $\dfrac{128.33}{116.642}$ = 1.1002   mol

6.2.1 At Feed Inlet Temperature @ 125°C

Raw material is not completely evaporated. There are 2 fractions: one is a liquid with boiling point lower than 125°C, and is assumed to be totally evaporated in the first distillation tower. The other fraction is a liquid with boiling point higher than 125°C, and is not evaporated.
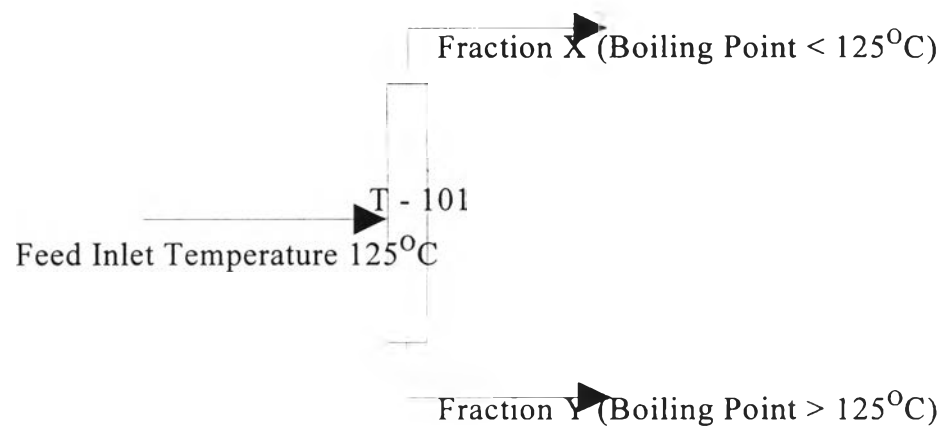
Fraction X (Boiling Point < 125°C)

T - 101

Feed Inlet Temperature 125°C

Fraction Y (Boiling Point > 125°C)

Figure 6.6 Drawing of T-101 on mass balance.

Table 6.12 Boiling range of raw material (ASTM D86)

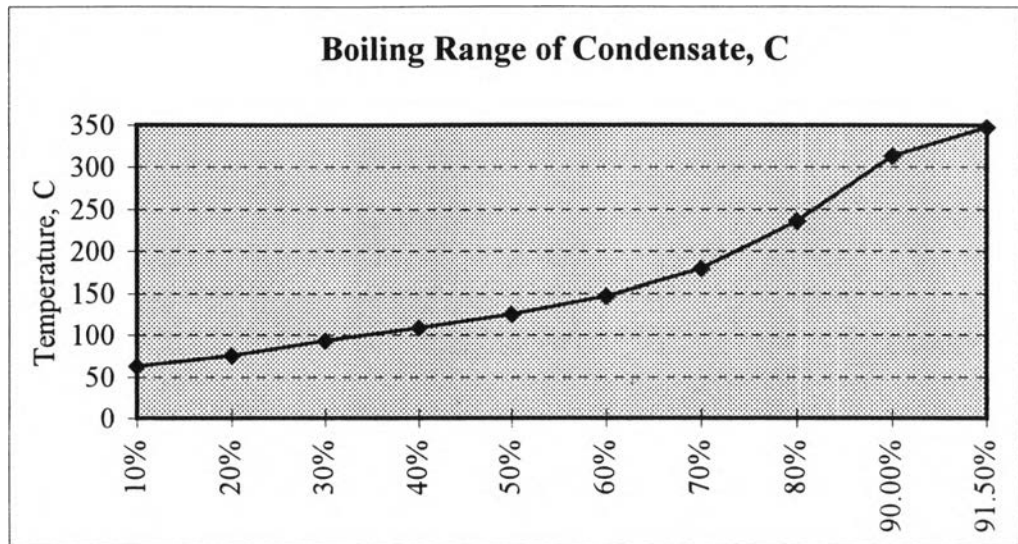| IBP	30
10%	63
20%	75
30%	93
40%	109
50%	125
60%	147
70%	179
80%	236
90.00%	313.5
EP	348

Figure 6.6 Equilibrium Flash Vaporization curve of raw material.

From Figure 6.6 at 125^OC, fraction X = 0.5 and fraction Y = 0.415

$$Q = \Delta H = [X(mCp\Delta T + mL)] + [Y(mCp\Delta T)] \qquad (6.9)$$

$$\Delta H_{feed} = [0.5(1.1002*0.39556*(125-25) + 1.1002*39624.92*10^5)$$
$$+ [0.415(1.1002*0.39556*(125-25)]$$
$$= 21819.43 + 18.061$$

$$[(mol)(J/molK)(K)+(mol(J/mol)]+[(mol)(J/molK)(K)]$$

$$= 21837.49 \ J$$

Therefore, ΔH of feed inlet (raw material) @ 125^OC = 21,837.49 J

Table 6.13 Product Specification

Products	Boiling Range,^{O}C	% from EFV Curve
Rubber	68 - 112	25.458
Straight Run Lt. HC	87 - 145	30.910
Spirit	137 - 178	13.641
Distillate	152.5 - 276	23.636

Table 6.14 ΔH of products

Products	ΔH @ 125 °C
Rubber	5,559.38
Straight Run Light HC	6,747.78
Spirit	2,978.85
Distillate	5,161.51

6.2.2 At Feed Inlet Temperature @ 130°C

Raw material is not completely evaporated. There are 2 fractions, one is a liquid with boiling point lower than 130°C and is assumed to be totally evaporated in the first distillation tower. The other fraction is a liquid with boiling point higher than 130°C and is not evaporated.

Fraction X (Boiling Point < 130°C)

T - 101

Feed Inlet Temperature 130°C
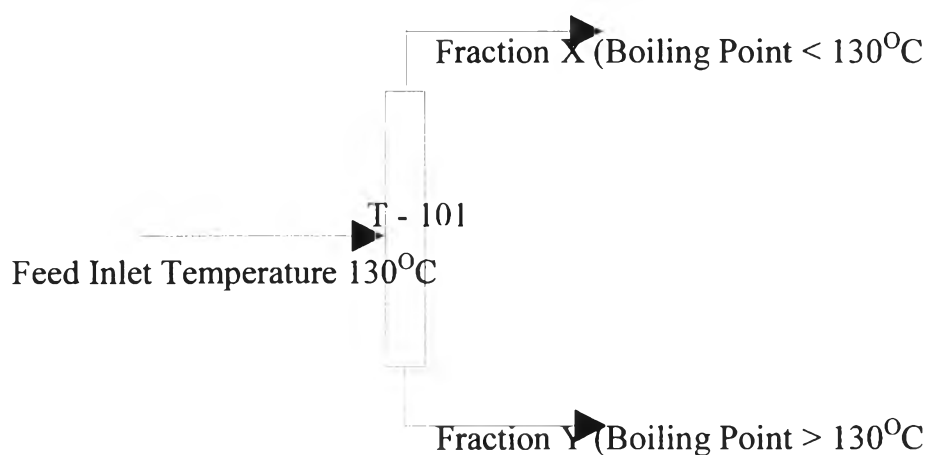
Fraction Y (Boiling Point > 130°C)

Figure 6.7 Drawing of T-101 on mass balance.

From Figure 6.6 at $130^{O}C$, fraction X = 0.52 and fraction Y = 0.395

$$Q = \Delta H = [X(mCp\Delta T + mL)] + [Y(mCp\Delta T)] \tag{6.9}$$

ΔH feed = [0.52(1.1002*0.39556*(130-25) + 1.1002*39624.92)

     + [0.395(1.1002*0.39556*(130-25)]

    = 22693.34 + 18.049

    = 22711.39 J

Therefore ΔH of feed inlet (raw material) @ $130^{O}C$ = 22,711.39 J

Table 6.15 Product specification

Products	Boiling Range, ^{O}C	% from EFV Curve
Rubber	69 - 111	26.25
Straight Run Lt. HC	83 - 155	38.06
Spirit	141 - 187	14.13
Distillate	149 - 271	23.89

Table 6.16 ΔH of products

Products	ΔH @ $130^{O}C$ (J)
Rubber	5,961.74
Straight Run Lt. HC	8,643.96
Spirit	3,209.12
Distillate	5,425.75

6.2.3 At Feed Inlet Temperature @ 135 °C

Raw material is not completely evaporated. There are 2 fractions, one is a liquid with boiling point lower than 135°C and is assumed to be totally evaporated in the first distillation tower. The other fraction is a liquid with boiling point higher than 135°C and is not evaporated.
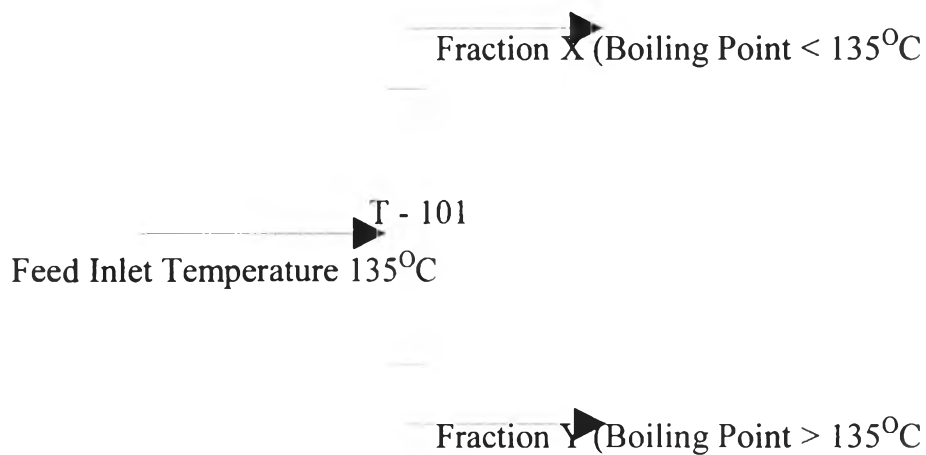
Fraction X (Boiling Point < 135^OC)

T - 101

Feed Inlet Temperature 135^OC

Fraction Y (Boiling Point > 135^OC)

Figure 6.8 Drawing of T-101 on mass balance.

From Figure 6.8 at 135^OC, fraction X = 0.545 and fraction Y = 0.

$Q = \Delta H = [X(mCp\Delta T + mL)] + [Y(mCp\Delta T)]$

$\Delta H_{feed} = [0.545(1.1002*0.39556*(135-25) + 1.1002*39624.92)$

$\quad\quad + [0.37(1.1002*0.39556*(135-25)]$

$\quad\quad = 23785.55 + 17.712$

$\quad\quad = 23803.26$ J

Therefore ΔH of feed inlet (raw material) @ 135^OC = 23,803.26 J

Table 6.17 Product specification

| Products	Boiling Range,^{O}C	% from EFV Curve
Rubber	73 - 105.5	19.48
Straight Run Lt. HC	89 - 141	29.49
Spirit	130 - 171	15.23
Distillate	140 - 266	27.05

Table 6.18 ΔH of products

Products	ΔH @ 135°C (J)
Rubber	4,636.88
Straight Run Lt. HC	7,019.58
Spirit	3,625.24
Distillate	6,438.78

6.2.4 At Feed Inlet Temperature @ 150°C

Raw material is not completely evaporated. There are 2 fractions, one is a liquid with boiling point lower than 150°C and is assumed to be totally evaporated in the first distillation tower. The other fraction is a liquid with boiling point higher than 150°C and is not evaporated.

Fraction X (Boiling Point < 150°C

Feed Inlet Temperature 150° T - 101

Fraction Y (Boiling Point > 150°C
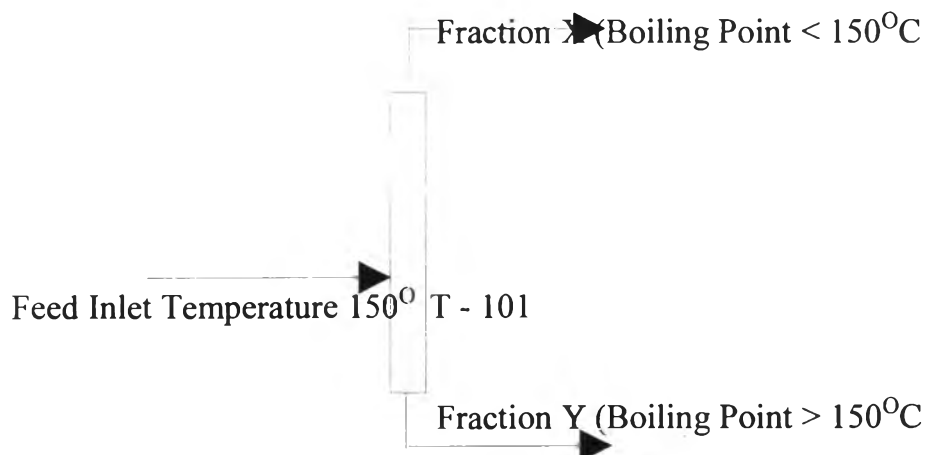
From Figure 6.8 at 150°C, fraction X = 0.61 and fraction Y = 0.305

$$Q = \Delta H = [X(mCp\Delta T + mL)] + [Y(mCp\Delta T)] \qquad (6.9)$$

$$\Delta H_{feed} = [0.61(1.1002*0.39556*(150-25) + 1.1002*39624.92)$$
$$+ [0.305(1.1002*0.39556*(150-25)]$$
$$= 26626.33 + 16.59$$
$$= 26642.92 \; J$$

Therefore ΔH of feed inlet (raw material) @ 150°C = 26,642.92 J

Table 6.19 Product specification

Products	Boiling Range,$^{\circ}$C	% from EFV Curve
Rubber	72 - 106	20.62
Straight Run Lt. HC	92 - 154	32.74
Spirit	140 - 183	13.88
Distillate	151 - 286	25.20

Table 6.20 ΔH of products

Products	ΔH @ 150°C (J)
Rubber	5,493.77
Straight Run Lt. HC	8,722.89
Spirit	3,698.04
Distillate	6,714.02

6.3 Comparison of ΔH from GC PIONA Analysis and Theory

Enthalpy change from 6.1 (PIONA Analysis) in unit of J/mol. But for enthalpy change from theory, the unit is J. For comparison, we have to convert J/mol to J by the following:

For Rubber Solvent : [(feed inlet, Gal.)(%Yield of Rubber)(Sp.Gr.of Rubber)
(conversion factor from Gal. to m^3)
(conversion factor from Kg to g)]/MW.of Rubber C_7H_{16}
= [(45)(0.25)(0.74)(0.003785)(1000)]/100
= 0.315 mol

For Straight Run Lt. HC :
[(feed inlet, Gal.)(%Yield of SRLHC)(Sp.Gr.of SRLHC
(conversion factor from Gal. to m^3)
(conversion factor from Kg to g)]/MW.of SRLHC C8H1
= [(45)(0.31)(0.77)(0.003785)(1000)]/114
= 0.357 mol

For Spirit :
[(feed inlet, Gal.)(%Yield of Spirit)(Sp.Gr.of Spirit)
(conversion factor from Gal. to m^3)
(conversion factor from Kg to g)]/MW.of Spirit C9H20
= [(45)(0.14)(0.79)(0.003785)(1000)]/128
= 0.147 mol

For Distillate :
[(feed inlet, Gal.)(%Yield of Distillate)(Sp.Gr.of Distill
(conversion factor from Gal. to m^3)
(conversion factor from Kg to g)]/MW.of Dist. C10H22
= [(45)(0.24)(0.81)(0.003785)(1000)]/142
= 0.233 mol

Table 6.21 ΔH from GC PIONA Analysis

Feed Inlet Temp., °C	Rubber	Straight Run Lt. HC	Spirit	Distillate
ΔH (J/mol)				
125	16,388.72	7,346.66	4,930.95	725.98
130	22,410.84	19,443.45	26,008.89	2,700.45
135	11,999.68	16,009.85	77,465.21	49,046.44
150	26,647.42	7,694.03	10,156.63	5,090.65

Table 6.22 ΔH from GC PIONA Analysis

Feed Inlet Temp., °C	Rubber	Straight Run Lt. HC	Spirit	Distillate
ΔH (J)				
125	5,162.45	2,622.76	724.85	169.15
130	7,059.41	6,941.31	3,823.31	629.20
135	3,779.90	5,715.52	11,387.39	11,427.82
150	8,393.94	2,746.77	1,493.02	1,186.12

Table 6.23 ΔH from Theory

Feed Inlet Temp., °C	Rubber	Straight Run Lt. HC	Spirit	Distillate
ΔH (J)				
125	5,559.38	6,747.78	2,978.85	5,161.51
130	5,961.74	8,643.96	3,209.12	5,425.75
135	4,636.88	7,019.58	3,625.24	6,438.78
150	5,493.77	8,722.89	3,698.04	6,714.02