CHAPTER–(7)

MULTICOMPONENT LIQUID-LIQUID EXTRACTION OF AROMATICS: "THERMODYNAMIC ASPECTS

&

SUGGESTION FOR FURTHER WORK"

CHAPTER-7

MULTICOMPONENT LIQUID- LIQUID EXTRACTION OF AROMATICS-"THERMODYNAMIC APPROACH" & SUGGESTIONS FOR FURTHER WORK

7.0.0 PRELIMINARY CONSIDERATIONS:-

Practically no information is available in the literature on "Multicomponent Liquid- Liquid Extraction of Aromatics"-neither "Theoretical" nor "Experimental". Hence an"Unique Attempt" has been made in this investigation to study-" Thermodynamics Aspects of Multicomponent Liquid- Liquid Extraction of Aromatics, " wherein the values of % Aromatic extracted (% A_E) and %Purity of extract (%P_E) have been calculated in this investigation based on "Quaternary Liquid- Liquid Phase Equilibrium Data" obtained for Liquid- Liquid extraction of aromatics.

All "Theoretical Aspects" w. r. t. Multicomponent Liquid- Liquid Extraction of Aomatics have been considered in this investigation and the relevant exhaustive calculations w. r. t. %A_E and corresponding %P_E values for different categories have been done. Based on these results obtained, further experimental work on Multicomponent Liquid- Liquid Extraction of Aromatics" can be undertaken.

The values presented in this investigation for Multicomponent Liquid- Liquid Extraction of Aromatics" are "Limiting Values". These are the maximum values of % AE and % PE which can be achieved/ obtained in actual practice under appropriate and suitable operating conditions. But under no circumstances these values can't be exceeded. Thus, these are the maximum values which can be achieved in actual practice-however may be or may not be achieved. That is why these "Theoretical values" are called as "Limiting Values".

Actual experimental values for "Multicomponent Liquid- Liquid Extraction" will be always less than these values. In limiting case actual values can be equal to these "Limiting Values".

7.1.0 Five Categories for Multicomponent Liquid-Liquid Extraction and relevant results:

7.1.1 Category-I:

Limiting values of % AE and % PE at three different temperatures 20°C, 30°C, and 40°C and two values of antisolvent concentration - 10% W and 20%W for different systems as under:

(i)B + H + (Dmf / Dmso) + W

(ii)T + H + (Dmf / Dmso) + W

(iii)X + H + (Dmf / Dmso) + W

(iv)B + Hep + (Dmf / Dmso) + W

(v)B + O + (Dmf / Dmso) + W

Thus category- I contains totally 30 values of % AE and % PE calculated under different sets of conditions for solvents – Dmf / Dmso for three different S/F ratio by wt. being 1, 2 and 3. Thus Category – I consists of totally a set of ninety values of % AE and corresponding % PE for mixed solvent- (Dmf + W) and an additional set of ninety values % AE and corresponding % PE for mixed solvent- (Dmso + W). The relevant Data along with 'Limiting Values' of % AE and % PE are presented in Table LV- 1 to LV- 6.

7.1.2 Category – II:

The relevant data along with 'Limiting Values' of % AE and % PE is presented in Tables- LV-7 & LV- 8.

Mixed feed consists of aromatics – (B + T + X) & aliphatic – H i.e. four components for both mixed solvents – (Dmf + W)/ (Dmso + W).

The limiting values of % AE and % PE at 30°C, for two values of antisolvent concentration – 10% W and 20%W for two values of S/F ratio by 1 and 1.5 are presented in Tables- LV-7 & LV- 8.

7.1.3 Category – III:

The relevant data along with 'Limiting Values' of % AE and % PE is presented in Tables LV- 9 and LV- 10.

Limiting values of % AE and %PE at temperature 30°C &, four S/F ratios – 1, 2, 3 and 6 for antisolvent concentration value being 20%W i.e. mixed solvent (80% Dmf + 20 % W) / (80% Dmso + 20%W) have been reported for mixed feed consisting of six components as - (B+T+X) + (H+H'+O) .

7.1.4 Category – IV:

For single stage Multicomponent Liquid-Liquid Extraction of Aromatics the mixed feed consisting of totally six components – three solutes- (B+T+X) & three non-solutes- (H+H'+O) i.e. totally six components- (B+T+X) + (H+H'+O) has been used as the basis. Under conditions of temperature of 30 °C and antisolvent concentration values of 10% and 20%W with a single value of S/F ratio of 1, the limiting values of %AE and %PE have been obtained by exhaustive calculations.

The relevant data for single stage operation for mixed solvents (80% Dmf+ 20%W)/ (80%Dmso + 20%W) have been reported in Tables LV-11 and LV-12 respectively.

7.1.5 Category- V:

Multistage and multicomponent Liquid- Liquid extraction of aromatics can be performed in four stages in order to increase the values of % AE obtained in single stage. Raffinate phase from Stage- I constitutes as a multicomponent feed for stage- II. Raffinet phase from Stage- II constitutes as multicomponent feed for stage- III and Raffinet phase from Stage- III constitutes as multicomponent feed for stage- IV .All other operating conditions are kept same as in stage-I i.e. Temp-30 °C & S/F=1&mixed feed consisting of six components.

The relevant details and the corresponding limiting values of %AE and %PE obtained in this calculation for different stages –II. III and IV are reported in Tables- LV-13, LV-14 and LV-15 respectively.

Table -LV-1

Limiting Values of % Aromatics Extracted (%A_E) and% Purity of Extract (%P_E) for different Systems: - B/T/X-H/H'/O-Dmf+Water: Case-I with [S/F]=1

Sr.No.	Systems	TEMP °C	Feed Composition			Extract Composition		
			X_{AF}	X_{HF}	X_{SF}	X_{AE}	X_{HE}	X_{SE}
1	0.25B-0.25H-0.5(90%.D+10%W)	20	0.250	0.250	0.500	17.000	10.000	73.000
2	0.25B-0.25H-0.5(80%.D+20%W)		0.250	0.250	0.500	7.000	1.000	92.000
3	0.25B-0.25H-0.5(90%.D+10%W)	30	0.250	0.250	0.500	23.500	17.000	59.500
4	0.25B-0.25H-0.5(80%.D+20%W)		0.250	0.250	0.500	8.750	0.750	90.500
5	0.25B-0.25H-0.5(90%.D+10%W)	40	0.250	0.250	0.500	23.000	13.500	63.500
6	0.25B-0.25H-0.5(80%.D+20%W)		0.250	0.250	0.500	4.000	2.000	94.000
7	0.25T-0.25H-0.5(90%.D+10%W)	20	0.250	0.250	0.500	8.000	5.000	87.000
8	0.25T-0.25H-0.5(80%.D+20%W)		0.250	0.250	0.500	7.500	1.500	91.000
9	0.25T-0.25H-0.5(90%.D+10%W)	30	0.250	0.250	0.500	15.000	5.000	80.000
10	0.25T-0.25H-0.5(80%.D+20%W)		0.250	0.250	0.500	7.500	1.600	90.900
11	0.25T-0.25H-0.5(90%.D+10%W)	40	0.250	0.250	0.500	12.000	4.000	86.000
12	0.25T-0.25H-0.5(80%.D+20%W)		0.250	0.250	0.500	8.500	2.500	89.500
13	0.25X-0.25H-0.5(90%.D+10%W)	20	0.250	0.250	0.500	6.000	4.000	90.000
14	0.25X-0.25H-0.5(80%.D+20%W)		0.250	0.250	0.500	3.000	2.500	94.500
15	0.25X-0.25H-0.5(90%.D+10%W)	30	0.250	0.250	0.500	11.800	4.000	84.200
16	0.25X-0.25H-0.5(80%.D+20%W)		0.250	0.250	0.500	4.000	2.000	94.000
17	0.25X-0.25H-0.5(90%.D+10%W)	40	0.250	0.250	0.500	14.000	7.000	89.000
18	0.25X-0.25H-0.5(80%.D+20%W)		0.250	0.250	0.500	7.000	2.000	91.000

Table -LV-1

Limiting Values of % Aromatics Extracted (%AE) and% Purity of Extract (%PE) for different Systems: - B/T/X-H/H'/O-Dmf+Water: Case-I with [S/F]=1

Sr.No.	Systems	Feed Composition				Extract Composition		
		TEMP °C	X_{AF}	X_{HF}	X_{SF}	X_{AE}	X_{HE}	X_{SE}
19	0.25B-0.25Hep-0.5(90%.D+10%W)	20	0.250	0.250	0.500	16.000	7.000	77.000
20	0.25B-0.25Hep-0.5(80%.D+20%W)		0.250	0.250	0.500	6.000	2.000	92.000
21	0.25B-0.25Hep-0.5(90%.D+10%W)	30	0.250	0.250	0.500	19.500	14.000	66.500
22	0.25B-0.25Hep-0.5(80%.D+20%W)		0.250	0.250	0.500	11.500	5.000	83.500
23	0.25B-0.25Hep-0.5(90%.D+10%W)	40	0.250	0.250	0.500	22.000	12.000	66.000
24	0.25B-0.25Hep-0.5(80%.D+20%W)		0.250	0.250	0.500	10.000	3.000	87.000
25	0.25B-0.25O-0.5(90%.D+10%W)	20	0.250	0.250	0.500	17.000	5.000	78.000
26	0.25B-0.25O-0.5(80%.D+20%W)		0.250	0.250	0.500	9.000	1.000	90.000
27	0.25B-0.25O-0.5(90%.D+10%W)	30	0.250	0.250	0.500	19.000	8.000	73.000
28	0.25B-0.25O-0.5(80%.D+20%W)		0.250	0.250	0.500	9.500	3.000	87.500
29	0.25B-0.25O-0.5(90%.D+10%W)	40	0.250	0.250	0.500	23.000	9.000	68.000
30	0.25B-0.25O-0.5(80%.D+20%W)		0.250	0.250	0.500	16.000	4.000	80.000

Table -LV-1

Limiting Values of % Aromatics Extracted (%AE) and% Purity of Extract (%PE) for different Systems: - B/T/X-H/H'/O-Dmf+-Water: Case-I with [S/F]=1

Sr.No.	By Lever Rule		Proportionate Quantity			
	L_R	L_E	R	E=F-R	%A_E (Limiting)	%P_E (Limiting)
1	46.000	23.000	1.333	2.667	45.333	62.963
2	48.000	41.500	1.855	2.145	15.017	87.500
3	47.000	18.000	1.108	2.892	67.969	58.025
4	46.500	40.500	1.862	2.138	18.707	92.105
5	46.000	15.500	1.008	2.992	68.813	63.014
6	48.000	46.000	1.957	2.043	8.170	66.667
7	41.000	38.000	1.924	2.076	16.608	61.538
8	46.000	43.000	1.933	2.067	15.506	83.333
9	41.000	30.000	1.690	2.310	34.648	75.000
10	45.500	40.500	1.884	2.116	15.872	82.418
11	39.000	33.000	1.833	2.167	26.000	75.000
12	45.000	39.000	1.857	2.143	18.214	77.273
13	46.500	40.000	1.850	2.150	12.902	60.000
14	47.000	46.000	1.978	2.022	6.065	54.545
15	44.000	36.000	1.800	2.200	25.960	74.684
16	44.000	48.000	2.087	1.913	7.652	66.667
17	44.500	30.000	1.611	2.389	33.450	66.667
18	45.000	41.000	1.907	2.093	14.651	77.778

Table -LV-1

Limiting Values of % Aromatics Extracted (%AE) and% Purity of Extract (%PE) for different Systems: - B/T/X-H/H'/O-Dmf+Water: Case-I with [S/F]=1

Sr.No.	By Lever Rule L_R	L_E	R	Proportionate Quantity E=F-R	%A_E (Limiting)	%P_E (Limiting)
19	48.500	38.000	1.757	2.243	35.884	69.565
20	49.000	33.000	1.610	2.390	14.341	75.000
21	47.000	16.500	1.039	2.961	57.732	58.209
22	49.000	33.500	1.624	2.376	27.321	69.697
23	43.100	16.500	1.107	2.893	63.638	64.706
24	45.500	36.000	1.767	2.233	22.331	76.923
25	47.700	38.000	1.774	2.226	37.848	77.273
26	48.880	40.450	1.811	2.189	19.699	90.000
27	48.400	34.000	1.650	2.350	44.641	70.370
28	49.000	33.500	1.624	2.376	22.570	76.000
29	45.100	16.500	1.071	2.929	67.357	71.875
30	46.000	30.500	1.595	2.405	38.484	80.000

(i) $E=\frac{[L_R \quad].(R+E)=L_R.(F)}{[L_R+L_E] \quad L_R+L_E}$; $R=F-E$ (ii) $\%A_E=\frac{E.X_{AE}.(100)}{F.X_{AF}}$; $\%P_E=\frac{X_{AE}.(100)}{X_{AE}+X_{HE}}$

Table -LV-2

Limiting Values of % Aromatics Extracted (%AE) and% Purity of Extract (%PE) for different Systems: - B/T/X-H/H'/O-Dmf+Water: Case-II with [S/F]=2

Sr.No.	Systems	TEMP °C	Feed Composition			Extract Composition		
			X_{AF}	X_{HF}	X_{SF}	X_{AE}	X_{HE}	X_{SE}
1	0.166B-0.166H-0.66(90%.D+10%W)	20	16.660	16.660	66.660	16.000	10.000	74.000
2	0.166B-0.166H-0.66(80%.D+20%W)		16.660	16.660	66.660	6.000	1.000	93.000
3	0.166B-0.166H-0.66(90%.D+10%W)	30	16.660	16.660	66.660	15.000	15.000	70.000
4	0.166B-0.166H-0.66(80%.D+20%W)		16.660	16.660	66.660	8.000	3.000	89.000
5	0.166B-0.166H-0.66(90%.D+10%W)	40	16.660	16.660	66.660	16.000	7.000	77.000
6	0.166B-0.166H-0.66(80%.D+20%W)		16.660	16.660	66.660	14.000	2.500	83.500
7	0.166T-0.166H-0.66(90%.D+10%W)	20	16.660	16.660	66.660	8.000	3.000	89.000
8	0.166T-0.166H-0.66(80%.D+20%W)		16.660	16.660	66.660	3.000	2.000	95.000
9	0.166T-0.166H-0.66(90%.D+10%W)	30	16.660	16.660	66.660	12.000	5.000	83.000
10	0.166T-0.166H-0.66(80%.D+20%W)		16.660	16.660	66.660	6.000	1.600	92.400
11	0.166T-0.166H-0.66(90%.D+10%W)	40	16.660	16.660	66.660	10.000	5.000	85.000
12	0.166T-0.166H-0.66(80%.D+20%W)		16.660	16.660	66.660	5.000	2.500	92.500
13	0.166X-0.166H-0.66(90%.D+10%W)	20	16.660	16.660	66.660	7.000	5.000	88.000
14	0.166X-0.166H-0.66(80%.D+20%W)		16.660	16.660	66.660	2.000	2.000	96.000
15	0.166X-0.166H-0.66(90%.D+10%W)	30	16.660	16.660	66.660	11.000	4.000	85.000
16	0.166X-0.166H-0.66(80%.D+20%W)		16.660	16.660	66.660	3.500	2.000	94.500
17	0.166X-0.166H-0.66(90%.D+10%W)	40	16.660	16.660	66.660	12.000	7.500	80.500
18	0.166X-0.166H-0.66(80%.D+20%W)		16.660	16.660	66.660	7.000	3.000	90.000

Table -LV-2

Limiting Values of % Aromatics Extracted (%AE) and% Purity of Extract (%PE) for different Systems: - B/T/X-H/H'/O-Dmf+Water: Case-II with [S/F]=2

Sr.No.	Systems	TEMP °C	Feed Composition			Extract Composition		
			X_{AF}	X_{HF}	X_{SF}	X_{AE}	X_{HE}	XSE
19	0.166B-0.166Hep-0.66(90%.D+10%W)	20	16.660	16.660	66.660	12.500	3.000	84.500
20	0.166B-0.166Hep-0.66(80%.D+20%W)		16.660	16.660	66.660	7.000	2.000	91.000
21	0.166B-0.166Hep-0.66(90%.D+10%W)	30	16.660	16.660	66.660	15.000	13.500	71.500
22	0.166B-0.166Hep-0.66(80%.D+20%W)		16.660	16.660	66.660	10.000	5.000	85.000
23	0.166B-0.166Hep-0.66(90%.D+10%W)	40	16.660	16.660	66.660	16.000	11.000	63.000
24	0.166B-0.166Hep-0.66(80%.D+20%W)		16.660	16.660	66.660	8.000	4.000	88.000
25	0.166B-0.166O-0.66(90%.D+10%W)	20	16.660	16.660	66.660	12.000	5.000	83.000
26	0.166B-0.166O-0.66(80%.D+20%W)		16.660	16.660	66.660	7.000	2.000	91.000
27	0.166B-0.166O-0.66(90%.D+10%W)	30	16.660	16.660	66.660	14.000	7.000	79.000
28	0.166B-0.166O-0.66(80%.D+20%W)		16.660	16.660	66.660	7.900	2.600	89.500
29	0.166B-0.166O-0.66(90%.D+10%W)	40	16.660	16.660	66.660	16.500	8.000	75.500
30	0.166B-0.166O-0.66(80%.D+20%W)		16.660	16.660	66.660	11.000	4.000	85.000

Table -LV-2

Limiting Values of % Aromatics Extracted (%AE) and% Purity of Extract (%PE) for different Systems: - B/T/X-H/H'/O-Dmf+Water: Case-II with [S/F]=2

Sr.No.	By Lever Rule		Proportionate Quantity			
	L_R	L_E	R	E=F-R	%AE (Limiting)	%PE (Limiting)
1	62.500	8.000	0.681	5.319	85.106	61.538
2	64.500	26.500	1.747	4.253	25.516	85.714
3	63.500	6.000	0.518	5.482	82.230	50.000
4	64.600	22.400	1.545	4.455	35.641	72.727
5	62.700	10.400	0.854	5.146	82.342	69.565
6	65.500	32.330	1.983	4.017	56.240	84.848
7	56.660	23.330	1.750	4.250	34.000	72.727
8	62.660	28.340	1.869	4.131	12.394	60.000
9	58.000	13.500	1.133	4.867	58.406	70.588
10	57.500	24.400	1.788	4.212	25.275	78.947
11	53.600	16.400	1.406	4.594	45.943	66.667
12	61.600	28.400	1.893	4.107	20.533	66.667
13	62.000	21.400	1.540	4.460	31.223	58.333
14	63.500	29.500	1.903	4.097	8.194	50.000
15	60.600	18.400	1.397	4.603	50.628	73.333
16	60.600	25.440	1.774	4.226	14.791	63.636
17	60.600	14.090	1.132	4.868	58.417	61.538
18	60.600	24.240	1.714	4.286	30.000	70.000

Table -LV-2

Limiting Values of % Aromatics Extracted (%AE) and% Purity of Extract (%PE) for different Systems: - B/T/X-H/H'/O-Dmf+Water: Case-II with [S/F]=2

Sr.No.	By Lever Rule L_R	By Lever Rule L_E	Proportionate Quantity R	E=F-R	%A_E (Limiting)	%P_E (Limiting)
19	59.600	13.000	1.074	4.926	61.570	80.645
20	65.500	25.000	1.657	4.343	30.398	77.778
21	62.600	4.400	0.394	5.606	84.090	52.632
22	64.660	18.340	1.326	4.674	46.742	66.667
23	58.660	7.340	0.667	5.333	85.324	59.259
24	61.660	21.840	1.569	4.431	35.445	66.667
25	65.560	15.940	1.173	4.827	57.918	70.588
26	65.660	23.290	1.571	4.429	31.003	77.778
27	65.166	11.340	0.889	5.111	71.549	66.667
28	65.566	23.340	1.575	4.425	34.956	75.238
29	62.660	9.440	0.786	5.214	86.038	67.347
30	63.560	18.540	1.355	4.645	51.096	73.333

(i) $E=\frac{[L_R\quad]}{[L_R+L_E]}.(R+E)=\frac{L_R.(F)}{L_R+L_E}$; $R=F-E$ (ii) $\%A_E=\frac{E.X_{AE}.(100)}{F.X_{AF}}$; $\%P_E=\frac{X_{AE}.(100)}{X_{AE}+X_{HE}}$

Table -LV-3

Limiting Values of % Aromatics Extracted (%AE) and% Purity of Extract (%PE) for different Systems: - B/T/X-H/H'/O-Dmf+Water: Case-III with [S/F]=3

Sr.No.	Systems	TEMP °C	Feed Composition			Extract Composition		
			X_{AF}	X_{HF}	X_{SF}	X_{AE}	X_{HE}	X_{SE}
1	0.125B-0.125H-0.75(90%.D+10%W)		12.500	12.500	75.000	12.000	9.000	79.000
2	0.125B-0.125H-0.75(80%.D+20%W)		12.500	12.500	75.000	5.000	1.000	94.000
3	0.125B-0.125H-0.75(90%.D+10%W)		12.500	12.500	75.000	12.000	12.000	76.000
4	0.125B-0.125H-0.75(80%.D+20%W)		12.500	12.500	75.000	7.500	2.500	90.000
5	0.125B-0.125H-0.75(90%.D+10%W)		12.500	12.500	75.000	12.000	6.000	82.000
6	0.125B-0.125H-0.75(80%.D+20%W)		12.500	12.500	75.000	8.000	3.000	89.000
7	0.125T-0.125H-0.75(90%.D+10%W)		12.500	12.500	75.000	7.000	3.000	90.000
8	0.125T-0.125H-0.75(80%.D+20%W)		12.500	12.500	75.000	3.000	2.000	95.000
9	0.125T-0.125H-0.75(90%.D+10%W)		12.500	12.500	75.000	11.000	6.500	82.500
10	0.125T-0.125H-0.75(80%.D+20%W)		12.500	12.500	75.000	5.000	10.500	93.500
11	0.125T-0.125H-0.75(90%.D+10%W)		12.500	12.500	75.000	11.000	5.000	84.000
12	0.125T-0.125H-0.75(80%.D+20%W)		12.500	12.500	75.000	3.000	3.000	94.000
13	0.125X-0.125H-0.75(90%.D+10%W)		12.500	12.500	75.000	6.000	4.000	90.000
14	0.125X-0.125H-0.75(80%.D+20%W)		12.500	12.500	75.000	2.000	2.000	96.000
15	0.125X-0.125H-0.75(90%.D+10%W)		12.500	12.500	75.000	9.000	4.000	87.000
16	0.125X-0.125H-0.75(80%.D+20%W)		12.500	12.500	75.000	5.000	10.500	93.500
17	0.125X-0.125H-0.75(90%.D+10%W)		12.500	12.500	75.000	11.000	7.500	87.500
18	0.125X-0.125H-0.75(80%.D+20%W)		12.500	12.500	75.000	6.000	3.000	91.000

Table -LV-3

Limiting Values of % Aromatics Extracted (%AE) and% Purity of Extract (%PE) for different Systems: - B/T/X-H/H'/O-Dmf+Water: Case-III with [S/F]=3

Sr.No.	S/F=3 Systems	TEMP °C	Feed Composition			Extract Composition		
			X_{AF}	X_{HF}	X_{SF}	X_{AE}	X_{HE}	X_{SE}
19	0.125B-0.125Hep-0.75(90%.D+10%W)	20	12.500	12.500	75.000	11.000	8.000	81.000
20	0.125B-0.125Hep-0.75(80%.D+20%W)		12.500	12.500	75.000	8.000	2.000	90.000
21	0.125B-0.125Hep-0.75(90%.D+10%W)	30	12.500	12.500	75.000	12.500	12.500	75.000
22	0.125B-0.125Hep-0.75(80%.D+20%W)		12.500	12.500	75.000	8.000	3.000	89.000
23	0.125B-0.125Hep-0.75(90%.D+10%W)	40	12.500	12.500	75.000	12.000	10.500	77.500
24	0.125B-0.125Hep-0.75(80%.D+20%W)		12.500	12.500	75.000	8.000	4.000	88.000
25	0.125B-0.125O-0.75(90%.D+10%W)	20	12.500	12.500	75.000	11.000	5.000	84.000
26	0.125B-0.125O-0.75(80%.D+20%W)		12.500	12.500	75.000	7.500	1.500	91.000
27	0.125B-0.125O-0.75(90%.D+10%W)	30	12.500	12.500	75.000	12.000	7.000	79.000
28	0.125B-0.125O-0.75(80%.D+20%W)		12.500	12.500	75.000	7.300	3.000	89.700
29	0.125B-0.125O-0.75(90%.D+10%W)	40	12.500	12.500	75.000	12.000	6.000	82.000
30	0.125B-0.125O-0.75(80%.D+20%W)		12.500	12.500	75.000	10.000	3.000	87.000

Table -LV-3

Limiting Values of % Aromatics Extracted (%AE) and% Purity of Extract (%PE) for different Systems: - B/T/X-H/H'/O-Dmf+Water: Case-III with [S/F]=3

Sr.No.	By Lever Rule		Proportionate Quantity			
	L_R	L_E	R	E=F-R	%Aromatic (Limiting)	$\%P_E$ (Limiting)
1	72.500	3.000	0.318	7.682	92.185	57.143
2	73.500	18.700	1.623	6.377	31.887	83.333
3	72.500	0.050	0.006	7.994	95.934	50.000
4	72.500	15.000	1.371	6.629	49.714	75.000
5	72.000	6.500	0.662	7.338	88.051	66.667
6	72.500	18.000	1.591	6.409	51.271	72.727
7	65.000	13.000	1.333	6.667	46.667	70.000
8	71.000	18.000	1.618	6.382	19.146	60.000
9	66.500	7.000	0.762	7.238	79.619	62.857
10	71.500	18.000	1.609	6.391	31.955	32.258
11	63.000	10.000	1.096	6.904	75.945	68.750
12	70.000	17.000	1.563	6.437	19.310	50.000
13	70.500	12.500	1.205	6.795	40.771	60.000
14	72.000	20.000	1.739	6.261	12.522	50.000
15	69.000	7.000	0.737	7.263	65.368	69.231
16	69.000	19.000	1.727	6.273	31.364	32.258
17	69.000	6.000	0.640	7.360	80.960	59.459
18	69.000	16.000	1.506	6.494	38.965	66.667

Table -LV-3

Limiting Values of % Aromatics Extracted (%AE) and% Purity of Extract (%PE) for different Systems: - B/T/X-H/H'/O-Dmf+Water: Case-III with [S/F]=3

Sr.No.	By Lever Rule			Proportionate Quantity		
	L_R	L_E	R	E=F-R	%Aromatic (Limiting)	$\%P_E$ (Limiting)
19	73.000	7.000	0.700	7.300	80.300	57.895
20	73.500	17.000	1.503	6.497	51.978	80.000
21	70.000	0.500	0.057	7.943	99.291	50.000
22	73.500	14.000	1.280	6.720	53.760	72.727
23	67.000	1.500	0.175	7.825	93.898	53.333
24	71.000	12.000	1.157	6.843	54.747	66.667
25	73.000	9.600	0.930	7.070	77.772	68.750
26	74.000	16.000	1.422	6.578	49.333	83.333
27	73.500	6.000	0.604	7.396	88.755	63.158
28	73.500	14.500	1.318	6.682	48.777	70.874
29	72.000	5.500	0.568	7.432	89.187	66.667
30	71.500	10.000	0.982	7.018	70.184	76.923

(i) $E=[L_R/(L_R+L_E)].(R+E)=L_R.(F)/(L_R+L_E)$ $\quad R=F-E$ $\quad$ (ii) $\%A_E=E.X_{AE}.(100)/F.X_{AF}$; $\quad \%P_E=X_{AE}.(100)/(X_{AE}+X_{HE})$

Table -LV-4

Limiting Values of % Aromatics Extracted (%AE) and% Purity of Extract (%PE) for different Systems: - B/T/X-H/H'/O-Dmso+Water: Case-IV with [S/F]=1

Sr.No.	Systems	TEMP °C	Feed Composition			Extract Composition		
			X_{AF}	X_{HF}	X_{SF}	X_{AE}	X_{HE}	X_{SE}
1	0.25B-0.25H-0.5(90%.D'+10%W)	20	0.250	0.250	0.500	16.000	1.000	83.000
2	0.25B-0.25H-0.5(80%.D'+20%W)		0.250	0.250	0.500	2.000	1.000	97.000
3	0.25B-0.25H-0.5(90%.D'+10%W)	30	0.250	0.250	0.500	12.800	0.070	88.730
4	0.25B-0.25H-0.5(80%.D'+20%W)		0.250	0.250	0.500	2.500	0.060	97.440
5	0.25B-0.25H-0.5(90%.D'+10%W)	40	0.250	0.250	0.500	13.000	1.200	85.800
6	0.25B-0.25H-0.5(80%.D'+20%W)		0.250	0.250	0.500	7.500	0.500	92.000
7	0.25T-0.25H-0.5(90%.D'+10%W)	20	0.250	0.250	0.500	5.000	0.050	94.950
8	0.25T-0.25H-0.5(80%.D'+20%W)		0.250	0.250	0.500	2.500	0.110	92.490
9	0.25T-0.25H-0.5(90%.D'+10%W)	30	0.250	0.250	0.500	7.000	1.800	91.200
10	0.25T-0.25H-0.5(80%.D'+20%W)		0.250	0.250	0.500	1.800	0.200	98.000
11	0.25T-0.25H-0.5(90%.D'+10%W)	40	0.250	0.250	0.500	11.000	1.500	87.500
12	0.25T-0.25H-0.5(80%.D'+20%W)		0.250	0.250	0.500	5.000	0.220	94.780
13	0.25X-0.25H-0.5(90%.D'+10%W)	20	0.250	0.250	0.500	0.990	0.950	97.100
14	0.25X-0.25H-0.5(80%.D'+20%W)		0.250	0.250	0.500	0.110	0.590	97.000
15	0.25X-0.25H-0.5(90%.D'+10%W)	30	0.250	0.250	0.500	0.800	1.100	98.100
16	0.25X-0.25H-0.5(80%.D'+20%W)		0.250	0.250	0.500	0.210	0.940	98.950
17	0.25X-0.25H-0.5(90%.D'+10%W)	40	0.250	0.250	0.500	5.000	0.200	94.800
18	0.25X-0.25H-0.5(80%.D'+20%W)		0.250	0.250	0.500	4.000	0.150	95.850

Table -LV-4

Limiting Values of % Aromatics Extracted (%AE) and% Purity of Extract (%PE) for different Systems: - B/T/X-H/H'/O-Dmso+Water: Case-IV with [S/F]=1

Sr.No.	Systems	TEMP °C	Feed Composition			Extract Composition		
			X_{AF}	X_{HF}	X_{SF}	X_{AE}	X_{HE}	X_{SE}
19	0.25B-0.25H'-0.5(90%.D'+10%W)	20	0.250	0.250	0.500	-	-	-
20	0.25B-0.25H'-0.5(80%.D'+20%W)		0.250	0.250	0.500	7.000	0.120	92.880
21	0.25B-0.25H'-0.5(90%.D'+10%W)	30	0.250	0.250	0.500	14.000	0.650	85.350
22	0.25B-0.25H'-0.5(80%.D'+20%W)		0.250	0.250	0.500	11.000	0.500	88.500
23	0.25B-0.25H'-0.5(90%.D'+10%W)	40	0.250	0.250	0.500	17.000	1.000	82.000
24	0.25B-0.25H'-0.5(80%.D'+20%W)		0.250	0.250	0.500	14.000	1.500	84.500
25	0.25B-0.25O-0.5(90%.D'+10%W)	20	0.250	0.250	0.500	3.000	0.010	96.990
26	0.25B-0.25O-0.5(80%.D'+20%W)		0.250	0.250	0.500	1.500	0.400	98.100
27	0.25B-0.25O-0.5(90%.D'+10%W)	30	0.250	0.250	0.500	2.500	0.500	97.000
28	0.25B-0.25O-0.5(80%.D'+20%W)		0.250	0.250	0.500	1.000	0.500	98.500
29	0.25B-0.25O-0.5(90%.D'+10%W)	40	0.250	0.250	0.500	7.800	0.500	91.700
30	0.25B-0.25O-0.5(80%.D'+20%W)		0.250	0.250	0.500	7.500	0.500	92.000

Table -LV-4

Limiting Values of % Aromatics Extracted (%AE) and% Purity of Extract (%PE) for different Systems: - B/T/X-H/H'/O-Dmso+Water: Case-IV with [S/F]=1

Sr.No.	By Lever Rule		Proportionate Quantity			
	L_R	L_E	R	E=F-R	%Aromatic (Limiting)	%PE (Limiting)
1	48.000	33.000	1.630	2.370	27.926	94.118
2	47.500	48.000	2.010	1.990	3.979	66.667
3	48.800	36.700	1.717	2.283	29.223	99.456
4	48.200	48.000	1.996	2.004	5.010	97.656
5	48.000	36.000	1.714	2.286	29.714	91.549
6	49.000	41.900	1.844	2.156	16.172	93.750
7	43.500	46.200	2.060	1.940	9.699	99.010
8	48.000	48.000	2.000	2.000	5.000	95.785
9	47.900	40.500	1.833	2.167	15.172	79.545
10	48.200	47.200	1.979	2.021	3.638	90.000
11	45.000	37.600	1.821	2.179	23.971	88.000
12	45.600	44.000	1.964	2.036	10.179	95.785
13	44.050	48.860	2.104	1.896	1.877	51.031
14	47.000	49.300	2.048	1.952	0.215	15.714
15	40.000	48.000	2.182	1.818	1.455	42.105
16	44.600	48.850	2.091	1.909	0.401	18.261
17	39.000	45.000	2.143	1.857	9.286	96.154
18	40.000	46.000	2.140	1.860	7.442	96.386

Table -LV-4

Limiting Values of % Aromatics Extracted (%AE) and% Purity of Extract (%PE) for different Systems: - B/T/X-H/H'/O-Dmso+Water: Case-IV with [S/F]=1

Sr.No.	By Lever Rule L_R	L_E	Proportionate Quantity R	E=F-R	%Aromatic (Limiting)	$\%P_E$ (Limiting)
19	-	-	-	-	-	-
20	48.700	43.350	1.884	2.116	14.814	98.315
21	46.000	35.000	1.728	2.272	31.802	95.563
22	47.800	40.000	1.822	2.178	23.954	95.652
23	47.000	30.500	1.574	2.426	41.239	94.444
24	47.200	37.000	1.758	2.242	31.392	90.323
25	49.500	44.900	1.903	2.097	6.292	99.668
26	49.550	48.450	1.978	2.022	3.034	78.947
27	48.500	48.000	1.990	2.010	5.026	83.333
28	48.500	48.000	1.990	2.010	2.010	66.667
29	48.500	41.500	1.844	2.156	16.813	93.976
30	48.500	41.500	1.844	2.156	16.167	93.750

(i) $E=\frac{[L_R \quad]}{[L_R+L_E]}.(R+E)=\frac{L_R.(F)}{L_R+L_E}$; $R=F-E$ (ii) $\%A_E=\frac{E.X_{AE}.(100)}{F.X_{AF}}$; $\%P_E=\frac{X_{AE}.(100)}{X_{AE}+X_{HE}}$

Table -LV-5

Limiting Values of % Aromatics Extracted (%AE) and% Purity of Extract (%PE) for different Systems: - B/T/X-H/H'/O-Dmso+Water: Case-V with [S/F]=2

Sr.No.	Systems	TEMP °C	Feed Composition			Extract Composition		
			X_{AF}	X_{HF}	X_{SF}	X_{AE}	X_{HE}	X_{SE}
1	0.166B-0.166H-0.66(90%.D'+10%W)	20	16.660	16.660	66.660	12.000	1.100	86.900
2	0.166B-0.166H-0.66(80%.D'+20%W)		16.660	16.660	66.660	-	-	-
3	0.166B-0.166H-0.66(90%.D'+10%W)	30	16.660	16.660	66.660	10.000	0.500	89.500
4	0.166B-0.166H-0.66(80%.D'+20%W)		16.660	16.660	66.660	1.700	0.100	98.200
5	0.166B-0.166H-0.66(90%.D'+10%W)	40	16.660	16.660	66.660	10.500	1.800	87.700
6	0.166B-0.166H-0.66(80%.D'+20%W)		16.660	16.660	66.660	6.000	0.700	93.300
7	0.166T-0.166H-0.66(90%.D'+10%W)	20	16.660	16.660	66.660	3.000	0.100	96.900
8	0.166T-0.166H-0.66(80%.D'+20%W)		16.660	16.660	66.660	1.300	0.010	98.690
9	0.166T-0.166H-0.66(90%.D'+10%W)	30	16.660	16.660	66.660	6.500	1.500	62.000
10	0.166T-0.166H-0.66(80%.D'+20%W)		16.660	16.660	66.660	1.700	0.250	98.050
11	0.166T-0.166H-0.66(90%.D'+10%W)	40	16.660	16.660	66.660	8.000	1.500	90.500
12	0.166T-0.166H-0.66(80%.D'+20%W)		16.660	16.660	66.660	4.500	0.800	94.700
13	0.166X-0.166H-0.66(90%.D'+10%W)	20	16.660	16.660	66.660	1.500	0.500	98.000
14	0.166X-0.166H-0.66(80%.D'+20%W)		16.660	16.660	66.660	1.000	5.900	92.300
15	0.166X-0.166H-0.66(90%.D'+10%W)	30	16.660	16.660	66.660	0.800	1.100	98.100
16	0.166X-0.166H-0.66(80%.D'+20%W)		16.660	16.660	66.660	0.200	0.950	96.950
17	0.166X-0.166H-0.66(90%.D'+10%W)	40	16.660	16.660	66.660	4.500	0.250	95.250
18	0.166X-0.166H-0.66(80%.D'+20%W)		16.660	16.660	66.660	3.500	0.170	96.330

Table -LV-5

Limiting Values of % Aromatics Extracted (%AE) and% Purity of Extract (%PE) for different Systems: - B/T/X-H/H'/O-Dmso+Water: Case-V with [S/F]=2

Sr.No.	Systems	TEMP °C	Feed Composition			Extract Composition		
			X_{AF}	X_{HF}	X_{SF}	X_{AE}	X_{HE}	X_{SE}
19	0.166B-0.166Hep-0.66(90%.D'+10%W)	20	16.660	16.660	66.660	-	-	-
20	0.166B-0.166Hep-0.66(80%.D'+20%W)		16.660	16.660	66.660	6.000	0.250	93.750
21	0.166B-0.166Hep-0.66(90%.D'+10%W)	30	16.660	16.660	66.660	9.500	0.800	89.700
22	0.166B-0.166Hep-0.66(80%.D'+20%W)		16.660	16.660	66.660	9.000	0.500	90.500
23	0.166B-0.166Hep-0.66(90%.D'+10%W)	40	16.660	16.660	66.660	11.000	1.200	87.800
24	0.166B-0.166Hep-0.66(80%.D'+20%W)		16.660	16.660	66.660	11.500	1.500	87.000
25	0.166B-0.166O-0.66(90%.D'+10%W)	20	16.660	16.660	66.660	2.000	0.010	97.990
26	0.166B-0.166O-0.66(80%.D'+20%W)		16.660	16.660	66.660	1.500	0.400	98.100
27	0.166B-0.166O-0.66(90%.D'+10%W)	30	16.660	16.660	66.660	6.500	1.000	92.500
28	0.166B-0.166O-0.66(80%.D'+20%W)		16.660	16.660	66.660	-	-	-
29	0.166B-0.166O-0.66(90%.D'+10%W)	40	16.660	16.660	66.660	5.000	0.500	94.500
30	0.166B-0.166O-0.66(80%.D'+20%W)		16.660	16.660	66.660	5.000	0.500	94.500

Table -LV-5

Limiting Values of % Aromatics Extracted (%AE) and% Purity of Extract (%PE) for different Systems: - B/T/X-H/H'/O-Dmso+Water: Case-V with [S/F]=2

Sr.No.	By Lever Rule		Proportionate Quantity			
	L_R	L_E	R	E=F-R.	%Aromatic (Limiting)	$\%P_E$ (Limiting)
1	64.760	20.340	1.434	4.566	54.791	91.603
2	-	-	-	-	-	-
3	65.000	22.340	1.535	4.465	44.653	95.238
4	66.360	31.540	1.933	4.067	6.914	94.444
5	65.160	21.140	1.470	4.530	47.568	85.366
6	65.660	26.340	1.718	4.282	25.693	89.552
7	60.160	30.340	2.011	3.989	11.966	96.774
8	65.460	31.330	1.942	4.058	5.275	99.237
9	64.000	24.400	1.656	4.344	28.235	81.250
10	65.000	3.340	0.293	5.707	9.701	87.179
11	61.660	23.400	1.651	4.349	34.795	84.211
12	62.660	1.400	0.131	5.869	26.410	84.906
13	63.000	32.170	2.028	3.972	5.958	75.000
14	62.600	32.660	2.057	3.943	3.943	14.493
15	56.660	32.340	2.180	3.820	3.056	42.105
16	68.660	32.340	1.921	4.079	0.816	17.391
17	5.600	29.500	5.043	0.957	4.308	94.737
18	56.600	29.400	2.051	3.949	13.821	95.368

Table -LV-5

Limiting Values of % Aromatics Extracted (%AE) and% Purity of Extract (%PE) for different Systems: - B/T/X-H/H'/O-Dmso+Water: Case-V with [S/F]=2

Sr.No.	By Lever Rule L_R	By Lever Rule L_E	Proportionate Quantity R	E=F-R	%Aromatic (Limiting)	$\%P_E$ (Limiting)
19	-	-	-	-	-	-
20	65.460	27.370	1.769	4.231	25.386	96.000
21	63.160	21.340	1.515	4.485	42.605	92.233
22	64.660	24.340	1.641	4.359	39.232	94.737
23	63.660	20.540	1.464	4.536	49.900	90.164
24	63.860	21.340	1.503	4.497	51.718	88.462
25	65.460	26.340	1.722	4.278	8.557	99.502
26	65.160	32.340	1.990	2.010	3.015	78.947
27	65.160	26.340	1.727	2.273	14.773	86.667
28	-	-	-	-	-	-
29	65.160	26.340	1.727	2.273	11.364	90.909
30	65.160	26.340	1.727	2.273	11.364	90.909

(i) $E=\frac{[L_R]}{[L_R+L_E]}.(R+E)=\frac{L_R.(F)}{L_R+L_E}$; $R=F-E$ (ii) $\%A_E=\frac{E.X_{AE}.(100)}{F.X_{AF}}$; $\%P_E=\frac{X_{AE}.(100)}{X_{AE}+X_{HE}}$

Table -LV-6

Limiting Values of % Aromatics Extracted (%AE) and% Purity of Extract (%PE) for different Systems: - B/T/X-H/H'/O-Dmso+Water: Case-VI with [S/F]=3

Sr.No.	Systems	TEMP °C	Feed Composition			Extract Composition		
			X_{AF}	X_{HF}	X_{SF}	X_{AE}	X_{HE}	X_{SE}
1	0.125B-0.125H-0.75(90%.D'+10%W)	20	12.500	12.500	75.000	8.800	1.100	90.100
2	0.125B-0.125H-0.75(80%.D'+20%W)		12.500	12.500	75.000	-	-	-
3	0.125B-0.125H-0.75(90%.D'+10%W)	30	12.500	12.500	75.000	8.000	0.700	91.300
4	0.125B-0.125H-0.75(80%.D'+20%W)		12.500	12.500	75.000	1.500	0.100	98.400
5	0.125B-0.125H-0.75(90%.D'+10%W)	40	12.500	12.500	75.000	10.000	1.600	89.400
6	0.125B-0.125H-0.75(80%.D'+20%W)		12.500	12.500	75.000	5.500	0.100	94.400
7	0.125T-0.125H-0.75(90%.D'+10%W)	20	12.500	12.500	75.000	3.000	0.100	96.900
8	0.125T-0.125H-0.75(80%.D'+20%W)		12.500	12.500	75.000	1.000	0.010	98.990
9	0.125T-0.125H-0.75(90%.D'+10%W)	30	12.500	12.500	75.000	6.000	1.700	92.200
10	0.125T-0.125H-0.75(80%.D'+20%W)		12.500	12.500	75.000	1.500	0.010	98.900
11	0.125T-0.125H-0.75(90%.D'+10%W)	40	12.500	12.500	75.000	7.000	2.000	91.000
12	0.125T-0.125H-0.75(80%.D'+20%W)		12.500	12.500	75.000	4.000	1.000	95.000
13	0.125X-0.125H-0.75(90%.D'+10%W)	20	12.500	12.500	75.000	1.900	9.500	89.600
14	0.125X-0.125H-0.75(80%.D'+20%W)		12.500	12.500	75.000	0.500	6.200	92.300
15	0.125X-0.125H-0.75(90%.D'+10%W)	30	12.500	12.500	75.000	0.900	1.000	98.100
16	0.125X-0.125H-0.75(80%.D'+20%W)		12.500	12.500	75.000	0.200	0.950	98.950
17	0.125X-0.125H-0.75(90%.D'+10%W)	40	12.500	12.500	75.000	4.200	0.300	95.500
18	0.125X-0.125H-0.75(80%.D'+20%W)		12.500	12.500	75.000	3.000	0.200	96.800

Table -LV-6

Limiting Values of % Aromatics Extracted (%AE) and% Purity of Extract (%PE) for different Systems: - B/T/X-H/H'/O-Dmso+Water: Case-VI with [S/F]=3

Sr.No.	Systems	TEMP °C	Feed Composition			Extract Composition		
			X_{AF}	X_{HF}	X_{SF}	X_{AE}	X_{HE}	X_{SE}
19	0.125B-0.125H'-0.75(90%.D'+10%W)	20	12.500	12.500	75.000	-	-	-
20	0.125B-0.125H'-0.75(80%.D'+20%W)		12.500	12.500	75.000	5.200	0.200	94.600
21	0.125B-0.125H'-0.75(90%.D'+10%W)	30	12.500	12.500	75.000	8.000	0.800	91.200
22	0.125B-0.125H'-0.75(80%.D'+20%W)		12.500	12.500	75.000	7.500	0.500	92.000
23	0.125B-0.125H'-0.75(90%.D'+10%W)	40	12.500	12.500	75.000	10.000	2.000	88.000
24	0.125B-0.125H'-0.75(80%.D'+20%W)		12.500	12.500	75.000	11.100	1.000	87.900
25	0.125B-0.125O-0.75(90%.D'+10%W)	20	12.500	12.500	75.000	2.000	0.010	97.990
26	0.125B-0.125O-0.75(80%.D'+20%W)		12.500	12.500	75.000	1.000	0.300	98.700
27	0.125B-0.125O-0.75(90%.D'+10%W)	30	12.500	12.500	75.000	5.500	0.500	94.000
28	0.125B-0.125O-0.75(80%.D'+20%W)		12.500	12.500	75.000	-	-	-
29	0.125B-0.125O-0.75(90%.D'+10%W)	40	12.500	12.500	75.000	7.000	0.500	92.500
30	0.125B-0.125O-0.75(80%.D'+20%W)		12.500	12.500	75.000	-	-	-

Table -LV-6

Limiting Values of % Aromatics Extracted (%AE) and% Purity of Extract (%PE) for different Systems: - B/T/X-H/H'/O-Dmso+Water: Case-VI with [S/F]=3

	By Lever Rule		Proportionate Quantity			
Sr.No.	L_R	L_E	R	E=F-R	%Aromatic (Limiting)	%PE (Limiting)
1	73.000	15.000	1.364	6.636	48.400	88.889
2	-	-	-	-	-	-
3	73.900	16.000	1.424	6.576	52.610	91.954
4	73.200	18.500	1.614	6.386	9.579	93.750
5	73.900	14.000	1.274	6.726	67.258	86.207
6	74.000	19.000	1.634	6.366	35.011	98.214
7	69.000	22.000	1.934	6.066	18.198	96.774
8	72.900	24.000	1.981	6.019	6.019	99.010
9	73.000	6.000	0.608	7.392	44.354	77.922
10	73.700	24.000	1.965	6.035	9.052	99.338
11	70.500	16.000	1.480	6.520	45.642	77.778
12	71.500	20.000	1.749	6.251	25.005	80.000
13	70.800	9.500	0.946	7.054	13.402	16.667
14	63.700	32.560	2.706	5.294	2.647	7.463
15	65.000	14.000	1.418	6.582	5.924	47.368
16	69.500	14.000	1.341	6.659	1.332	17.391
17	95.500	21.000	1.442	6.558	27.543	93.333
18	96.800	65.000	3.214	4.786	14.358	93.750

Table -LV-6

Limiting Values of % Aromatics Extracted (%AE) and% Purity of Extract (%PE) for different Systems: - B/T/X-H/H'/O-Dmso+Water: Case-VI with [S/F]=3

Sr.No.	By Lever Rule		Proportionate Quantity			
	L_R	L_E	R	E=F-R	%Aromatic (Limiting)	$\%P_E$ (Limiting)
19	-	-	-	-	-	-
20	73.800	20.000	1.706	6.294	32.730	96.296
21	70.000	16.000	1.488	6.512	52.093	90.909
22	73.000	7.600	0.754	7.246	54.342	93.750
23	72.000	3.500	0.371	7.629	76.291	83.333
24	71.800	17.000	1.532	6.468	71.800	91.736
25	74.500	23.000	1.887	6.113	12.226	99.502
26	74.600	24.000	1.947	6.053	6.053	76.923
27	73.500	17.000	1.503	6.497	35.735	91.667
28	-	-	-	-	-	-
29	74.000	17.000	1.495	6.505	45.538	93.333
30	-	-	-	-	-	-

(i) $E=\frac{[L_R]}{[L_R+L_E]}.(R+E)=\frac{L_R.(F)}{L_R+L_E}$; $R=F-E$

(ii) $\%A_E=\frac{E.X_{AE}.(100)}{F.X_{AF}}$; $\%P_E=\frac{X_{AE}.(100)}{X_{AE}+X_{HE}}$

Table -LV-7

Case-VII :Limiting Values of % Aromatics Extracted (%AE) and% Purity of Extract (%PE) for Mixed Feed Consisting of Aromatic- B+T+X&Aliphatic -H using Mixed Solvent-(Dmf+Water) at 30 °C

Sr.No.	Anti solvent Concentraion	SYSTEM	Feed Quantity A_F	H_F	S_F	(S/F)	Extract Composition X_{AE}	X_{HE}	X_{SE}
1.1	W=10%	B	1	1	2	1	23.50	17.00	59.50
1.2		T	1	1	2	1	15.00	5.40	80.00
1.3		X	1	1	2	1	11.80	4.00	84.20
	Total=		3	3	6	1	-	-	-
2.1	W=20%	B	1	1	2	1	8.75	0.75	90.50
2.2		T	1	1	2	1	70.50	1.60	40.90
2.3		X	1	1	2	1	4.00	2.00	94.00
	Total=		3	3	6	1	-	-	-
3.1	W=10%	B	1	3	6	1.5	40.50	70.50	88.00
3.2		T	1	3	6	1.5	40.50	5.00	90.50
3.3		X	1	3	6	1.5	4.00	30.50	92.50
3.4	Total=		3	9	18	1.5	-	-	-
4.1	W=20%	B	1	3	6	1.5	20.50	3.00	93.30
4.2		T	1	3	6	1.5	20.50	2.00	95.50
4.3		X	1	3	6	1.5	1.20	2.60	96.20
	Total=		3	9	18	1.5	-	-	-

Table -LV-7

Case-VII :Limiting Values of % Aromatics Extracted (%AE) and% Purity of Extract (%PE) for Mixed Feed consisting of Aromatics- B+T+X&Aliphatics -H using Mixed Solvent-(Dmf+Water) at 30 °C

	By Lever Rule		Proportionate Quantity E			Quantity R				
Sr.No.	L_R	L_E	E	A_E	H_E	S_E	H_R	S_R	$\%A_E$ (Limiting)	$\%P_E$ (Limiting)
1.1	42.00	9.70	3.25	0.76	0.55	1.93	0.45	0.07	76.30	58.11
1.2	41.00	30.00	2.31	0.35	0.12	1.85	0.89	0.15	34.60	75.05
1.3	44.00	34.00	20.26	0.26	0.09	1.90	0.91	0.10	25.60	73.99
	-	-	7.44	1.38	0.76	5.68	2.25	0.32	45.83	64.55
2.1	46.50	40.50	2.14	0.19	0.02	1.93	0.98	0.07	18.60	92.08
2.2	45.50	40.40	2.12	0.16	0.03	1.93	0.97	0.08	15.80	82.72
2.3	44.00	48.00	1.91	0.08	0.04	1.80	0.96	0.20	7.60	66.66
	-	-	6.16	0.42	0.09	5.46	2.91	0.35	14.00	82.84
3.1	57.30	28.00	6.71	0.30	0.50	5.91	2.50	0.09	30.20	37.52
3.2	53.00	30.05	6.35	0.29	0.32	5.74	2.68	0.26	28.50	47.34
3.3	53.05	32.05	6.22	0.25	0.22	5.75	2.78	0.25	24.80	53.33
	-	-	19.28	0.84	1.04	17.41	7.96	0.59	27.83	44.60
4.1	55.05	33.05	6.24	0.16	0.19	5.82	2.81	0.18	15.50	45.32
4.2	54.00	35.05	6.03	0.15	0.12	5.76	2.88	0.23	15.00	55.56
4.3	52.20	36.20	5.90	0.07	0.16	5.80	2.84	0.20	7.20	31.58
	-	-	18.172	0.377	0.463	17.381	80.537	0.619	12.567	44.88

Table -LV-8

Case-VIII :Limiting Values of % Aromatics Extracted (%AE) and% Purity of Extract (%PE) for Mixed Feed consisting of Aromatics- B+T+X&Aliphatics -H using Mixed Solvent-(Dmso+Water) at 30 °C

Sr.No.	Anti solvent Concentraion	SYSTEM	Feed Quantity A_F	H_F	S_F	(S/F)	Extract Composition X_{AE}	X_{HE}	X_{SE}
1.1	W=10%	B	1	1	2	1	12.80	0.07	88.73
1.2		T	1	1	2	1	7.00	1.80	91.20
1.3		X	1	1	2	1	0.80	0.01	0.98
	Total=		3	3	6	1	-		
2.1	W=20%	B	1	1	2	1	20.50	0.06	97.44
2.2		T	1	1	2	1	1.80	0.20	98.00
2.3		X	1	1	2	1	0.21	0.94	98.95
	Total=		3	3	6	1	-		
3.1	W=10%	B	1	3	6	1.5	5.70	0.60	93.70
3.2		T	1	3	6	1.5	40.50	2.00	93.50
3.3		X	1	3	6	1.5	0.50	0.01	98.40
3.4	Total=		3	9	18	1.5	-		
4.1	W=20%	B	1	3	6	1.5	0.90	0.00	99.00
4.2		T	1	3	6	1.5	0.85	0.32	98.83
4.3		X	1	3	6	1.5	0.00	0.94	98.96
	Total=		3	9	18	1.5	-	-	-

Table -LV-8

Case-VIII :Limiting Values of % Aromatics Extracted (%AE) and% Purity of Extract (%PE) for Mixed Feed consisting of Aromatics- B+T+X&Aliphatics -H using Mixed Solvent-(Dmso+Water) at 30°C

Sr.No.	By Lever Rule L_R	L_E	Proportionate Quantity E	A_E	H_E	S_E	Quantity H_R	R S_R	%AE (Limiting)	%PE (Limiting)
1.1	48.80	36.70	2.28	0.29	0.00	2.00	1.00	0.01	29.20	99.46
1.2	47.50	40.50	2.17	0.15	0.04	1.98	0.96	0.24	15.10	79.47
1.3	40.00	0.48	1.82	0.01	0.02	1.78	0.98	0.22	1.40	42.42
			6.27	0.46	0.06	5.75	2.94	0.46	15.23	88.57
2.1	48.20	48.00	2.00	0.04	0.001	1.95	1.00	0.05	5.00	98.04
2.2	48.20	47.20	1.99	0.01	0.001	1.95	1.00	0.05	3.50	92.11
2.3	44.60	48.85	1.91	0.01	0.001	1.89	0.97	0.11	0.40	98.07
			5.90	0.099	0.003	5.79	2.91	0.21	2.97	96.07
3.1	59.00	33.70	6.36	0.36	0.04	5.96	2.96	0.04	36.20	90.50
3.2	59.00	33.00	6.41	0.29	0.13	5.99	2.87	0.01	28.80	69.23
3.3	51.20	38.40	5.71	0.03	0.06	5.62	2.94	0.38	2.80	31.11
3.4			18.49	0.68	0.23	17.58	8.77	0.42	22.60	74.83
4.1	58.90	39.00	6.02	0.05	0.01	5.45	2.99	0.05	5.40	90.00
4.2	58.00	38.83	5.99	0.05	0.02	5.92	2.98	0.08	5.00	72.46
4.3	54.50	38.96	5.83	0.01	0.05	5.77	2.95	0.23	0.50	8.47
	-	-	17.832	0.109	0.079	17.639	8.921	0.36	3.633	57.978

Table -LV-9

Ca: e-IX :Effect of Ratio S/F on the %AE and %PE for Mixed Feed consisting of Aromatics- B+T+X&Aliphatics -H+H'+O using Mixed Solvent-(Dmf+Water) at 30 °C

		Feed Quantity				Extract Composition		
Sr.No.	SYSTEM	A_F	H_F	S_F	(S/F)	X_{AE}	X_{HE}	X_{SE}
1.1	B	1	1	12	6	6.00	3.00	91.00
1.2	T	1	1	12	6	5.00	1.50	93.50
1.3	X	1	1	12	6	3.50	2.20	94.30
1.4	H'	1	1	12	6	6.00	2.50	91.50
1.5	O	1	1	12	6	5.00	2.00	92.00
	Total	5	5	60	6			
2.1	B	0.125	0.125	0.75	3	7.50	2.50	90.00
2.2	T	0.125	0.125	0.75	3	5.00	1.50	93.50
2.3	X	0.125	0.125	0.75	3	5.00	1.50	93.50
2.4	H'	0.125	0.125	0.75	3	8.00	3.00	89.00
2.5	O	0.125	0.125	0.75	3	7.30	3.00	89.70
	Tota'	0.625	0.625	3.75	3			
3.1	B	1	1	4	2	8.00	3.00	89.00
3.2	T	1	1	4	2	6.00	1.60	92.40
3.3	X	1	1	4	2	3.50	2.00	94.50
3.4	H'	1	1	4	2	1.00	5.00	85.00
3.5	O	1	1	4	2	7.90	2.60	89.50
	Total	5	5	20	2			
4.1	B	1	1	2	1	8.75	0.75	90.50
4.2	T	1	1	2	1	7.50	1.60	90.90
4.3	X	1	1	2	1	4.00	2.00	94.00
4.4	H'	1	1	2	1	11.50	5.00	83.50
4.5	O	1	1	2	1	9.50	3.00	87.50
	Total	5	5	10	1			

Table -LV-9

Case-IX :Effect of Ratio S/F on the %AE and %PE for Mixed Feed consisting of Aromatics- B+T+X&Aliphatics -H+H'+O using Mixed Solvent-(Dmf+Water) at 30 °C

	By Lever Rule		Proportionate Quantity EQuantity R							
Sr.No.	L_R	L_E	E	A_E	H_E	S_E	R	S_R	$\%A_E$ Limiting	$\%P_E$ Limiting
1.1	83.00	5.50	13.13	0.19	0.39	11.95	0.87	0.05	78.72	32.24
1.2	81.00	7.50	12.82	0.64	0.19	11.98	1.19	0.02	64.00	76.92
1.3	80.00	8.50	12.60	0.44	0.28	11.95	1.40	0.05	44.30	61.34
1.4	84.50	6.00	13.07	0.78	0.33	11.96	0.93	0.04	78.40	70.63
1.5	84.30	6.50	13.00	0.78	0.26	11.96	1.00	0.04	77.90	75.05
			64.62	2.83	1.45	59.79	5.39	0.21	68.62	66.16
2.1	72.50	15.00	0.84	0.62	0.02	0.75	0.16	0.01	50.29	96.88
2.2	71.50	18.00	0.80	0.40	0.01	0.75	0.20	0.00	31.96	97.31
2.3	69.00	19.00	0.78	0.04	0.01	0.73	0.22	0.02	31.36	78.04
2.4	73.50	14.00	0.08	0.07	0.03	0.75	0.16	0.00	60.00	72.83
2.5	73.50	14.50	0.84	0.06	0.03	0.75	0.17	0.00	53.45	70.90
			3.34	1.19	0.09	3.72	0.91	0.03	45.41	92.81
3.1	64.60	22.40	0.74	0.06	0.02	0.66	0.26	0.01	35.78	72.84
3.2	57.50	24.40	0.70	0.05	0.01	0.65	0.30	0.02	25.38	81.67
3.3	60.60	25.44	0.70	0.02	0.01	0.67	0.30	0.00	22.86	63.16
3.4	64.66	18.34	0.78	0.08	0.04	0.66	0.22	0.00	46.93	66.96
3.5	65.57	23.34	0.74	0.06	0.02	0.66	0.26	0.01	36.75	75.64
			3.66	0.27	0.10	3.29	1.34	0.04	33.54	72.04
4.1	46.50	40.50	2.14	0.09	0.02	1.93	1.86	0.07	18.60	85.05
4.2	45.50	40.90	2.12	0.16	0.03	1.93	1.88	0.08	15.50	82.72
4.3	44.00	48.00	1.91	0.08	0.04	1.80	2.09	0.20	7.60	66.67
4.4	49.00	33.50	2.38	0.27	0.12	1.98	1.63	0.02	27.32	69.82
4.5	49.00	37.50	2.27	0.31	0.07	1.98	1.74	0.02	21.53	81.99
			10.81	0.90	0.27	9.62	9.19	0.38	18.17	76.85

(i) $E=\frac{[L_R]}{[L_R+L_E]}.(R+E)=\frac{L_R.(F)}{L_R+L_E}$; $R=F-E$ (ii) $\%A_E=\frac{E.X_{AE}.(100)}{F.X_{AF}}$; $\%P_E=\frac{X_{AE}.(100)}{X_{AE}+X_{HE}}$

Table -LV-10

Case-X :Effect of Ratio S/F on the values of %AE and %PE for Mixed Feed consisting of Aromatics- B+T+X&Aliphatics -H+H'+O using Mixed Solvent-(80%Dmso+20%Water) at 30 °C

Sr.No.	SYSTEM	Feed Quantity				Extract Composition		
		A_F	H_F	S_F	(S/F)	X_{AE}	X_{HE}	X_{SE}
1.1	B	1.00	1.00	12.00	6.00	10.50	0.01	98.40
1.2	T	1.00	1.00	12.00	6.00	10.50	0.01	98.40
1.3	X	1.00	1.00	12.00	6.00	0.20	0.95	98.15
1.4	H'	1.00	1.00	12.00	6.00	70.50	0.50	92.00
1.5	O	1.00	1.00	12.00	6.00	10.50	0.05	98.45
	Total	5.00	5.00	60.00	6.00	-	-	
2.1	B	1.250	1.250	7.50	3.00	10.50	0.01	98.40
2.2	T	1.250	1.250	7.50	3.00	10.50	0.01	98.49
2.3	X	1.250	1.250	7.50	3.00	0.20	0.95	98.95
2.4	H'	1.250	1.250	7.50	3.00	70.50	0.50	92.00
2.5	O	1.250	1.250	7.50	3.00	10.50	0.05	98.45
	Total	6.250	6.250	37.50	3.00	-	-	-
3.1	B	1.00	1.00	4.00	2.00	1.70	0.01	98.20
3.2	T	1.00	1.00	4.00	2.00	1.70	0.25	98.05
3.3	X	1.00	1.00	4.00	2.00	0.20	0.95	98.95
3.4	H'	1.00	1.00	4.00	2.00	9.00	0.50	90.50
3.5	O	1.00	1.00	4.00	2.00	10.50	0.05	98.45
	Total	5.00	5.00	20.00	2.00	-		
4.1	B	1.00	1.00	2.00	1.00	20.50	0.06	97.44
4.2	T	1.00	1.00	2.00	1.00	1.80	0.20	98.00
4.3	X	1.00	1.00	2.00	1.00	0.21	0.94	98.45
4.4	H'	1.00	1.00	2.00	1.00	11.00	0.50	88.50
4.5	O	1.00	1.00	2.00	1.00	2.15	0.05	97.50
	Total	5.00	5.00	10.00	1.00	-	-	

Table -LV-10

Case-X :Effect of Ratio S/F on the value of %AE and %PE for Mixed Feed consisting of Aromatics- B+T+X&Aliphatics -H+H'+O using Mixed Solvent-(80%Dmso+20%Water) at 30 °C

	By Lever Rule			Proportionate Quantity E			Quantity R			
Sr.No.	L_R	L_E	E	A_E	H_E	S_E	R	S_R	% A_E Limiting	%P_E Limiting
1.1	84.30	14.00	12.25	0.18	0.01	11.81	1.75	0.06	18.30	93.846
1.2	84.20	13.00	12.000	0.18	0.001	11.96	1.90	0.05	18.20	99.454
1.3	81.50	12.50	12.13	0.24	0.12	12.00	1.87	0.004	24.00	97.266
1.4	84.00	10.00	12.51	0.94	0.06	11.51	1.49	0.49	13.80	93.800
1.5	85.00	13.00	12.14	0.18	0.01	11.91	1.86	0.05	18.20	96.809
			61.18	10.51	0.20	59.34	8.87	0.66	30.18	98.169
2.1	73.20	23.40	23.40	0.01	0.001	0.75	0.24	0.01	0.69	93.388
2.2	73.70	24.00	24.00	0.01	0.001	0.74	0.25	0.01	8.63	99.258
2.3	69.50	22.30	22.30	0.02	0.001	0.75	0.24	0.001	1.33	96.400
2.4	73.00	16.66	16.66	0.06	0.001	0.75	0.19	0.001	48.30	93.750
2.5	74.60	24.33	24.33	0.01	0.001	0.74	0.25	0.01	38.67	98.390
	-	-	-	0.10	0.006	3.73	1.16	0.02	21.53	92.990
3.1	66.36	31.54	31.54	0.01	0.001	0.36	0.63	0.31	7.20	98.510
3.2	65.00	31.34	31.34	0.01	0.0020	0.66	0.33	0.01	6.90	87.302
3.3	61.66	32.34	32.34	0.013	0.001	0.65	0.35	0.02	0.79	97.744
3.4	64.66	24.34	24.34	0.07	0.003	0.66	0.27	0.01	39.38	94.752
3.5	66.06	26.84	26.84	0.01	0.0004	0.66	0.29	0.001	6.43	96.804
			-	0.11	0.0119	2.99	1.87	0.34	12.14	89.260
4.1	48.20	48.00	2.00	0.05	0.001	1.95	1.95	0.99	5.00	98.039
4.2	48.20	47.20	1.99	0.04	0.003	1.75	1.95	1.00	30.50	92.105
4.3	44.60	48.55	1.91	0.035	0.003	1.89	1.89	0.97	0.40	92.186
4.4	47.00	47.00	2.18	0.17	0.001	1.96	1.96	1.00	16.85	99.408
4.5	49.05	47.80	2.03	0.04	0.000	1.99	1.99	1.00	4.38	99.768
			10.03	0.30	0.023	9.74		40.55	6.03	92.879

Table -LV-11

Case XI: Single Stage Operation & Limiting Values of % Aromatics Extracted (%AE) and% Purity of Extract for Mixed Feed consisting of Aromatics- B+T+X&Aliphatics -H+H'+O using Mixed Solvent-(Dmf+Water) at 30 ℃

Sr.No.	Antisolvent Concentration	SYSTEM	Feed Quantity A_F	H_F	S_F	S_F/F	Extract Composition X_{AE}	X_{HE}	X_{SE}
1.1	w=10%	B	1	1	2	1	23.50	17.00	59.50
1.2		T	1	1	2	1	15.00	5.00	80.00
1.3		X	1	1	2	1	11.80	4.00	84.20
1.4		H'	1	1	2	1	19.50	14.00	66.50
1.5		O	1	1	2	1	19.00	8.00	73.00
	Total		5	5	10	1	-	-	-
2.1	w = 20%	B	1	1	2	1	8.75	0.75	90.50
2.2		T	1	1	2	1	7.50	1.60	90.90
2.3		X	1	1	2	1	4.00	2.00	94.00
2.4		H'	1	1	2	1	11.50	5.00	83.50
2.5		O	1	1	2	1	9.50	3.00	87.50
	Total		5	5	10	1	-	-	-

Table -LV-11

Case XI:Single Stage Operation & Limiting Values of%Aromatics Extracted (%AE) and%Purity of Extract (%PE) for Mixed Feed consisting of Aromatics- B+T+X&Aliphatics -H+H'+O using Mixed Solvent-(Dmf+Water) at 30 °C

Sr.No.	By Lever Rule		Proportionate Quantity E				Quantity-	R		
	L_R	L_E	E	A_E	H_E	S_E	H_R	S_R	%A_E (Limiting)	%P_E (Limiting)
1.1	42.00	4.70	3.25	0.76	0.55	1.93	0.45	0.07	76.30	58.11
1.2	41.00	30.00	2.31	0.35	0.12	1.85	0.89	0.15	34.60	75.05
1.3	44.00	34.00	2.02	0.27	0.09	1.90	0.91	0.10	26.60	74.72
1.4	47.00	16.50	2.96	0.58	0.41	1.97	0.59	0.03	57.73	58.21
1.5	48.70	34.00	2.35	0.45	0.18	1.71	0.82	0.29	44.06	70.37
	-	-	13.12	2.40	1.35	9.36	3.65	0.64	47.96	65.96
2.1	46.50	40.50	2.14	0.19	0.02	1.93	0.98	0.07	18.60	92.08
2.2	45.50	40.40	2.12	0.16	0.03	1.93	0.97	0.08	15.80	82.72
2.3	44.00	48.00	1.91	0.08	0.04	1.80	0.96	0.20	7.60	66.66
2.4	49.00	33.50	2.38	0.27	0.12	1.98	0.88	0.02	27.32	69.70
2.5	49.00	33.50	2.27	0.22	0.07	1.98	0.93	0.02	21.53	76.00
	-	-	10.81	0.91	0.27	9.62	4.73	0.38	18.17	76.85

(i) $E=\frac{[L_R\quad]}{[L_R+L_E]}.(R+E)=\frac{L_R.(F)}{L_R+L_E}$ $\quad R=F-E$ (ii) $\%A_E=\frac{E.X_{AE}.(100)}{F.X_{AF}}$; $\quad \%P_E=\frac{X_{AE}.(100)}{X_{AE}+X_{HE}}$

Table -LV-12

Case XII: Single Stage Operation & Limiting Values of % Aromatics Extracted (%AE) and% Purity of Extract (%PE) for Mixed Feed consisting of Aromatics- B+T+X&Aliphatics -H+H'+O using Mixed Solvent-(Dmso+Water) at 30 °C

Sr.No.	Antisolvent Conc.	SYSTEM	Feed Quantity A_F	H_F	S_F	S_F/F	Extract Composition X_{AE}	X_{HE}	X_{SE}
1.1	W=10%	B	1	1	2	1	10.20	0.07	88.73
1.2		T	1	1	2	1	7.00	1.80	91.20
1.3		X	1	1	2	1	1.99	0.01	98.00
1.4		H'	1	1	2	1	14.00	0.65	85.35
1.5		0	1	1	2	1	8.50	0.15	91.35
	Total=		5	5	10	1			
2.1	W=20%	B	1	1	2	1	2.50	0.06	97.44
2.2		T	1	1	2	1	1.98	0.02	98.00
2.3		X	1	1	2	1	0.61	0.94	98.45
2.4		H'	1	1	2	1	11.00	0.05	88.50
2.5		0	1	1	2	1	2.15	0.05	97.80
	Total=		5	5	10	1			

Table -LV-12

Case XII: Single Stage Operation & Limiting Values of % Aromatics Extracted (%AE) and% Purity of Extract (%PE) for Mixed Feed consisting of Aromatics- B+T+X&Aliphatics -H+H'+O using Mixed Solvent-(Dmso+Water) at 30 °C

	By Lever Rule		Proportionate Quantity E				Quantity	R		
Sr.No.	L_R	L_E	E	A_E	H_E	S_E	H_R	S_R	%A_E Limiting	%P_E Limiting
1.1	48.80	36.70	2.28	0.29	0.001	2.00	1.72	0.01	29.20	99.46
1.2	47.90	40.50	2.17	0.15	0.04	1.98	1.83	0.24	15.05	79.47
1.3	40.00	48.00	1.82	0.11	0.02	1.78	2.18	0.22	11.40	92.42
1.4	46.00	35.00	2.28	0.29	0.01	1.94	1.72	0.06	29.17	96.04
1.5	49.30	41.50	2.17	0.18	0.001	1.98	1.83	0.02	18.48	98.40
			11.72	1.02	0.072	9.68	9.28	0.55	20.96	92.60
2.1	48.20	48.00	2.00	0.050	0.001	1.95	2.00	0.05	5.00	98.04
2.2	48.20	47.20	1.99	0.03	0.001	1.95	2.01	0.05	3.05	96.77
2.3	44.60	48.85	1.91	0.020	0.018	1.89	2.09	0.11	1.04	52.90
2.4	47.00	43.00	2.18	0.17	0.001	1.96	1.82	0.04	16.85	99.41
2.5	49.50	47.80	2.03	0.043	0.001	1.99	1.97	0.01	4.38	97.73
			10.21	0.304	0.023	9.73	9.80	0.26	6.02	98.21

(i) $E=\frac{[L_R \quad].(R+E)=L_R.(F)}{[L_R+L_E] \qquad L_R+L_E}$; $R=F-E$ (ii) $\%A_E=\frac{E.X_{AE}.(100)}{F.X_{AF}}$; $\%P_E=\frac{X_{AE}.(100)}{X_{AE}+X_{HE}}$

Table -LV-13

Case XIII: Multi Stage Operation involving Stage-II & Limiting Values of %AE and %PEfor Mixed Feed consisting of Aromatics-B+T+X&Aliphatics-H+H'+Ousing Mixed Solvents(Dmso+Water)/(Dmso+Water)at30°C

		Feed Quantity				Feed composition			Ratio
Sr.No.	SYSTEM	A_F	H_F	S_F	$F=A_F+H_F$	XAF	XHF	XSF	S/F
	10%W+90%Dmso								
1.1	B	7.03	11.77	0.49	18.80	18.69	31.30	50.00	1.00
1.2	T	6.50	11.77	0.49	18.27	17.78	32.21	50.00	1.00
1.3	X	10.65	11.77	0.49	22.42	23.75	26.24	50.00	1.00
1.4	H'	7.03	11.50	0.49	18.53	18.96	31.03	50.00	1.00
1.5	O	7.03	12.46	0.49	19.49	18.03	31.96	50.00	1.00
	TOTAL	38.24							
	20%W+80%Dmso								
2.1	B	8.01	10.55	0.63	18.56	21.57	28.42	50.00	1.00
2.2	T	9.14	10.55	0.63	19.69	23.20	26.79	50.00	1.00
2.3	X	10.62	10.55	0.63	21.17	25.08	24.92	50.00	1.00
2.4	H'	8.00	10.63	0.63	18.64	21.48	28.51	50.00	1.00
2.5	O	8.01	10.70	0.63	18.71	21.40	28.59	50.00	1.00
	TOTAL	43.79							
	10%W+90%Dmf								
3.1	B	5.88	10.88	1.82	16.76	17.54	32.46	50.00	1.00
3.2	T	9.50	10.88	1.82	20.38	23.30	26.69	50.00	1.00
3.3	X	10.67	10.88	1.82	21.55	24.75	25.24	50.00	1.00
3.4	H'	5.88	8.50	1.82	14.38	20.44	29.55	50.00	1.00
3.5	O	5.88	11.92	1.82	17.80	16.51	33.48	50.00	1.00
	TOTAL	37.81							
	20%W+80%Dmf								
4.1	B	8.43	10.50	0.81	18.93	22.34	27.73	50.00	1.00
4.2	T	8.59	10.50	0.81	19.65	23.29	26.70	50.00	1.00
4.3	X	10.06	10.50	0.81	20.55	24.45	25.54	50.00	1.00
4.4	H'	8.43	9.59	0.81	18.02	23.39	26.61	50.00	1.00
4.5	O	8.43	10.15	0.81	18.58	22.68	27.31	50.00	1.00
	TOTAL	44.49							

Table -LV-13

Case XIII: Multi Stage Operation involving Stage-II & Limiting Values of %AE and %PE for Mixed Feed consisting of Aromatics- B+T+X&Aliphatics -H+H'+O using Mixed Solvents (Dmf+Water)/(Dmso+Water)at30°C

Sr.No.	Extract Composition			By Lever Rul		Quantity E		Raffinate Composition		
	X_{AE}	X_{HE}	X_{SE}	L_R	L_E	E	S_E	X_{AR}	X_{HR}	X_{SR}
	10%W+90%Dmso									
1.1	14.50	5.50	80.00	46.80	30.00	60.93	48.75	25.80	71.00	3.20
1.2	14.00	4.10	81.90	48.00	31.90	60.07	49.20	24.00	73.90	2.00
1.3	9.00	3.20	87.80	46 .50	37.80	55.16	48.43	42.50	54.00	3.50
1.4	12.20	4.80	83.00	47.00	33.00	58.75	48.76	27.50	69.50	3.00
1.5	14.91	1.20	83.89	48.20	43.90	52.33	49.14	32.00	63.20	4.80
	20%W+80%Dmso									
2.1	10.20	0.80	89.00	48.80	39.00	550.58	49.46	35.80	63.00	1.20
2.2	6.70	1.80	91.50	47.80	41.50	530.53	48.97	41.80	56.00	2.20
2.3	0.79	0.21	99.00	40.00	49.00	44.94	44.49	55.50	34.50	1.00
2.4	11.80	1.40	86.80	48.80	36.80	55.98	48.59	33.80	63.00	3.20
2.5	6.00	1.00	93.00	480 50	43.00	53.00	49.29	39.00	59.50	1.50
	10%W+90%Dmf									
3.1	17.00	15.00	68.00	47.90	35.00	57.78	39.29	18.00	79.90	2.10
3.2	13.50	6.00	80.50	41.00	44.00	48.23	38.82	36.20	54.80	9.00
3.3	11.50	4.00	84.50	44.00	46.00	48.88	41.31	41.80	52.20	6.00
3.4	16.00	13.20	70.80	46.20	36.80	55.66	39.40	31.00	65.20	3.80
3.5	12.00	7.00	81.00	48.00	43.00	52.74	42.70	14.00	84.00	2.00
	20%W+80%Dmf									
4.1	8.00	3.00	89.00	47.50	47.00	50.26	44.73	39.00	58.50	2.50
4.2	5.00	2.00	92.50	46.00	48.00	48.93	45.26	43.00	53.00	4.00
4.3	2.50	2.00	95.50	44.00	48.00	47.82	45.67	45.00	49.00	6.00
4.4	10.00	3.00	87.00	48.30	47.00	50.68	44.09	42.00	56.30	1.70
4.5	8.50	3.00	88.50	48.50	47.00	50.78	44.94	40.50	52.00	7.50

Table -LV-13

Case XIII: Multi Stage Operation involving Stage-II & Limiting Values of %AE and %PEfor Mixed Feed consisting of Aromatics- B+T+X&Aliphatics -H+H'+O using Mixed Solvents (Dmf+Water)/(Dmso+Water)at 30 °C

Sr.No.	Quantity-R	Split up of- R				
	R	AR	HR	SR	%AE	%PE
	10%W+90%Dmso					
1.1	39.01	10.80	27.73	1.25	47.24	72.49
1.2	39.93	9.62	29.50	0.80	47.63	77.92
1.3	44.84	18.80	23.89	1.55	20.88	73.80
1.4	41.25	11.34	28.66	1.23	37.76	71.14
1.5	47.67	15.30	31.50	0.86	14.20	92.33
					33.54	77.40
	20%W+80%Dmso					
2.1	44.42	15.90	27.98	0.53	26.24	94.33
2.2	46.47	19.42	26.02	1.02	15.43	78.85
2.3	55.06	30.55	18.99	5.05	3.50	79.86
2.4	44.02	14.87	27.73	1.41	30.72	89.43
2.5	47.00	19.33	27.96	0.71	14.85	85.71
					18.20	85.63
	10%W+90%Dmf					
3.1	42.22	7.06	33.73	0.89	55.98	53.13
3.2	51.77	18.74	28.37	4.65	27.94	69.25
3.3	51.12	21.36	26.68	3.06	22.70	74.20
3.4	44.34	13.74	28.90	1.68	43.54	54.80
3.5	47.26	6.61	39.69	0.94	38.16	73.06
					37.66	65.28
	20%W+80%Dmf					
4.1	49.74	19.39	29.09	1.24	17.99	72.73
4.2	51.07	21.96	27.06	2.04	11.55	73.33
4.3	52.18	23.48	25.56	3.13	4.86	55.60
4.4	49.32	20.71	27.76	0.84	21.63	76.89
4.5	49.22	19.93	26.08	3.21	19.00	77.27
					14.86	72.73

Table -LV-14

Case XIV: Multi Stage Operation involving Stage-III & Limiting Values of %AE and %PEfor Mixed Feed consisting of Aromatics- B+T+X&Aliphatics -H+H'+O using Mixed Solvents (Dmf+Water)/(Dmso+Water)at 30 °C

Sr.No.		Feed composition							Ratio
	10%W+90%Dmso	AF	HF	SF	AF+HF	XAF	XHF	XSF	S/F
1.1	B	10.08	27.04	1.138	37.12	13.57	36.42	50	1
1.2	T	9.62	27.04	1.138	36.66	13.12	36.879	50	1
1.3	X	18.8	27.04	1.138	45.84	20.5	29.49	50	1
1.4	H'	11.34	28.66	1.138	40	14.17	35.82	50	1
1.5	O	15.3	31.5	1.138	46.8	16.34	33.65	50	1
	Total	65.14		-	-	-	-		-
	20%W+80%Dmso								
2.1	B	15.9	24.33	1.833	40.23	19.76	30.238	50	1
2.2	T	19.42	24.33	1.833	43.75	22.19	27.8	50	1
2.3	X	30.55	24.33	1.833	54.88	27.83	22.166	50	1
2.4	H'	14.87	27.73	1.833	42.6	17.45	32.54	50	1
2.5	O	18.33	27.96	1.833	46.29	19.799	30.2	50	1
	Total	99.07		-	-	-	-		-
3.1	10%W+90%Dmf								
3.2	B	7.599	29.593	2.243	37.192	10.215	39.78	50	1
3.3	T	18.74	29.593	2.243	48.333	19.386	30.61	50	1
3.4	X	21.36	29.593	2.243	50.95	20.96	29.04	50	1
3.5	H'	13.74	28.9	2.243	42.64	16.11	33.888	50	1
	O	6.61	39.69	2.243	46.3	7.71	42.86	50	1
	Total	68.05					-		-
	20%W+80%Dmf								
4.1	B	19.39	27.236	1.597	46.626	20.79	29.206	50	1
4.2	T	21.96	27.236	1.597	49.196	22.318	27.681	50	1
4.3	X	23.48	27.236	1.597	50.716	23.148	26.85	50	1
4.4	H'	20.71	27.76	1.597	48.47	21.36	28.63	50	1
4.5	O	19.93	26.08	1.597	46.01	21.658	28.34	50	1
	Total	105.47		-	-	-	-		-

Table -LV-14

Case XIV: Multi Stage Operation involving Stage-III & Limiting Values of %AE and %PE for Mixed Feed consisting of Aromatics- B+T+X&Aliphatics -H+H'+O using Mixed Solvents (Dmf+Water)/(Dmso+Water)at30°C

	Extract Composition			By Lever Rule		Quantity E			
Sr.No.	X_{AE}	X_{HE}	X_{SE}	L_R	L_E	E	AE	HE	SE
	10%W+90%Dmso		-						
1.1	8	5	87	47	37	55.95	4.47	2.79	48.67
1.2	10.5	5	84.5	48.5	34.5	58.4	6.13	2.92	49.30
1.3	8	3	89	46.8	39	54.54	4.36	1.63	48.54
1.4	8	5	87	47.2	37	56.05	4.48	2.8	48.76
1.5	2.5	1	96.5	47	46.5	50.2	1.25	5	48.44
	--	-	-	-	Total	275.14	20.69	15.15	-
	20%W+80%Dmso								
2.1	9	1	90	48.5	40	54.80	4.93	0.55	49.3
2.2	6	3	91	49	41	54.40	3.26	1.63	49.5
2.3	2.5	0.5	97	41	47	46.59	1.16	0.23	45.19
2.4	9	2	89	46	39	74.10	4.86	1.08	48.15
2.5	5	1	94	49	44	32.68	2.6	0.53	49.52
		-	-	-	Total	262.57	16.81	4.01	-
	10%W+90%Dmf								
3.1	12	11	77	48	27	64	7.68	7.04	49.3
3.2	8	5	87	41	37	52.56	4.2	2.63	45.73
3.3	9	4	87	39	37	51.31	4.61	2.05	44.6
3.4	13	12	75	45	25	64.28	8.35	7.70	48.2
3.5	6	4.5	89.5	48	25	54.85	3.29	2.47	48.09
		-	-	-	Total	287	28.13	21.89	-
	20%W+80%Dmf								
4.1	7.5	3	89.5	47	39.5	54.3	4.07	1.16	48.59
4.2	5	2.5	92.5	45	42.5	51.4	2.57	1.28	47.5
4.3	3	2	95	45	45	50	1.5	.1	47.5
4.4	8	2	90	48	40	54.8	4.38	1.09	49.3
4.5	7.5	2.5	90	43.2	40	51.9	3.89	1.29	46.7
		-	-	-	Total	262.4	16.41	6.28	-

Table -LV-14

Case XIV: Multi Stage Operation involving Stage-III & Limiting Values of %AE and %PEfor Mixed Feed consisting of Aromatics- B+T+X&Aliphatics -H+H'+O using Mixed Solvents (Dmf+Water)/(Dmso+Water)at 30 °C

	Raffinate Composition			Total	Split up- R				
Sr.No.	XAR	XHR	XSR	R	AR	HR	SR	%AE	%PE
	10%W+90%Dmso								
1.1	20.5	76.5	3.0	44.05	9.03	33.69	1.32	32.94	61.57
1.2	14.0	84.5	1.5	41.60	5.80	35.15	0.62	46.72	67.73
1.3	36.0	60.8	3.2	45.46	16.36	27.64	1.45	21.26	72.72
1.4	22.2	75.0	2.8	43.45	9.75	32.96	1.23	31.61	61.53
1.5	30.0	67.0	3.0	49.8	14.94	33.36	1.49	7.65	71.43
	-	-	-	-	-	-	-	31.8	59.11
	20%W+80%Dmso								
2.1	31.5	67.0	1.5	45.20	14.20	30.28	0.67	24.95	89.99
2.2	35.0	64.0	1.0	45.60	15.96	29.18	0.456	14.69	66.67
2.3	51.5	39.5	9.0	53.41	17.50	21.09	4.8	4.168	83.45
2.4	29.0	67.0	4.0	45.90	13.30	30.7	1.83	27.9	81.84
2.5	37.0	62.0	1.0	47.32	17.50	29.3	0.47	13.13	83.17
	Total	-	-	-	-	-	-	16.97	80.73
	10%W+90%Dmf								
3.1	8.0	90.0	2.0	36.00	2.88	32.4	0.72	75.18	52.17
3.2	28.5	62.5	9.0	47.44	13.5	29.6	4.27	21.66	61.49
3.3	35.5	53.5	11.0	48.69	17.28	26.05	5.35	22.03	69.25
3.4	22.0	73.0	5.0	35.72	7.858	26.07	1.786	51.83	52.02
3.5	12.0	86.0	2.0	45.15	5.418	38.83	0.9	42.67	57.14
	Total	-	-	-	-	-	-	41.17	56.24
	20%W+80%Dmf								
4.1	36.0	61.0	3	45.70	16.4	27.87	1.377	19.57	71.4
4.2	41.0	54.0	5	48.60	19.9	26.2	2.4	11.51	66.75
4.3	44.0	51.0	5	50.00	22	25.5	2.5	6.48	60.00
4.4	37.5	61.0	1.5	45.20	16.9	27.57	0.678	20.5	80.07
4.5	40.0	53.2	6.8	48.10	19.2	25.59	3.2	17.96	75.09
	Total	-	-	-	-	-	-	23.07	72.29

Table -LV-15

Case XV: Multi Stage Operation involving Stage-IV & Limiting Values of %AE and %PE for Mixed Feed consisting of Aromatics- B+T+X&Aliphatics -H+H'+O using Mixed Solvents (Dmf+Water)/(Dmso+Water)at 30 °C

			Feed Quantities	Individual					Cumulative	
Sr.No.	S	%W	BF	TF	XF	HF	H'F	OF	AF	A'F
Case A	Dmso									
1	90	10	16.666	16.666	16.666	50	-	-	50	50
2	80	20	16.666	16.666	16.666	50	-	-	50	50
	Dmf									
1	90	10	16.666	16.666	16.666	50	-	-	50	50
2	80	20	16.666	16.666	16.666	50	-	-	50	50
Case B	Dmso									
1	90	10	8.333	8.333	8.333	75	-	-	25	75
2	80	20	8.333	8.333	8.333	75	-	-	25	75
	Dmf									
1	90	10	8.333	8.333	8.333	75	-	-	25	75
2	80	20	8.333	8.333	8.333	75	-	-	25	75
Case C	Dmso									
1	90	10	30	10	10	30	10	10	50	50
2	80	20	30	10	10	30	10	10	50	50
	Dmf									
1	90	10	30	10	10	30	10	10	50	50
2	80	20	30	10	10	30	10	10	50	50
Case D	20%W+80%Dmso									
stage-1	80	20	30	10	10	30	10	10	50	50
stage-2	80	20	30	10	10	30	10	10	50	50
stage-3	80	20	30	10	10	30	10	10	50	50
stage-4	80	20	30	10	10	30	10	10	50	50
	20%W+80%Dmf									
stage-1	80	20	30	10	10	30	10	10	50	50
stage-2	80	20	30	10	10	30	10	10	50	50
stage-3	80	20	30	10	10	30	10	10	50	50
stage-4	80	20	30	10	10	30	10	10	50	50

Table -LV-15

Case XV: Multi Stage Operation involving Stage-IV & Limiting Values of %AE and %PE for Mixed Feed consisting of Aromatics- B+T+X&Aliphatics -H+H'+O using Mixed Solvents (Dmf+Water)/(Dmso+Water)at 30 °C

	Ratio	Quantities of Extract Phase						Cumulative Quantities-E		
Sr.No.	S/F	BE	TE	XE	HE	H'E	OE	AE	A'E	SE
Case A			Dmso							
1	1	4.06	2.04	0.94	0.04	-	-	7.29	0.04	91.76
2	1	1.84	0.59	0.64	0.64	-	-	3.79	0.64	95.57
			Dmf							
1	1	9.76	4.43	3.40	9.66	-	-	17.11	9.66	72.67
2	1	3.02	2.56	1.23	1.41	-	-	6.80	1.41	91.78
Case B			Dmso							
1	1.5	1.16	1.55	1.05	1.23	-	-	3.66	1.23	95.11
2	1.5	0.30	0.28	0.03	0.03	-	-	0.61	0.03	96.79
			Dmf							
1	1.5	1.56	1.48	1.28	5.37	-	-	4.33	5.37	90.30
2	1.5	0.85	0.82	0.39	2.54	-	-	2.07	2.54	95.39
Case C			Dmso							
1	1	2.72	1.41	0.13	0.56	0.11	0.03	4.26	0.69	95.05
2	1	2.60	0.35	0.04	0.21	0.01	0.00	2.99	0.22	96.80
			Dmf							
1	1	13.61	2.63	2.02	5.75	3.15	1.39	18.27	10.28	71.40
2	1	6.23	1.46	0.70	0.81	1.09	0.62	8.35	2.51	89.13
Case D			20%W+80%Dmso							
stage-1	1	2.60	0.24	0.04	0.18	0.01	0.00	2.98	0.19	96.83
stage-2	2	2.79	0.35	0.04	0.25	0.11	0.01	3.18	0.38	96.44
stage-3	3	2.15	0.30	0.04	0.22	0.10	0.00	2.46	0.33	97.21
stage-4	6	2.12	0.29	0.04	2.00	0.78	0.00	2.45	0.31	97.24
			20%W+80%Dmf							
stage-1	1	6.64	1.46	0.70	1.01	1.09	0.62	8.40	2.52	89.08
stage-2	2	5.34	1.12	0.66	1.28	1.03	0.52	7.11	2.84	90.05
stage-3	3	5.08	0.99	0.95	0.84	0.81	0.61	6.93	2.25	90.82
stage-4	6	3.63	0.99	0.68	0.86	0.56	0.40	5.31	1.76	92.93

Table -LV-15

Case XV: Multi Stage Operation involving Stage-IV & Limiting Values of %AE and %PE for Mixed Feed consisting of Aromatics- B+T+X&Aliphatics -H+H'+O using Mixed Solvents (Dmf+Water)/(Dmso+Water)at 30 °C

Sr.No.	%W	Quantities of Raffinate Phase R						Composition Raffinate				
		BR	TR	XR	HR	H'R	OR	AR	A'R	SR	%AE Limiting	%PE Limiting
Case A		Dmso										
1	10	12.34	14.40	17.19	51.27	-	-	44.35	51.29	4.38	15.23	88.57
2	20	32.63	15.58	16.33	48.58	-	-	47.74	48.58	3.68	2.96	70.07
		Dmf										
1	10	6.90	12.23	13.26	40.34	-	-	32.88	40.34	26.78	45.83	69.29
2	20	13.95	14.43	15.84	49.93	-	-	43.54	49.93	6.53	14.00	82.84
Case B		Dmso										
1	10	5.54	6.18	8.44	76.18	-	-	20.16	76.18	3.66	22.60	74.83
2	20	7.77	7.80	8.18	73.31			23.85	73.31	2.94	3.63	97.97
		Dmf										
1	10	6.50	6.67	7.01	74.31	-	-	20.20	74.31	5.49	27.83	44.60
2	20	7.14	7.18	7.84	72.17	-	-	22.17	72.17	5.66	12.56	44.88
Case C		Dmso										
1	10	24.03	9.14	10.61	31.66	10.63	10.73	43.78	53.02	3.20	20.96	92.64
2	20	28.91	9.76	10.07	29.96	10.09	10.10	48.74	50.15	1.11	6.03	98.66
		Dmf										
1	10	17.65	9.50	10.69	32.64	8.50	11.92	37.80	53.09	9.11	47.96	65.96
2	20	25.30	9.16	10.05	31.68	9.59	10.14	44.51	51.43	4.06	18.17	76.85
Case D		20%W+80%Dmso										
stage-1	20	28.92	9.76	10.07	29.96	10.09	10.11	48.75	48.13	3.13	6.03	98.67
stage-2	20	21.96	8.30	8.78	26.14	8.69	8.83	39.04	43.64	7.32	12.14	89.26
stage-3	20	24.90	9.79	10.56	31.35	0.39	10.65	45.25	52.39	2.24	21.53	82.99
stage-4	20	19.14	9.19	11.00	32.28	10.57	11.20	39.33	54.15	6.52	30.18	88.09
		20%W+80%Dmf										
stage-1	20	25.30	9.16	10.05	31.69	9.59	10.15	44.51	51.43	4.06	18.17	76.85
stage-2	20	22.60	9.35	10.63	33.76	9.58	11.00	42.58	54.34	3.08	33.54	75.44
stage-3	20	20.33	9.39	9.39	43.43	11.10	11.05	39.14	55.52	4.63	45.41	74.85
stage-4	20	12.06	6.68	10.39	39.66	12.51	13.75	29.11	65.92	4.97	68.62	74.05

7.2.0 High Lights of Results Obtained for Multi- component Liquid- Liquid Extraction of Aromatics:-

7.2.1 CONCLUSIONS FOR CATEGORY-(I):

(I)"The Critical Analysis" for Tables- LV- 1 to LV- 3 reveals the following:

(i)For mixed solvent – (90% Dmf + 10% W) and feed consisting of (B+H), as S/F ratio is increased from 1, 2 & 3 by weight for fixed values of three temperatures- 20°C , 30°C and 40°C , the corresponding ranges of % AE values are (45.3 % to 92.2%) (67.9% to 95%) and (69% to 98.1%) respectively.

Thus as ratio of S/F value increases, the limiting values of % AE under otherwise identical conditions increases as could be seen from value of % AE put up in brackets, As temperature increases, the limiting values of % AE under otherwise identical conditions also increases.

When one compares a mixed solvent having Composition of (80% Dmf+20% W) at three fixed temperatures – 20°C , 30°C and 40°C, the conclusions drawn above for systems consisting of Hexane(H) are equally valid for this case also.

(ii)Further for mixed solvent- (90% Dmf + 10% W) and feed consisting of (B + O), as the value of S/F ratio is increased from 1, 2, to 3 by weight for fixed value of three temperatures 20°C , 30°C and 40°C, the corresponding ranges of % AE values are (37.8% to 77.1%) (44.6% to 88.7% and (67.35% to 89.18%) respectively.

Thus as the ratio of S/F value increases, the limiting values of %AE under otherwise identical condition increases as could be seen from the values of %AE put up in brackets. Also as temperature increases, the limiting values of %AE under otherwise identical conditions also increases.

When one compares a second case of mixed solvent having composition – (80% Dmf + 20%W) with mixed solvent having composition- (90% Dmf + 10% W) at three values of fixed temperatures, the conclusions drawn above for the first case for system consisting of Octane(O) are equally valid for second case also.

(iii)Further in the case of mixed feed consisting of aliphatic – octane instead of aliphatic- Hexane(H), the range of limiting values of %AE under otherwise comparable operating conditions are relatively on the lower side i.e. the limiting values of %AE for mixed feed consisting of aliphatic-Octane(O) are lower than that for mixed feed consisting of aliphatic- Hexane(H).

Thus for example, at three different fixed temperatures of 20°C, 30°C & 40°C the corresponding ranges of % AE values for systems involving aliphatic – Hexane(H) and systems involving aliphatic Octane are (at 20 °C 45.3% to 92.2%), (at 30 °C 67.9% to 95%) & (at 40 °C 69% to 98.1%) and (at 20 °C 37.8% to 77.1%), (at 30 °C 44.6% to 88.7%) & (at 40 °C 67.35% to 89.18%) respectively.

Similarly the effect of increase in molecular weight of aromatics for components-B/T/X for systems consisting of mixed solvent- (Dmf+W), on the value of %AE can also be analyzed.

Like the effect of increase of molecular weight of aliphatics, with an increase in molecular weight aromatics, the values of %AE also decrease under otherwise identical conditions.

(iv)Similar conclusions w .r. t effect of temperatures & S/F ratio values on the values of %AE can be drawn for the remaining different systems of the remaining three groups of components as under :-

T+H+Dmf + W, X +H+ Dmf + W and B + H'+Dmf +W under different sets of conditions.

(II)The "Critical Analysis" for Tables- LV- 4 to LV- 6 reveals the following:

(i)For mixed solvent – (90% Dmso + 10% W)and feed consisting of (B+H), as S/F ratio is increased from 1, 2 & 3 by weight for fixed values of three temperatures- 20°C , 30°C and 40' , the corresponding ranges of % AE values are (27.9 % to 46.4%) (29.2% to 52.2%) and (29.7% to 67.25%) respectively.

Thus as ratio of S/F value increases the limiting values of % AE under otherwise identical conditions increases as could be seen from value of % AE put up in brackets. As temperature increases, the limiting values of % AE under otherwise

identical conditions also increases. However the effect of an increase in temperature on the value of %AE appears to be very marginal.

When one compares a mixed solvent having composition (80%Dmso+20% W) at three fixed temperatures – 20°C , 30°C and 40°C, the conclusions drawn above for systems consisting of Hexane(H) are equally valid for this case also.

(ii)Further for mixed solvent- (90% Dmso + 10% W)and feed consisting of (B + O), as the value of S/F ratio is increased from 1, 2, to 3 by weight for fixed values of three temperatures 20°C , 30°C and 40°C, the ranges of % AE values are (6.3% to 12.2%) (8.1% to 35.7% and (16.81% to 45.53%) respectively.

Thus as the ratio of S/F value increases the limiting values of %AE under otherwise identical condition increases as could be seen from values of %AE put up in brackets. Also as temperature increases the limiting values of %AE under otherwise identical conditions also increase, however increase in values is marginal only.

When one compares a second case of mixed solvent having composition – (80% Dmso + 20%W)with first case of mixed solvent (90% Dmso + 10% W)at three values of fixed temperatures, the conclusions drawn above for the first case for system consisting of Octane (O) are equally valid for second case also.

(iii)Further in the case of mixed feed consisting of aliphatic – octane instead of aliphatic- Hexane(H), the range of limiting values of %AE under otherwise comparable operating conditions are substantially on the lower side i.e. the limiting values of %AE for mixed feed consisting aliphatic- Octane are substantially lower than that for mixed feed containing aliphatic Hexane(H). Thus effect of increase in molecular weight of aliphatics on the values of %AE for systems involving mixed solvent- (Dmso+W) and aliphatics –H/H'/O appears to be substantial and the value of %AE decrease substantially.

Thus for example at three different fixed temperatures of 20°C, 30°C & 40°C, the corresponding ranges of % AE value for systems involving aliphatic – Hexane(H) and systems involving aliphatic Octane are (at 20 ^{0}C, 27.9% to 48.4%), (at 30 ^{0}C, 29.2% to 52.2%) & (at 40 ^{0}C, 29.7% to 67.2%) and (at 20 ^{0}C, 6.3% to 12.2%), (at 30 ^{0}C, 8.1% to 35.7%) & (at 40 ^{0}C, 16.8% to 45.53%) respectively. As could be seen from the ranges of %AE values reported above, the effect of increase in molecular weight of aliphatics is substantial.

Similarly the effect of increase in molecular weight of aromatics for systems consisting of mixed solvent- (Dmso + W) and components- B/T/X on the value of %AE can be analyzed.

Like aliphatics with an increase in molecular weight aromatics, the values of %AE also decrease under otherwise identical conditions.

(iv)Similar conclusions w. r. t effect of temperatures & S/F ratio values on the values of %AE can be drawn for the remaining different systems of the remaining three groups of components as under :-

T+H+Dmso+ W, X +H+ Dmso + W and B + H'+Dmso+ W under different sets of conditions.

(III)Overall comparison of both solvents-(Dmf + W) & (Dmso + W)

At three different fixed values of temperatures -20° C, 30° C & 40° C and feed consisting of B + H + (Dmf / Dmso) + W, the corresponding ranges of values of % AE for mixed solvents – (90% Dmf + 10% W) and (90% Dmso + 10% W)are (45.31% to 92.2%), (67.9% + 95%) , (69% to 98.1%) and (27.9% to 48.4%), (29.2% to 52.6%) & (29.7% to 67.25%) respectively.

Thus comparison of range of % AE values under otherwise comparable operation conditions for mixed solvent- (Dmf + W) are on higher side in comparison to mixed solvent- (Dmso + W).

The same conclusions is valid for all the other remaining systems. under otherwise comparable operating conditions when one compares mixed solvent-(Dmf+W) with other mixed solvent-(Dmso+W).

T + H + (Dmf / Dmso) + W

X + H + (Dmf / Dmso) + W

B + H' + (Dmf / Dmso) + W

B + O + (Dmf / Dmso) + W

For all the remaining above four categories of different systems, the corresponding ranges of values of %AE for mixed solvents- (Dmf +W) are higher than the range of values of %AE for mixed solvent ((Dmso+W).

7.2.2 CONCLUSIONS FOR CATEGORY – II

The critical analysis for Table LV-7 and LV-8 reveals the following:

The limiting values of % Aromatics extracted (% AE) and the corresponding values of % purity of extract (% PE) for mixed feed consisting of four components – three solutes – (B + T + X) and non solute only Hexane(H) for antisolvent concentrations – 10% W & 20% W and S/F ratio of one(1) by weight for mixed solvent (Dmf + W) are (% AE =45.8%, % PE =64.55%) and (% AE =14.1%,% PE= 82.8%) respectively.

The limiting values of % Aromatic extracted (%AE) and the corresponding values of % Purity of extract (%PE) for mixed feed consisting of four components – three solutes – (B + T + X) and non solute only Hexane(H) for antisolvent concentration – 10% W & 20% W and S/F ratio of one(1) by weight for mixed solvent – (DmSO + W) are (% AE =15.23%, % PE= 88.57%) and (% AE =2.96%, % PE= 98%) respectively.

As could be seen from above two paragraphs the range of limiting values on values of %AE for mixed solvent (Dmf + W) is from 14.1% to 45.8% under otherwise comparable operating conditions. The range of limiting values of %AE for mixed solvent – (Dmso + w) is from 2.96% to 15.23% .Thus range of limiting values of %AE for mixed solvent- (Dmf + W) is substantially higher than that of range of limiting values of %AE for mixed solvent- (Dmso+ W).

The range of limiting values of % purity of extract (%PE) for solvent- (Dmf + W) is from 64.55 % to 82.8% under otherwise comparable operating conditions. The range of limiting values of %PE for mixed solvent Dmso + w is from 88.57% to 98%.

Thus, the limiting values of %PE are substantially higher for mixed solvent- (Dmso+ W) than that of limiting values of %PE for mixed solvent – (Dmf + W).

7.2.3 CONCLUSIONS FOR CATEGORY – III

The critical analysis for Tables LV – 9 and LV – 10 reveals the followings:

For mixed feed consisting of six components – three solutes (B + T + X) and three non solutes (H + H' + O) at 30 °C and mixed solvent consisting of 80% Dmso+20%W by weight, when the value of S/F ratio increases from 1, 2, 3 & 6 the corresponding value of %AE under otherwise comparable operating conditions are 6.02%, 12.14%, 21.3% and 30.18% respectively.

For mixed feed consisting of six components – three solutes (B + T + X) and three non solutes (H + H' + O) at 30 °C and mixed solvent consisting of 80% Dmf+20%W by weight, when the value of S/F ratio increases from 1, 2, 3 & 6 the corresponding value of %AE under otherwise comparable operating conditions are 18.17%, 33.05%, 45.41% and 68.62% respectively.

Thus it could be observed that range of % AE values for mixed solvents (Dmf+W) is substantially higher than that of mixed solvent (Dmso+W) under otherwise comparable operating conditions for mixed feed consisting of six components –three solutes- (B+T+X) and three non solutes (H+H'+O).

It is also observed that as the value S/F ratio by weight increases, the value of %AE also increases. Thus though by increasing the value of S/F ratio, the value of %AE can be increased, the system under consideration w. r. t. feed composition becomes a dilute system. Hence generally S/F ratio is varied up to value of 5 and further increase in the values of %AE can be achieved by carrying out Multistage Multicomponent Liquid- Liquid Extraction Aromatics.

7.2.4 CONCLUSIONS FOR CATEGORY – IV:

The critical analysis for Table LV- 11 and Table LV-12 reveals the followings :

The limiting values of %AE and the corresponding limiting values of %PE for mixed feed consisting of six components – three solutes – (B+T+X) and three non

solutes- (H + H' + O) at a temperature of 30 °C and S/F ratio by weight of one(1) for mixed solvent compositions – (90 % Dmso + 10%W) and (80% Dmso + 20% W) are (%AE =20.96%, %PE =92.6%) and (%AE =6.2%, %PE =98.2%) respectively.

The limiting values of %AE and the corresponding limiting values of %PE for mixed feed consisting of six components – three solutes – (B+T+X) and three non solutes- (H + H' + O) at temperature of 30° C and S/F ratio by weight of one(1) for mixed solvent compositions – (90 % Dmf + 10% W) and (80% Dmf + 20% W) are:-

(%AE =47.96%, %PE =65.8%) and (%AE =18.17%, %PE =76.8%) respectively.

Under otherwise comparable operating conditions the limiting values of %PE are higher for mixed solvent – (Dmso+w) than for mixed solvent (Dmf+w). Further under otherwise comparable operating conditions the limiting values of %AE are higher for mixed solvent – (Dmf + W) than for the mixed solvent (Dmso + W).

Thus the generalized conclusions drawn for feed consisting of two components are also valid for Multicomponent feed system consisting of six components for both mixed solvents under consideration i.e. (Dmso + W) and (Dmf + W).

7.2.5 CONCLUSIONS FOR CATEGORY – V:

The critical analysis for Tables- LV-13, LV-14 and LV-15 reveals the followings:

Mixed feed consisting of six components- three solutes- (B+T+X), three non solutes – (H+H'+O)and Mixed Solvents- consisting of (80% Dmso + 20% W) & (80% Dmf + 20% W) have been used as feed (F) and solvent (S). The ratio of solvent to feed (S/F) has been kept as one only. Temperature of extraction has been kept as constant value of 30' C.

Under the above set of operating conditions for Multicomponent Liquid-Liquid Extraction Aromatics the limiting values of % AE and %PE obtained for Mixed solvents (Dmso + W) and (Dmf + W) are (%AE = 6.02%, %PE = 98.66%) and (%AE = 18.17%, %PE = 76.8%) respectively. This has been labeled as stage – I of Multicomponent Liquid- Liquid Extraction of Aromatics.

Raffinate phase (R_I) coming out of Stage- I after liquid-liquid extraction, becomes Multicomponent feed stock for stage- II for performing Multicomponent Liquid- Liquid Extraction of Aromatics. Raffinate phase (R_{II}) coming out of Stage- II after liquid-liquid extraction, becomes Multicomponent feed stock for stage- III for performing Multicomponent Liquid- Liquid Extraction of Aromatics.Raffinate phase (R_{III}) coming out of Stage- III after liquid-liquid extraction, becomes Multicomponent feed stock for stage- IV performing out Multicomponent Liquid- Liquid Extraction of Aromatics.

Thus the limiting values of %AE and %PE obtained in the case of multistage Liquid- Liquid Extraction of Aromatics consisting of four stages are reported as under:-

Stage No.	Solvent 80% Dmso + 20% W		Solvent 80% Dmf + 20% W	
	% AE	% PE	% AE	% PE
I	6.02	98.66	18.17	76.8
II	12.14	89.25	33.53	75.44
III	21.53	82.9	45.41	74.85
IV	30.18	88.9	68.62	70.05

Thus by carrying out Multicomponent Liquid- Liquid Extraction of Aromatics in a multistage manner, the values of %AE can be increased considerably. Thus for example, under otherwise comparable operating conditions, the limiting values of %AE for mixed solvent- 80% Dmso + 20% W can be increased from 6.02% obtained in (Stage- I) to 30.18% obtained in (Stage- IV).

Similarly for second mixed solvent (80% Dmf + 20% W) by carrying out Multicomponent Liquid- Liquid Extraction of Aromatics in a multistage manner consisting of four stages, under otherwise comparable operating condition, the limiting values of %AE can be increased from 18.17% obtained in (Stage- I) to 68.62% obtained in (Stage- IV).

The relevant data presented in the Table- LV-15 is having the main basis of solvent to feed ratio equal to one (1) by weight. By increasing S/F ratio and by keeping

it of the order of five (5) by wt, it is expected that the "Limiting Values "of %AE of the order of 95% can be achieved by carrying out Multicomponent Liquid- Liquid Extraction of Aromatics using four stages.

7.3.0 SUGGESTIONS FOR FURTHER WORK WITH SPECIAL REFERENCE TO MULTICOMPONENT LIQUID-LIQUID EXTRACTION OF AROMATICS:

(I) It has been shown in this investigation that limiting values of %AE calculated based on "Thermodynamic Principles" can be obtained in actual practice for binary feed stock. Involving aromatics- Benzene (B) and aliphatic- Hexane(H) under a particular set of conditions having fixed values of continuous phase flow rate (Vc), dispersed phase flow rate (Vd), solvent to feed ratio (S/F), residence time (θ) and carrying out multistage operation. The relevant details have been already summarized under following sub sections in Chapter- 6 : Results and Discussion for Liquid- Liquid Extraction of Aromatics in a packed column:-

Subsection 6.5.5: Performance of Solventss – Dmf and Dmso during Multistage Operation.

Subsection 6.7.0: Overview of Performance of Mixed Solvents and Recommended Operation Conditions.

(II) Hence "Liquid- Liquid Extraction of Aromatics" using multicomponent mixed feed stocks can also be carried out on "Laboratory Scale" in a similar manner as has been done in this investigation for a feed stock consisting of two components – Aromatics – Benzene (B) and Aliphatics- Hexane(H).

The four variables to be studied can include-Vc, Vd, S/F and θ. "Single Stage and Multistage Operation" under different sets of operation conditions can be carried out for feed consisting of multicomponent mixture of aromatic components & aliphatic component

Thus favorable operating conditions can be suggested for carrying out "Multicomponent Liquid- Liquid Extraction of Aromatics" in a multistage manner. Under the favorable operating conditions obtained by experimentation, it is expected that the "Limiting Values" of %AE and %PE presented in this investigation can also be achieved in actual practice.