TABLES

TABLES

Table-1: Typical Fractions Obtained on Distillation of Crude Oil

Output %	Boiling Range, °C	Carbon Atoms	Product
2	< 30	1 to 4	Light products *
15 – 30	30 – 200	4 to 12	Naphtha
5 to 20	200 – 300	12 to 15	Kerosene
10 to 40	300 – 400	15 to 25	Gas Oil
Residue	400 +	25 +	Residual Oil

* - Also Known as Light Hydrocarbons

Table-2: Physicochemical Properties of the Studied Samples

Sample Properties	Vacuum Residues	
	From Alexandria	From Suez
Density at 60 °F, g/ml *	1.0050	1.0009
GRAVITY: *		
* Specific, at 60/60 °F	1.0060	1.0019
* API	9.16	9.74
VISCOSITY, cSt at:		
• 50 ° C *	23466.83	17072.38
• 80 ° C	1658.60	1369.60
• 100 ° C	460.50	401.80
Pour Point, ° C	+ 48	+ 48
Sulfur Content, wt.	3.09	2.89
Nitrogen, wt %	0.65	0.44
Carbon Residue, wt %	18.19	18.75
Wax Content, wt %	2.89	1.75
Ash, wt %	0.038	0.039
Nickel, ppm	89.94	113.45
Vanadium, ppm	118.23	145.23

* Calculated.

Table-3: Composition of the Two Residues Using Different Solvents

Components, wt %	Alexandria			SUEZ	
	n-Pentane	n-Heptane	Ethyl Acetate	n-Heptane	Ethyl Acetate
Asphaltenes	15.09	8.11	16.67	7.65	16.13
Maltenes	84.91	91.89	83.33	92.35	83.87
*-Saturates	15.28	14.14	15.94	8.63	8.48
*-Aromatics	42.29	41.31	45.45	65.24	62.48
-Mono-		8.73		17.61	
-Di-		16.76		24.02	
-Poly-		15.82		23.61	
Resins	27.34	36.44	21.94	18.48	12.91

N.B.: 1- All the figures in the table are calculated with reference to the residue.

Table – 4: Elemental Distribution of Sulfur, Nitrogen, vanadium and Nickel

The Element, wt %	In Alexandria			In Suez	
	n-Pentane	n-Heptane	Ethyl Acetate	n-Heptane	Ethyl Acetate
Sulfur In:					
Asphaltenes	3.69 (0.57)	3.83 (0.31)	3.65 (0.61)	3.12 (0.24)	2.99(0.48)
Maltenes	2.90 (2.46)	2.98 (2.74)	2.95 (2.46)	2.85 (2.63)	2.81 (2.36)
Nitrogen In:					
Asphaltenes	2.05 (0.31)	2.37 (0.19)	2.27 (0.38)	0.97 (0.07)	0.92 (0.15)
Maltenes	0.40 (0.34)	0.49 (0.45)	0.31 (0.26)	0.40 (0.37)	0.34 (0.28)
***Nickel In*:**					
Asphaltenes	414.5 (62.54)	458.91(37.22)	382.69 (63.79)	571.89 (43.75)	421.45 (67.97)
Resins	91.27(24.95)	130.45(47.53)	95.81 (21.02)	320.50 (59.22)	285.36 (36.84)
***Vanadium In*:**					
Asphaltenes	514.73 (77.67)	617.26 (50.06)	469.54 (78.27)	857.56 (65.60)	616.40 (99.42)
Resins	132.37 (36.19)	189.92 (67.02)	148.17 (32.51)	389.61(72.00)	311.47 (40.21)

N.B.: 1- The figures between brackets are calculated relative to the residue.

2- Nickel and Vanadium are in ppm.

Table-5: Physicochemical Characteristics of Separated Maltenes

PROPERTIES	Alexandria			Suez	
	n-Pentane	n-Heptane	Ethyl Acetate	n-Heptane	Ethyl Acetate
Density at 60^0 F, g/ml *	0.9815	0.9945	0.9887	0.9876	0.9823
GRAVITY:					
Specific, at $60/60^0$ F *	0.9825	0.9955	0.9897	0.9886	0.9833
^{0}API*	12.53	10.65	11.47	11.63	12.40
VISCOSITY, cSt at:					
• 50^o C *	801.25	1230.77	666.87	1288.07	567.43
• 80^o C	505.84	401.19	220.50	377.17	207.82
• 100^o C	101.91	218.90	122.05	195.94	120.74
Pour Point, ^{o} C	42	45	42	45	39
Sulfur Content, wt.	2.90	2.98	2.95	2.85	2.81
Nitrogen, wt %	0.40	0.49	0.31	0.40	0.34
Carbon Residue, wt %	11.88	13.28	12.83	14.12	12.15
Wax Content, wt %	3.38	3.14	3.47	1.88	2.07
Nickel, ppm	31.93	57.76	31.38	75.17	54.20
Vanadium, ppm	47.69	74.19	47.88	84.71	54.61

* Calculated.

Table-6 Assignment of the Vibrations of the Functional Groups in the Infrared Spectra of the Petroleum Products

Wave numbers, Cm^{-1}	Assignment of the Vibrations of the Functional Groups
3600 - 3200	OH Stretching, NH Stretching,
3100 – 3000	CH Stretching in Aromatic Rings
2955 – 2945	CH_3 asymmetric Stretching
2930 – 2910	CH_2 asymmetric Stretching
2900 – 2880	CH Stretching in CH_3, CH_2, and CH
2875 – 2850	CH_3 Symmetric Stretching
2860 - 2845	CH_2 Symmetric Stretching
2730 - 2725	CH stretching in Aldehyde Groups
2000 – 1800	Overtones of Polycondenced Aromatics
1760 – 1640	C = O Stretching in Carbonyl Groups.
1610 – 1590	C = C Stretching in Aromatic Rings.
1485 – 1445	CH_2 and CH_3 a Symmetric Deformation (Scissoring).
1380 – 1365	CH_3 Symmetric Deformation (Scissoring).
1315 – 1300	CH_2 Wagging in Long Chain Paraffins.
1165 – 1155	$(CH_3)_2$ - C.
1035 - 1020	C – O Stretching, C – N Stretching, S = O Stretching.
970 – 950	CH in naphthenic rings.
945 - 910	OH out-of-plane deformation.
890 – 860	CH aromatic out-of-plane deformation (1 free hydrogen
815 – 805	CH aromatic out-of-plane deformation (2 or 3 adjacent free hydrogen atoms).
760 – 740	CH aromatic out-of-plane deformation (4 adjacent free hydrogen atoms)
730 – 720	CH_2 rocking in chains $-(CH_2)_n$, $n \geq 4$

Table-7 Gas Chromatographic Data of The Saturates Separated From Maltenes By Liquid (Column) Chromatography.

Fraction	Saturates of Alexandria			Saturates of Suez	
	n-Pentane	n-Heptane	Ethyl Acetate	n-Heptane	Ethyl Acetate
n-Paraffins	10.98	14.65	13.04	13.70	12.31
Cyclic compounds	89.02	85.35	86.96	86.30	87.69

Table-8: Infrared Data of the Vacuum Residues Under Studies

Wave Number, Cm^{-1}	Absorbance	
	AVR (a)	SVR (b)
3500 – 3300	0.0574	0.1038
3100	0.0301	0.0617
2950	1.2501	0.8730
2920	1.8030	1.3452
2850	1.3296	1.0084
1600	0.1098	0.1150
1460	0.6060	0.4492
1375	0.3558	0.2687
1310	0.1509	0.1270
1030	0.0745	0.0924
930	0.0334	0.0511
870	0.0678	0.0586
810	0.0854	0.0726
745	0.0872	0.0791
720	0.1151	0.0999

(a) Alexandria Vacuum Residue, (b) Suez Vacuum Residue

Table-9: Infrared Data of the Asphaltenes Extracted By Different Solvents

Wave Number, Cm^{-1}	Absorbance				
	Alexandria			Suez	
	n-Pentane	n-Heptane	Ethyl Acetate	n-Heptane	Ethyl Acetate
3500 – 3300	0.1214	0.0792	0.1205	0.1388	0.1218
3050 - 3040	0.0918	0.0560	0.1045	0.0873	0.1047
2920	1.3156	0.7010	1.4805	1.4473	1.4010
2850	0.9859	0.5390	1.1594	1.1016	1.0994
1750	0.0502	0.0243	0.0525	0.0530	0.0558
1693	0.0485	0.0293	0.0217	0.0531	0.0835
1595	0.2294	0.1128	0.2224	0.2322	0.2374
1450	0.5312	0.2874	0.5979	0.5422	0.5513
1375	0.3969	0.2203	0.4538	0 3984	0.4046
1310	0.2916	0.1693	0.3260	0.2835	0.3052
1030	0.1404	0.0798	0.1257	0.1480	0.1760
930	0.0453	0.0223	0.0468	0.0512	0.0545
860	0.0922	0.0435	0.1076	0.0816	0.0929
808	0.1162	0.0580	0.1310	0.1006	0.1035
745	0.1203	0.0601	0.1221	0.1034	0.1006
720	0.1002	0.0541	0.1149	0.0916	0.1218

Table-10 Infrared Data of the Maltenes Extracted By Different Solvents

Wave Number, Cm^{-1}	Absorbance				
	Alexandria			Suez	
	n-Pentane	n-Heptane	Ethyl Acetate	n-Heptane	Ethyl Acetate
3500 – 3300	0.0822	0.0916	0.0725	0.0902	0.0997
3050 - 3040				0.1702	
2950	1.8198	2.0860	1.7579	1.5268	1.5458
2930	2.2249	2.5276		3.2097	1.9888
2920	2.3299	2.9397	2.3681	2.2159	2.2130
2850	1.8798	2.3552	1.7200	1.8610	1.5669
1750	0.1051	0.0815	0.0399		
1693	0.0733	0.0940	0.0778		
1595	0.1808	0.2411	0.1454	0.1520	0.2162
1460	1.0114	1.1112	0.8996	0.7059	0.7663
1375	0.5962	0.6955	0.5261	0.4094	0.5440
1310	0.2714	0.3305	0.1968	0.1892	0.2932
1030	0.2141	0.2325	0.1182	0.1207	0.2317
928			0.0525	0.463	0.1452
865	0.1760	0.1906	0.1263	0.0826	0.1778
810	0.1930	0.2121	0.1645	0.0949	0.1796
745	0.1764	0.1970	0.1708	0.0892	0.1531
720	0.2164	0.2371	0.1816	0.1139	0.1592

Table-11: Infrared Data of the Saturates Extracted From Maltenes

Wave Number, Cm^{-1}	Absorbance				
	Alexandria			Suez	
	n-Pentane	n-Heptane	Ethyl Acetate.	n- Heptane	Ethyl Acetate
3500 – 3300	0.1060	0.1074	0.1255	0.2053	0.1541
2950	0.5895	1.0932	2.5098	2.0581	1.0015
2920	0.8327	1.8870	1.1355	2.3789	1.5830
2850	0.6279	1.2515	0.5484	1.9672	1.1398
1600	0.0943	0.0957	0.1289	0.1937	0.1405
1460	0.3946	0.5693	0.9144	1.3117	0.6115
1375	0.2535	0.3348	0.4984	0.7176	0.3697
1310	0.1281	0. 1469	0.1510	0.2415	0.1781
1070	0.1211	0.1327	0.1170	0.1778	0.1573
970	0.1080	0.1265	0.1176	0.1786	0.1524
890	0.0896	0.1134	0.1038	0.1576	0.1273
730	0.1431	0.1564	0.2587	0.4430	0.2121
720	0.1616	0.1813	0.3004	0.4990	0.2384

Table-12: Infrared Data of the Aromatics Extracted From Maltenes

Wave Number, Cm^{-1}	Absorbance				
	Alexandria			Suez	
	n-Pentane	n-Heptane	Ethyl Acetate.	n- Heptane	Ethyl Acetate
3500 – 3300	0.7940	0.0455	0.0592	0.0781	0.0934
3050 - 3040					
2950	1.2670	1.0001	1.1991	1.5198	1.1497
2920	1.8665	1.5390	1.7441	1.1615	1.8304
2250	1.3024	1.0576	1.2409	1.5310	1.2084
1750	0.0276				
1700-1660			0.0495	0.0638	
1600	0.1077	0.0786	0.1122	0.1530	0.1171
1450	0.6865	0.5308	0.6445	0.7690	0.5882
1375	0.3971	0.3042	0.3831	0.4615	0.3499
1310	0.1606	0.1261	0.1648	0.2181	0.1622
1030	0.1371	0.1070	0.1262	0.1712	0.1350
930	0.0635	0.0563	0.0690	0.1142	0.1087
860	0.1194	0.0955	0.1127	0.1407	0.1090
808	0.1517	0.1193	0.1428	0.1551	0.1241
745	0.1355	0.1060	0.1283	0.1377	0.1074
720	0.1451	0.1151	0.1297	0.1431	0.1034

Table-13: Infrared Data of the Resins Extracted From Maltenes

Wave Number, Cm^{-1}	Absorbance				
	Alexandria			Suez	
	n-Pentane	n-Heptane	Ethyl Acetate.	n- Heptane	Ethyl Acetate.
3500 – 3300	0.2417	0.1289	0.1316	0.1188	0.1658
3050 - 3040	0.1598	0.0824	0.0479	0.1013	0.1201
2920	1.3635	2.0252	1.7403	2.0287	2.0887
2850	1.1075	1.5124	1.3184	1.5299	4.4710
1700-1660	0.2117	0.1976	0.1191	0.2599	0.3717
1600	0.3096	0.2658	0.2068	0.2912	0.3068
1450	0.6857	0.7233	0.6493	0.7636	0.7407
1375	0.4809	0.4722	0.4319	0.5118	0.4806
1310	0.2928	0.2752	0.2374	0.3186	0.2844
1030	0.2529	0.2216	0.2407	0. 2535	0.2841
930	0.0862	0.0726	0.0498	0.0869	0.0792
860	0.1015	0.0934	0.0680	0.1152	0. 0792
808	0.1287	0.1155	0.0913	0.1360	0.1186
745	0.1571	0.1313	0.1197	0.1502	0.1331
720	0.1109	0.1184	0.1002	0.1440	0.1145

Table-14: Infrared Data of the Mono-, Di-, and Poly-Aromatics

Wave Number, Cm^{-1}	Absorbance					
	Alexandria			Suez		
	Mono-	Di-	Poly-	Mono-	Di-	Poly-
3500-3300	0.1518	0.0264	0.1852	0.1086	0.0571	0.1839
3050			0.2204		0.1046	0.1431
2950	1.9149	0.3963	1.2344	2.4544	1.4017	0.6797
2920	2.7627	0.4103	1.4957	2.7073	2.0532	0.9135
2850	2.1164	0.3946	1.1052	2.2781	1.3222	0.7160
1750-1700		0.0143	0.3462	0.0791		0.1496
1600	0.1722	0.0699	0.2045	0.1414	0.1521	0.1943
1460	1.1132	0.3282	0.6992	1.4253	0.6630	0.4295
1375	0.5582	0.2429	0.4816	0.7451	0.4428	0.3146
1310	0.2323	0.1043	0.3042	0.2015	0.2250	0.2201
1070	0.1949	0.0663	0.2090	0.1330	0.1864	0.1384
920	0.1620	0.0344	0.0773	0.1056	0.1380	0.0743
870	0.1815	0.0868	0.0997	0.1229	0.1583	0.1093
810	0.2082	0.1216	0.1381	0.1623	0.1849	0.1426
745		0.1097	0.1685		0.1416	0.1725
730	0.3480			0.3318		
720	0.3867	0.1092	0.1464	0.3764	0.1130	0.1366

Table-15: Chain Length, Degree Of Branching And Substitution Degree In The Aromatics Structures Of The Asphaltenes, Resins And Aromatics Determined By The Infrared Spectrometry.

Fractions	Chain Length		Degree of Branching	Substitution Degree	
	A_{720}/A_{1375}	A_{720}/A_{1450}	A_{1370}/A_{1450}	A_{810}/A_{870}	A_{750}/A_{870}
Asphaltenes:					
- Alexandria:					
- *n*-Pentane	0.252	0.189	0.747	1.260	1.305
- *n*- Heptane	0.246	0.188	0.767	1.333	1.382
- Ethyl acetate	0.253	0.192	0.759	1.217	1.135
- Suez:					
- *n*- Heptane	0.230	0.169	0.735	1.233	1.267
- Ethyl acetate	0.301	0.221	0.734	1.114	1.083
Resins:					
- Alexandria:					
- *n*-Pentane	0.231	0.162	0.701	1.268	1.548
- *n*- Heptane	0.251	0.164	0.653	1.237	1.406
- Ethyl acetate	0.231	0.154	0.665	1.343	1.760
- Suez:					
- *n*- Heptane	0.281	0.181	0.664	1.181	1.304
- Ethyl acetate	0.238	0.155	0.649	1.497	1.681
Aromatics:					
- Alexandria:					
- *n*-Pentane	0.365	0.211	0.578	1.271	1.135
- *n*- Heptane	0.378	0.217	0.572	1.249	1.110
- Ethyl acetate	0.338	0.201	0.573	1.267	1.138
- Suez:					
- *n*- Heptane	0.310	0.186	0.600	1.102	0.979
- Ethyl acetate	0.295	0.176	0.595	1.138	0.985

Table-16: Ultraviolet Spectra of Suez Vacuum Residue and its Constituents as Separated by different Solvents

Suez Fraction	Monoaromatics		Diaromatics		Polyaromatics	
	λ_1	α_1	λ_2	α_2	λ_3	α_3
Residue	194.5@	64.29	235	108.15	254.5	160.92
Maltenes Extracted By:						
n-Heptane.	194.5	60.06	231.5	111.18	257.5	133.16
Ethyl Acetate.	193.0	55.78	230.5	102.03	254.5	110.09
Asphaltene Extracted By:						
n-Heptane.	191.5	78.06	234.0	138..92	251.0	446.57
Ethyl Acetate.	198.5	75.03	234.0	139..63	255.0	390.59
Aromatics Extracted By:						
n-Heptane.	195.0	43.93	227.0	78.03	257.0	86..61
Ethyl Acetate	193.5	39.72	227.5	61.77	257.5	78.96
Resin Extracted By:						
n-Heptane.	198.0	123.82	233.0	262.16	257.0	373.54
Ethyl Acetate	192.0	104.36	234.0	193.72	251.0	305.04
Monoaromatics (†)	195.0	57.59	232.0	43.95	257.5	40.13
Diaromatics (†)	191.0	36.19	231.0	103.00	256.0	98.16
Polyaromatics (†)	197.5	29.79	229.5	76.49	256.5	109.76

α = L g^{-1}.Cm^{-1}, (†): As separated by Column Chromatography.

Table-17: Ultraviolet Spectra of Alexandria Vacuum Residue and its Constituents as Separated by different Solvents

Alexandria Fraction	Monoaromatics		Diaromatics		Polyaromatics	
	λ_1	α_1	λ_2	α_2	λ_3	α_3
Residue	193@	54.14	229.5	103.76	253.50	139.48
Maltenes extracted by:						
n-Heptane.	194.5	54.64	234.0	100.35	257.5	117.88
Ethyl Acetate.	192.5	59.04	232.5	108.11	257.5	127.94
n-Pentane.	192.0	57.45	228.5	90.42	257.0	121.17
Asphaltenes extracted by:						
n-Heptane.	194.5	44.32	230.5	127.60	244	324.31
Ethyl Acetate.	195.5	40.01	230.5	101.21	258	210.64
n-Pentane.	192.5	39.7	230.5	134.69	256	242.70
Aromatics extracted by:						
n-Heptane.	191	64.17	230.50	105.43	251	99.39
Ethyl Acetate	192	57.19	235.00	134.14	258	133.97
n-Pentane	198	60.29	232.00	96.38	259	111.47
Resin extracted by:						
n-Heptane.	192.0	64.11	232.5	116.25	257.5	193.49
Ethyl Acetate	196.5	80.34	232.0	115.61	257.5	195.15
n-Pentane	194.0	85.47	232.5	113.36	245.0	190.32
Monoaromatics (†)	194.0	130.68	231.0	68.92	256.0	51.78
Diaromatics (†)	194.0	48.41	229.5	175.18	257.5	96.81
Polyaromatics (†)	193.5	49.43	231.0	72.42	256.0	125.72

α = L g^{-1}.Cm^{-1}, (†): As separated by Column Chromatography.

FIGURES

FIGURES

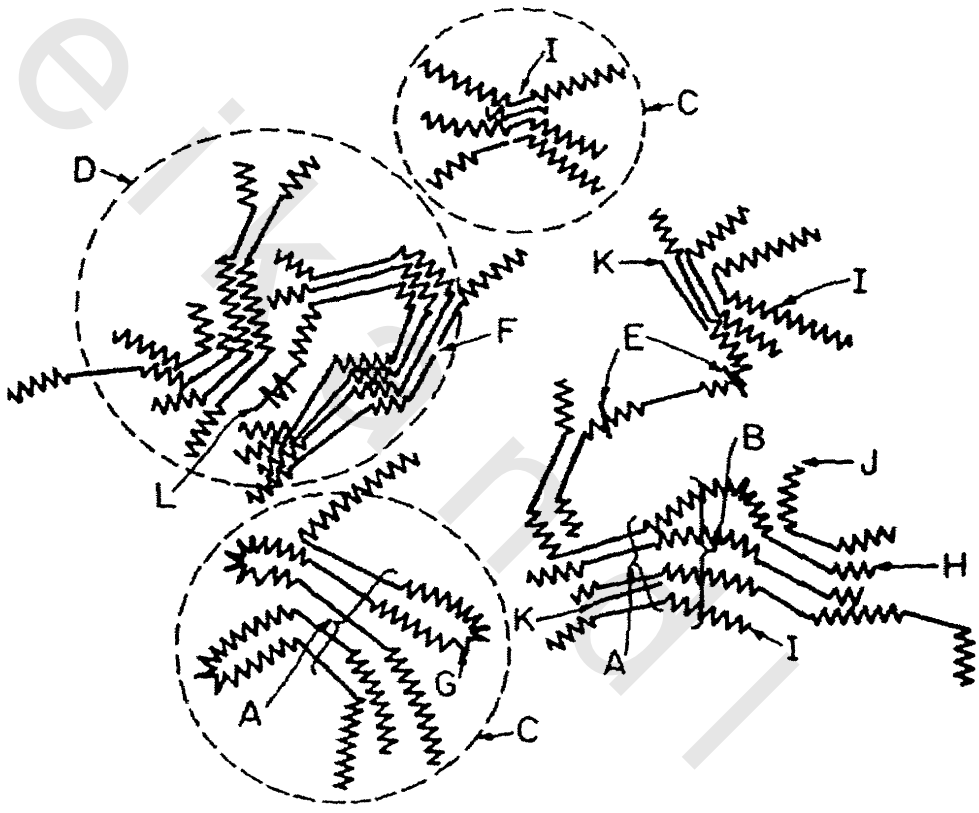


Figure – 1: Macrostructure of Asphaltic: A- Crystalline, B- Chain Bundle, C- Particle, D- Micelle, E- Weak Link, F- Gap and Hole, G- & H- Intercluster, I- Resin, J- Single Layer, K- Petroporphyrins, and L- Metal

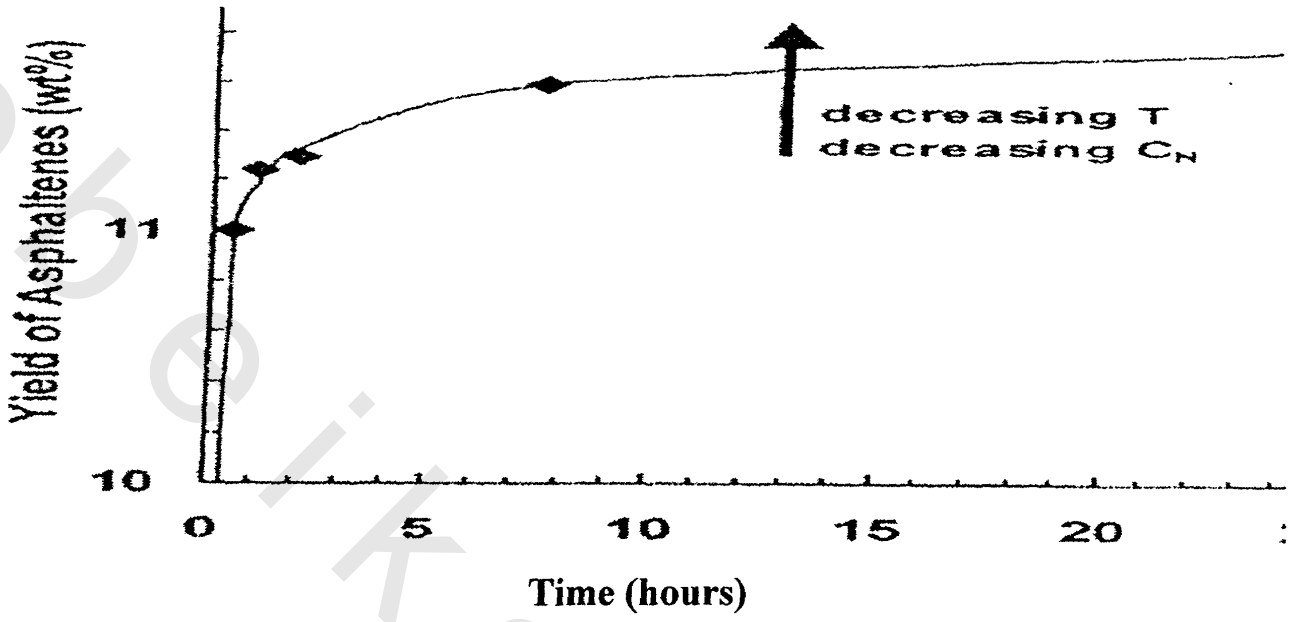


Figure-2: Effect of Time on the Yield of Asphaltenes

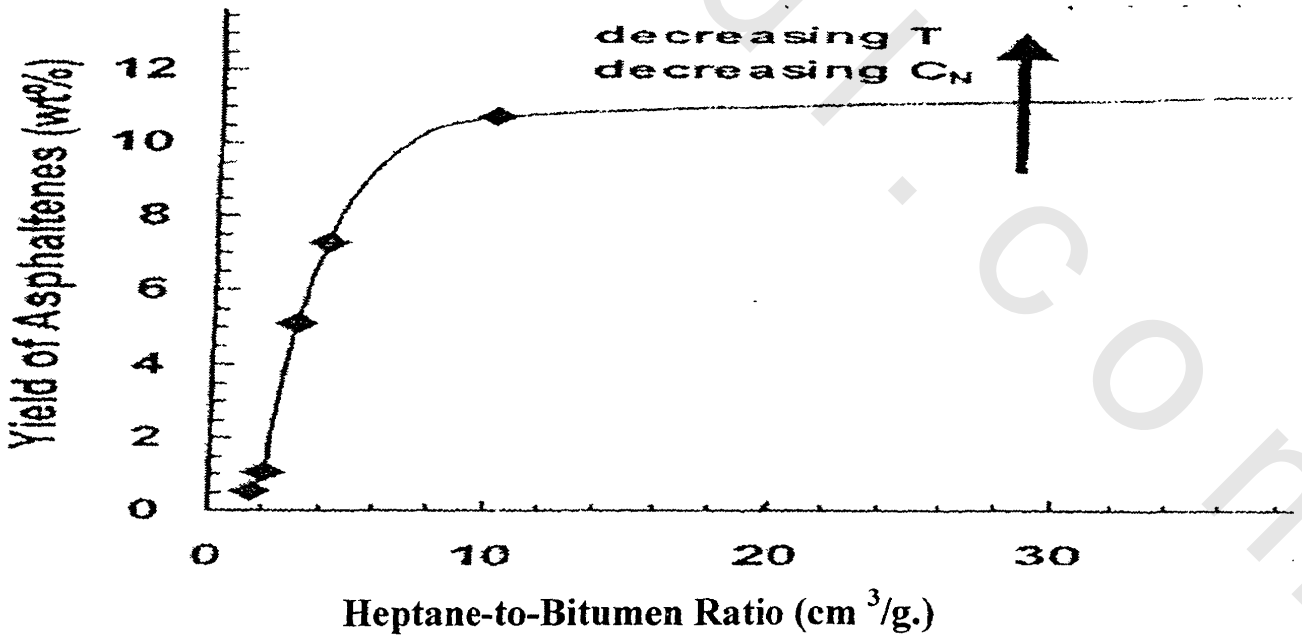


Figure-3: Effect of Solvent to Bitumen Ratio on the Yield of Asphaltenes

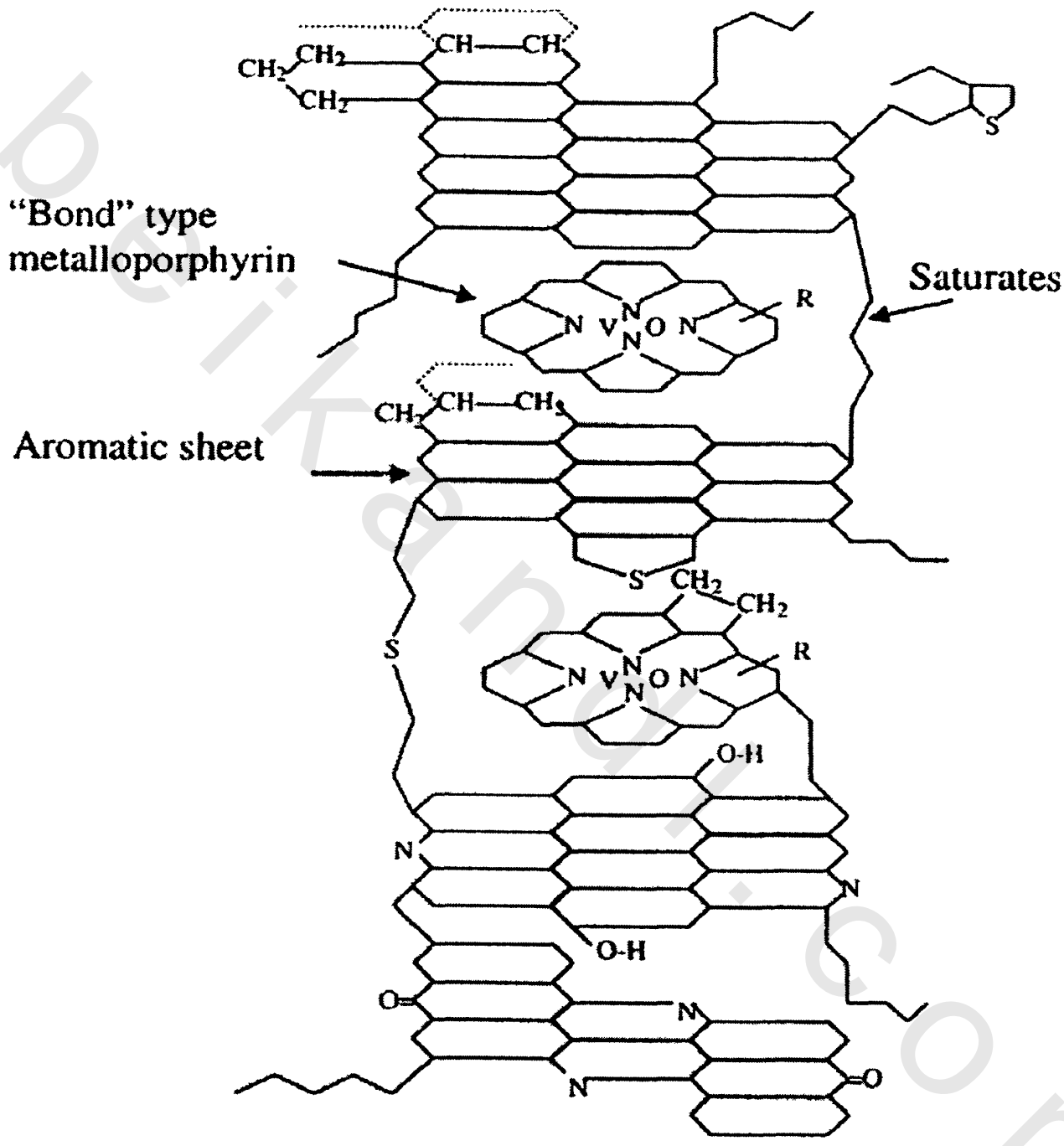


Figure-4: Hypothetical Asphaltene Molecule and its Interaction with the Metaloporfphyrins.

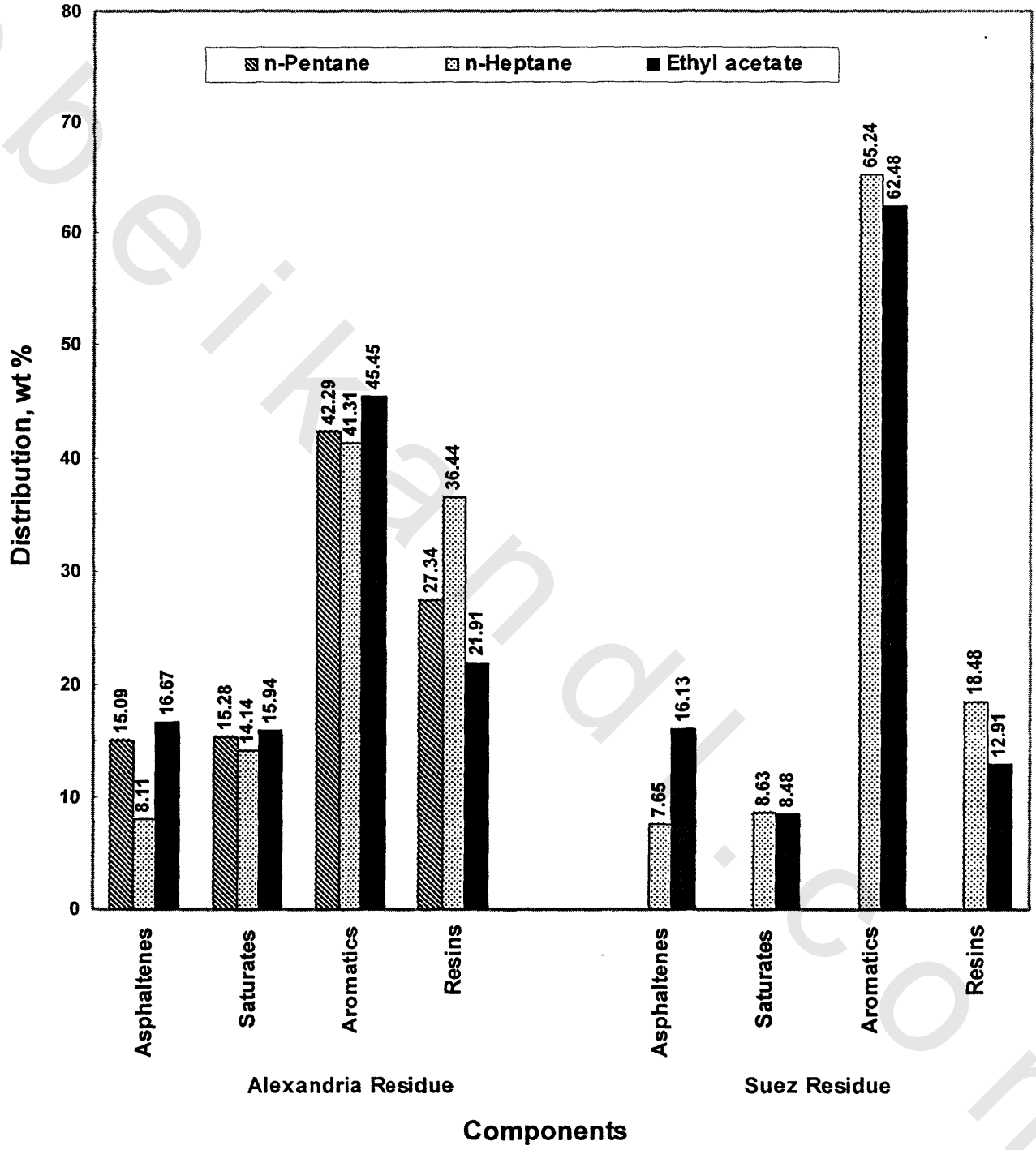


Figure-5. Distribution of the Saturates, Aromatics, Resins and Asphaltenes (SARA) in the Studied Vacuum Residues.

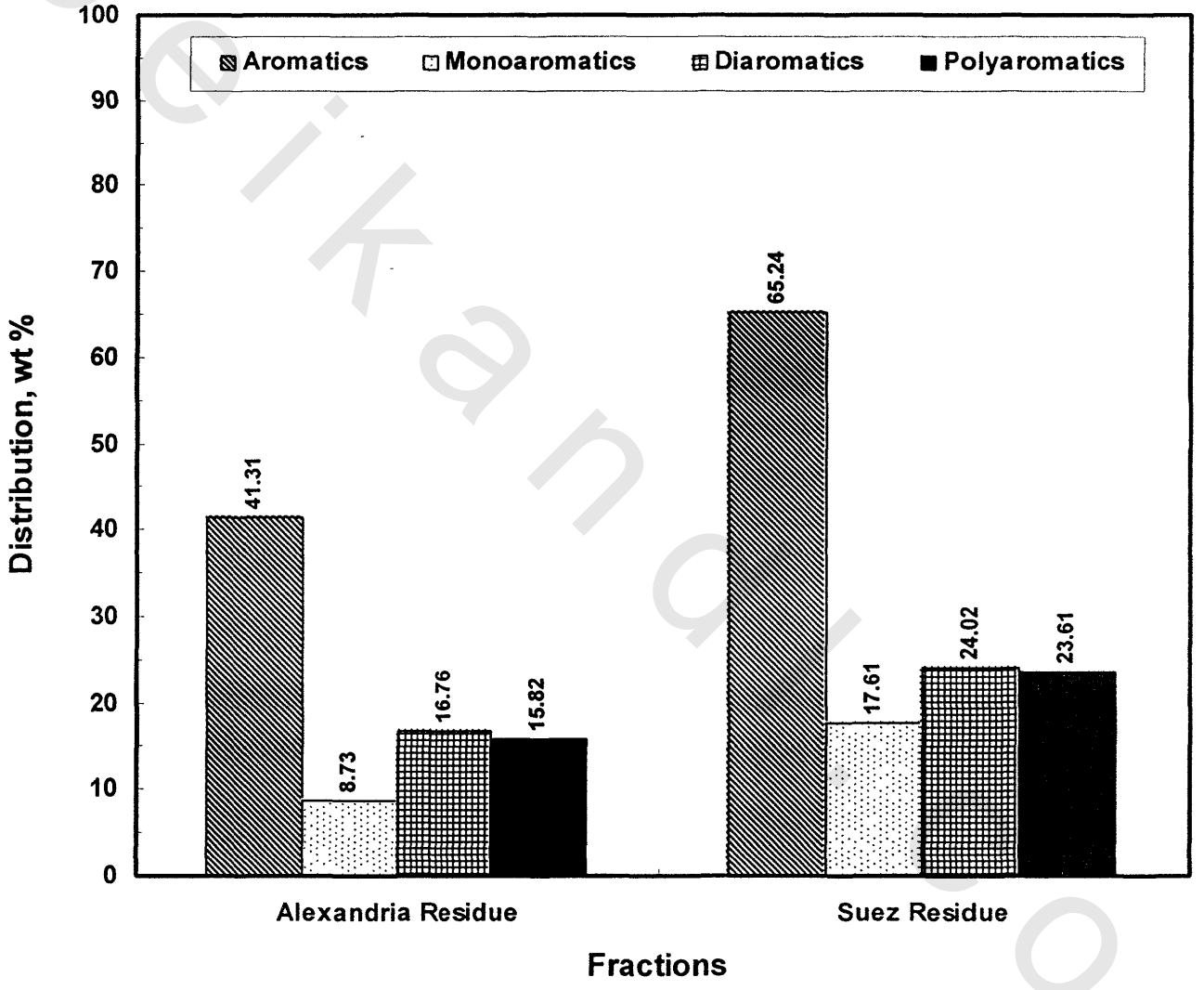


Figure-6. Distribution of the Aromatics, Mono, Di- and Poly-Aromatics In the Studied Vacuum Residues.

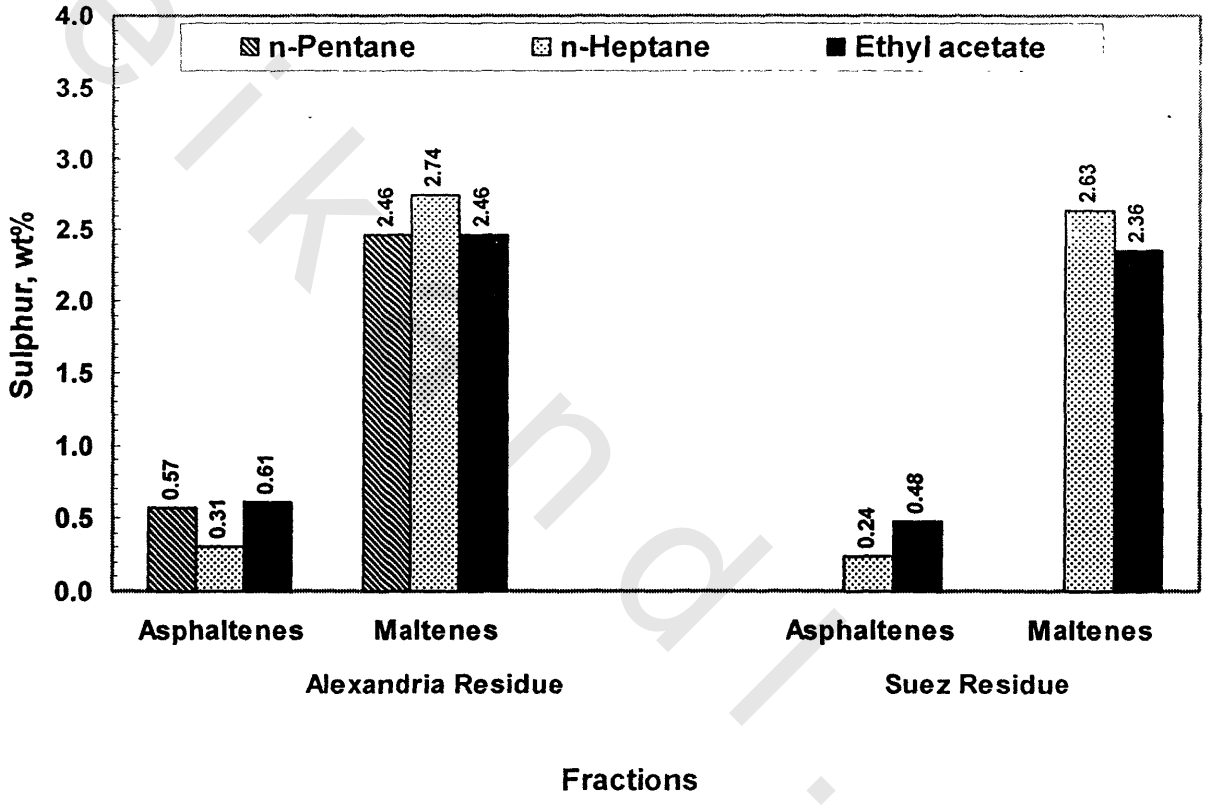


Figure-7: Distribution of the Sulphur in the Asphaltenes and Maltenes in the Studied Vacuum Residues.

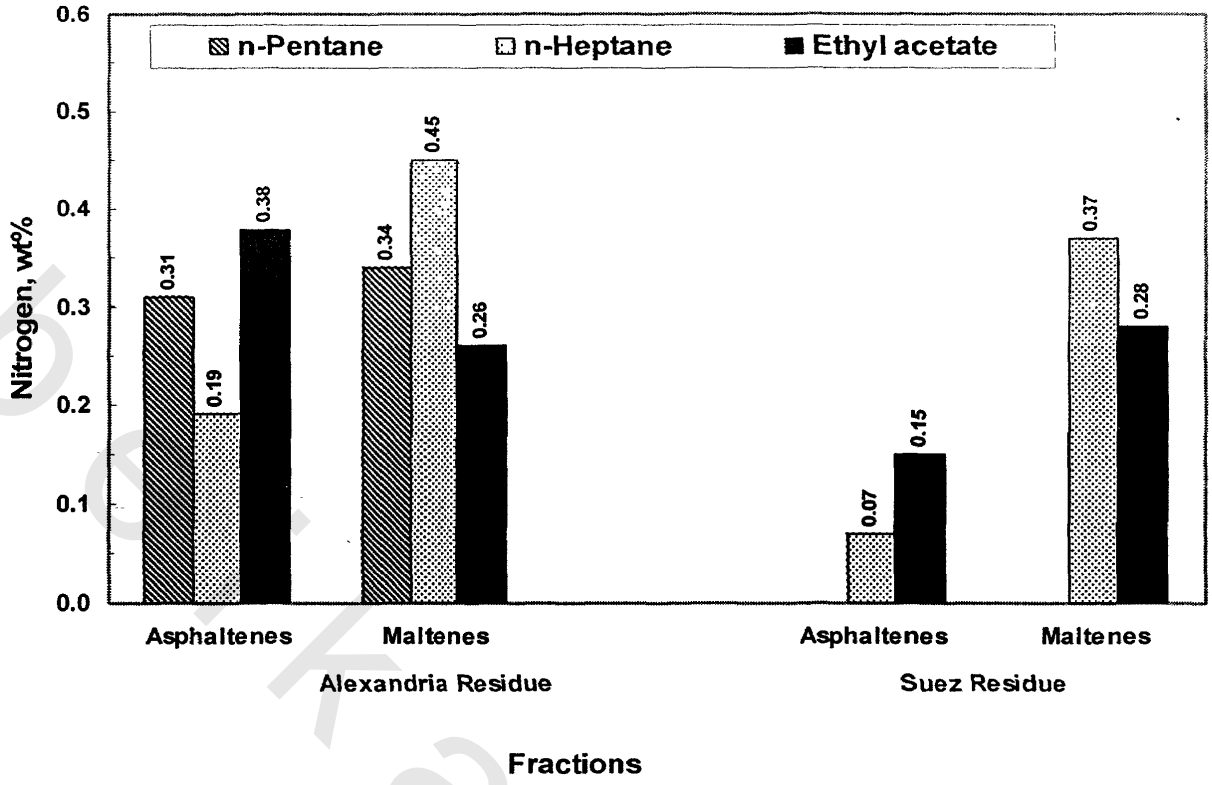


Figure-8: Distribution of the Nitrogen in the Asphaltenes and Maltenes in the Studied Vacuum Residues.

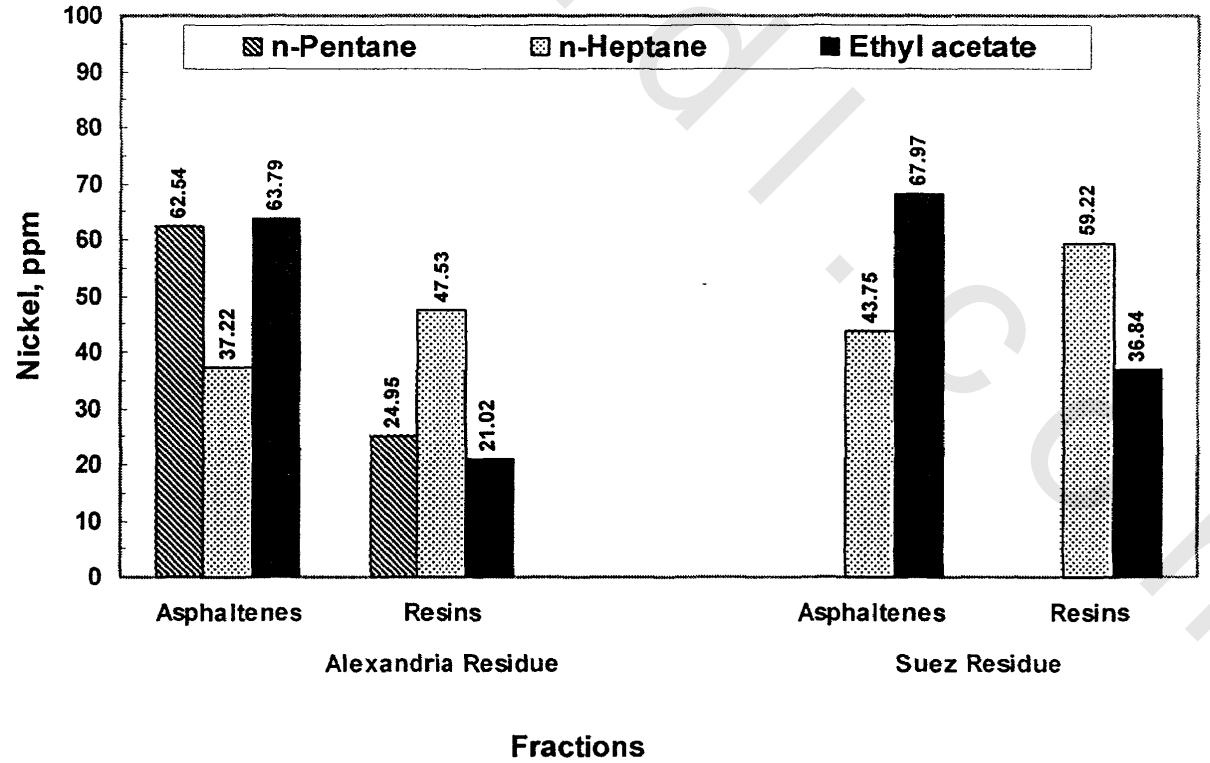


Figure-9: Distribution of the Nickel in the Asphaltenes and Rtesins in the Studied Vacuum Residues.

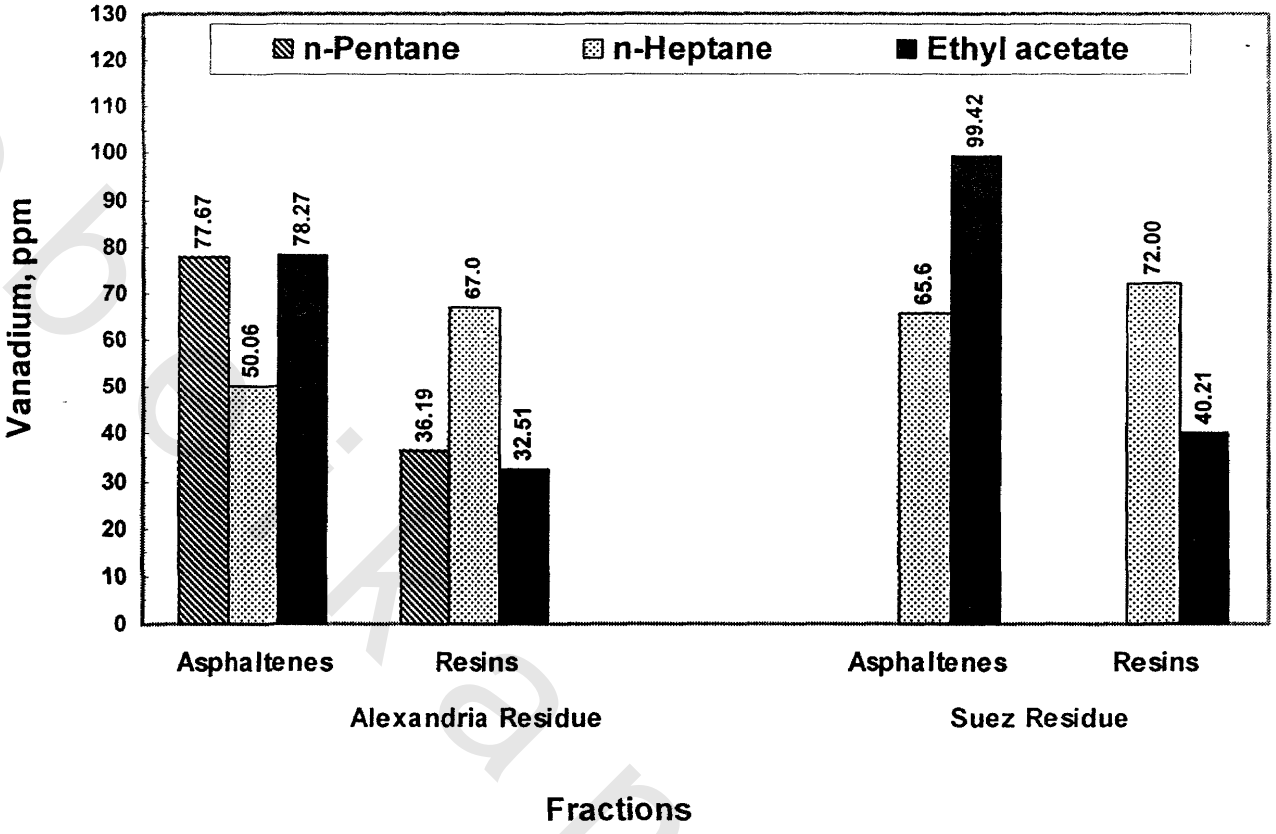


Figure-10: Distribution of the Vanadium in the Asphaltenes and Rtesins in the Studied Vacuum Residues.

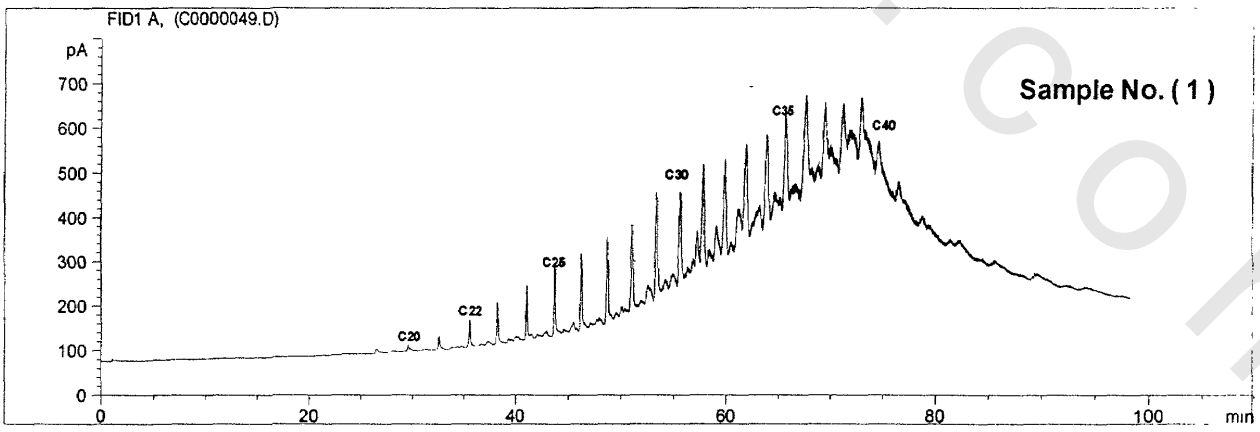


Figure-11:Gas chromatogram of Saturates Separated from Alexandria Residue Using n-Pentane

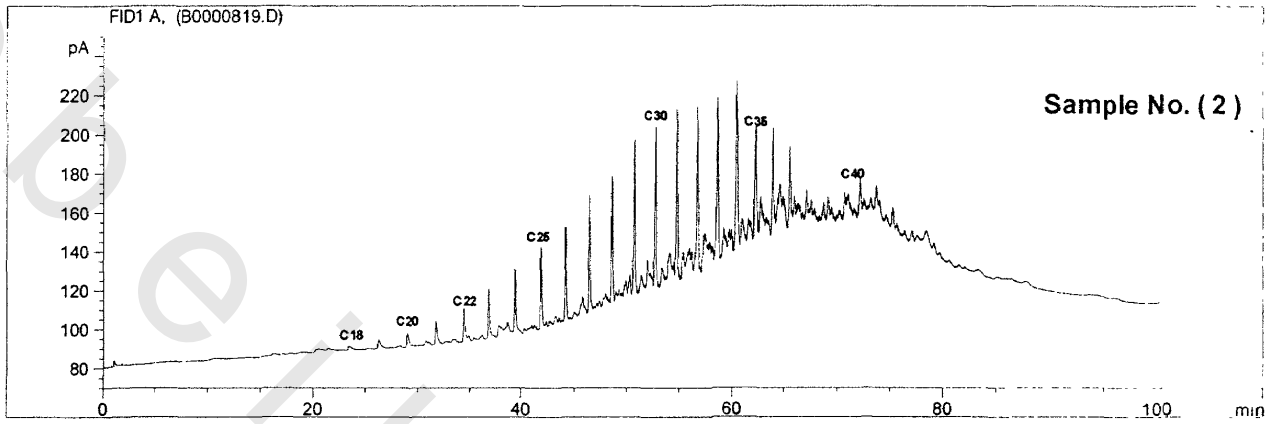


Figure-12:Gas chromatogram of Saturates Separated from Alexandria Residue Using n-Heptane

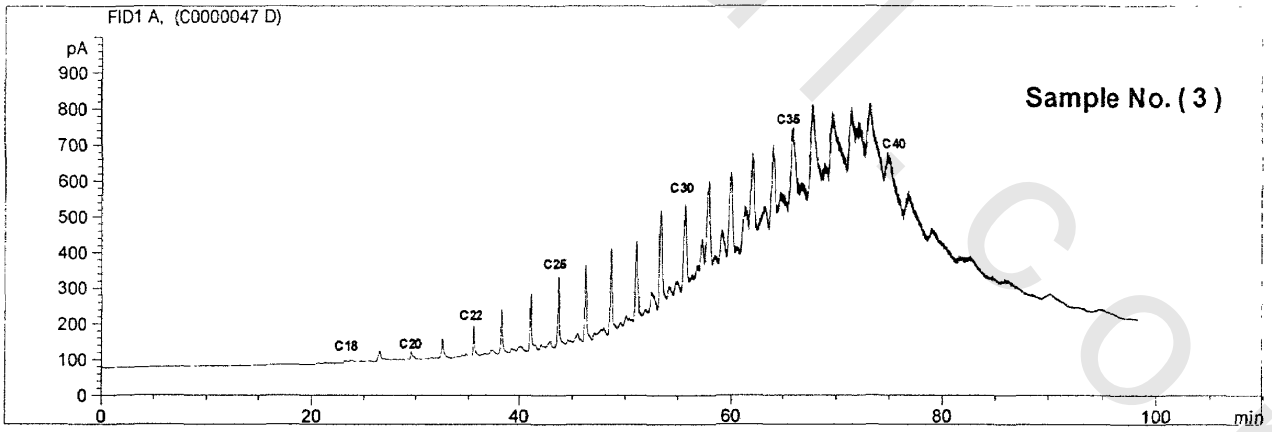


Figure-13:Gas chromatogram of Saturates Separated from Alexandria Residue Using Ethyl Acetate

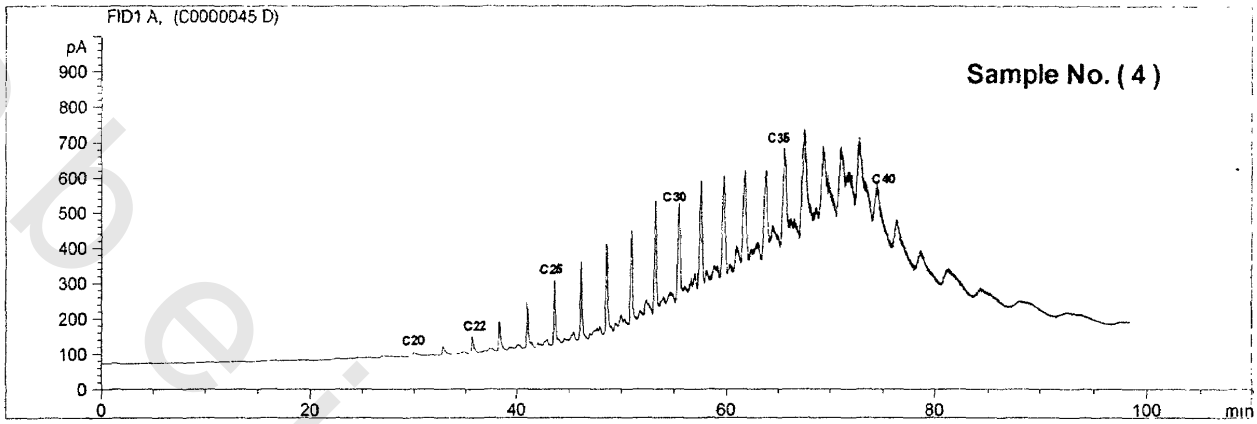


Figure-14:Gas chromatogram of Saturates Separated from Suez Residue Using n- Heptane

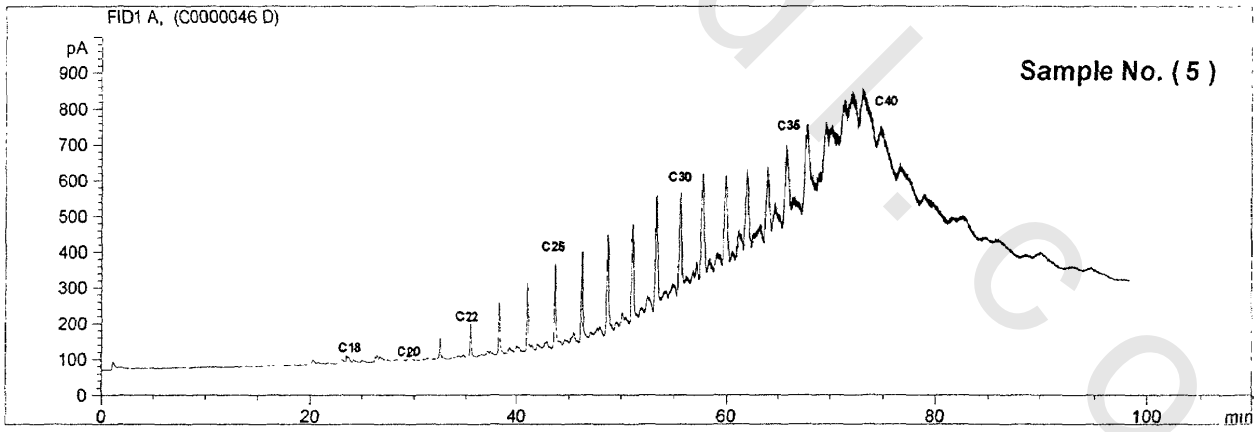


Figure-15:Gas chromatogram of Saturates Separated from Suez Residue Using Ethyl Acetate

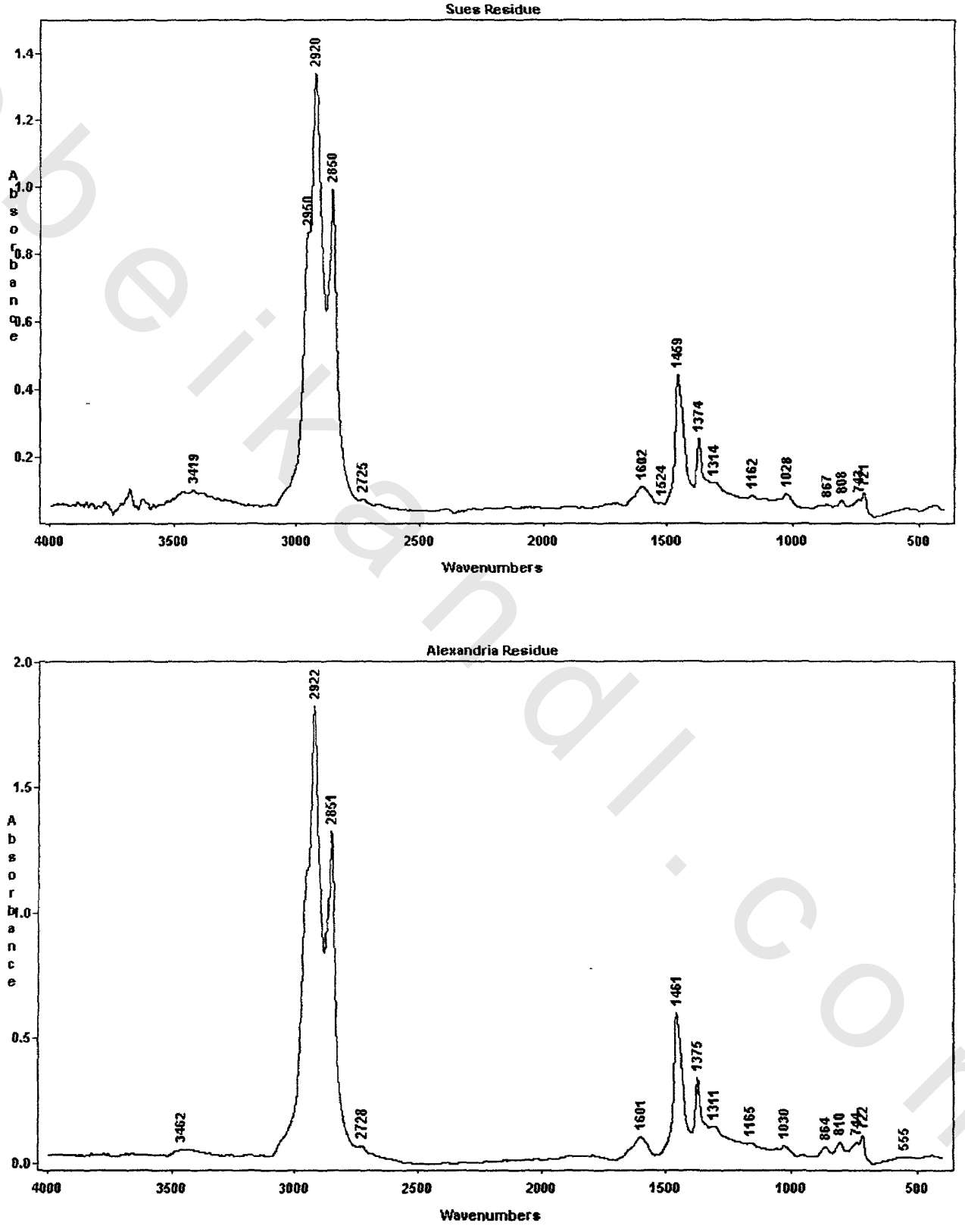


Figure-16: Infrared Spectra of the Studied Vacuum Residues.

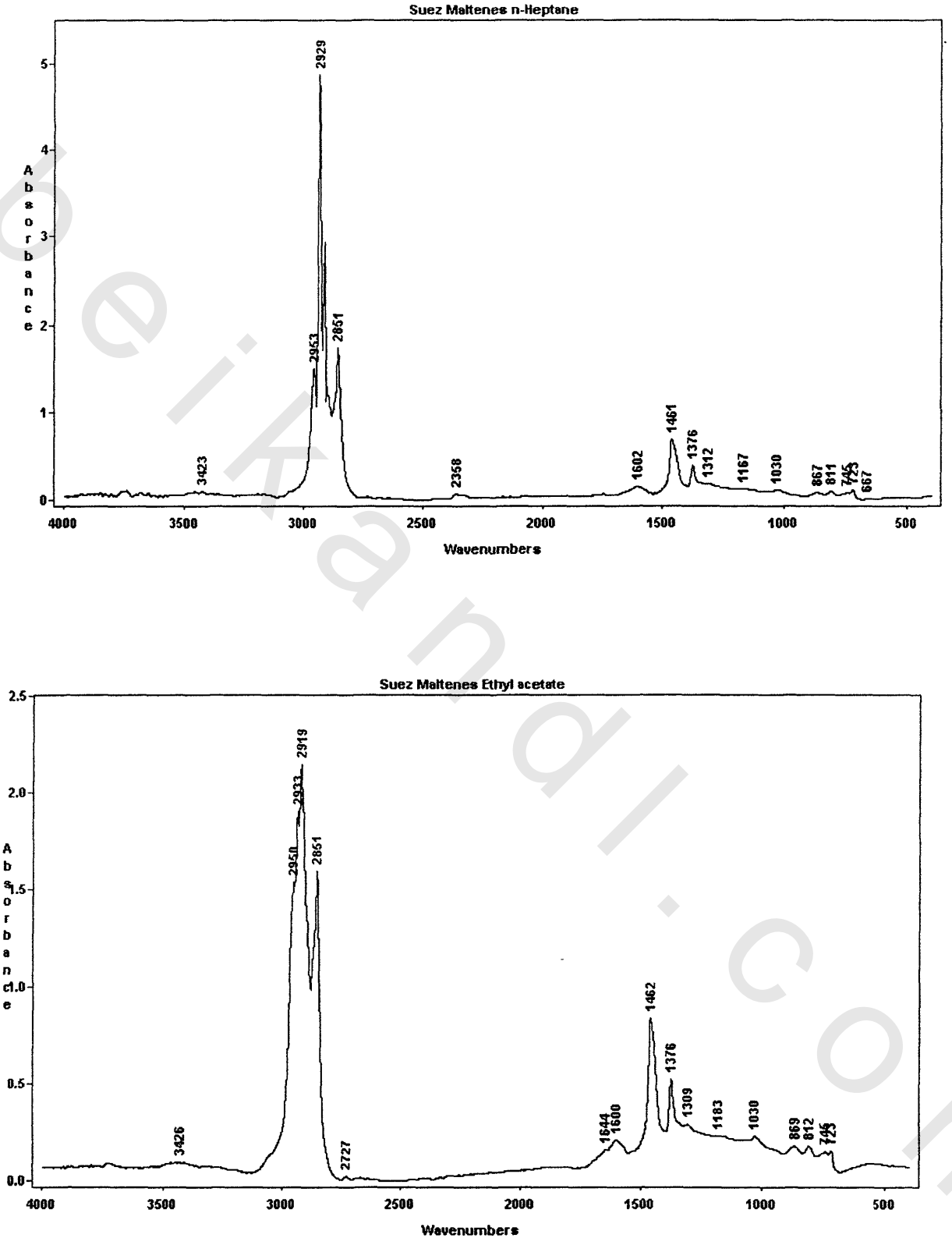
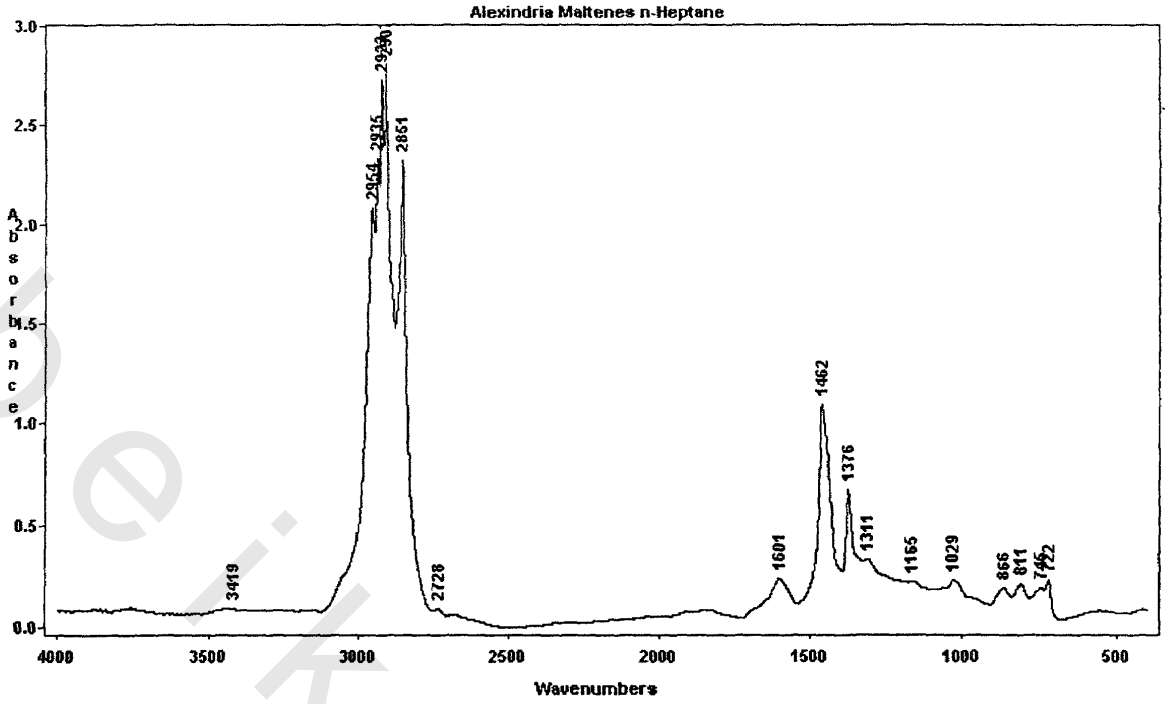


Figure-17: Infrared Spectra of the Suez Maltenes as Separated By *n*-Heptane and Ethyl Acetate Solvents.



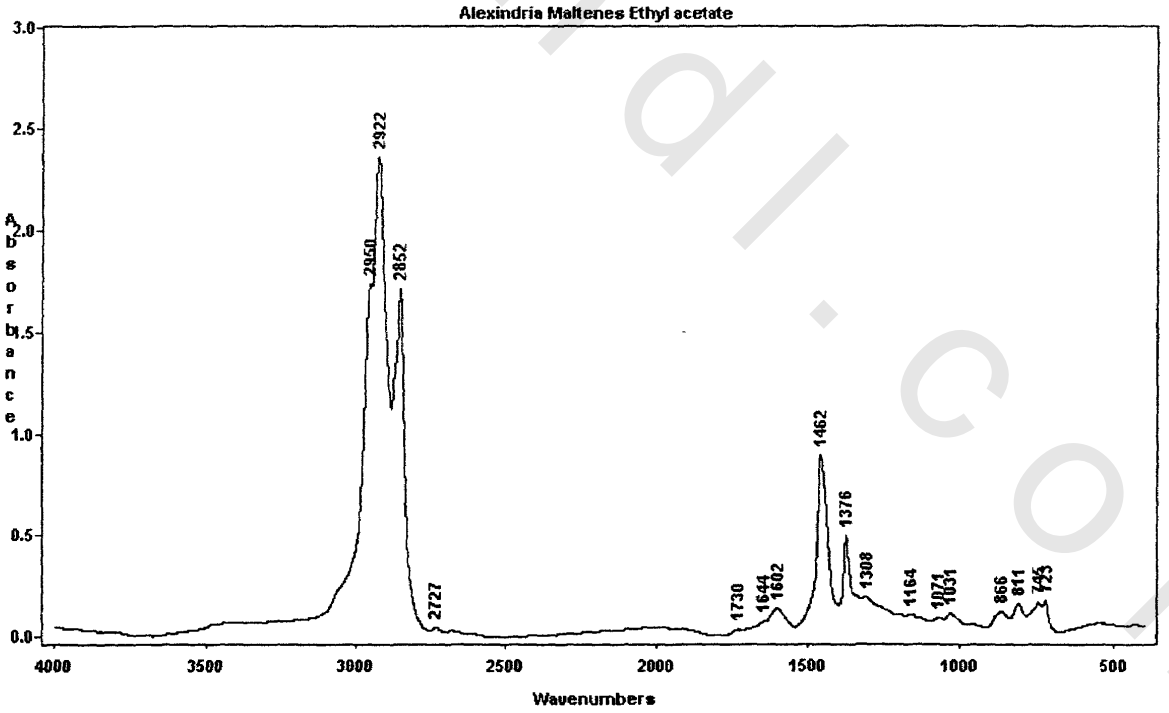
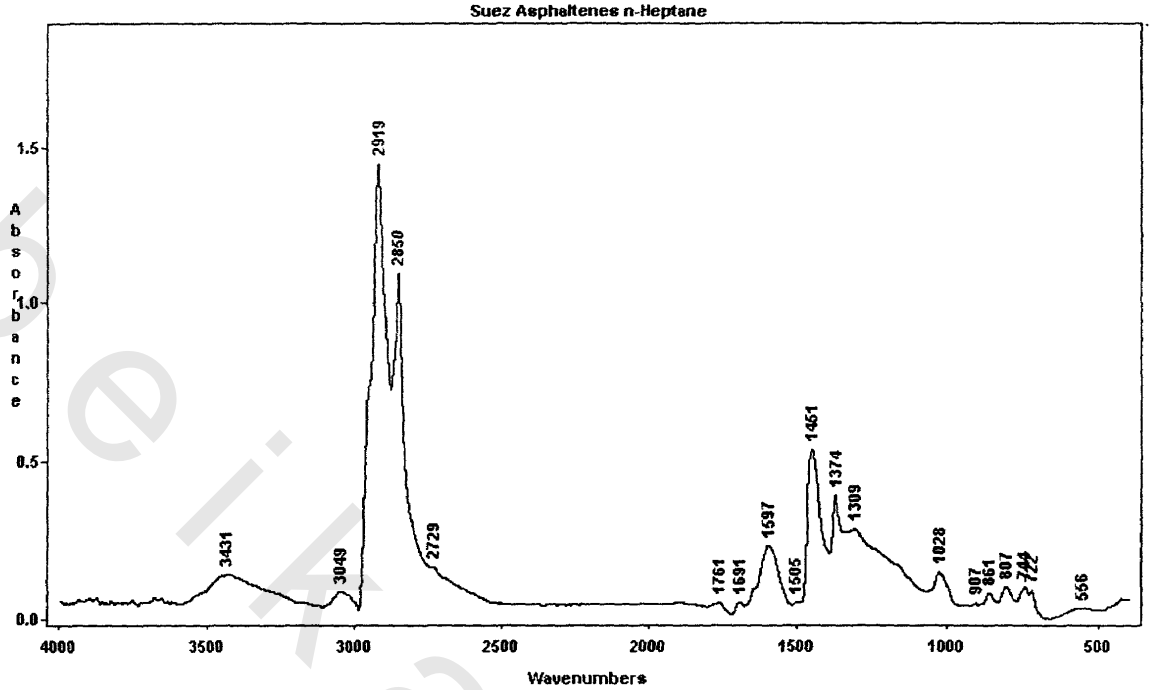


Figure-18: Infrared Spectra of the Alexandria Maltenes as Separated By *n*-Heptane and Ethyl Acetate Solvents.



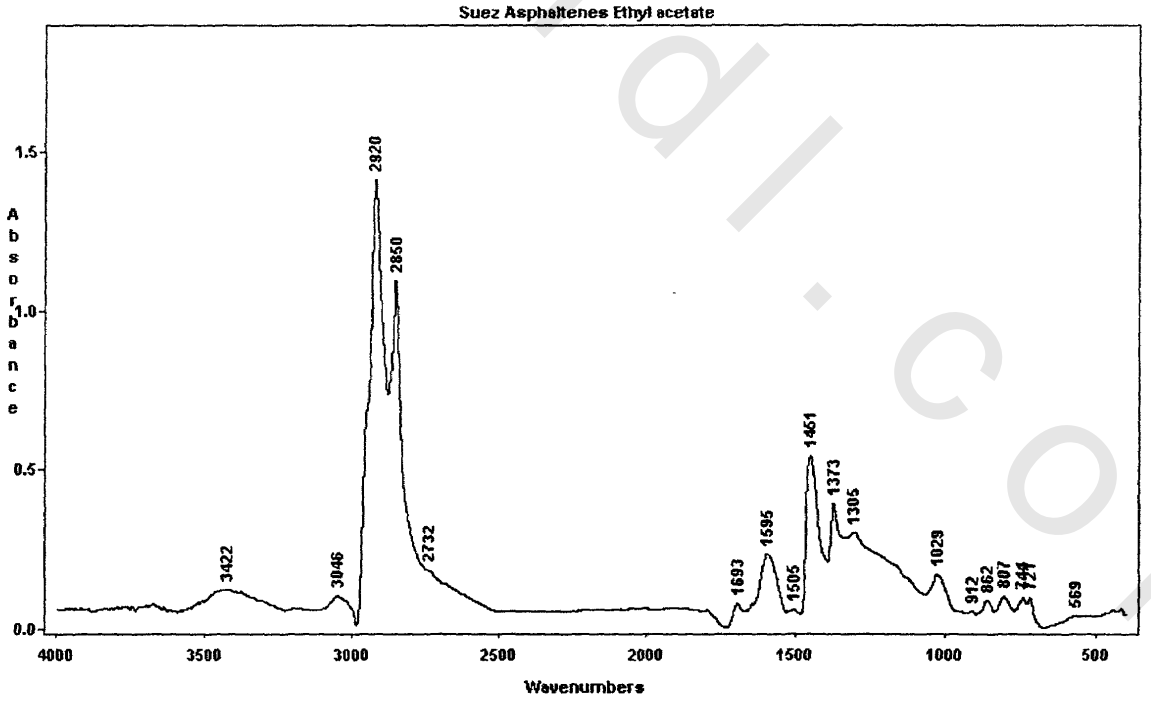


Figure-19: Infrared Spectra of the Suez Asphaltenes as Separated By *n*-Heptane and Ethyl Acetate Solvents.

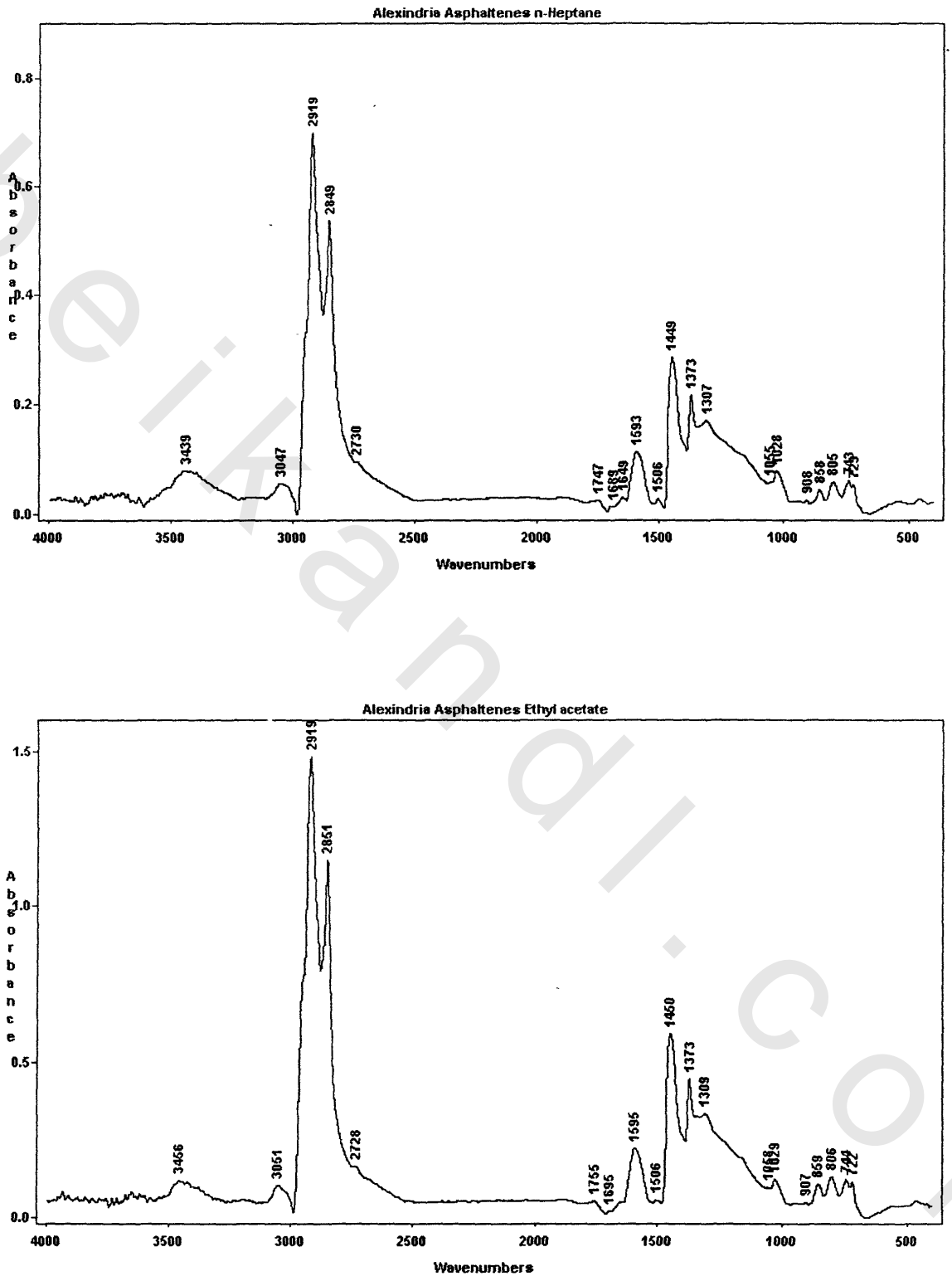


Figure-20: Infrared Spectra of the Alexandria Asphaltenes as Separated By *n*-Heptane and Ethyl Acetate Solvents.

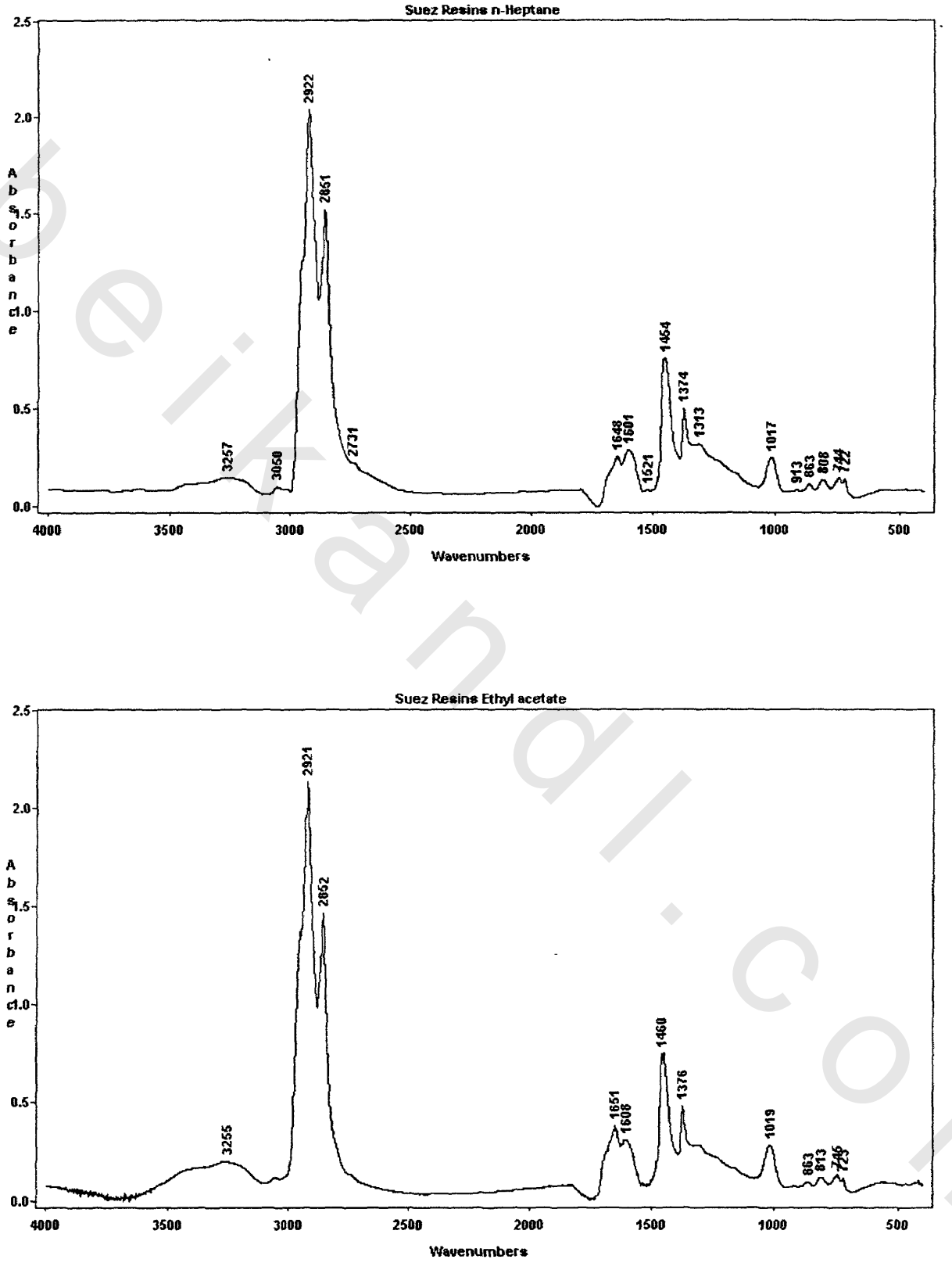


Figure-21: Infrared Spectra of the Suez Resins as Separated By *n*-Heptane and Ethyl Acetate Solvents.

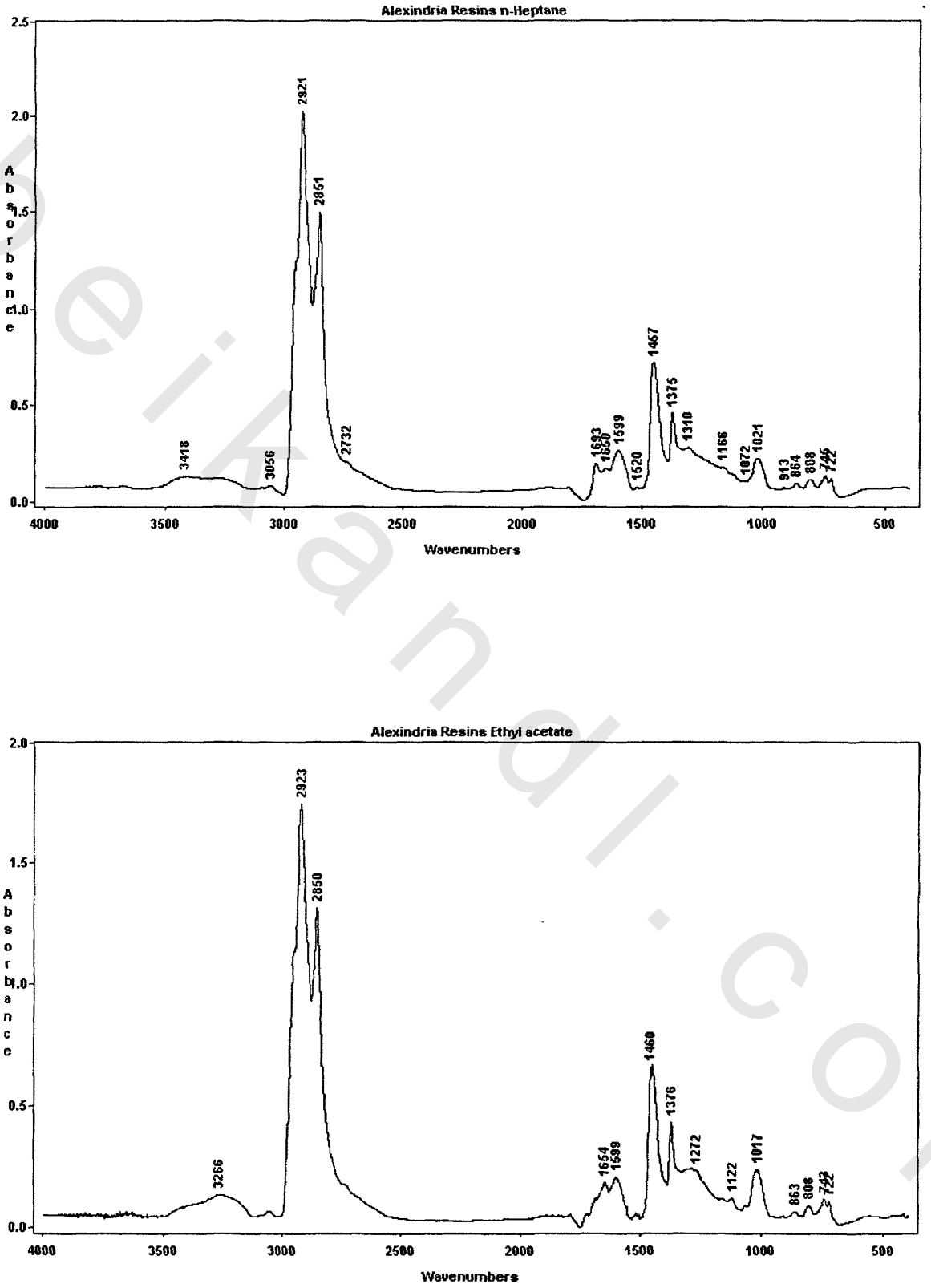
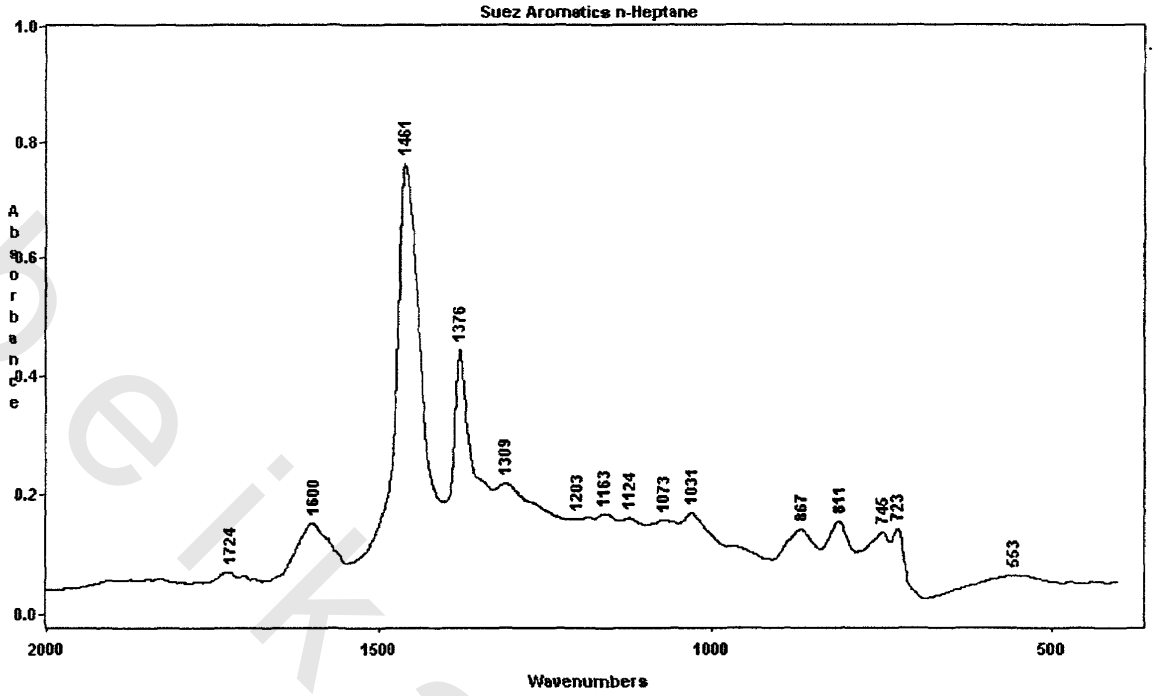


Figure-22: Infrared Spectra of the Alexandria Resins as Separated By *n*-Heptane and Ethyl Acetate Solvents.



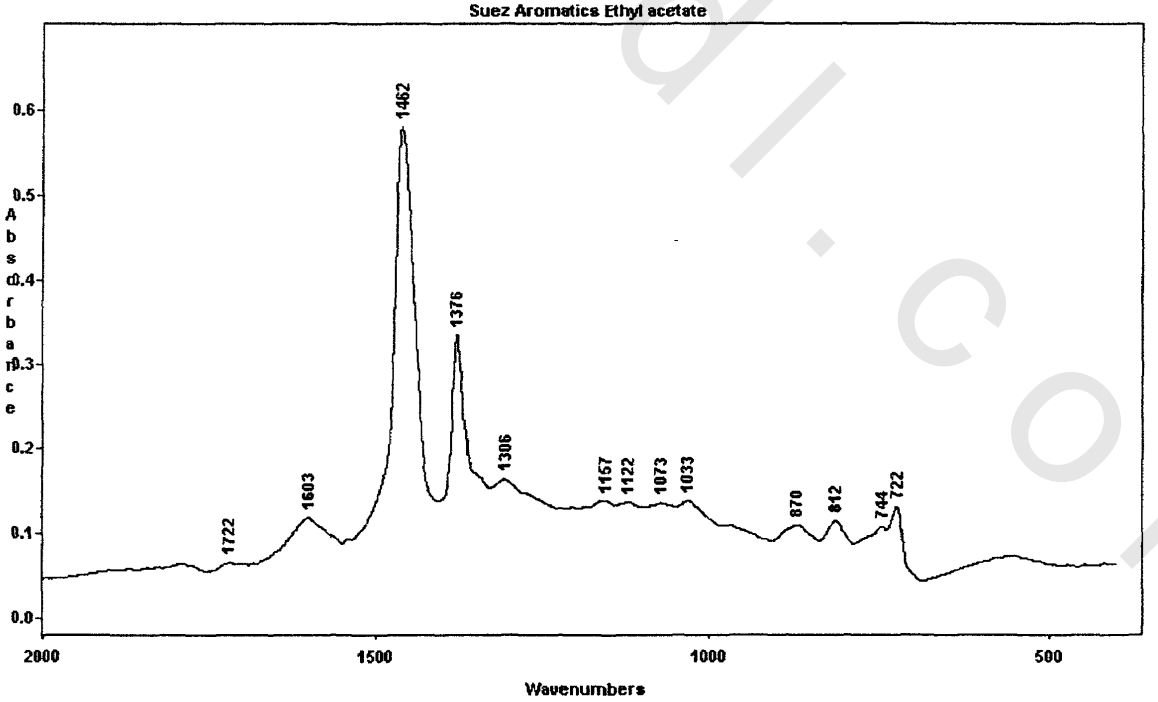
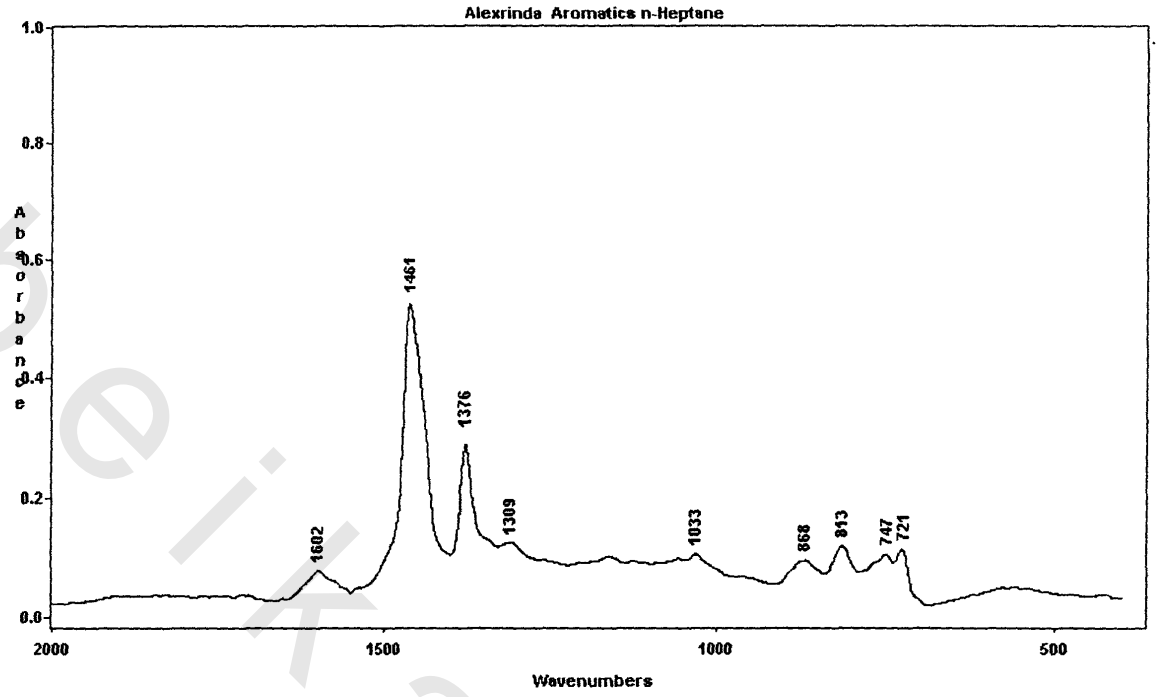


Figure-23: Infrared Spectra of the Suez Aromatics as Separated By *n*-Heptane and Ethyl Acetate Solvents.



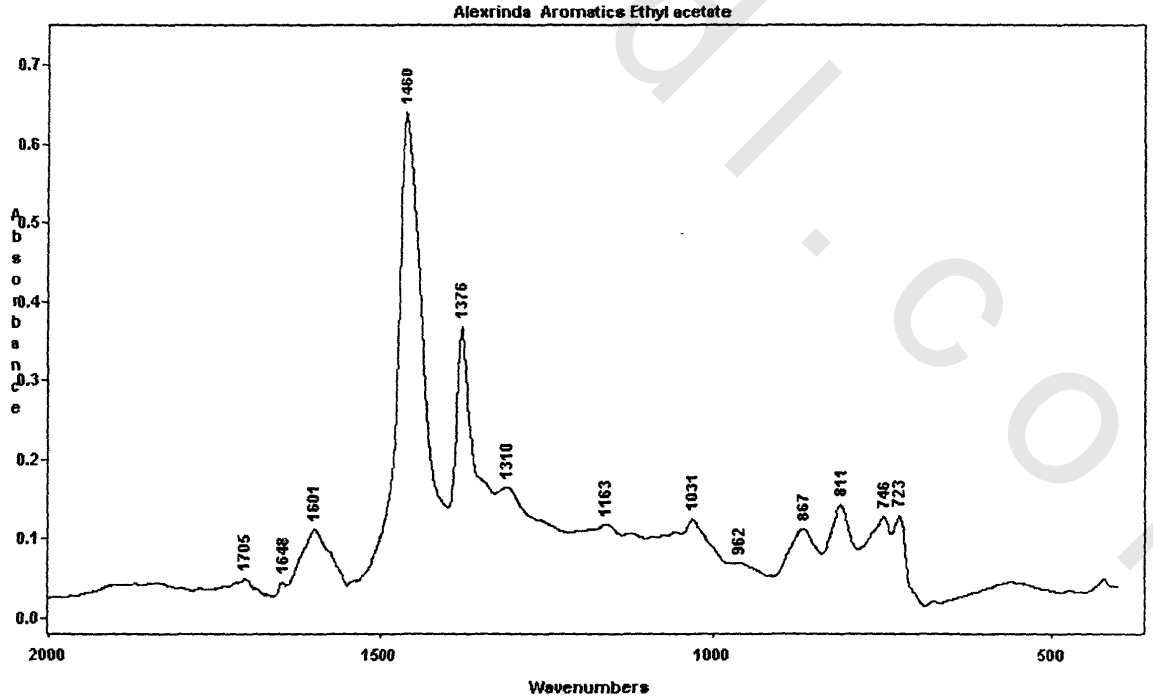


Figure-24: Infrared Spectra of the Alexandria Aromatics as Separated By *n*-Heptane and Ethyl Acetate Solvents.

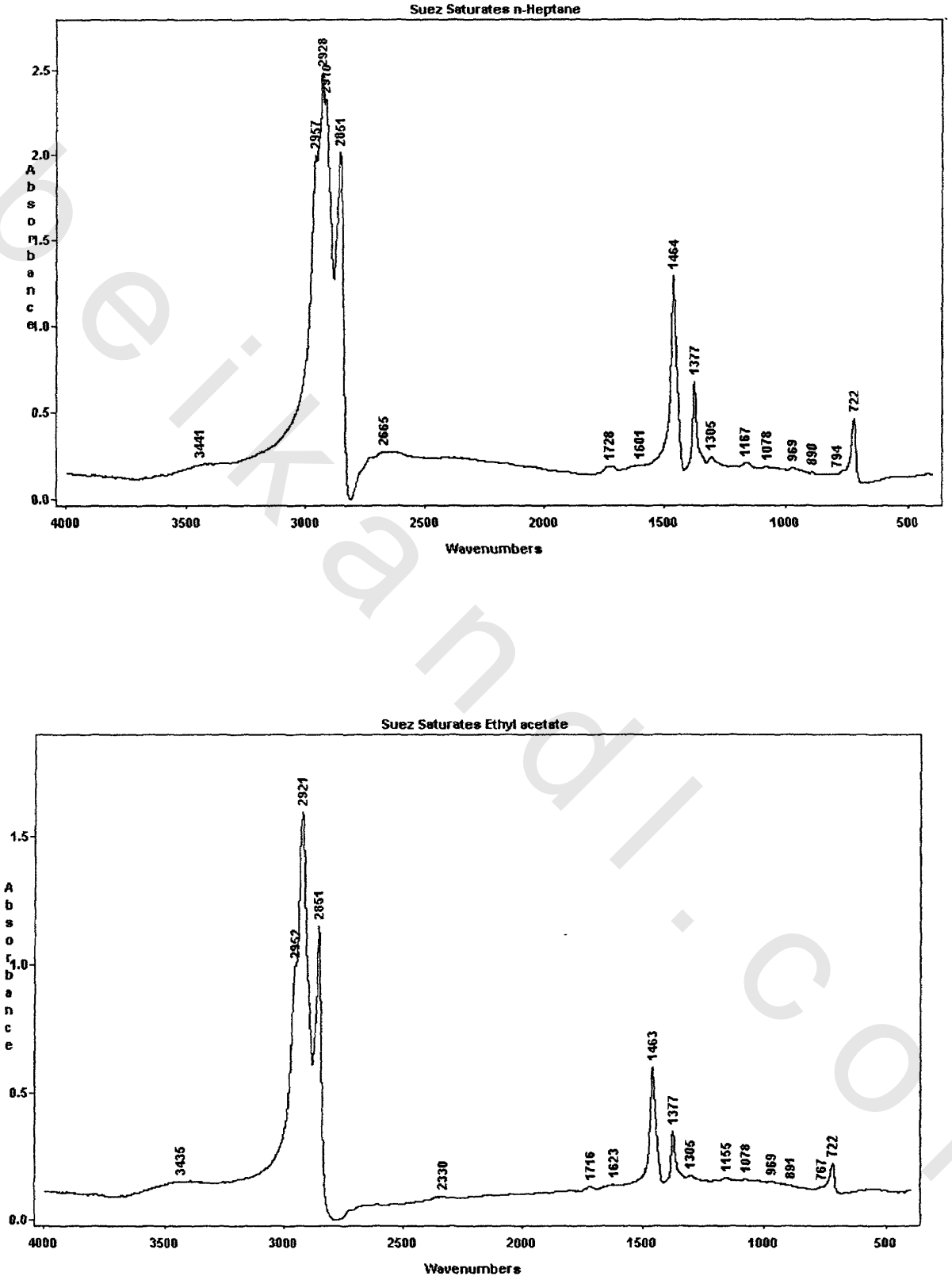


Figure-25: Infrared Spectra of the Suez Saturates as Separated By *n*-Heptane and Ethyl Acetate Solvents.

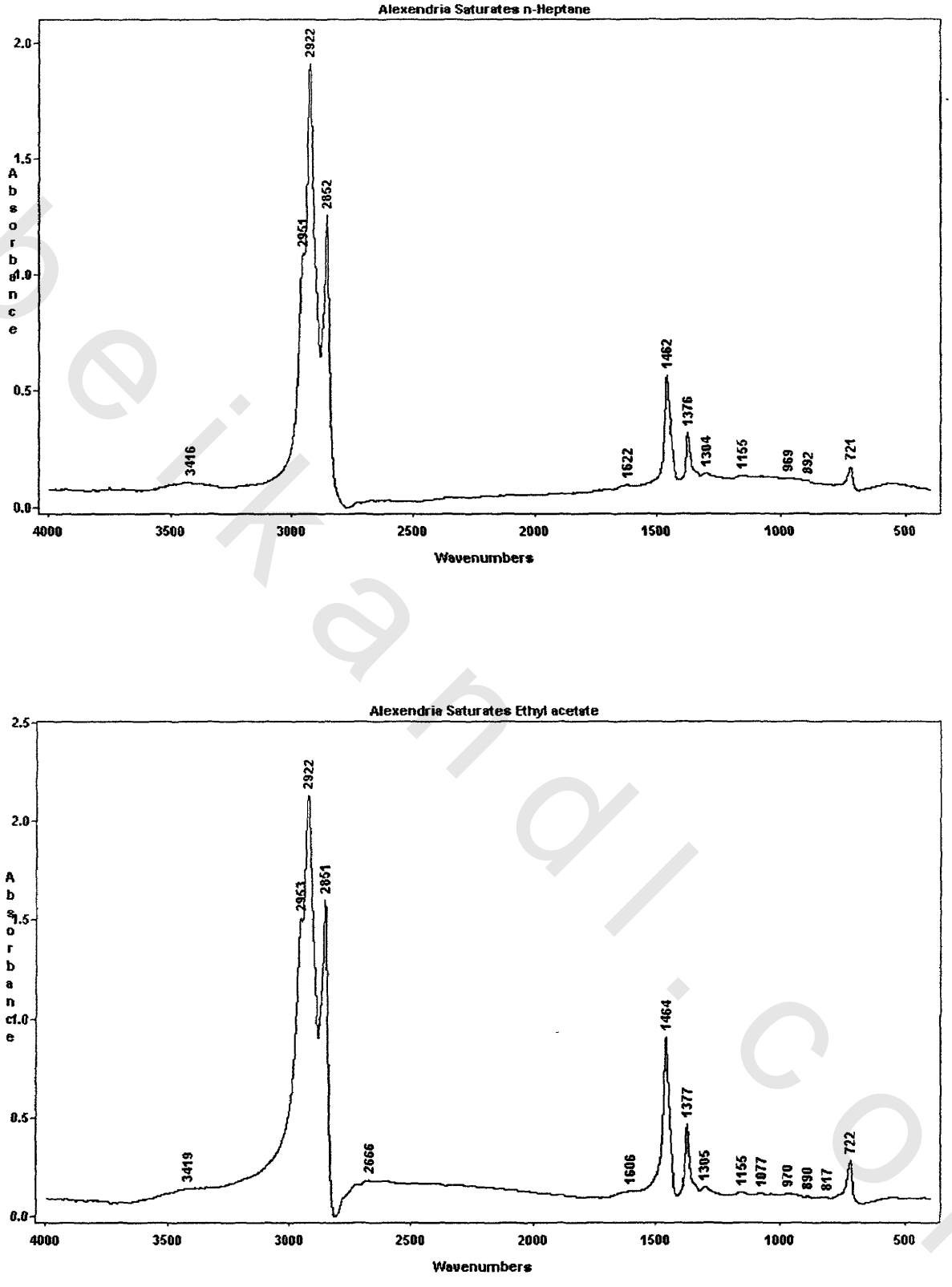


Figure-26: Infrared Spectra of the Alexandria Saturates as Separated By *n*-Heptane and Ethyl Acetate Solvents.

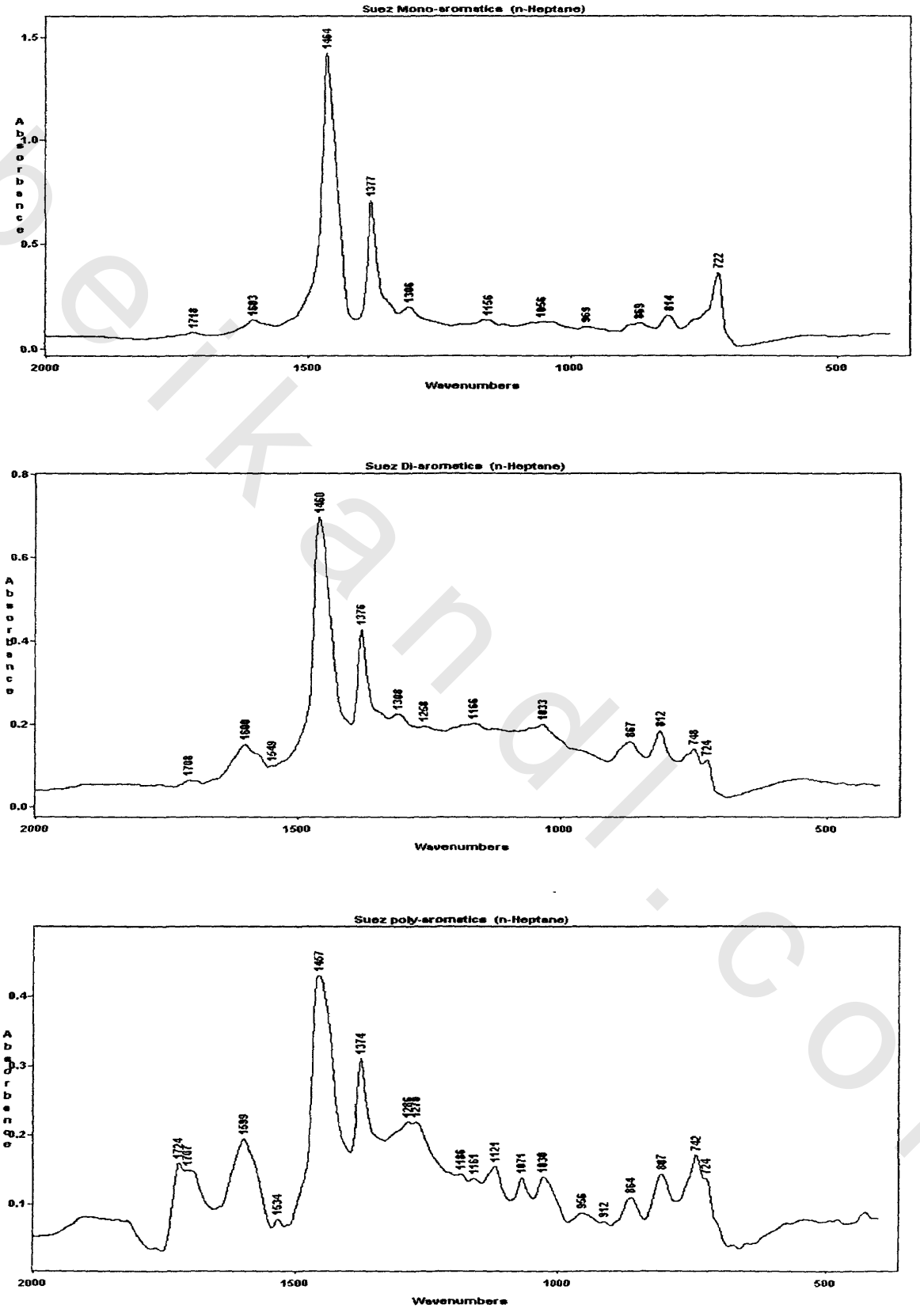


Figure-27:Infrared Spectra of the Suez Mono-, Di-, and Poly-Aromatics as Separated By *n*-Heptane Solvent.

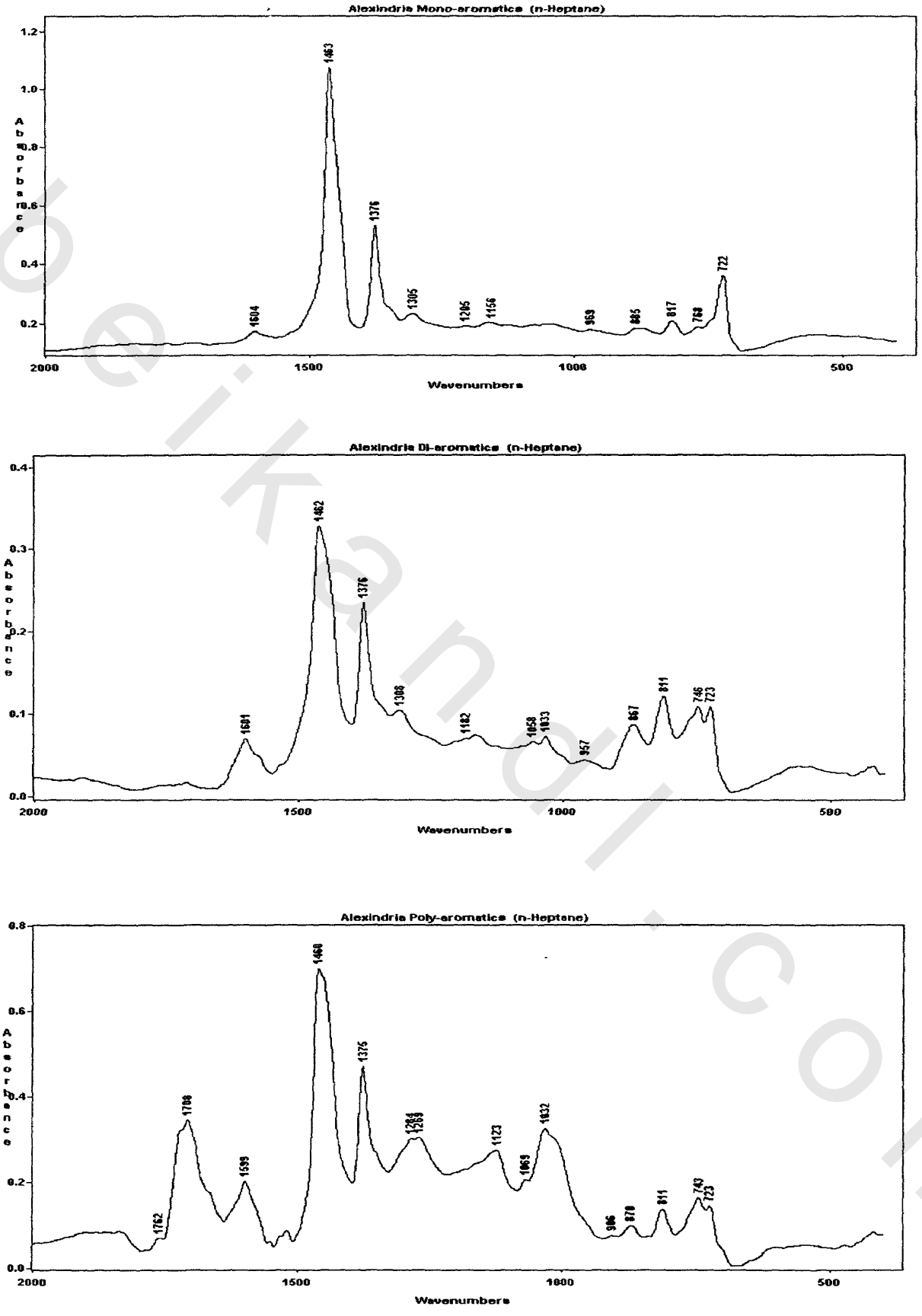
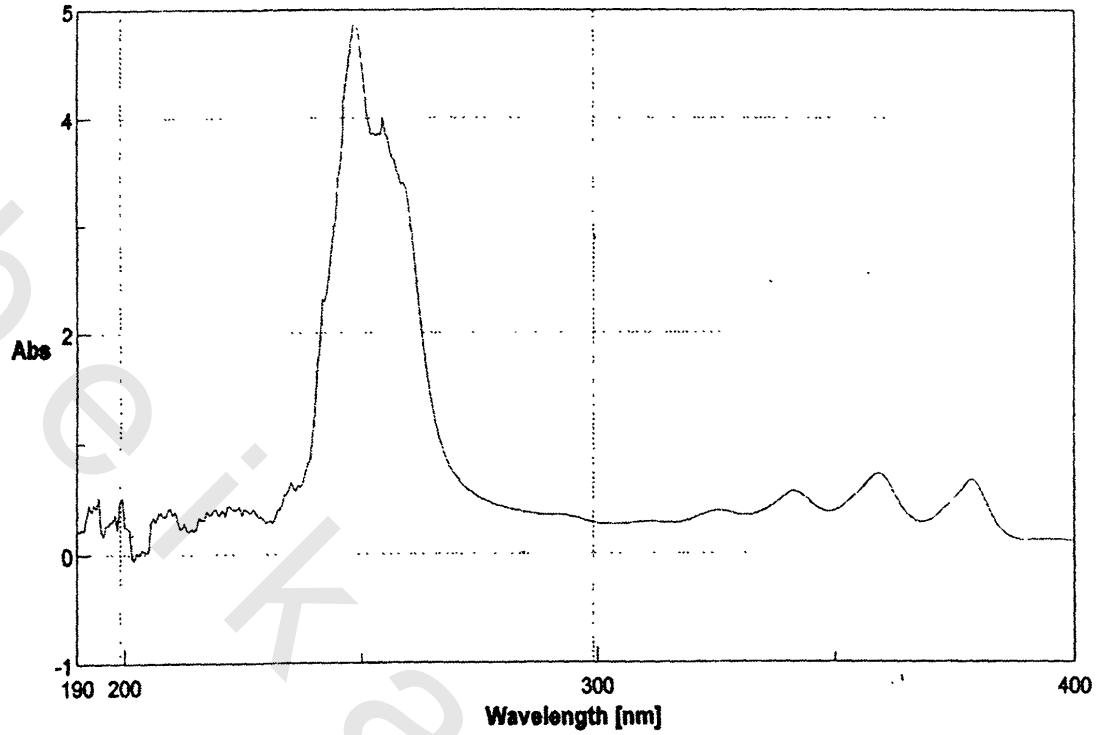
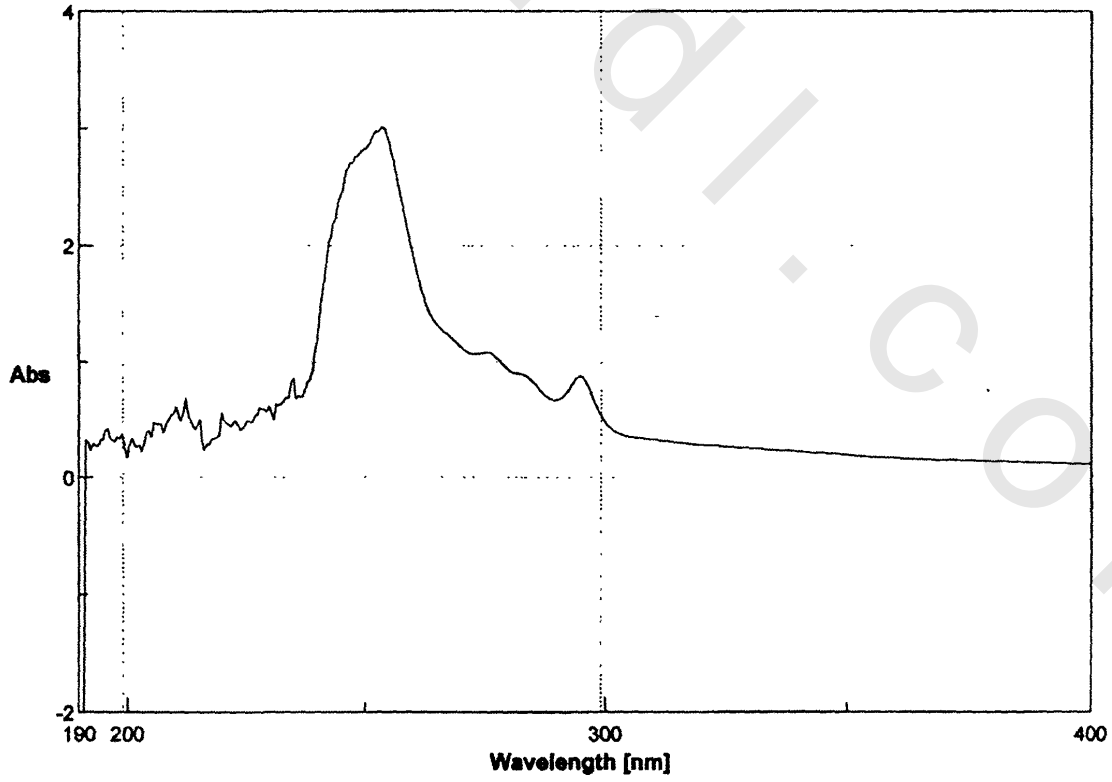


Figure-28:Infrared Spectra of the Alexandria Mono-, Di-, and Poly-Aromatics as Separated By *n*-Heptane Solvent.

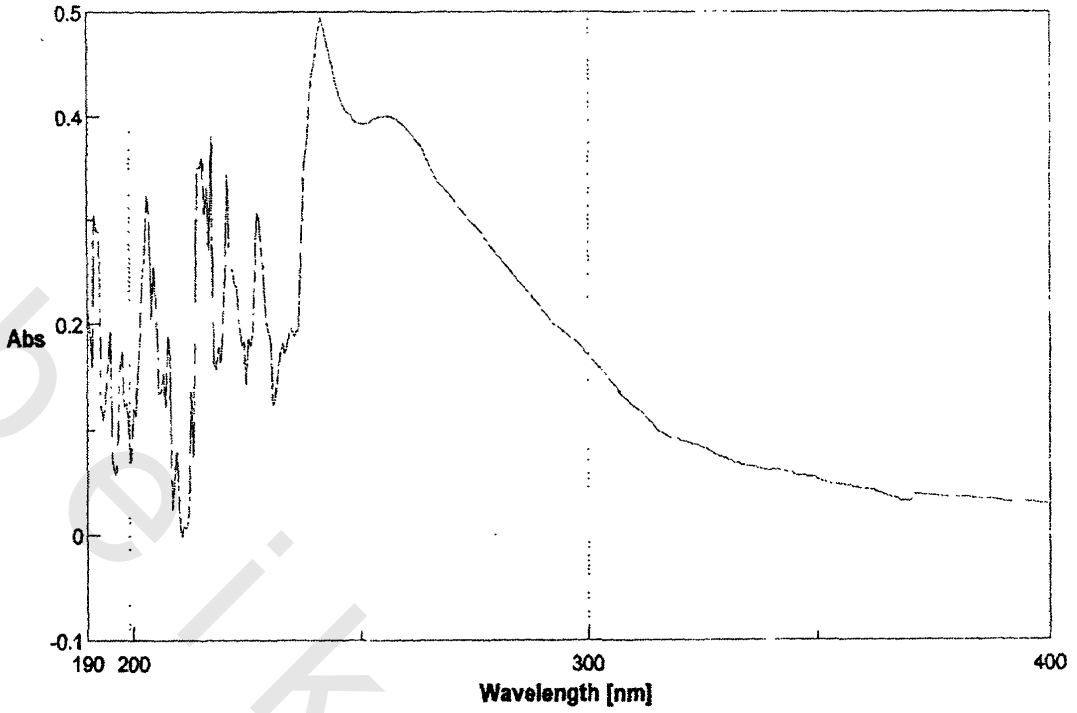


Suez Vacuum Residue

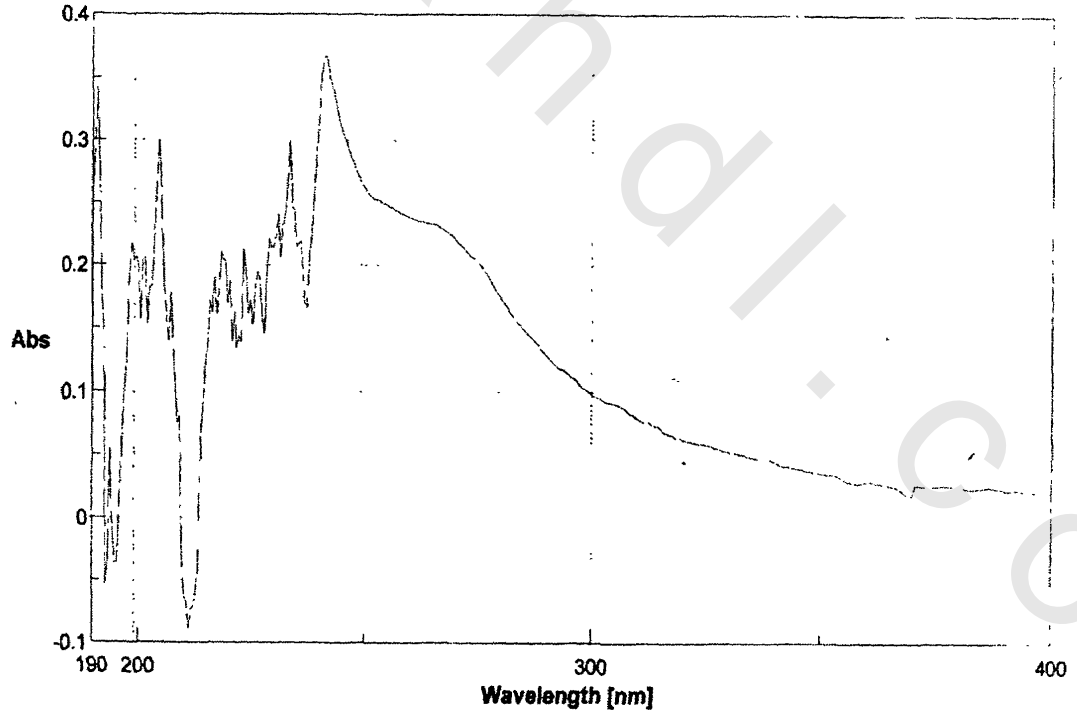


Alexandria Vacuum Residue

Figure-29: Ultraviolet Spectra of the Suez and Alexandria Vacuum Residues.



Suez *n*-Heptane Aromatics



Alexandria *n*-Heptane Aromatics

Figure-30: Ultraviolet Spectra of the n-Heptane Aromatics Separated from Suez and Alexandria Vacuum Residues.

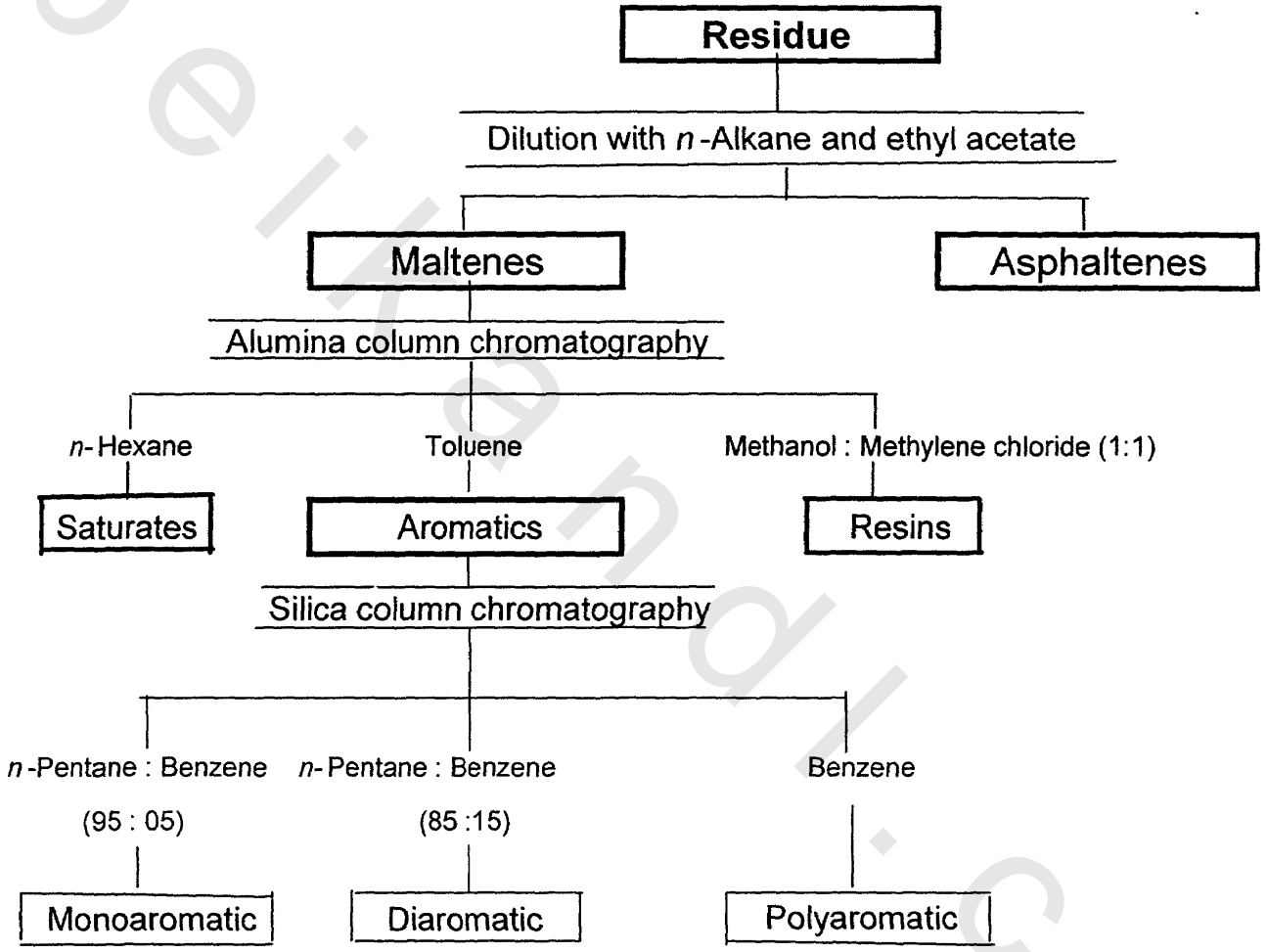


Figure- 31: SCHEME OF SEPARATION OF THE RESIDUE INTO SATURATES, AROMATICS, RESINS AND ASPHALTENES.