The deviations of surface tension of a liquid mixture from linearity, reflects changes of structure and cohesive forces during the mixing process. Excess values of surface tension are negative over the entire composition range and for all frequencies, indicating weak interaction between the components of the mixture. It is the least negative in case of chlorobenzene mixture and maximum negative in case of Nitrobenzene mixture indicating difference in degree of interaction between the component molecules in the different mixtures. In all the cases surface tension decreases with increase in frequency, which indicate reduction in the intermolecular interaction.

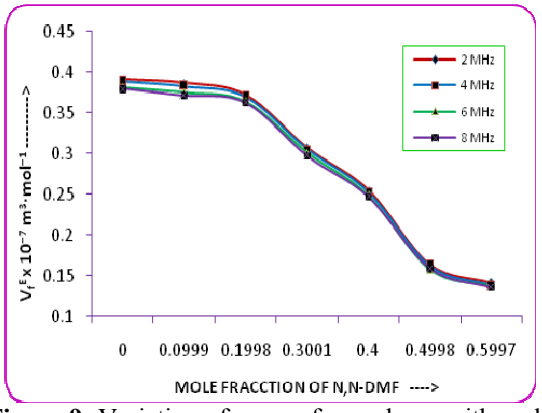

Figure 9: Variation of excess free volume with mole fraction of DMF for system-III mixture

5. Conclusion

It is obvious that, there exist a molecular interaction between the components of the mixture. In specific weak molecular interaction (like dipole-dipole, dipole-induced dipole and dispersive forces) are found to exist between components of the individual mixtures. Molecular interactions are studied through different excess parameters as they play a vital role in assessing the same.

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Table 1: Experimental values of density (ρ), Viscosity (η) and velocity (U) of pure liquids for different frequencies at temperature 318 K.

Pure Liquid	ρ Kg.m^{-3}	η x 10^{-3} N.s.m^{-2}	Velocity (U) m.s^{-1}			
			2MHz	4MHz	6MHz	8MHz
DMF	928.95	0.622	1401.7	1398.6	1397.4	1395.2
C.H	761.0	0.511	1160.9	1159.4	1158	1156.4
Ben.	862.4	0.638	1212.1	1210.4	1209	1207.6
C.Ben.	1082.1	0.628	1997.3	1195.2	1193.7	1192.4
N. Ben	1179.5	1.010	1383.1	1382.0	1381.5	1380.8
Pyr.	964.2	0.530	1341.4	1338.6	1336.5	1332.2

Table 2: Calculated excess values of adiabatic comp. (β^E), and free length (L_f^E) in ternary mixtures for different frequencies at temperature 318 K.

Mole fraction		Excess adiabatic comp. (β^E) (10^{-10} $N^{-1}.m^2$)				Excess free length (L_f^E) (10^{-10} m)			
X_1	X_2	2 MHz	4 MHz	6 MHz	8 MHz	2 MHz	4 MHz	6 MHz	8 MHz
SYSTEM – I (DMF + Cyclohexane + benzene)									
0.0000	0.6000	0.314	0.312	0.308	0.297	0.032	0.026	0.014	0.011
0.0999	0.4999	0.340	0.346	0.345	0.341	0.034	0.029	0.017	0.014
0.1998	0.4001	0.373	0.365	0.376	0.368	0.036	0.030	0.019	0.016
0.3001	0.3000	0.379	0.385	0.381	0.376	0.037	0.032	0.020	0.017
0.4000	0.1999	0.404	0.397	0.397	0.401	0.039	0.033	0.022	0.019
0.4998	0.1001	0.438	0.435	0.446	0.443	0.040	0.035	0.024	0.021
0.5997	0.0000	0.467	0.470	0.460	0.474	0.042	0.037	0.025	0.023
SYSTEM – II (DMF + Cyclohexane + Chlorobenzene)									

0.0000	0.6000	1.2901	0.8123	0.2989	0.2562	0.5305	0.3369	0.1488	0.1223
0.0999	0.4999	1.2582	0.8141	0.3410	0.3097	0.5187	0.3402	0.1587	0.1465
0.1998	0.4001	1.2200	0.8120	0.3853	0.3726	0.5039	0.3411	0.1785	0.1733
0.3001	0.3000	1.1655	0.8043	0.4175	0.4179	0.4826	0.3397	0.1936	0.1933
0.4000	0.1999	1.1389	0.8221	0.4667	0.4837	0.4727	0.3488	0.2161	0.2220
0.4998	0.1001	1.1238	0.8297	0.5153	0.5338	0.4667	0.3536	0.2378	0.2443
0.5997	0.0000	1.1061	0.8443	0.5720	0.5956	0.4602	0.3615	0.2630	0.2714
SYSTEM – III (DMF + Cyclohexane + Nitrobenzene)									
0.0000	0.6000	1.965	1.975	1.999	2.009	0.0828	0.0831	0.0839	0.0842
0.0999	0.4999	1.672	1.687	1.714	1.727	0.0715	0.0719	0.0729	0.0733
0.1998	0.4001	1.424	1.433	1.452	1.458	0.0616	0.0618	0.0625	0.0627
0.3001	0.3000	1.203	1.212	1.228	1.240	0.0526	0.0529	0.0534	0.0538
0.4000	0.1999	0.956	0.964	0.980	0.986	0.0428	0.0430	0.0436	0.0438
0.4998	0.1001	0.740	0.749	0.767	0.761	0.0340	0.0342	0.0349	0.0346
0.5997	0.0000	0.496	0.507	0.515	0.519	0.0242	0.0245	0.0248	0.0249

Table 3: Calculated excess values of free volume (V_f^E), and surface tension (S^E) in ternary mixtures for different frequencies at temperature 318 K.

Mole fraction		**Excess free volume (10^{-7} $m^3 \cdot mol^{-1}$)**				**Excess surface tension (S^E) ($N.m^{-1}$)**			
X_1	X_2	2 MHz	4 MHz	6 MHz	8 MHz	2 MHz	4 MHz	6 MHz	8 MHz
SYSTEM – I (DMF + Cyclohexane + benzene)									
0.0000	0.6000	0.944	0.943	0.942	0.944	-0.75	-0.74	-0.76	-0.74
0.0999	0.4999	0.794	0.791	0.79	0.79	-1.10	-1.11	-1.10	-1.09
0.1998	0.4001	0.664	0.665	0.662	0.663	-1.46	-1.44	-1.45	-1.43
0.3001	0.3000	0.589	0.587	0.587	0.587	-1.75	-1.75	-1.77	-1.74
0.4000	0.1999	0.428	0.43	0.429	0.428	-2.04	-2.01	-2.04	-2.01
0.4998	0.1001	0.286	0.286	0.283	0.284	-2.33	-2.31	-2.36	-2.32
0.5997	0.0000	0.159	0.159	0.162	0.158	-2.58	-2.57	-2.60	-2.57
SYSTEM – II (DMF + Cyclohexane + Chlorobenzene)									
0.0000	0.6000	0.266	0.260	0.253	0.257	0.128	0.092	0.050	0.077
0.0999	0.4999	0.207	0.202	0.192	0.193	-0.125	-0.160	-0.225	-0.216
0.1998	0.4001	0.151	0.141	0.130	0.126	-0.379	-0.447	-0.527	-0.555
0.3001	0.3000	0.093	0.080	0.069	0.062	-0.634	-0.730	-0.816	-0.868
0.4000	0.1999	0.048	0.033	0.024	0.014	-0.955	-1.070	-1.144	-1.227
0.4998	0.1001	0.003	-0.007	-0.016	-0.026	-1.330	-1.409	-1.494	-1.572
0.5997	0.0000	-0.030	-0.023	-0.048	-0.058	-1.709	-1.633	-1.875	-1.956
SYSTEM – III (DMF + Cyclohexane + Nitrobenzene)									
0.0000	0.6000	0.391	0.388	0.382	0.379	-8.9	-8.9	-8.96	-8.97
0.0999	0.4999	0.387	0.383	0.376	0.372	-7.8	-7.8	-7.87	-7.89
0.1998	0.4001	0.372	0.370	0.365	0.363	-6.8	-6.8	-6.84	-6.85
0.3001	0.3000	0.307	0.305	0.301	0.297	-5.9	-5.9	-5.88	-5.90
0.4000	0.1999	0.255	0.253	0.249	0.247	-4.9	-4.9	-4.89	-4.89
0.4998	0.1001	0.165	0.163	0.158	0.160	-3.9	-3.9	-3.95	-3.92
0.5997	0.0000	0.142	0.139	0.137	0.136	-2.9	-2.9	-2.94	-2.93