

Microwave assisted synthesis, characterization and thermoacoustical study of β -Naphthol-guanidine-formaldehyde copolymer resin

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Supplementary file:

Formulas used in this study:

$$\text{Adiabatic compressibility: } \beta = \left(\frac{1}{U^2 \rho} \right) \dots \dots \dots (1)$$

(U = Ultrasonic velocity of solution, ρ = Density of the solution)

$$\text{Acoustic impedance: } Z = U \times \rho \dots \dots \dots (2)$$

$$\text{Intermolecular free length: } L_f = K_T \times \sqrt{\beta} \dots \dots \dots (3)$$

(K_T is Jacobson's constant, $K_T = (93.875 + 0.375T) \times 10^{-8}$)

and T = Absolute temperature in Kelvin)

$$\text{Relaxation time: } \tau = \frac{4\eta\beta}{3} \dots \dots \dots (4)$$

(η = viscosity of solution)

$$\text{Relative association: } R_A = \left[\frac{\rho}{\rho_0} \right] \times \left[\frac{U}{U_0} \right]^{1/3} \dots \dots \dots (5)$$

(ρ_0 and U_0 are the density and ultrasonic velocity of pure solvent)

$$\text{Gibb's free energy: } \Delta G^* = -2.303 kT \log \left[\frac{h}{kT\tau} \right] \dots \dots \dots (6)$$

[(k = Boltzmann's constant ($1.3806 \times 10^{-23} \text{ JK}^{-1}$) and h = Planck's constant ($6.6250 \times 10^{-34} \text{ Jsec}$)]

Table 1: Values of density, viscosity, ultrasonic velocity and related acoustical parameters of various concentration of solution at 298 K

Conc. of solution (%)	Density(ρ) (10^3 Kg m^{-3})	Viscosity(η) ($10^{-3} \text{ Kg m}^{-1} \text{ s}^{-1}$)	Ultrasonic velocity (U) (ms^{-1})	Acoustic Impedance (Z) ($10^3 \text{ Kg m}^{-2} \text{ s}^{-1}$)	Adiabatic compressibility (β) ($10^{-10} \text{ Kg}^{-1} \text{ ms}^2$)	Intermolecular free length(L_f) (10^{-11} m)	Relative association (R_A)	Relaxation time(τ) (10^{-13} sec.)	Gibb's free energy(ΔG^*) ($10^{-20} \text{ J mol}^{-1}$)
0 %	0.827	1.09	1236.41	1022.51	7.910	5.782	1.000	11.496	0.809
0.25 %	0.832	1.33	1236.48	1028.75	7.861	5.765	1.006	13.941	0.888
0.50 %	0.831	1.30	1242.27	1032.32	7.798	5.741	1.006	13.516	0.875
0.75 %	0.834	1.32	1257.67	1048.89	7.581	5.661	1.014	13.342	0.870
1 %	0.836	1.43	1261.35	1054.48	7.518	5.637	1.018	14.335	0.900

Table 2: Values of density, viscosity, ultrasonic velocity and related acoustical parameters of various concentration of solution at 303 K

Conc. of solution (%)	Density(ρ) (10^3 Kg m^{-3})	Viscosity(η) ($10^{-3} \text{ Kg m}^{-1} \text{ s}^{-1}$)	Ultrasonic velocity (U) (ms^{-1})	Acoustic Impedance (Z) ($10^3 \text{ Kg m}^{-2} \text{ s}^{-1}$)	Adiabatic compressibility (β) ($10^{-10} \text{ Kg}^{-1} \text{ ms}^2$)	Intermolecular free length(L_f) (10^{-11} m)	Relative association (R_A)	Relaxation time(τ) (10^{-13} sec.)	Gibb's free energy(ΔG^*) ($10^{-20} \text{ J mol}^{-1}$)
0 %	0.827	1.00	1222.81	1011.26	8.087	5.901	0.996	10.782	0.803
0.25 %	0.831	1.20	1218.99	1012.98	8.098	5.905	1.000	12.957	0.879
0.50 %	0.83	1.15	1225.49	1017.15	8.022	5.877	1.001	12.301	0.858
0.75 %	0.833	1.19	1240.03	1032.94	7.807	5.798	1.008	12.387	0.861
1 %	0.836	1.27	1246.31	1041.91	7.701	5.758	1.014	13.040	0.882

Table 3: Values of density, viscosity, ultrasonic velocity and related acoustical parameters of various concentration of solution at 308 K

Conc. of solution (%)	Density(ρ) (10^3 Kgm $^{-3}$)	Viscosity(η) (10^{-3} Kgm $^{-1}$ s $^{-1}$)	Ultrasonic velocity (U) (ms $^{-1}$)	Acoustic Impedance (Z) (10^3 Kgm $^{-2}$ s $^{-1}$)	Adiabatic compressibility (β) (10^{-10} Kg $^{-1}$ ms 2)	Intermolecular free length(L_f) (10^{-11} m)	Relative association (R_A)	Relaxation time(τ) (10^{-13} sec.)	Gibb's free energy(ΔG^*) (10^{-20} Jmol $^{-1}$)
0 %	0.806	0.91	1204.99	971.22	8.545	6.121	0.966	10.368	0.806
0.25 %	0.828	1.07	1201.58	994.90	8.365	6.056	0.992	11.934	0.866
0.50 %	0.827	1.03	1210.01	1000.67	8.259	6.018	0.993	11.342	0.844
0.75 %	0.833	1.03	1224.19	1019.75	8.010	5.927	1.004	11.001	0.831
1 %	0.835	1.19	1230.74	1027.66	7.906	5.888	1.008	12.545	0.887