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RESEARCH PUBLICATIONS

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Microwave assisted synthesis and characterization of terpolymer derived from o-aminophenol , urea and formaldehyde

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ABSTRACT: **This paper presents the microwave assisted synthesis of a terpolymer by using the o-aminophenol , urea and formaldehyde. The o-APUF terpolymer have been synthesized from o-aminophenol (o-AP), urea (U) and formaldehyde (F) in DMF media at 132±2 °C for 110 sec where as the conventional method took five hours refluxing at 126 to 128°C. The synthesized terpolymer was purified and then characterized on the basis of spectral data generated from FTIR, H^{1}NMR, C^{13}NMR and SEM.**

Keywords: **microwave irradiation, structure, spectral analysis, o-APUF.**

INTODUCTION

Tercopolymer are macromolecular entities which form an integral part of the backbone. Tercopolymers are found to be amorphous powder or crystalline resinous in nature and form special class of polymers which are widely known for their uses. Terpolymer is found very useful application as adhesive, high temperature flame resistant, fibers, coating materials, semiconductors, catalysis and ion exchange resins.[1,2,3] Ion-exchange resins have attracted much interest in the recent years due to their application in waste water treatment, metal recovery and for the identification of specific metal ions.[4,5]. However, the metal ion removal by chelating ion-exchange resin using batch equilibration method has gained rapid acceptance because of its wide variety of sorbent phases, high degree of selectivity, high loading capacity and enhanced hydrophilicity [6]. Ionexchangers are widely used for the treatment of radioactive wastes from nuclear power stations [4].

MATERIAL AND METHODS:

SYNTHESIS OF o-APUF TERPOLYMER

The proportionate mixture of o-aminophenol (0.1 mol, 1.091 g) and urea (0.1 mol, 0.70 g) with formaldehyde (7.50 ml of 37 %, 0.2 mol) in a proportion of 1:1:2 in the presence of DMF medium at 130 ± 2^{0}C for 110 Second using a microwave system. The resinous brown solid mass obtained was immediately removed from the flash as soon as the reaction period was over and then it purified.

The resinous brown product so obtained was repeatedly washed with cold distilled water, dried in air and powdered with the help of mortar and pestle. The powdered sample was washed many times with boiling water and ethanol to remove unreacted monomers. It was further purified by dissolving in 8% NaOH solution, filtered and reprecipitated by gradual addition of ice cold 1:1 (v/v) concentrated HCl/distill water with constant and rapid stirring to avoid lump formation. The process of reprecipitation was repeated thrice. The resulting terpolymer sample was filtered, washed several time with boiling water, dried in air, powdered and kept in vacuum over silica gel. The yield of the terpolymer was found to be 88%. The reaction is shown as follows.

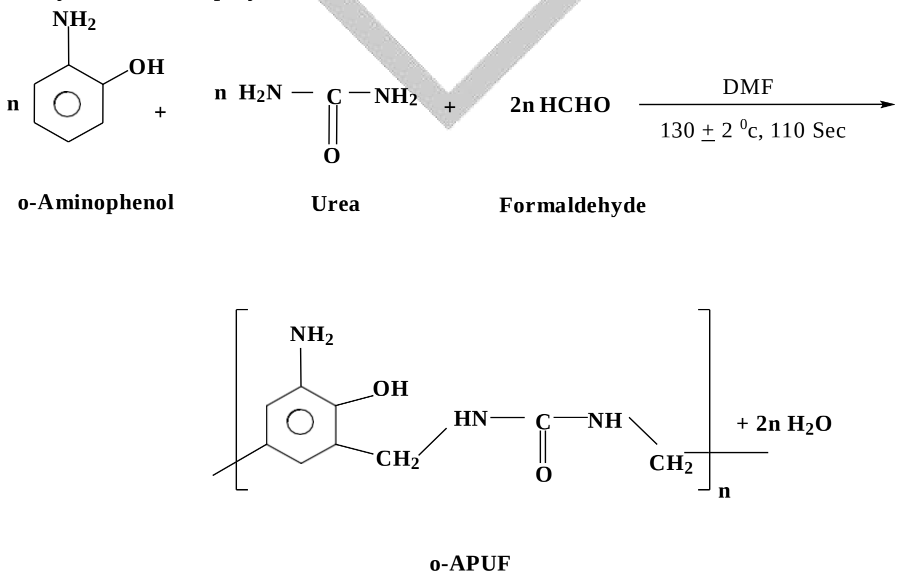


Fig. 1. Reaction and Suggested Structure of Representative o-APUF terpolymer

RESULTS AND DISCUSSION:

I. 1H-NMR SPECTROSCOPY

The NMR spectra of o-APUF terpolymers were scanned in DMSO and have been shown in (Fig. 2). The NMR spectral data are incorporated in (Table 1). Proton NMR spectra of terpolymer show a weak multiplet signal (unsymmetrical pattern) 7.80 to 7.90 (δ) ppm is due to the aromatic protons. The weak multiply signals in the range at 6.62 – 6.76 (δ) ppm is due to the amido $–CH_2$-NH-CO linkage. A signal at 3.66 – 4.12 (δ) ppm is due to methylene proton of (Ar – CH_2 – N) moiety. The signal appeared in the range of 8.28 – 8.34 (δ) ppm can be assigned to proton of phenolic -OH. A week signal appeared in the range of 1.2507-1.2526 (δ) ppm is due to the presence of Ar-NH_2 group. In the region of 2.16 – 2.69 (δ) ppm is due to methelenic bridges of Ar – CH_2 – Ar linkage[14].

Table 1
1H NMR Spectral Data of o-APUF Terpolymer

Chemical shift (δ) ppm of copolymer				Nature of proton assigned	Expected Values
o-APUF-I	o-APUF-II	o-APUF-III	o-APUF-IV		
7.9	7.8	7.89	7.88	Aromatic proton (unsymm. Pattern)	6.5-8.5
6.62	6.64	6.76	6.76	Amido proton of –CH2-NH-CO linkage	6-7
3.66	3.89	3.99	4.12	Mathelene proton of Ar-CH2-N moiety	3-5.5
8.28	8.34	8.31	8.34	Proton of Ar-OH (phenolic-OH)	7.5-8.5
1.2507	1.2526	1.2505	1.2513	Amine Ar-NH_2	1.1-3.5
2.16	2.49	2.54	2.69	Methelene proton of Ar-CH2-Ar	1.5-5.5

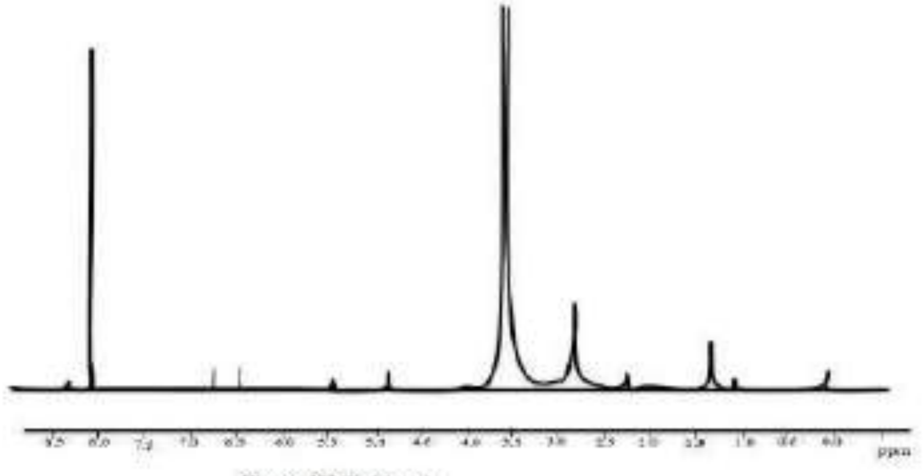


Fig. 2. ^{1}H NMR Spectra of o-APUF Terpolymer

II. ^{13}C NMR SPECTROSCOPY

13C NMR spectra of o-APUF terpolymers are presented in Fig. 3. The 13C NMR spectra of o-APUF terpolymers peak are assigned with reference to the literature values. The13C NMR spectra show the corresponding peaks at 122.14, 128.71, 129.49, 132.88 and 154.94 ppm with respect to C_1-C_6 of aromaticring of the benzophenone. The peak appeared at 163.11 ppm of may be corresponding to carbonyl group of biuret moiety. The peak appeared at 67.56 ppm may be due to the presence of –C-OH group in aromatic benzophenone group. The peaks appeared at 40.27 ppm may assigned to the –CH2 – bridge in terpolymer. The medium peak appeared at 116.33 ppm may be confirmed the presence of –C-NH group of terpolymer. The 13C NMR spectrum clearly established the linear structure of the terpolymer synthesized from o-aminophenol-urea-formaldehyde.

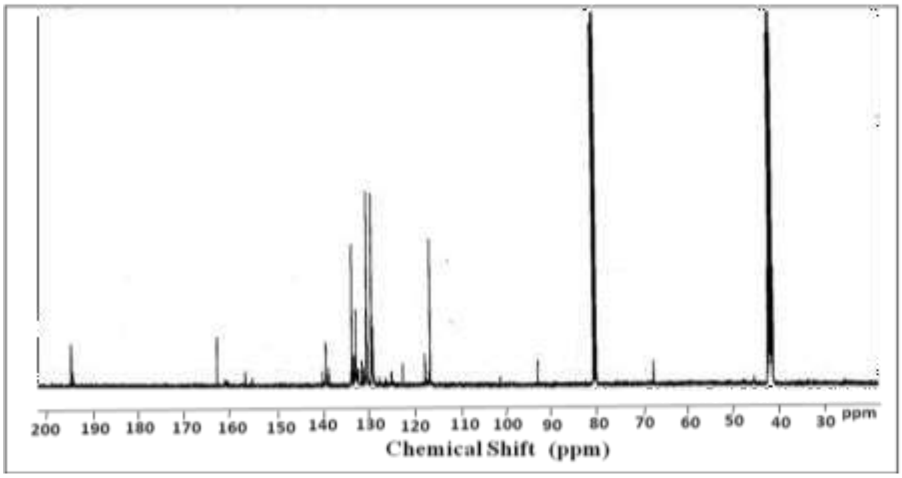


Fig. 3. ^{13}C NMR Spectra of o-APUF-I Terpolymer

III. INFRA-RED SPECTROSCOPY

The recorded FTIR spectra of o-APUF terpolymer is shown in (Fig. 4) and the important IR bands along with their assignments have appeared in the spectrum is tabulated in (Table 2). The spectrum shows a very broad absorption band at 3252-3403 cm^{-1} may due to the the stretching vibrations of phenolic hydroxyl (Ar-OH) involved in intramolecular hydrogen bonding between –OH, >CO and >NH group of amide/imides [15]. The 1,2,3,5 tetrasubstitution of aromatic benzene ring can be recognized from sharp and medium absorption bands appeared at 559-583cm^{-1}, 1086-1100 cm^{-1} respectively. The weak band at 2812-2887 cm^{-1} may be due to stretching vibration of >NH (amide/imides). The band at 1527-1535 cm^{-1} may be due to bending vibration of –NH in secondary amide. The bands at 1442-1447 cm^{-1} indicate the (-C-H bending) and –CH$_2$ bending of CH$_2$ group. The band obtained at 1288-1356 cm^{-1} suggests the presence of methylene (–CH$_{2)}$ bridge. The sharp and strong band at 1624 – 1654 cm^{-1} may be due to the bending vibration of >C=O group of urea moiety.

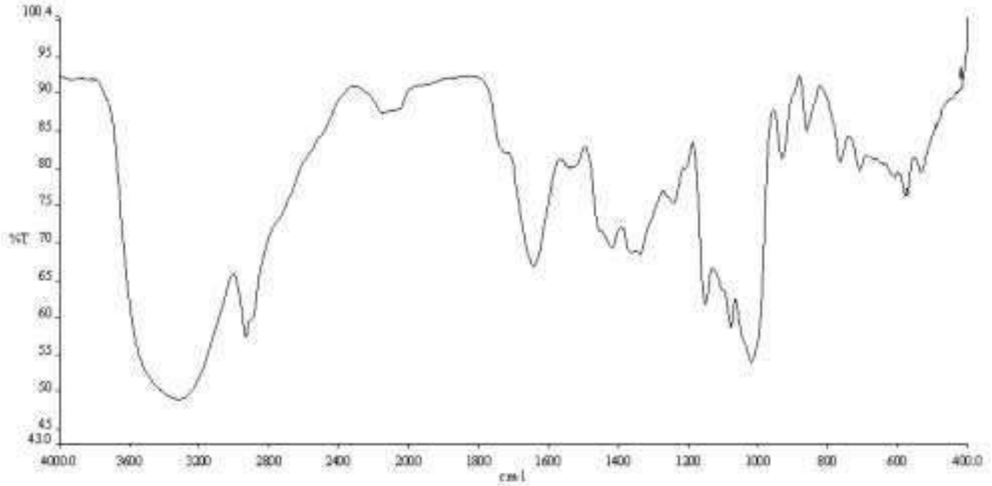


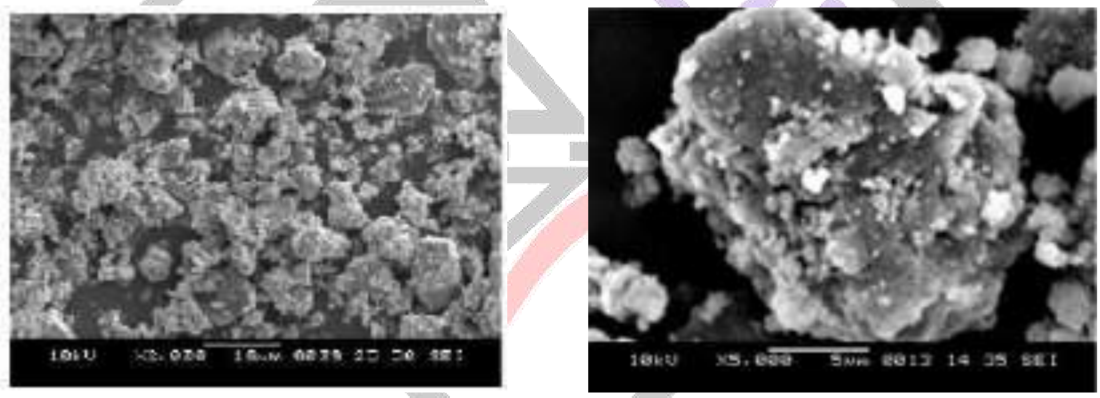
Fig.4. Infra Red Spectra of o-APUF Terpolymer

Table 2
IR frequencies of o-APUF Terpolymer

Observed band frequencies (cm^{-1})				Assignment	Expected band frequencies (cm-1)
o-APUF-I	**o-APUF-II**	**o-APUF-III**	**o-APUF-IV**		
3398(b)	3403(b)	3392 (b)	3252(b)	-OH phenolic intermolecular hydrogen bonding	3500-3200
2812(w)	2887(w)	2822(w)	2842(w)	>NH stretching (Amide/Imides)	2800-2900
1629 (st,sh)	1630 (st,sh)	1624 (st,sh)	1654(st,sh)	(Carbonyl Stretching vib.)	1630-1680
1535(m)	1537 (m)	1527 (m)	1528 (m)	NH bending vibration of secondary amide	1510-1550
1447 (m)	1444 (m)	1442(m)	1443 (m)	(-C-H bending) of CH_2 group	1445-1485
1355(sh,m)	1288 (sh,m)	1310(sh,m)	1356(sh,m)	-CH_2 methylene bridge	1250-1340
559 (m) 1100 (m)	583(m) 1086(m)	562 (m) 1094 (m)	594 (m) 1089 (m)	1,2,3,5 substitution in aromatic ring	550-600 1050

sh=sharp, b=broad, st= strong, m= medium, w=weak

IV. SCANNING ELECTRON MICROSCOPY (SEM)



(a) (b)

Fig. 5. SEM Micrographs of o-APUF Terpolymer

The scanning electron morphology of the o-APUF terpolymer sample was investigated by different magnification 1000X and 5000X, which are shown in Fig. 5 (a) and (b) respectively. The terpolymer appeared to be brown in colour. The SEM morphology of o-APUF terpolymer exbitits spherulites and fringed model. The spherules are typical polycrystalline formation having as good as smooth surface. In the present case the spherulites are complex polycrystalline nature of o-APUF terpolymer. The morphology of terpolymer shows also a fringes model of the crystalline amorphous structure. The extent of crystalline character depends on the acidic nature of the monomer. The morphology shows the fringed and scatted nature having shallow pits represent the transition between crystalline and amorphous. The terpolymer exhibits characters that are more amorphous with closed packed surface having deep pits. Thus, by SEM micrographs morphology study of o-APUF terpolymer shows a transition between amorphous and crystalline state. However, the o-APUF terpolymers show a more amorphous structure rather than crystalline, hence o-APUF terpolymer exhibits higher metal ion exchange characteristic.

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MICROWAVE ASSISTED SYNTHESIS AND CHARACTERISATION OF TERPOLYMER DERIVED FROM O-AMINOPHENOL, MELAMINE AND FORMALDEHYDE

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ABSTRACT
This paper presents the microwave assisted synthesis of a terpolymer by using the o-aminophenol , melamine and formaldehyde. The o-APMF terpolymer have been synthesized from o-aminophenol (o-AP), melamine (M) and formaldehyde (F) in DMF media at 132±2 ºC for 110 sec. The synthesized terpolymer was purified and then characterized on the basis of spectral data generated from FTIR, H^1NMR, C^{13}NMR and SEM.

Keywords: *microwave irradiation, structure, spectral analysis, o-APMF.*

INTODUCTION

The terpolymers offered novelty and versatility; hence they occupy the pivotal position in the field of material science. The progress in the field of terpolymer has been extensively rapid, as they are useful in packaging, adhesive, coating in electrical sensors and organometalic semiconductors. [1-3]. Polymer additives improve manufacture process and product quality. It can form continuous phase of coating with no deleterious effects on coatings, and having better thermal stability [4-6].

In recent years, microwave techniques have been mainly applied for domestic, industrial and research purposes. Various synthetic reactions using microwave irradiation involve processes to prevent pollution and consume minimum amounts of materials as well as energy while producing little or no waste material. More recently, microwave-assisted organic synthesis, a new method, has been developed to obtain more efficient compounds in a short reaction time period [12, 13]. This method has been applied for many inorganic, organic and polymer syntheses. [14-18]. Various researchers have reported the application of microwave technology in terpolymer synthesis [19,20]. Microwave irradiation has been applied in recent years for step-growth polymerizations and ring-opening polymerizations as well as radical polymerizations [21].

In this article, we present the synthesis and characterization of terpolymer (o-APMF) derived o-aminophenol, melamine using the linkage of formaldehyde. The newly synthesized terpolymer has been characterized by elemental analysis and spectral methods.

MATERIAL AND METHODS:

SYNTHESIS OF o-APMF TERPOLYMER

o-APMF terpolymer was prepared from o-aminophenol (0.1 mol, 1.243 gm,) and melamine (0.1 mol, 1.26 gm,) with formaldehyde (11.1 ml of 37 %, 0.3mol) in the molar ratios of 1:1:3 in the presence of DMF medium at 130 ± 2^0C for 110 Second using a microwave system. The resinous brown solid mass obtained was immediately removed from the flash as soon as the reaction period was over and then it purified. Excellent yield of terpolymer be obtained by this reaction.

The resinous brown product so obtained was repeatedly washed with cold distilled water, dried in air and powdered with the help of mortar and pestle. The powdered sample was washed many times with boiling water and methanol to remove unreacted monomers. It was further purified by dissolving in 8% NaOH solution, filtered and reprecipitated by gradual drop wise addition of ice cold 1:1 (v/v) concentrated HCl/distill water with constant and rapid stirring to avoid lump formation. The process of reprecipitation was repeated thrice. The resulting terpolymer sample was filtered, washed several time with boiling water, dried in air, powdered and kept in vacuum over silica gel. The yield of the copolymer resin was found to be 89%.

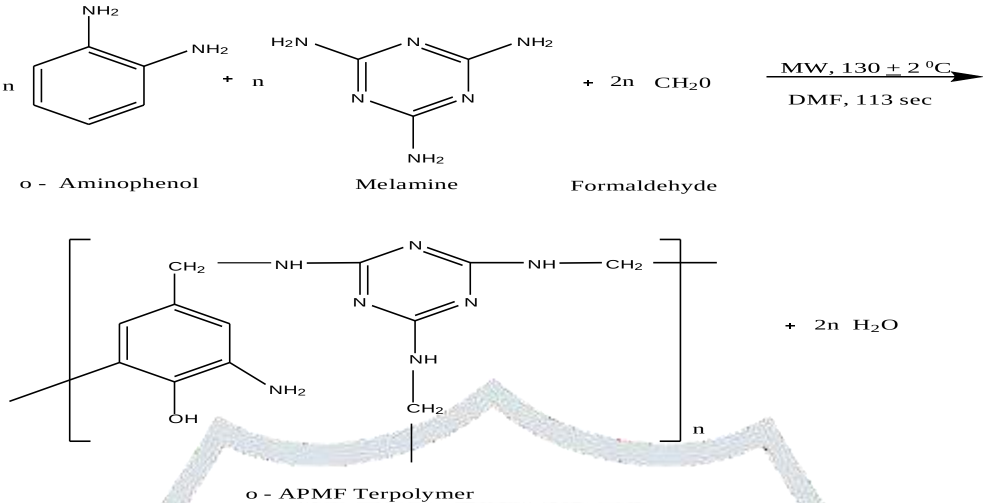


Fig. 1. Reaction and Suggested Structure of Representative o-APMF terpolymer

RESULTS AND DISCUSSION:

A) ^{1}H NMR SPECTROSCOPY

The NMR specta of o-APMFwere scanned in DMSO and have been shown (Fig. 2). The NMR spectral data are incorporated in (Table 1). All the o-APMF terpolymer show the weak multiplate signal (unsymmetrical pattern) in the region of 6.55 - 6.75(δ) ppm may be attributed to aromatic proton. The signal appeared in the range of 7.74 to 7.80 (δ) ppm can be assigned due to phenolic hydroxyl protons. The position of the signal of phenolic hydroxyl proton is slightly shifted to downfield, indicating clearly the intramolecular hydrogen bonding of -OH group [186-187]. The signal at 2.27 - 2.36 (δ) ppm may be due to methylene proton of Ar-CH_2 moiety.The intense weakly multiplate signals at 2.14 - 2.16 (δ) ppm may be attributed to methyl proton of Ar-CH_3 group. The signal at 3.26to 3.38 (δ) ppm may be due to the methylene proton of Ar-CH_2-N moiety. The signal in the region 5.18-5.22 (δ) ppm are attributed to protons of -NH bridge.

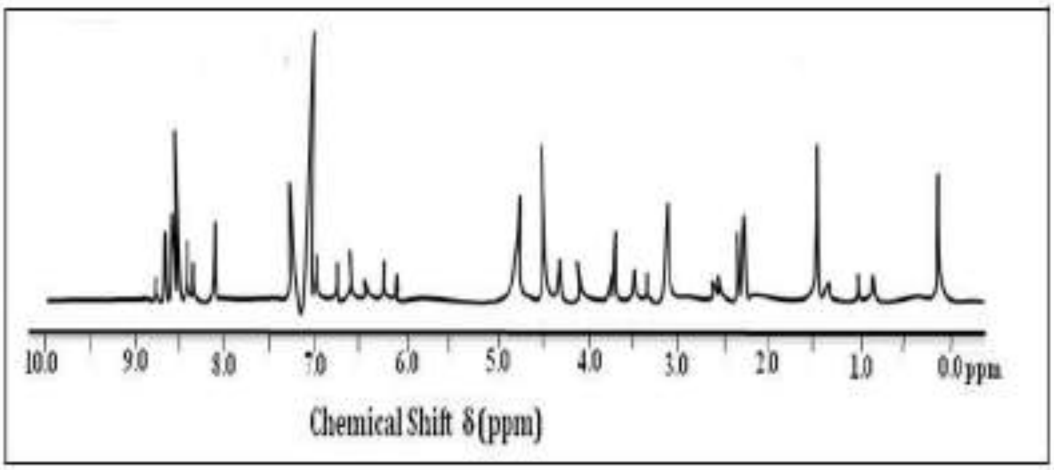


Fig. 2. ^{1}H NMR Spectra of o-APMF Terpolymer

Table-1 ^{1}H NMR Spectral Data of o-APMF Terpolymer

Observed Chemical Shift (δ) ppm				**Nature of proton assigned**	**Expected chemical shift (d) ppm**
o-APMF-I	**o-APMF-II**	**o-APMF-III**	**o-APMF-IV**		
2.15	2.14	2.16	2.17	Methyl proton Ar-CH$_3$ group	2.00 - 3.00
2.27	2.29	2.31	2.36	Methylene proton of Ar-CH$_2$ moiety	2.00 - 3.00
3.38	3.3	3.26	3.34	Methylenic proton of Ar-CH$_2$-N moiety	3.00 - 3.50
5.22	5.22	5.18	5.19	Proton of –NH bridge	5.00 - 8.00
6.8	6.55	6.7	6.7	Aromatic Proton (Ar-H)	6.2 - 8.5
7.74	7.76	7.77	7.8	Proton of phenolic-OH involved intramolecular hydrogen bonding	7.00 - 12.00

B) ^{13}C NMR SPECTROSCOPY

A ^{13}C NMR spectrum of o-APMF terpolmer is presented in Fig. 3. The ^{13}C NMR spectra of o-APMF terpolymer peak are assigned with reference to the literature value. The ^{13}C NMR spectra show the corresponding peaks appeared at 118.64, 119.92, 128.93, 133.90 and 136.90 ppm may be corresponded to carbons present in aromaticring of the benzophenone. The peak appeared at 164.77 ppm of may be corresponding to carbonyl group of biuret moiety. The medium peak appeared at 116.55 ppm may be confirmed the presence of –C-NH group of copolymer resin. The peak appeared at 80.48 ppm may be due to the presence of –C-OH group in aromatic benzophenone group. The peaks appeared at 43.46 ppm may be due to the –CH$_2$ – bridge in terpolymer. The ^{13}C NMR spectrum clearly established the linear structure of the terpolymer synthesized from o-aminophenol-melamine-formaldehyde.

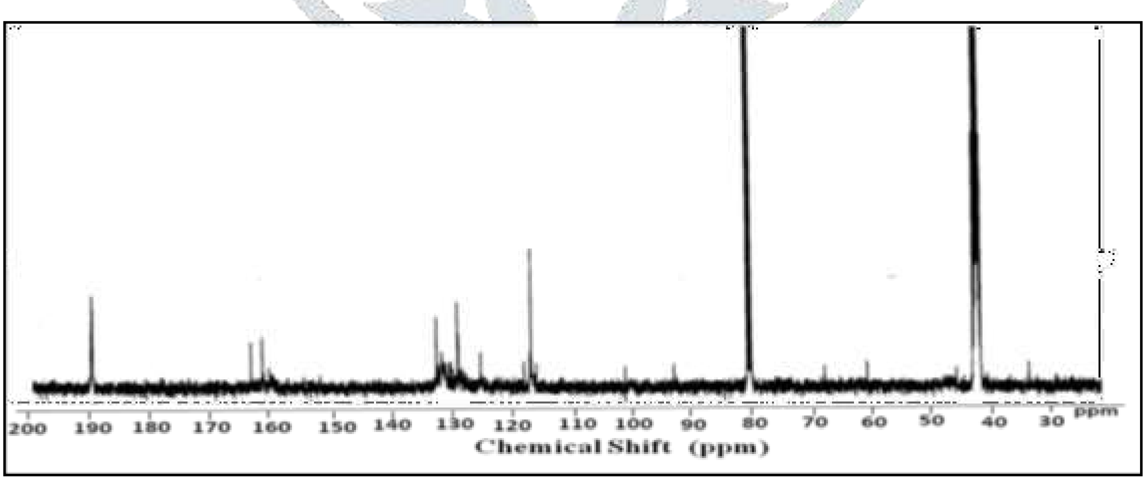


Fig. 3. ^{13}C NMR Spectra of o-APMF Terpolymer

C) INFRA-RED SPECTROSCOPY

The recorded FTIR spectra of o-APMF terpolymer are shown in (Fig. 4) and important IR band along with their assignments have appeared in the spectrum is tabulated in (Table 3). The FTIR spectra of terpolymer are found to be similar pattern of various bands at the characteristics frequencies, which are described below.

The spectrum shows a very board absorption band appeared at 3331-3419cm^{-1} may be due to the stretching vibrations of phenolic hydroxyl (-OH) groups involved in intramolecular hydrogen bonding. A peak at 1570-1700 cm^{-1} may be ascribed to aromatic skeletal ring. The sharp, medium/ weak absorption bands appeared at 946-949 cm^{-1} and 1038-1040 cm^{-1} may be due to 1,2,3,5 substitution of aromatic benzene ring respectively. The sharp and strong band appeared at 3042-3094 cm^{-1} indicates the presence of -NH bridge or may be due to -CH_3 stretching. The bands appeared at 1478 to 1482 cm^{-1} may be due to -NH bending of secondary amide and the band at 1354-1360 cm^{-1} may be due to (-CH_2-) bridge[22].

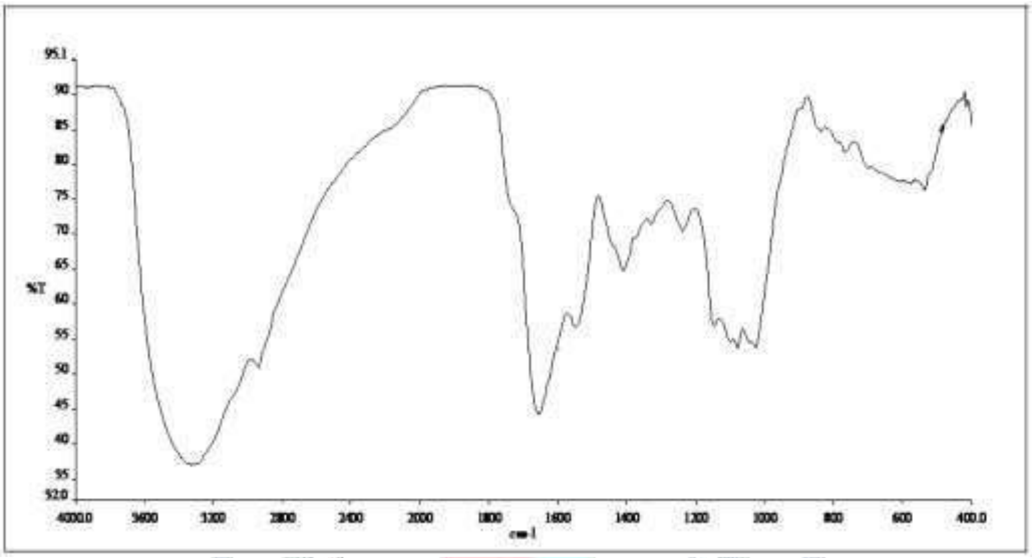


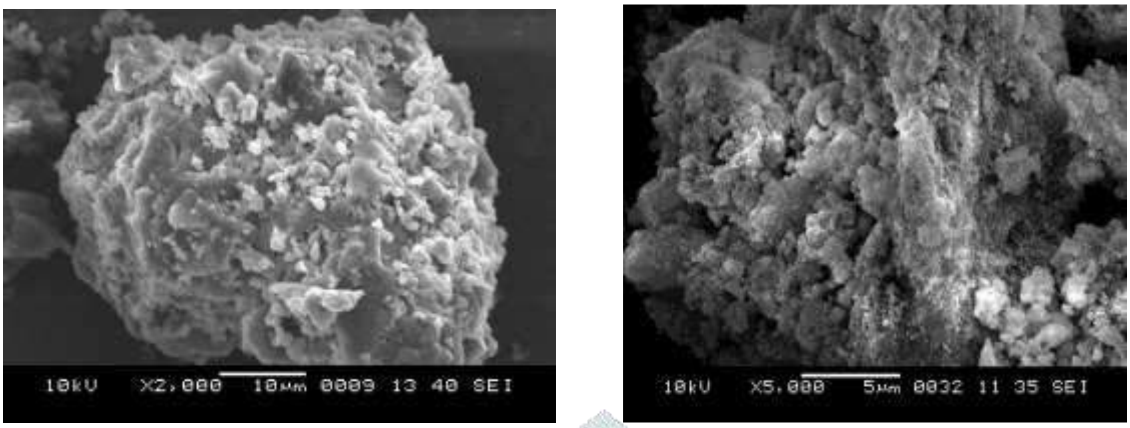
Fig. 4. Infra Red Spectra of o-APMF Terpolymer

Table 3
IR Frequencies of o-APMF Terpolymer

Observed band frequencies (cm^{-1})				Assignment	Expected band frequencies (cm-1)
o-APMF-I	o-APMF-II	o-APMF-III	o-APMF -IV		
3331 (b,st)	3381 (b,st)	3384 (b,st)	3382 (b,st)	-OH phenolic intermolecular hydrogen bonding	3450-3200
2912 (w, m)	2920 (w, m)	2942 (w, m)	2940 (w, m)	Aryl C-H stretching	3000-2910
3042 (b,st)	3066(b,st)	3086(b,st)	3094(b,st)	>CH_2, >NH, -CH3 stretching	~3000
1653 (sh,b)	1569 (sh,b)	1572 (sh,b)	1583 (sh,b)	Aromatic ring (substituted)	1700-1500
1482 (m)	1480 (m)	1478 (m)	1480 (m)	-NH bending of secondary amide	1500-1450
1354 (w)	1360 (w)	1357 (w)	1359 (w)	-CH_2- bridge	1390-1370
946 (w)	948 (w)	947 (w)	950(w)	1,2,3,5 substitution in benzene	~950
1038 (m)	1039 (m)	1040 (m)	1039 (m)		~1050

sh=sharp, b=broad, st= strong, m= medium, w=weak

D. SCANNING ELECTRON MICROSCOPY (SEM)



(a) **(b)**

Fig. 5. SEM Micrographs of o-APMF-I Terpolymer

The scanning electron morphology of o-APMF terpolymer sample was investigated by different magnification 2000X and 5000X, which are shown in Fig. 5 (a) and (b) respectively. The terpolymer appeared to be dark drawn in color. The scanning electron morphology of o-APMF terpolymer shown spherule and fringed model. The spherules are complex polycrystalline formation having as good as smooth surface. This indicates the crystalline nature of o-APMF terpolymer. The morphology of terpolymer shows also a fringes model of the crystalline amorphous structure. The extent of crystalline character depends on the acidic nature of the monomer. But the photograph shows the fringed and scatted nature having shallow pits represent the transition between crystalline and amorphous. The terpolmer exhibits more amorphous characters with closed packed surface having deep pits, which is shown Fig.5. Due to the deep pits, terpolmer exhibits higher exchange capacity for Pb (II) ions (as well as other many metal ions). This could be the reason of bigger nitrated Pd (II) ions, which can easily penetrate in to the deep pits. Thus by scanning electron morphology of the o-APMF terpolmer shows the transition between crystalline and amorphous nature. When compare to the other resin, the o-APMF terpolymer resin is more amorphous in nature, hence shows higher metal ion exchange capacity.

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OTHERS

Study of Acoustic Properties of Phenol Based Terpolymer in DMSO

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ABSTRACT

The experimental data of ultrasonic velocity, density, viscosity have been obtained for o-APUF terpolymer in DMSO, over the concentration range of (0.5 to 3.0) mol.Kg^{-1}. The derived parameters such as adiabatic compressibility (βs), free length (L_f), Relative Association (RA), Acoustic Impedance (Z) have been calculated from viscosity, velocity and density measurements. The variations of these properties with concentration give the information about solute-solvent interactions.

Keywords: Terpolymer, ultrasonic velocity, acoustic impedance, adiabatic compressibility, intermolecular free length.

Improved and convenient green one pot synthesis of chiral ethylphenidate hydrochloride

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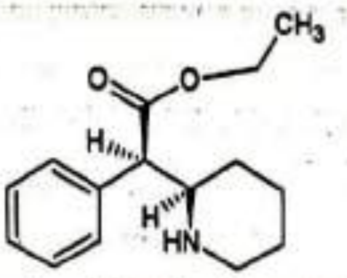
ABSTRACT

A novel one pot green process have been developed for the synthesis of dexethylphenidate hydrochloride via esterification of *d-threo*-2-phenyl-2-(piperidin-2-yl) –acetamide using sulphuric acid as catalyst. The present method offers significant advantages over the earlier reported methods like direct conversion of amide to ester, simple work-up procedure, less time and excellent yield with pharmacopeia grade purity of desired products. Moreover, here we have avoided highly hazardous and cancer causing carcinogenic chemicals (genotoxic impurities consideration).The structure confirmation is made by elemental analysis and spectral data.



ethyl (2R)-phenyl[(2R)-piperidin-2-yl]ethanoate

Keywords: Esterification, Green chemistry, Elemental analysis, spectral data.

Study of Acoustic Properties of Phenol Based Terpolymer in DMSO

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Abstract: The experimental data of ultrasonic velocity, density, viscosity have been obtained for o-APUF terpolymer in DMSO, over the concentration range of (0.5 to 3.0) mol.Kg^{-1}. The derived parameters such as adiabatic compressibility (βs), free length (L_f), Relative Association (RA), Acoustic Impedance (Z) have been calculated from viscosity, velocity and density measurements. The variations of these properties with concentration give the information about solute-solvent interactions.

Key words: *Terpolymer, ultrasonic velocity, acoustic impedance, adiabatic compressibility, intermolecular free length.*

Introduction:

Ultrasonic is a branch of science, which deals with waves of high frequencies. The study of intermolecular interaction plays an important role in the development of molecular sciences. In recent years Ultrasonic method has become a powerful tool in providing information regarding the physico-chemical properties of liquid system.[1-4] A large number of studies have been made on the molecular interaction in liquid systems by various physical methods like Infrared, [5,6] Raman effect, [7,8] Nuclear Magnetic resonance, Dielectric constant,[9] ultra violet[10] and ultrasonic method. [11,12] In the present investigation, free intermolecular length, acoustic impedance, adiabatic compressibility, relaxation time of terpolymer derived from o-Aminophenol (o-AP), Urea (U) and Formaldehyde (F) in DMF media has been evaluated in DMSO at 310.15 K different concentration using experimentally determined values of ultrasonic velocity, viscosity and density.

Materials & Methods:

The solutes used in the present investigation were synthesized by standard methods.[14] The solvent DMSO used was of analytical grade. It was obtained from E. Merck Chemical Company. Solvent was used after purification by distillation. A thoroughly cleaned and dried Ostwald viscometer filled

with the experimental liquid was placed vertically in a glass-fronted, well-stirred water bath. Once the thermal equilibrium was attained, the flow times of the liquid were recorded with an accurate stopwatch (+0.01s). The viscosities were calibrated with double distilled water and with DMSO. Care was taken to reduce evaporation during the measurements. The present value for the liquids agrees with the literature value within a deviation of +0.01 Poise. Ultrasonic velocity measurements were made by variable path single crystal interferometer (Mittal Enterprises, Model F–81) at 2MHz with the accuracy of +0.03 %. Ultrasonic and thermodynamic parameters have been measured at
310.15 K.

Theory and Formulae:

The ultrasonic velocity (Us), density (d) and viscosity (ηs) in terpolymer resin of various concentrations have been measured at 310.15 K. Acoustical parameters such as adiabatic compressibility (βs), free length (Lf), acoustic impedance (Z), relaxation time (τ), were determined using the observed values of velocity, density & viscosity using the standard relations given below.

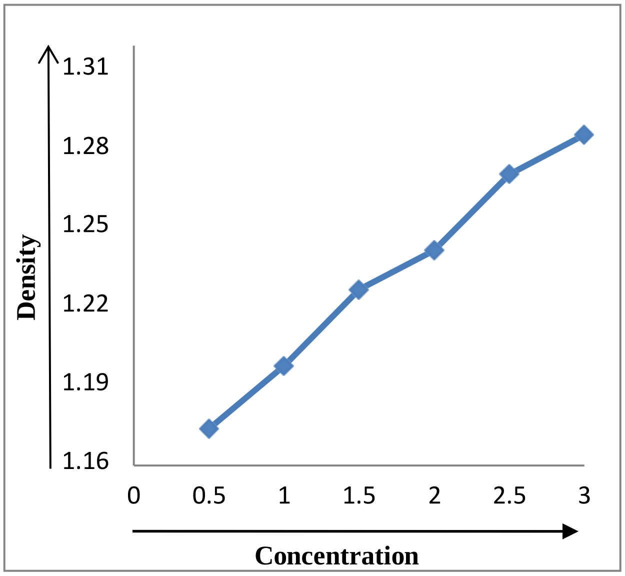
1) **Adiabatic compressibility (βs)** has been calculated from the ultrasonic velocity (Us) and the density (d) of the medium using the equation as:
   $\beta s = 1 / 2 \ Usd$
2) **Intermolecular free length (Lf)** has been determined as:
   $Lf = K \times \sqrt{\beta s}$
   Where K – is a Jacobson's constant.
3) **Relaxation time (τ)** has been calculated from the adiabatic compressibility (βa) and viscosity of the liquid (η) as:
   $\tau = 4/3 \ \beta s \ \eta$
4) **Acoustic impedance (Zs)** The specific acoustic impedance is related to density and ultrasonic velocity by the relation.
   $Zs = Us \times d$

Results & Discussion:

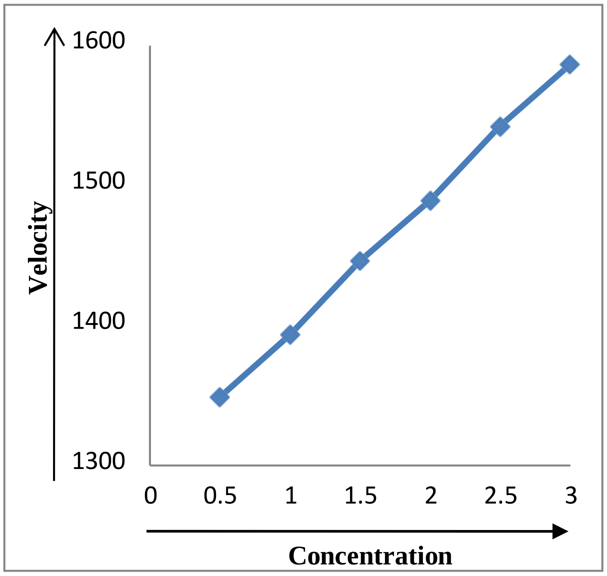
Table 1: Values of Density (d), Velocity (U_s), Viscosity (η_s), Adiabatic Compressibility (β_s), Specific Acoustic Impedance (Z_s), Intermolecular Free Length (L_f), Relaxation time (τ): at 310.15 K in DMSO.

Table–I

Sr. No	Conc. (C)	d (kgm^{-3})	Us (ms^{-1})	η_s	βs ($X10^{-10}m^2N^{-1}$)	Zs ($kgm^{-2}s^{-1}$)	Lf (10^{-8})	τ (10^{-10}sec)
1	3.0	1.286	1586.43	1.334	5.108	2039.6	1.498	9.085
2	2.5	1.271	1542.32	1.286	5.342	1959.8	1.532	9.161
3	2.0	1.242	1489.21	1.248	5.600	1849.5	1.569	9.320
4	1.5	1.227	1446.14	1.205	5.867	1774.3	1.606	9.423
5	1.0	1.198	1393.51	1.150	6.170	1669.7	1.647	9.465
6	0.5	1.174	1348.89	1.108	6.452	1583.5	1.684	9.532



(Fig. 1)



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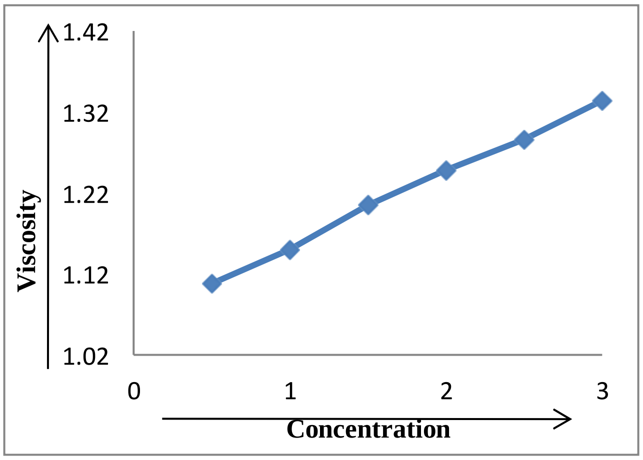

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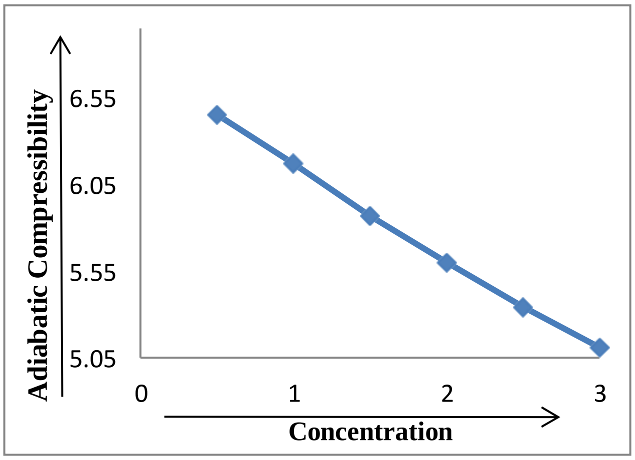

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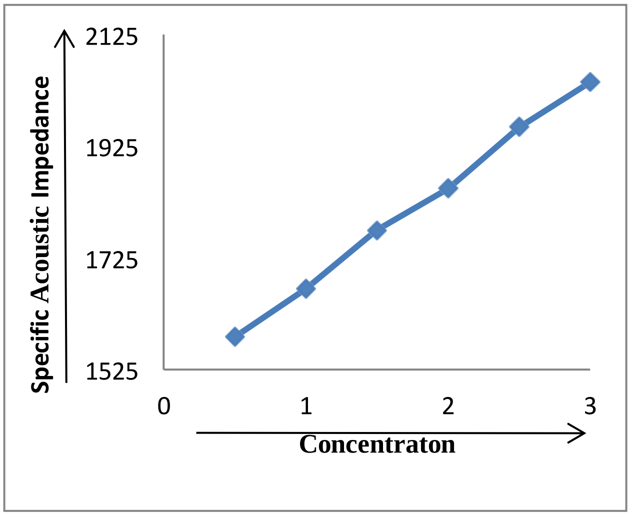

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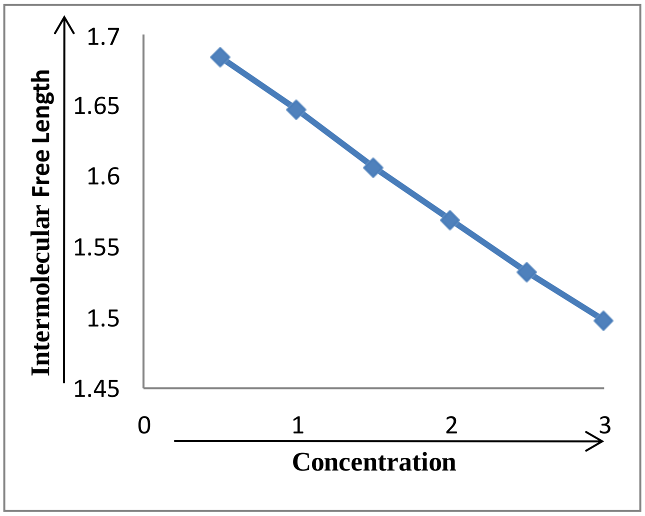

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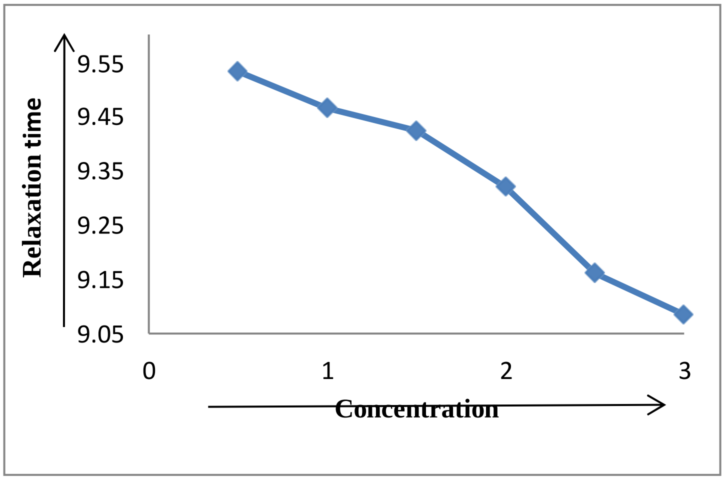

(Fig. 7)

The ultrasonic velocity, ‘U’ depends on the wavelength ‘λ’ of the sound wave. Since the frequency (2 MHz) is constant, λ increases with the increase in the concentration as depicted in Table−I. the ultrasonic velocity in medium depends inversely on density and adiabatic compressibility of the medium. For the terpolymer, data reveals increase in ultrasonic velocity (U) increases with increase in the concentration of solute. This suggests presence of solute-solvent interactions.[16,17] The increase suggests a structure-making capacity of polymers in solution. Moreover, the increase in ultrasonic velocity indicates the possibility of H-bond formation between solute and solvent. There is also an indication of greater association among the molecules.

As density and viscosity of any solution or solvent are directly related to each other, the measured values show similar trend. From the computed data given in Table-I, for the terpolymer viscosity increases with concentration of solute. This may be due to the formation of cage like structure during solute-solvent interactions. Again the increase suggests the H-bond forming tendency of the solute. The solutes are of structure-maker type. The terpolymer contains two bulky rings therefore viscosity is high and it increases with the concentration.

From the Table-I it can be seen that for the terpolymer, adiabatic compressibility decreases with increase in concentration of solute. This may be due to the aggregation of solvent molecules around the ions supporting solute-solvent interaction. The results are in accordance with the findings of earlier authors.[18,19] As concentration increases, a larger portion of the solvent molecules are electro restricted and the amount of bulk solvent decreases causing the compressibility to decrease. Decrease in adiabatic compressibility indicates the formation of large number of tightly bound systems.

The variation of RA values with increase in concentration is shown in Table–I.

It depicts that relative association (RA) increases with increase in concentration. This increase indicates salvation of solute molecules. A similar increase in the value of RA has been found in case of sucrose solution by Syal [20].

As concentration increases, number of ions or particles increase in a given volume leading to decrease in the gap (intermolecular free length) between two species. Also, the decreased compressibility brings the molecules to a closer packing resulting in decrease in intermolecular free length. Similar type of trend was also observed by Vasantharans.[20] Again for the terpolymer decrease in the intermolecular free length with the increase in ultrasonic velocity has been observed. The variation of intermolecular free length with concentration is shown in Table–I.

Acoustic impedance is the product of ultrasonic velocity and density. As density and velocity both increase with increase in concentration for the Zs value also increases as shown in Table−I which indicates the interaction between the solute and solvent molecules. A similar type of behavior has been obtained for tetra-alkylammonium and alkali metal salts in methanol-chlorobenzene mixtures by Syal.[20]

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ROLE OF IQAC IN QUALITY ENHANCEMENT IN HIGHER EDUCATION

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Abstract

The University Grant Commission (UGC) established National Assessment and Accreditation Council (NAAC). The key agenda NAAC as included in its abbreviation i.e to assess and accredit the institutions of higher education. The prime aim of NAAC has been to aid HEIs in improving the quality of higher education. Quality in higher education during these days has become a matter of utmost importance and concern. NAAC proposed that every accredited institution should have Internal Quality Assurance Cell (IQAC) as a post-accreditation quality sustenance measure. IQAC in the institute or college is significant administrative body which is responsible for all quality matters. The establishment IQAC has proven significant in creating a positive change in the overall performance of HEIs. IQAC has become an efficient instrument to ensure and to create a quality culture at the institutional level. Since quality enhancement is a continuous process IQAC helps institution to achieve academic excellence. The present paper is an attempt to analyze the functions and role of IQAC in HEIs in terms of quality assurance and quality enhancement.

Key words: NAAC, IQAC, Quality, HEIs, Function, Role

Introduction

Since independence there has been remarkable expansion in the number of HEIs in India. The traditional courses (in the faculty of Arts, Commerce and Science) offered with little efforts to better the qualitative part. As the globalisation began to blow its trumpet in education sector too during nineties, the governments of India seriously consider bringing metamorphosis in its conventional higher education system. Accordingly, National Assessment and Accreditation Council (NAAC), an autonomous institution of UGC come into existence at Bangalore on September, 1994. The task of evaluation, assessment and accreditation of colleges and universities is being done by NAAC. NAAC proposed every Higher Education Institute to establish an Internal Quality Assurance Cell (IQAC) after completion of first cycle of accreditation of several colleges and universities in order to monitor the sustenance and enhance the quality of education

Quality is backbone of any education system be it primary, secondary of higher education. As it is said by Foster that "quality is never an accident", quality requires persistent pursuance, high intention, sincere efforts, planning and sincere execution. The quality of any nation gets reflected in its citizen and the quality of citizens in turn depends on education system of the nation. The education system of the nation is eventually determined on the quality of teachers. The quality in higher education is the most essential aspect as India advancing towards becoming an educational hub. Therefore maintaining the momentum of quality realization is of vital importance. IQAC is in fact regarded as body that ensures to retain the impetus created by the accreditation at the institutional level. The very establishment of IQAC has been the step towards internalization and institutionalization of quality culture.

Formation of IQAC

IQAC formation has to be done after the guidelines laid down by NAAC with some essential amendments. The vice principals from both wings (where senior college is attached to junior college), Registrar, office superintendent are to be included as administrative officers in IQAC. The teacher representatives from different faculties are to be selected after the consideration of their participation in evaluation, teaching leaning process, research and extension work etc The positive, quality conscious, highly qualified and enthusiastic members of governing council should be requested to offer their contribution. Similarly, the local people from learned, qualified, social workers of repute may be selected in IQAC of the institution. The NAAC co-coordinator will act as co-coordinator of IQAC. The IQAC coordinator should be full time teacher having experience of more than five years and whose position should be non-transferable.

The objective/aim of IQAC

The aim of IQAC should be

- To develop a system for conscious, consistent and catalytic action to improve the academic and administrative performance of the institution.

- To promote measures for institutional functioning towards quality enhancement through internalization of quality culture and institutionalization of best practices

Strategies

IQAC shall evolve mechanisms and procedures for

a) Ensuring timely, efficient and progressive performance of academic, administrative and financial tasks;
b) The relevance and quality of academic and research programmes;
c) Equitable access to and affordability of academic programmes for various sections of society;
d) Optimization and integration of modern methods of teaching and learning;
e) The credibility of evaluation procedures;

f) Ensuring the adequacy, maintenance and proper allocation of support structure and services;
g) Sharing of research findings and networking with other institutions in India and abroad.

Functions Expected of the IQAC

a) Development and application of quality benchmarks/parameters for various academic and administrative activities of the institution;

b) Facilitating the creation of a learner-centric environment conducive to quality education and faculty maturation to adopt the required knowledge and technology for participatory teaching and learning process;

c) Arrangement for feedback response from students, parents and other stakeholders on quality-related institutional processes;

d) Dissemination of information on various quality parameters of higher education;
e) Organization of inter and intra institutional workshops, seminars on quality related themes and promotion of quality circles;
f) Documentation of the various programmes/activities leading to quality improvement;
g) Acting as a nodal agency of the Institution for coordinating quality-related activities, including adoption and dissemination of best practices;
h) Development and maintenance of institutional database through MIS for the purpose of maintaining /enhancing the institutional quality;
i) Development of Quality Culture in the institution;
j) Preparation of the Annual Quality Assurance Report (AQAR) as per guidelines and parameters of NAAC, to be submitted to NAAC.

(Revised Guidelines of NAAC, 2013, p.3-4)

Benefits of IQAC

a) Ensure heightened level of clarity and focus in institutional functioning towards quality enhancement .
b) Ensure internalization of the quality culture;
c) Ensure enhancement and integration among the various activities of the institution and institutionalize good practices;
d) Provide a sound basis for decision-making to improve institutional functioning;
e) Act as a dynamic system for quality changes in the HEIs;
f) Build an organized methodology of documentation and internal communication.

Role of IQAC Coordinator

The role of IQAC coordinator is crucial. For, he/she has to ensure the effective functioning and participation of all members. He /she has a major role in implementing the above mentioned functions.

Role of IQAC in Ensuring Quality enhancement of Higher Education

The primary responsibility of higher education is the quality. Undoubtedly the government has this exclusive responsibility viz quality assurance in majority of the nations, it is the very institute itself is responsible for providing and guarantying quality. IQAC at HEIs is mechanism of resources and information devoted to retaining and advancing the quality as well as standards of HEIs. Hence if the quality is sought after, there is need to have structured and organized quality assurance machinery to monitor and evaluate quality. IQAC performs the various tasks in HEIs. It sets up documentation in motion. It brings awareness among faculties and generate confidence. It evolves formats for the information and data of the institutions and designs stipulated schedule for the work as well as drafts the quality status report.

Areas for Qualitative Improvement

It is desirable that the HEIs should pay attention to the following aspects in order to improve performance in regard to criteria identified by NAAC.

First and foremost, for the quality enhancement of education the HEIs must establish dynamic IQAC comprising dynamic academicians. The members should be committed, well-versed in handling the human as well as physical resources in the institution. There should have effective and healthy communication among the principal, management and the rest of the staff members. IQAC should study the NAAC methodology of accreditation and set its target, annual as well as for five years and monitor activities in the institute till the forthcoming accreditation.

IQAC of an institute should encourage the faculty members to take initiative in designing/ revising curriculum of the university. There should be participation of teachers in the activities of Board of Studies, concrete say in revision of syllabi along with record thereof.

It should encourage various departments in the college/ institute to start need based certification and diploma courses. It will be beneficial in filling up the gaps in the university curricula and developing employment potential as well as personality of students. In the same way IQAC should strengthen UGC sponsored add on courses such as Remedial Coaching, NET / SET coaching for the students. There should be career counselling cell. These cells motivate student to cater their diverse needs. The teachers running these cells should have positive, dynamic approach and missionary zeal. IQAC shall also involve other stake-holders like alumni and parent teacher association members, management, and industrial officials.

Importantly, the admission process of the college should be such that the student should feel-at-home. The college should have student enrolment profile developed annually."The profile report should indicate the socio economic and geographic status of the students enrolled for its various academic, professional, certification, add on and other courses"(Hereker). IQAC should devise the departments to identify and shortlist the scholar students in various subjects and streams to shape their career through proving them with required resources as books, counselling, special coaching, and training etc.

IQAC should facilitate the student as well as faculty members the use of ICT and modern methods of teaching. It should develop e-learning resources and organize orientation, workshops for upgrading their technological skills. It should encourage teachers to prepare their presentations and notes and display them on college websites.

IQAC should design its own continuous internal evaluation system at the college level. It should consist of test, unit tests, individual and group assignments, PPT competitions, online tests etc and as the quality is decisive factor in the qualitative improvement in the education system the IQAC should ensure that the teachers from the various departments are deputized for research fellowships, orientations/refresher courses, seminars and conferences, and alike programmes and should encourage the departments to organise seminar, conferences and workshops etc. in the institution.

The IQAC should not only promote the research activities, providing departmental targets regarding major and minor research projects, research papers and publications to be done every year it should also have periodic follow up of the progress of the same.

The principal and IQAC should design short term and long term plan for development of infrastructure in consultation with college management. They should prepare a mechanism to realize those plans through assistance of UGC, government and other agencies and it should also exploit own financial resource.

There should be a strong and efficient feedback system. The constructive feedbacks from all stakeholders aids in increasing efficiency. The corrective measures are to be adopted soon after the feedback in order to improve efficiency of particular segment. The IQAC must cultivate the practice of maintaining appropriate records of every activity as expected by NAAC for assessment and accreditation.

Conclusion

There is a good prospect for Higher Education in India since world's largest population of young people is in the age group of 15 to 24 years (18% of all Indians). The role of IQAC for the quality enhancement in higher education is crucial and instrumental in about some positive change in the administration of the college/institute. IQAC functions for enhancement and retaining the quality. The duo, quality and excellence result out of team work and commitment. The leaders i.e. the principals and coordinators of IQAC should work on the guidelines of NAAC for proper realization of the role of IQAC and its accountability. Quality assurance is essential for improving institutional efficiency and also increasing public accountability.

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Acoustically Study of Internal Pressure and Gibbs Free Energy on Binary Liquid Mixture of 7-Hydroxy-4-Phenyl-2H-Chromen-2-One in Acetone-Water, DMF-Water DMSO-Water at 308.15K

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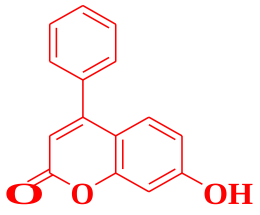
ABSTRACT

Due to the vast pharmacological activity of Coumarins derivatives the viscosity, ultrasonic velocity and density of 7-hydroxy-4-phenyl-2H-chromed-2-one has been measured in 70:30 (v/v) Acetone–water, 70:30 (v/v) NNDMF-water and 70:30 (v/v) DMSO-water with different concentration of 7-hydroxy-4-phenyl-2H-chromene-2-one at temperature 308.15K.To know the various interaction with the various Thermo acoustical parameters internal pressure, Gibb's free energy was calculated from experimental data of ultrasonic velocity, viscosity, and densities. The changes in values of this parameter with the change concentration of solute represent the different types of interaction like solute-solvent interaction, solvent-solvent, and dipole-dipole interactions present in the solutions.

Keyword:- 7-hydroxy-4-phenyl-2H-chromen-2-one, Acetone, DMF, DMSO, internal pressure, Gibb's free energy.

I. INTRODUCTION

Coumarins and chromones are ubiquitous and have relevant pharmacological activities such as anti-inflammatory, antioxidant, cardio protective, and antimicrobial properties[1,2]. The majority of the large numbers of drugs being introduced in pharmacopeias every year are heterocyclic compounds.



7-hydroxy-4-phenyl-2*H*-chromen-2-one

The knowledge of viscosities, densities, ultrasonic velocities, and various acoustical parameters are useful for the studies of thermo acoustical properties of a system. The study of molecular interaction in liquid shows valuable information regarding the internal structure, molecular association, complex formation, internal pressure. The studies of the solution properties of a liquid solution of polar and non-polar components have great applications in industrial and technological process[3]. The literature survey [4-7] reveals the many researchers who give attention to the study of ultrasonic velocity measurement and the study of acoustical properties. Due to these vast applications of 7-hydroxy-4-phenyl-2H-chromen-2-one make our interest in an investigation of its acoustical parameters. The measured values of ultrasonic velocity, internal pressure, Gibb's free energy gives idea regarding types of interaction present in the 7-hydroxy-4-phenyl-2H-chromen-2-one -70:30 (v/v) Acetone –water,7-hydroxy-4-phenyl-2H-chromen-2-one-70:30 (v/v) NNDMF-water and 7-hydroxy-4-phenyl-2H-chromen-2-one -70:30 (v/v) DMSO-water solutions.

II. MATERIALS AND METHODS

The compound 7-hydroxy-4-phenyl-2H-chromen-2-one synthesize by known method[8]. The densities of Ethanol, Acetone, DMF, and 8,10-dinitro-7H-benzo[c] carbazole solution were measured by using a specific gravity bottle, and the viscosity was measured using Ostwald's viscometer. The ultrasonic velocities of pure components and their mixture were measured by ultrasonic interferometer (Mittal enterprises, model F-81s) at 2 MHz having accuracy ±1 ms–1 in velocity.

Theory:-

Given acoustical parameters are calculated by using various equations.

Ultrasonic velocity (u)

$$(u) = v\lambda \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \text{(1)}$$

Where, u-ultrasonic velocity, λ-wavelength.

Internal pressure (Πi)

$$(\Pi i) = bRT\,(k\eta/U)^{1/2}\,(\rho^{2/3}/M^{7/6}) \ldots\ldots\ldots\ldots\ldots\ldots \text{(2)}$$

Where, b is the cubic packing factor which is assumed to be 2 in liquid systems. K = 4.28 x 109 and is independent to the nature of liquid. R is gas constant. η is the viscosity and ρ is the density of solution, M-molecular weight (M is the molar mass of the solute) of solute.

Gibb's free energy (ΔG)

$$(\Delta G) = R.T.\mathrm{Ln}\,(KT\tau/h) \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \text{(3)}$$

Where, $k = 1.23\times10^{-23}$, $h = 6.626\times10^{-34}$, R is the gas constant, T is the absolute temperature & (τ) is the Relaxation time.

III. RESULTS AND DISCUSSION

The experimentally determined values of density(ρ) and ultrasonic velocities (u) and viscosity (η) for 7-hydroxy-4-phenyl-2H-chromen-2-one- 70% Acetone, 7-hydroxy-4-phenyl-2H-chromen-2-one-70%NNDMF and 7-hydroxy-4-phenyl-2H-chromen-2-one-70% DMSO solutions measured at 318.5K are given in Table 1.At a constant temperature From fig.1 it is observed that increase in the concentration of 7-hydroxy-4-phenyl-2H-chromen-2-one with an increase ultrasonic velocity (u), also fig 2 and 3 indicates an increase of density and viscosity an increase in the concentration of solute at a constant temperature. An increase in concentration allows for a closer approach of solvent and solute molecules and a stronger association between solute and solvent molecules. This leads to a decrease in the volume and an increase in the density of the solution[9]. The increased values of viscosity and ultrasonic velocity indicate molecular association in the experimental systems, which are possible due to the presence of hydroxyl group solute structure notably; velocities of lower value are less molecular interaction. It may be due to breaking of molecular clusters, presence of dipole-dipole interaction, solute-solvent interactions, solvent- solvent interactions, and presence of hydrogen bonding between the solute molecule and water molecule solvents.

The internal pressure (πi) is the cohesive force, which is a result of the strength of attraction and force of repulsion between solute and solvent molecules of the solution. It is evident from fig 4 and Table-which internal pressure values increase with the increase of solute concentration for all the experimental systems. Further πi with attentiveness indicates an increase in intermolecular interactions due to the forming of aggregates of solvent molecules around the solute, which affects the structural arrangement of the solution system. Indicated may also accredit to the presence of solute-solvent interactions and hydrogen bonding[10]. Gibb's free energy (ΔG) decreases with an increase in the concentration of solute and a decrease at high temperatures [fig-5].decline of Gibb's free energy indicates the need for a longer time for the co-operative process to take place or for the rearrangement of molecules in the mixture. Stipulate the restricted flow of the ternary mixture compared with the behavior of pure components.

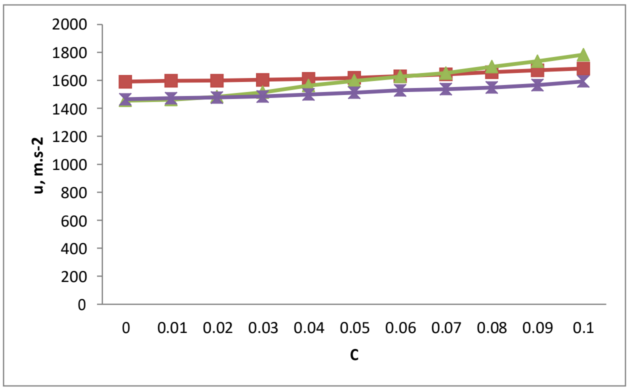


Figure1. Ultrasonic velocity (u) plotted against concentration of 7-hydroxy-4-phenyl-2H-chromen-2one -70% Acetone (■),7-hydroxy-4-phenyl-2H-chromen-2one – 70%NNDMF (▲) and 7-hydroxy-4-phenyl-2H-chromen-2one – DMSO (×), at 308.15K.

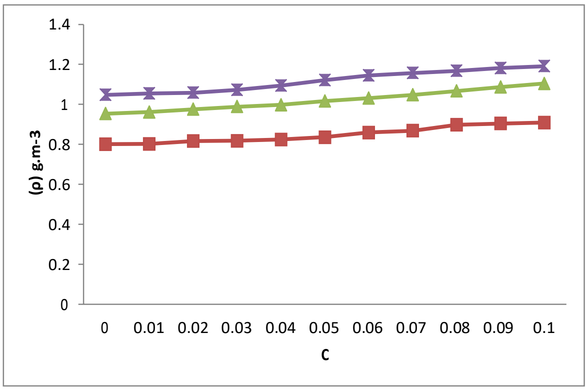


Figure 2. Density (ρ) plotted against concentration of 7-hydroxy-4-phenyl-2H-chromen-2one-70% Acetone (■),7-hydroxy-4-phenyl-2H-chromen-2one – 70%NNDMF (▲) and 7-hydroxy-4-phenyl-2H-chromen-2one – DMSO (×), at 308.15K.

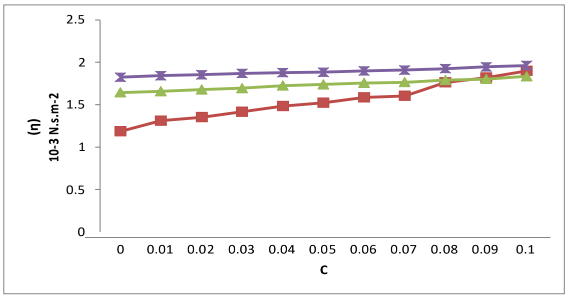


Figure 3. Viscosity (ŋ) plotted against concentration of 7-hydroxy-4-phenyl-2H-chromen-2one -70% Acetone (■),7-hydroxy-4-phenyl-2H-chromen-2one – 70% DMF (▲) and 7-hydroxy-4-phenyl-2H-chromen-2one –DMSO (×),at 308.15K.

Table 1. Experimental values of ultrasonic velocity, density and viscosity of 7-hydroxy-4-phenyl-2H-chromen-2one -70% Acetone, 7-hydroxy-4-phenyl-2H-chromen-2one – 70% DMF and 7-hydroxy-4-phenyl-2H-chromen-2one –DMSO solutions at temperatures 308.15K.

C	u, $m.s^{-2}$			(ρ) $kg.m^{-3}$			(η) 10^{-3} $N.s.m^{-2}$		
	70% Ac+L	70% NNDMF+L	70% DMSO+L	70% Ac+L	70% NNDMF+L	70% DMSO+L	70% Ac+L	70% NNDMF+L	70% DMSO+L
0	1590.1	1456.2	1464.5	0.801	0.954	1.048	1.185	1.643	1.822
0.01	1596.9	1462.3	1472.2	0.802	0.962	1.055	1.311	1.658	1.841
0.02	1598.3	1483.7	1476.9	0.816	0.976	1.059	1.352	1.678	1.852
0.03	1604.4	1515.6	1484.3	0.818	0.989	1.073	1.417	1.695	1.867
0.04	1610.5	1563.1	1498.6	0.824	0.998	1.094	1.483	1.724	1.876
0.05	1618.6	1596.9	1512.1	0.836	1.017	1.122	1.523	1.738	1.882
0.06	1630.1	1627.2	1528.5	0.859	1.032	1.145	1.585	1.756	1.896
0.07	1642.7	1652.8	1536.7	0.868	1.048	1.157	1.603	1.764	1.907
0.08	1658.3	1698.4	1548.6	0.898	1.067	1.168	1.762	1.789	1.923
0.09	1672.1	1736.8	1566.4	0.904	1.087	1.182	1.819	1.802	1.945
0.1	1684.6	1784.3	1592.8	0.909	1.105	1.191	1.898	1.835	1.961

Table 2. Gibb's free energy(ΔG), internal pressure (πi) of 7-hydroxy-4-phenyl-2H-chromen-2one -70% Acetone ,7-hydroxy-4-phenyl-2H-chromen-2one – 70%NNDMF and 7-hydroxy-4-phenyl-2H-chromen-2one –DMSO solutions at different concentration(c) and at temperature 308.15K.

C	(πi)10-6 Pa			(ΔG)(x 10-20 k.J.mol-1)		
	70% Ac+L	70%NNDMF+L	70%DMSO+L	70% Ac+L	70%NNDMF+L	70%DMSO+L
0	133.075	183.979	205.683	0.125	0.1258	0.1258
0.01	139.789	185.461	207.128	0.1249	0.1257	0.1257
0.02	143.542	187.018	207.939	0.1248	0.1256	0.1257
0.03	146.912	187.622	210.09	0.1247	0.1254	0.1256
0.04	150.742	187.452	212.314	0.1244	0.1252	0.1255
0.05	153.855	188.565	215.299	0.1243	0.1249	0.1253
0.06	159.256	189.608	217.863	0.1243	0.1248	0.1252
0.07	160.655	190.506	219.431	0.1241	0.1246	0.1251
0.08	171.481	191.538	220.89	0.1239	0.1243	0.125
0.09	174.284	192.464	222.646	0.1238	0.1241	0.1249
0.1	178.02	193.725	222.823	0.1234	0.1239	0.1248

(Uncertainties in isnotropic internal pressure 1×10^{-6} Pa, Gibb's free energy 0.01 x 10^{-20} $k.J.mol^{-1}$).

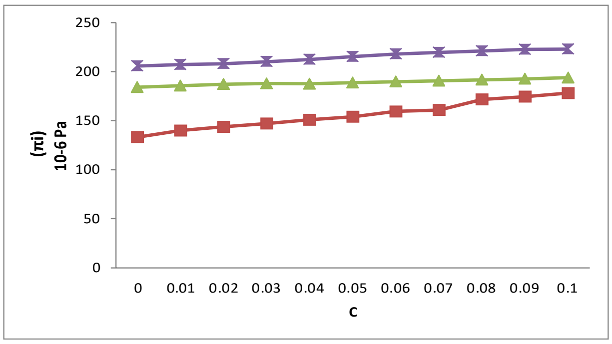


Figure 4 Internal pressure (Лi) plotted against concentration of 7-hydroxy-4-phenyl-2H-chromen-2one -70% Acetone (■),7-hydroxy-4-phenyl-2H-chromen-2one – 70%NNDMF (▲) and 7-hydroxy-4-phenyl-2H-chromen-2one – DMSO (×), at 308.15K

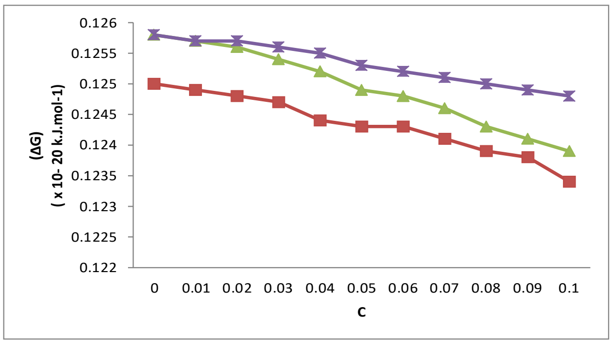


Figure 5 Gibb's free energy (ΔG) plotted against concentration of 7-hydroxy-4-phenyl-2H-chromen-2one -70% Acetone (■),7-hydroxy-4-phenyl-2H-chromen-2one – 70%NNDMF (▲) and 7-hydroxy-4-phenyl-2H-chromen-2one –70%DMSO (×), at

IV. CONCLUSION

In the present article, the densities, ultrasonic velocities, viscosity, and thermodynamical parameters at temperatures, 308.15K over the entire range of composition of 7-hydroxy-4-phenyl-2H-chromen-2one in 70% Acetone, 70%NNDMF and 70% DMSO has been scope. From these measured physical property data, internal pressure, Gibb's free energy intend and used to found the solute-solvent, solvent-solvent interaction, and hydrogen bonding. From the above investigation, it is the effect that 7-hydroxy 4-phenyl-2H-chromen-2one shows absorbing interactive behavior with solvents like Acetone, DMF, and DMSO.

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Molecular Interactions Studies of Phenol Based Terpolymer Using Ultrasonic Techniques

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Abstract. Ultrasonic velocity, density, and viscosity measurements for o-APUF (o-aminophenol, urea and formaldehyde) terpolymer in DMSO were collected throughout a concentration range of (0.5 to 3.0) mol.Kg^{-1}. From viscosity, velocity, and density measurements, derived metrics such as adiabatic compressibility (s), free length (Lf), Relative Association (RA), and Acoustic Impedance (Z) were determined. The knowledge concerning solute-solvent interactions comes from the fluctuations of these properties with concentration.

Key words: Terpolymer, ultrasonic velocity, acoustic impedance, adiabatic compressibility.

1. Introduction:

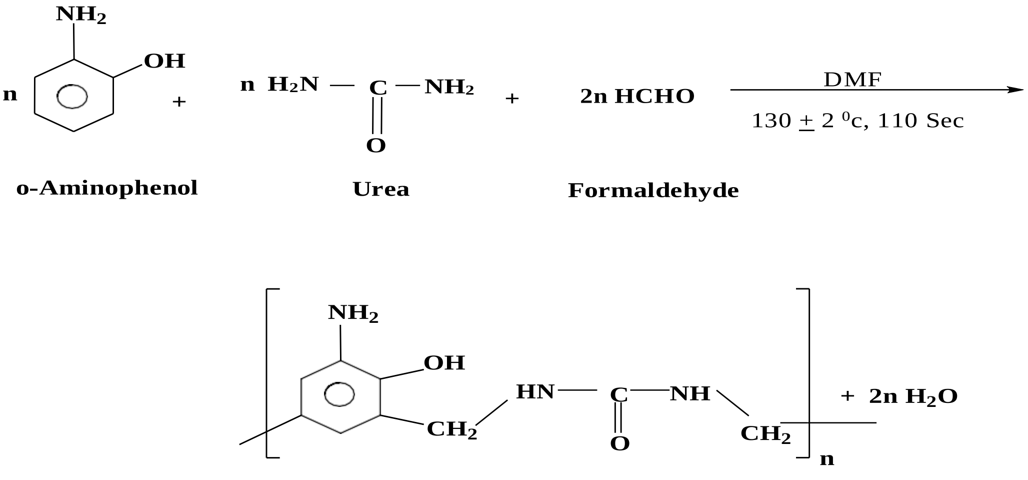
Ultrasonic is a branch of science that studies high-frequency waves, intramolecular interaction. Intermolecular interaction research is critical for the advancement of molecular sciences. In recent years, the ultrasonic method has shown to be a useful instrument for determining the physico-chemical properties of liquid systems.[1-4] Molecular interaction could be studied by numerous physical approaches including infrared,[5,6] Raman effect,[7,8] Nuclear Magnetic Resonance, Dielectric constant,[9] ultra violet[10], and ultrasonic method. In this study molecule interaction in liquid systems by Ultra sonic studies for pre synthesized [12] terpolymer is described here. Free intermolecular length, acoustic impedance, adiabatic compressibility, and relaxation time of terpolymer derived from o-Aminophenol (o-AP), Urea (U), and Formaldehyde (F) in DMF media [12]have been evaluated in DMSO at 310.15 K using experimentally determined values of ultrasonic velocity, viscosity, and density in DMF media also studied.

2. Materials & Methods:

Material: O-aminophenol (Spectrochem.), urea (Spectrochem), formaldehyde (Solution in water), Analytical grade Dimtheylformamide (DMF) and DMSO the E. Merck Chemical Company.

Method : Synthesis of o-APUF (o-aminophenol urea formaldehyde) Terpolymer

The o-aminophenol (0.1mol,1.091g) with urea (0.1 mol, 0.70 g) and formaldehyde (7.50 ml of 37 %, 0.2 mol) was taken and mixed in a proportion of 1:1:2 in DMF (130 °C) ± 2^0C for and reaction mixture was treatment for 110 Second using a microwave system. After which, the brown solid mass obtained was immediately filtered from solution. Further no purification required for product. The resinous brown product so obtained was repeatedly washed with cold distilled water, dried in air and using vaccum desiccators and crushed as a powdered with the help of mortar and pestle. Unreacted monomer was removed from product by washing with many times with boiling water and ethanol. The product was isolated and purified by following literature procedure. It was necessary to wash resulting terpolymer sample with several time with boiling water. The product was dried in air under vacuum, powdered using motel pestle and kept in vacuum over silica gel. The experimental yield was found 88%. On the basic of studies of different characterization we have confirmed that the synthesized terpolymer is o-APUF.[12]



o-APUF

Scheme-1 : Synthesis scheme for (o-aminophenol urea formaldehyde) terpolymer using Urea formaldehyde and o-aminophenol

In above work the solutes used in this work were synthesized using standard procedures.[15] Analytical grade DMF and DMSO were used as solvents. It was provided by the E. Merck Chemical Company. All solvents purified by distillation, after distillation, used for study. Double distilled water was used for the various percentages of DMF-water system. In an Ostwald viscometer that had been well cleaned and dried, the experimental liquid was placed vertically in a glass fronted, well-stirred water bath. Once thermal equilibrium was reached, the flow timings of the liquid were recorded using an accurate stopwatch (+0.01s). The viscosities were calibrated using DMF and double distilled water.

The Ultrasonic Detail

Every attempt was made to limit evaporation to a minimum during the measurements. The current liquids value corresponds to the known value within a margin of +0.01poise. The ultrasonic velocity was measured with an accuracy of +0.03 percent using a variable path single crystal interferometer (Mittal Enterprises, Model F–81) at 2MHz. The terpolymer of o-aminophenol, melamine, and formaldehyde was measured ultrasonically and thermodynamically at 310.15 K.

3. Results & Discussion:

Table I: Ultrasonic data for o-APUF terpolymer

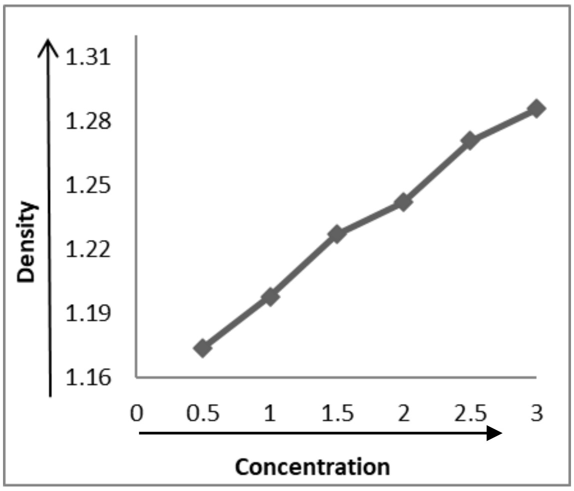
Values of Density (d), Velocity (U_s), Viscosity (η_s), Adiabatic Compressibility (β_s), Specific Acoustic Impedance (Z_s), Intermolecular Free Length (L_f), Relaxation time (**τ**): at 310.15 K in DMSO.

Detail about ultrasonic data for o-APUF terpolymer has been shown in Table-I.

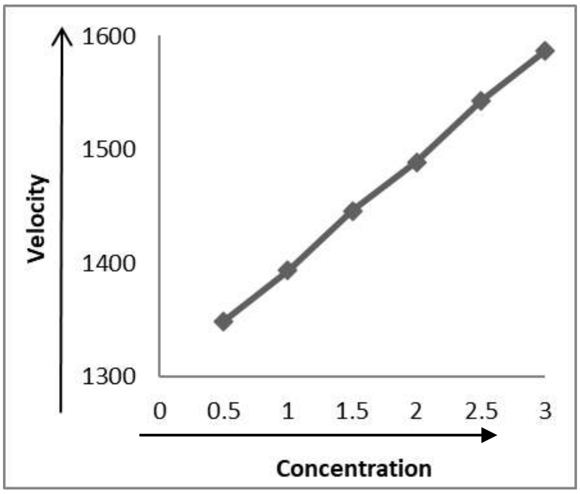
Table−I

Sr. No	**Conc. (C)**	**d (kgm^{-3})**	**Us (ms^{-1})**	**η_s**	**βs ($X10^{-10}m^2N^{-1}$)**	**Zs ($kgm^{-2}s^{-1}$)**	**Lf (10^{-8})**	**τ (10^{-10}sec)**
1	3	1.286	1586.43	1.334	5.108	2039.6	1.498	9.085
2	2.5	1.271	1542.32	1.286	5.342	1959.8	1.532	9.161
3	2	1.242	1489.21	1.248	5.6	1849.5	1.569	9.32
4	1.5	1.227	1446.14	1.205	5.867	1774.3	1.606	9.423
5	1	1.198	1393.51	1.15	6.17	1669.7	1.647	9.465
6	0.5	1.174	1348.89	1.108	6.452	1583.5	1.684	9.532

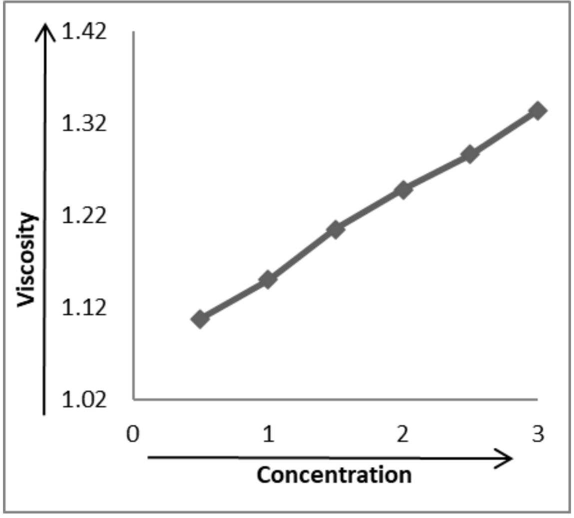
Graphs for o-APUF terpolymer properties measurement all result shown below in Fig. 1 to Fig. 7.



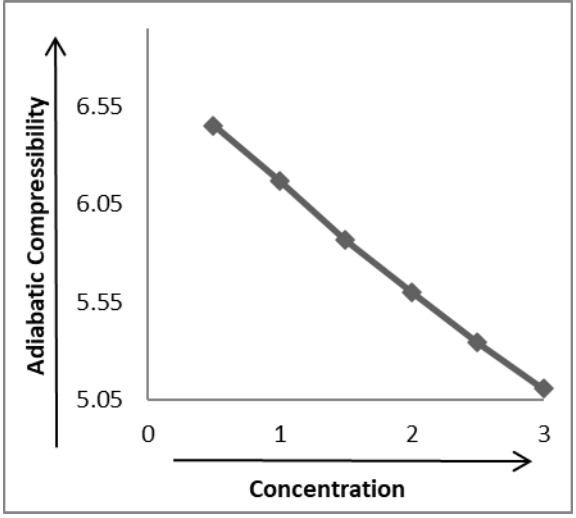
(Fig. 1)



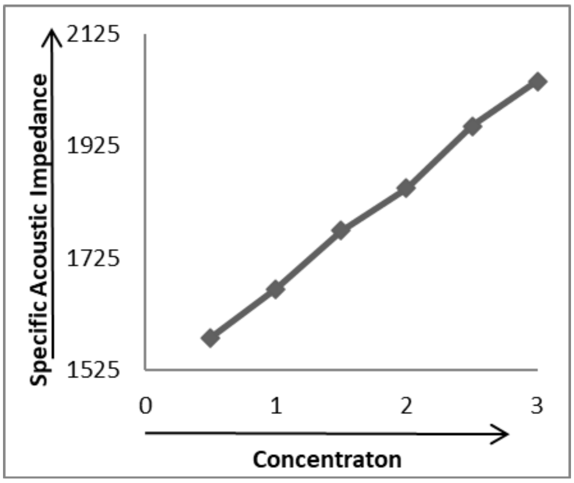
(Fig. 2)



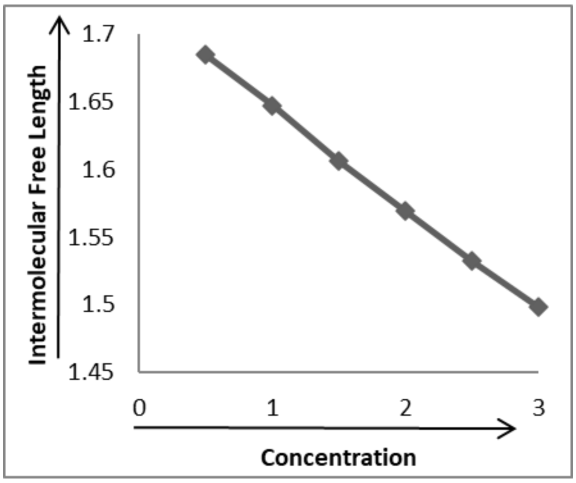
(Fig. 3)



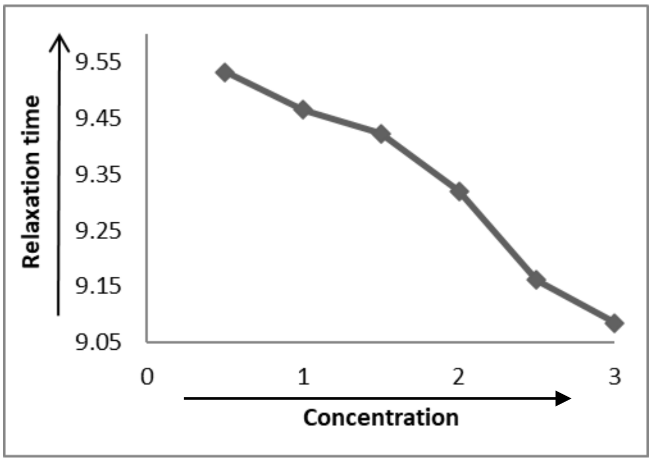
(Fig. 4)



(Fig. 5)



(Fig. 6)



(Fig. 7)

The wavelength of the sound wave determines the ultrasonic velocity, 'U.' Because the frequency (2 MHz) remains constant, increases as the concentration rises, as shown in Table I. The ultrasonic velocity in a medium is inversely proportional to its density and adiabatic compressibility. The ultrasonic velocity (U) of the o-APUF terpolymer increases as the concentration of solute increases, according to the data. This indicates that there are interactions between the solute and the solvent.[16,17] The increase shows that polymers in solution have the ability to form structures. Furthermore, a rise in ultrasonic velocity suggests the creation of H-bonds between the solute and the solvent. There's also evidence of a stronger bond between the molecules.

Because the density and viscosity of any solution or solvent are proportional, the measured values follow a similar pattern. According to the computed data in Table-I, the o-APUF terpolymer viscosity increases as the solute concentration increases. This could be because of the creation of a cage-like structure during the interactions between the solute and the solvent. Rise again, indicates the solute has a proclivity for creating H-bonds. Structure-maker solutes are present. Because the o- APUF terpolymer has bulky rings, it has a high viscosity that rises with concentration.

The adiabatic compressibility of the o-APUF terpolymer diminishes as the concentration of solute increases, as shown in Table-I. This could be because solvent molecules clump together around the ions that support the solute-solvent interaction. The findings are consistent with those of previous researchers.[18,19] As the concentration rises, a proportion of the solvent mole become electrically restrict. It reduces bulk solvent amount which is available, lowering compressibility. The creation of a large number of closely bound systems is indicated by a decrease in adiabatic compressibility.

Table–I shows the variance in RA values as concentration increases. It shows that relative association (RA) increases as concentration rises. This rise suggests that solute molecules are being saved. Syal [20] discovered a comparable increase in the value of RA in the case of sucrose solution.
The number of ions or particles in a given volume increases as concentration rises, resulting in a decrease in the gap (intermolecular free length) between two species. Also, because of the reduced compressibility, the molecules pack closer together, resulting in a reduction in intermolecular free length. Syal and co-workers have noticed a similar pattern.[20] In the case of the o-APUF terpolymer, a decrease in intermolecular free length was seen as ultrasonic velocity was increased. Table–I shows the fluctuation of intermolecular free length with concentration.

The product of ultrasonic velocity and density is acoustic impedance. The Zs value increases as density and velocity both increase with increasing concentration, as shown in Table-I, indicate solute and solvent molecule interaction. According to literature study Syal and co-workers observed a similar result for tetra-alkylammonium and alkali metal salts in methanol-chlorobenzene combinations as a solvent system.[20]

4. Conclusion:

The presence of molecular interactions between the solute-solvent interactions is shown by ultrasonic analysis of o-APUF (o-aminophenol urea formaldehyde) terpolymer. The decrease in intermolecular free length of the solute-solvent causes an increase in ultrasonic velocity with increasing concentration. As concentration increase, so does the density and viscosity. With increasing concentration, adiabatic compressibility and intermolecular free length decreases

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NEW EDUCATION POLICY FOR SUSTAINABLE DEVELOPMENT IN INDIA: A NARRATIVE REVIEW

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Abstract :-

In India, a new education policy that was implemented in 2020 brought about significant changes to the country's educational system. The global community, including India, adopted the Sustainable Development Goals in 2015. SDG-4, which is focused on providing high-quality education, has ten targets. But it's important to comprehend the main obstacles to putting NEP 2020's recommendations into practise and meeting SDG-4 targets. In an effort to successfully establish solutions for ensuring SDG targets, important limits are being highlighted, and a list of recommendations and possible directions is being compiled.

Keywords: New Education Policy 2020, Implementation strategies, Sustainable Development Goals.

A. Introduction :

Education is fundamental for achieving full human potential, developing an equitable and just society and promoting national development. Providing universal access to quality education is the key to India's continued ascent, and leadership on the global stage in terms of economic growth, social justice and equality, scientific advancement, national integration, and cultural preservation.

India's previous Education Policy was passed and implemented in 1986. After thirty-four years, the National Education Policy (NEP) for India has been updated, revised and approved on 29 July 2020.[1] The policy signifies a huge milestone for India's Education System, which will certainly make India an attractive destination for higher education worldwide. The policy is based on the pillars of "Access, Equity, Quality, and Affordability & Accountability" and will transform India into a vibrant knowledge hub. NEP 2020 emphasis systematic and institutional improvements to regulate govern and promote multidisciplinary academic and research in Indian HEIs.[3] NEP 2020 has marked an epoch development in the educational landscape of India.

B. New Education Policy and its Vision to Education for Sustainable Development :

India's first 21st-century education policy, the National Education Policy (NEP), was unveiled in 2020. By providing comprehensive and equitable education to everyone, the NEP is projected to put India on the path to achieving Goal 4: Quality Education. The NEP is introduced with a vision on Education for Sustainable Development. If India wishes to timely meet the established goals and targets, NEP has given special regard to the need to structure the whole educational system of the nation[5].

Comprehensive and integrated environmental education, including topics like sustainable living, waste management, environmental preservation, biodiversity, safeguarding natural and biological resources, sanitation, and climate change, is a priority for NEP 2020.[7]

Environmental education is now required in the curriculum as part of NEP's emphasis on training and educating teacher educators and trainers about sustainable development. The National Education Program (NEP) intends to deliver education in a way that will produce sustainable means of subsistence and strengthen the national economy.[8]

Prior to the NEP, efforts were concentrated on advancing Sustainable Education via Education. In order to improve knowledge and understanding and to advance sustainable practises, the Pacific Education for Sustainable Development Framework has already highlighted areas of priority in the fields of formal education and teacher preparation, with a focus on advancing quality education.[9]

Nationally and internationally, there has been a lot of attention paid to education for sustainable development (ESD). NEP was only recently adopted, thus there is still much work to be done before the policy is fully and effectively implemented. Until then, the country can continue to study and put into practise good practises, and make efforts to ensure that NEP and ESD components are reached and used in all educational institutions across India.

C. Obstacles to Education for Sustainable Development:

Even though ESD has been a top priority for both national and international organisations, just very little progress has been made to yet. The lack of advancement is a result of numerous elements and causes. According to the author's in-person conversations with Global Schools Ambassadors and Advocates from the United Nations Sustainable Development Solutions Network (UNSDSDN), who have worked to implement ESD in schools and communities, there are many significant obstacles and difficulties for education for sustainable development in India. A few of these are listed below:

1. Lack of Awareness: The necessity to raise awareness of the Sustainable Development Goals and the significance of education in accomplishing these goals was discovered during personal interactions with Global Schools Advocates operating at grassroots level schools in rural India. Even after the SDGs were proclaimed more than six years ago, the teacher community in rural areas is still unaware of the global targets. It is crucial that the educational community is aware of and understands how crucial it is to reform the entire educational system since achieving sustainability is impossible without doing so.

2. Practicing ESD in the Curriculum: ESD implementation across the curriculum in schools, including in rural and urban settings, should be made apparent. The country must make sure that it is taught to kids in more ways than merely being included in textbooks and memorization exercises. Implementing ESD in the curriculum entails doing it rather than simply teaching it.

3. Simplifying the Concept of ESD: The idea of ESD needs to be clarified. Numerous studies and research have demonstrated that over the years, professionals and scholars have made an effort to define sustainable development and its complexity. The idea of ESD should not be complicated; instead, it should be broken down into manageable steps that the school community can understand and apply. Even the 17 SDGs are incredibly ambitious, thus it is important to assist the student community understand how even the smallest actions may contribute to sustainability. And reaching sustainability is feasible if everyone across the nation and the world takes such modest steps.

4. Community Participation to ESD: Understanding ESD in the context of the local area is crucial and vital. Implementing the ESD Concept is almost difficult without local involvement. The residents of the community should be aware of what ESD is, what activities are taking place in the classrooms, what their children are learning, and how the school system is assisting in the growth of the neighbourhood.

5. Lack of Shared Ownership, Collaboration and Strong Partnerships: No industry can claim to have no connection to sustainable development. Every agency, public or commercial, has an equal obligation to ESD. We are prevented from implementing ESD effectively by weak ties and partnerships between the public and private sectors, a lack of cooperation between government ministries and departments, and a failure to include civil society organisations.

6. Lack of financial resources and materials: It is true that India spends specifically designated monies on education, but there are still some sectors where there isn't a significant focus. Both national and local levels must provide financial support for investments in curriculum development, teacher training, resource creation, and related items. Long-term sustainability promotion through action and education is difficult due to funding limitations.

D. Results, Discussions and Suggestions to Overcome Challenges and for Effective Implementation of ESD:

1. **Spreading Awareness:** The first step shall be to raise awareness of ESD.

It is hard to advance in the correct path if people don't understand what sustainability and educations are, let alone how the two are related.

2. **Effective ESD Curriculum:** The ESD Curriculum's goal is to help students, teachers, and other stakeholders acquire the proper attitudes, abilities, and behaviours.

It should encourage and bring about behavioural change, and it should be easy to understand, precise, and implement. The ESD curriculum must include sustainability-related activities.

3. **Encouraging Community Participation:** It is crucial that curriculum designers take the local context and relevance into account. The School Management Committee should incorporate local residents in meetings and planning, with a special emphasis on how the community may participate in school activities and support sustainability.

4. **Sustainability Forums:** To promote ESD in schools, it is necessary to create new committees, reorganise current ones, and utilise existing forums and platforms. Platforms like Bal Sansad, Bal Sabha, Children Cabinet, School Management Committee, etc. should promote

year-round sustainability-related activities and action.

All relevant stakeholders, including children, teachers, parents, and community members, will become more involved as a result.

5. Networking, Partnerships and Collaborations: Government, the private sector, civil society organisations, institutions, and all other relevant parties must work closely together to implement ESD as a single collective. This will increase capability and aid in overcoming resource and budgetary restrictions.

E. Conclusion:

Without a question, education is a vital to achieving sustainable development and a powerful tool. The school community can experience the necessary changes in attitude, behaviour, and abilities that will enable them to solve problems and make decisions in the future. One of the biggest contributions to ESD would come from schools, institutions, and universities if they could make sustainability a key component of instruction in a realistic way. This essay made an effort to review all previous studies and publications in the area of ESD, provide best practises, and identify any remaining significant difficulties and impediments to ESD and how to overcome them. The review article focuses on education for sustainable development rather than education about sustainable development and attempts to expound on the actions and procedures needed to address sustainability.

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ENVIRONMENT AND STRATERGIES FOR SUSTAINABLE DEVELOPMENT

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Abstract

The long-term idea of sustainable development prioritises the growth of present and future generations equally. The economic development improves the quality of life of peoples. Rapid industrialization, urbanisation, and high rate of population growth in the last 50 years has led to large-scaled environmental degradation. As a result, natural resources are rapidly depleting and environmental pollution has become one of the most important challenges being faced by the world today. Thus, it is more important to balancing economic growth and environmental protection side by side. We focus on strategies for sustainable development which are necessary for survival of present as well as upcoming generation.

Keywords: Environment, development, economic, pollution, strategies

1. Introduction :

The environment consists all living or biotic factor and non-living or abiotic factor that influence to each other. Living things included plants, birds, animals, microbes etc. and non-living thing included soil, rocks, water, air, temperature, etc. The environment provides

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A Review of Plastic Waste Management Strategies

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Abstract:

Due to their inherent qualities, including as inertness and low bulk densities, which make them appropriate transport materials and provide little risk of contamination, plastics have been frequently utilised in both water and food packing. Plastic bottles and sachets are now widely used across the nation, but especially in urban areas. The packaging revolt was not supported by an effective plastic waste management strategy, leaving many Indian cities covered with plastic debris, leading to terrible visual issues and other issues with community health. Most wealthy nations now have plastic recycling programmes in place as a result of rising environmental consciousness and declining landfill capacity. Only 5 to 25% of plastic garbage is currently recycled, nevertheless. The study addresses the potential for programmes to manage plastic trash.

Keywords: Plastics, packaging, recycling, plastic waste management.

Introduction:

Almost every area of human activity today has benefited significantly from the use of plastics, including agriculture, medicine, transportation, piping, electrical and heat insulation, packaging, manufacturing of household and electronic goods, furniture, and other items with specialised or everyday uses. Plastics have made a substantial contribution to supporting human life in medical items such disposable syringes, blister packaging of tablets and capsules, joint replacement prostheses, intravenous (IV) fluid bottles, blood bags, catheters, heart valves, etc. Plastic-made medical gadgets are inserted into people.
One of the most significant uses of plastics is in packaging.

In fact, packaging uses account for nearly 40% of all plastic materials worldwide. A sustainable, hygienic, energy-efficient, economical, and environmentally friendly packaging solution has been made possible thanks to plastics. Due to the versatility of plastics, it is now possible to package food items including milk, spices, edible oil, bread, confections, rice, wheat flour, snack foods, and other types of pharmaceuticals in a way that is effective, hygienic, and economical. Plastic is used to package a variety of everyday and specialty products for usage by all people, whether they are wealthy or impoverished, living in urban centres or rural communities.

The synthetic organic polymers that make up plastics are widely utilised in a variety of products, including water bottles, clothing, food packaging, medical supplies, electronics, building materials, etc.[1]. Plastics evolved during the last 60 years into a necessary and adaptable material with a diverse variety of characteristics, chemical makeup, and applications. Although plastic was initially thought to be innocuous and inert, years of environmental plastic waste have resulted in a variety of related issues. Plastic trash pollution is now widely acknowledged to be a significant environmental burden[2,3], particularly in the aquatic environment where plastics undergo prolonged biophysical breakdown[4,5], have severe effects on species[6,7], and have few choices for disposal[5,7,8].

Plastics used for sheeting and packaging are frequently discarded after use, but due to their endurance, they are ubiquitous and persistent in the environment. Although research on the monitoring and effects of plastic wastes is still in its infancy, the reports thus far are alarming.

Plastics based on gasoline are widely used in both the workplace and home environment of humans. These polymers are often landfilled along with municipal solid trash when their useful lives are through. Phthalates, polyfluorinated compounds, bisphenol A (BPA), brominated flame retardants, and repercussions on the environment and public health are only a few of the harmful components found in plastics. Due to the abundance of plastics in electronic garbage (e-waste) and the lack of suitable treatment practises in many nations, this material is becoming a severe environmental and public health hazard on a global scale. Plastic hazardous chemicals from e-wastes can migrate outside of processing sites and into the environment, according to reports from China, Nigeria, and India[9–11].

Types of Plastics and their Major Applications:
The Society of the Plastics Industry, Inc. (SPI) introduced its resin identification coding system in 1988 at the urging of recyclers around the country.
The seven types of plastic include:

1. Polyethylene Terephthalate (PETE or PET)
2. High-Density Polyethylene (HDPE)
3. Polyvinyl Chloride (PVC)
4. Low-Density Polyethylene (LDPE)
5. Polypropylene (PP)
6. Polystyrene or Styrofoam (PS)
7. Miscellaneous plastics (includes: polycarbonate, polylactide, acrylic, acrylonitrile butadiene, styrene, fiberglass, and nylon)

Figure1: Types of Plastic

Figure 2 : Examples of different types of Plastic

The various types of plastics and their major applications are as follows:

Thermosets:

Thermoset or thermosetting plastics strengthen on heating, but cannot be remolded or recycled such as Sheet Molding Compounds (SMC), Fiber Reinforced Plastic (FRP), Bakelite etc. are the examples of the same.

Thermoplastics:

These types of plastics become soft when heated, they can be moulded or shaped with pressure when in plastic state and, when cooled, they solidify and retain the shape or mould. Some common thermoplastics with their uses and properties are as follows: -

Polyethylene terephthalate (PET):

Some common properties are: i. Tough and clear, good strength and stiffness, chemical and heat resistant, good barrier properties for oxygen and carbon dioxide. ii. It is used in-packaging, soft drink and mineral water bottles, fibres for clothing, films, food containers, transport, building and appliance industry (as it is fire resistant), etc.

High density polyethylene (HDPE):

Some common properties: i. good process ability, excellent balance of rigidity and impact strength, excellent chemical resistance, crystalline, melting point (130-1350C), and excellent water vapour barrier properties. ii. Used for making blow moulded products (various types of containers, water bottles), pipes, injection moulded products (storage bins, caps, buckets, mugs), films (carrier bags), etc.

Polyvinyl chloride (PVC):

Its properties are: i. Versatility, energy saving, adaptability to changing time and environment, durability, fire resistance. ii. It is used in industries such as building and construction, packaging, medical, agriculture, transport. Also used for making wires and cables, furniture, footwear, domestic appliances, films and sheets, bottles, etc.

Low density polyethylene (LDPE):

Characteristics of LDPE are: i. Easy process ability, low density, semi crystalline nature, low melting range, low softening point, good chemical resistance, excellent dielectric properties, low moisture barrier, poor abrasion and stretch resistance. ii. It is used for making carrier bags, heavy duty bags, nursery bags, small squeeze bottles. Also used in milk packaging, wire and cable insulation, etc.

Polypropylene (PP):

Properties are: i. Low density, excellent chemical resistance, environmental stress resistance, high melting point, good process ability, dielectric properties, low cost, creep resistance. ii. Used for making bottles, medical containers, pipes, sheets, straws, films furniture, house wares, luggage, toys, hair dryer, fan, etc.

Polystyrene (PS):

Some of the properties of polystyrene are: i. Glassy surface, clear to opaque, rigid, hard, high clarity, affected by fats and solvents. ii. Used for making electrical and communication equipments e.g. plugs, sockets, switch plates, coil forms, circuit boards, spacers and housings. Also used for making containers, toys, wall tiles, baskets, cutlery, dishes, cups, tumblers, dairy containers, etc.

Others plastics: There are many other types of plastics except these six types, often used in the engineering sector. Examples include polycarbonate (PC), nylon, and acrylonitrile butadiene styrene (ABS).

Plastic Waste Management (PWM Rules), 2016:

The Government of India notified Plastic Waste Management (PWM) Rules, 2016 on 18thMarch, 2016, superseding Plastic Waste (Management & Handling) Rules, 2011. These rules were further amended and named as 'Plastic Waste Management (Amendment) Rules, 2018.

Salient features of Plastic Waste Management (PWM Rules), 2016:

These rules shall apply to every Waste Generator, Local Body, Gram Panchayat, Manufacturer, Importer, Producer and Brand Owner. • Carry bags made of virgin or recycled plastic, shall not be less than fifty microns in thickness. The provision of thickness shall not be applicable to carry bags made up of Compostable plastic, complying IS/ISO: 17088.

Waste Generators

including institutional generators, event organizers shall not litter the plastic waste, shall segregate waste and handover to authorized agency and shall pay user fee as prescribed by ULB and spot fine in case of violation.

Local Bodies

shall encourage use of plastic waste for road construction or energy recovery or waste to oil or co-processing in cement kilns etc. It shall be responsible for development and setting up of infrastructure for segregation, collection, storage, transportation, processing and disposal of the plastic waste either on its own or by engaging agencies or producers

Gram Panchayat

either on its own or by engaging an agency shall set up, operationalize and coordinate for waste management in the rural area under their control and for performing the associated functions, namely, ensuring segregation, collection, storage, transportation, plastic waste and channelization of recyclable plastic waste fraction to recyclers having valid registration; ensuring that no damage is caused to the environment during this process; creating awareness among all stakeholders about their responsibilities; and ensuring that open burning of plastic waste does not take place

Producer, Importers and Brand Owners

need to work out modalities for waste collection system for collecting back the plastic waste within a period of six months in consultation with local authority/State Urban Development Department and implement with two years thereafter.

State Pollution Control Board (SPCB)/ Pollution Control Committee (PCC)

shall be the authority for enforcement of the provisions of PWM Rules, 2016, relating to registration, manufacture of plastic products and multi-layered packaging, processing and disposal of plastic wastes.

Concerned Secretary-in-charge of Urban Development of the State or a Union Territory and concerned Gram Panchayat in the rural area of the State or a Union Territory shall be the authority for enforcement of the provisions of PWM Rules, Rules relating to waste management by waste generator, use of plastic carry bags, plastic sheets or like, covers made of plastic sheets and multilayered packaging.

District Magistrate or Deputy Commissioner

shall provide the assistance to PCBs/PCCs, Secretary-in- Charge, Urban Development Department and Gram Panchayat under his jurisdiction, whenever required for enforcement of provisions of PWM Rules, 2016.

Reduce, Reuse, Recycle, and Recovery

Consumers and retailers alike choose plastic bags because they are practical, lightweight, robust, affordable, and hygienic for transporting food and other goods11. After use, the majority of these are recycled, however some end up in landfills and rubbish piles. Plastic bags can contaminate our streets, parks, and waterways after becoming littered. Even though plastic bags only make up a small portion of all litter, they nonetheless have a big impact. Plastic bags can affect both aquatic and terrestrial creatures and cause visual pollution issues.

Due to their bulk and propensity to take a very long time to completely decompose, plastic bags are particularly prominent components of the litter stream. Many carry bags become unattractive litter in parks, gardens, streets, and trees, which not only looks bad but can also harm wildlife like birds and small

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mammals. Bags that make it to the ocean run the risk of being mistaken for jellyfish by marine mammals and sea turtles, which would be disastrous. Billion bags are discarded annually in affluent nations, the most of which have only been used once. The main issue with plastic bags is that they take a long time to decompose in the environment. The ordinary plastic carrier bag is used for five minutes on average, but it takes 500 years for it to degrade.

Reduce

Plastic, of course, presents a special difficulty because it is not biodegradable and consequently persists much longer than other types of waste. A few simple actions in daily living could help keep plastics from entering the waste stream. Some of these actions could be:

1. Discourage the use of disposal plastics

The majority of plastic products we use on a daily basis—grocery bags, plastic wrap, throwaway cutlery, straws, coffee cup lids—are only used once before being thrown away. Keep track of how frequently we use these things and switch to reusable alternatives. Before it gets ingrained, we only need a few occasions to carry our own bags to the store, silverware to the office, or travel mugs to the office tea facilities.

2. Minimize Buying Water

Nearly 20 billion plastic bottles are discarded in the trash each year. establishing a routine of carrying a reusable bottle and drinking water from reliable sources at work, home, and in the office.

3. Minimize use of Plastics Cutlery

Using metal utensils regularly in place of plastic cutlery would help reduce the amount of plastic that is discarded in trash each year.

4. Purchase item Secondhand

The newer items comes with lot of packaging materials instead try to use secondhand materials until it is very necessary

5. Support a bag Tax or Ban

Support legislations and by laws which put taxes on ban of single use plastics

Conclusion

In the modern setting, managing plastic waste has taken on significant importance. In India, a number of programmes are being put into place to lessen the effects of plastic trash. One such plan for managing plastic product waste is recycling. Current trends show a noticeably higher percentage of recovery and recycling of plastic trash, which is both environmentally and economically sensible. These trends are anticipated to continue, but there are still some substantial obstacles due to technological constraints as well as economic or societal difficulties surrounding the collection of recyclable garbage and the replacement of virgin material. Recycling used plastic trash is a practical strategy to enhance the environmental performance of the polymer sector, especially when combined with initiatives to expand the specification and use of recycled grades as substitutes for virgin plastic.

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The Role of ICT (Information and Communication Technology) In Higher Education

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ABSTRACT

The planning and execution of education must be improved in order to meet the goals set for each age group. A modest growth trend in total representation is reflected in India's higher education. The NPE-2019 declares a favourable long-term policy. It is about providing a large-scale facility and access to educational needs, as well as the total integration of physical and biological educational resources with technology. It would be possible to produce the most amount of higher education with greater values if the teacher, students, curriculum, extracurricular activities, teaching aids, facilitators, evaluations, assessments, virtual utility, etc. were all integrated. The agencies and organisations involved in the direction, supervision, and management of higher education keep a close eye on the programmes, and education technology will give the organisation a timely and ideal functionalism for developing new policies. The government's aim and vision for education are made possible through both private and public initiatives. The actual preservation and analysis of data for educational purposes is guaranteed by educational technology. The electrification of higher education and its use of technology and communication have a positive impact on student interest and performance.

Keywords:- Technology, Higher Education, Challenges

I. INTRODUCTION

The Diploma, Graduation, Post-Graduation, Doctoral, Post-Doctoral, and Fellowship educational programmes are offered to applicants to enrol under colleges, institutions, universities, and research centres in order to enhance their knowledge for practical application. In India, many public and private institutes of higher learning have been established. The main goal of educational institutions is to impart knowledge as effectively as possible through the efficient use of its input resources, which include lecturers, classrooms, libraries, and laboratories. Every programme has a different aim, but the most typical one is to equip the participants with knowledge for future learning or professional competencies.

Social well-being is a component of sustainable development, and it depends on education. Reforms in education are primarily motivated by the emergence of information technology as a tool for the dissemination of knowledge. Education in schools and institutions has changed as a result of the introduction of new technology-assisted learning tools like mobile devices, smart boards, MOOCs, tablets, laptops, simulations, dynamic visualisations, and virtual laboratories. One of the most economical strategies for training developing minds is the Internet of Things (IoT), which has been demonstrated. Additionally, it serves as a method for universally integrating top-notch educational opportunities [1-3]. Businesses in the educational technology sector are always tempted to develop innovative solutions to increase access to education for people who lack suitable educational facilities. Social media has advanced significantly as a tool for education.

Social media is used by many teachers and students as a crucial component of the whole e-learning experience. These days, it serves as a vital forum for the exchange of knowledge about important subjects. Social media websites are a great resource for creating networking opportunities to build social activities and maybe new occupations [4,5] in addition to the ability to share information anywhere, at any time.

The versatility and non-intrusive nature of modern technology do, in fact, make learning more enticing to the younger generation. It could be a difficult technique to master at first, though, as conventional educators is reluctant to integrate modern technology and gadgets into the classroom because they see them as a distraction rather than a clever learning tool [6, 7]. Students can better prepare for class by using an online calendar that shows the times of classes, assignments, field trips, guest speakers, exams, and semester breaks. Student response systems, such smartphones and clicker devices, give teachers a quick and simple way to assess how quickly students are absorbing the pre-sented material and whether further explanation is needed [8–9].

Digital learning is a fantastic way to reduce expenses, more effectively use resources, encourage sustainability, and increase both reach and impact for students and teachers. This is true of the environmental impact of using less paper for handouts and books as well as the time savings and convenience of research. [16,17]. Modern life and society are heavily reliant on technology in many areas. The worldwide digital revolution has started to permeate the field of education. Technology is projected to change education by making it more affordable and accessible because it is fast changing how students learn [18–20].

ICT (Information And Communication Technology) Role in Higher Education:

A number of factors combined over the course of the 1990s to force institutions of higher learning to investigate the expanding possibilities that information and communication technology (ICT) offered in terms of enhancing pedagogy and simultaneously changing the way that administrators and academics engaged with various student cohorts [21]. Many factors are driving the adoption of ICTs in education as we enter the twenty-first century, and current trends indicate that we will soon witness significant changes in how education is organised and delivered utilising ICT [22]. Furthermore, the quick development and transition of new technology suggests that higher education systems must adapt to improvements in knowledge and abilities. Universities must ensure that their students have the information, abilities, and skills necessary to compete in an increasingly global and cutthroat industry [24]. The goal of the ICT policy in higher education is to "prepare young for creative participation in the establishment, sustaining, and expansion of a knowledge society contributing to overall socioeconomic development of the nation and worldwide competitiveness"[25]. ICT is used for management and administration tasks in addition to delivering lectures and course materials. It is obvious that the usage of ICT has helped administrative processes such student registration, grades, course scheduling, and even staffing evaluation [26]. Higher education will inevitably incorporate ICT, and the emphasis will be on using it to improve the system for open and distance learning. The unique function of ICT in strengthening research capabilities should be identified in institution- and sector-wide higher education ICT policy and planning, and sufficient infrastructure should be supported by capacity building. Digital libraries, access to online databases, networking etc .can be enhanced through inter institutional collaboration to ensure optimal usage of ICT expertise and resources[24].

Benefits and Implications of applying ICT in Higher Education

ICT application in higher education can serve the following:

- Speed and automatic functions: the feature of ICT which enables routine tasks to be completed and repeated quickly, enabling teachers to demonstrate, explore or explain aspects of their subject, and allowing students to concentrate on thinking and on tasks such as analyzing and looking for patterns within data, asking questions and looking for answers, and explaining and presenting results.
- Capacity and range: the ability of ICT to access and to handle large amounts of information; change timescales, or remove barriers of distance; give teachers and pupils access to historical, recent and immediate information and control over situations which would normally be outside their everyday experience.
- Provisionality: the feature of ICT which allows information to be changed easily and enables alternatives to be explored readily.
- Interactivity: the function of ICT which enables rapid and dynamic feedback and response
- Furthermore, applying ICT in education has the following advantages:
- A sense of presence, possibly even community, in online interaction;
- Improved learner support;
- Unlimited practice of difficult concepts, skills, etc.;
- Unlimited access to resources via the Internet;
- Improved delivery of learner preferences;
- Global access to resources and teaching; and
- Learning anywhere, anytime [21].
- There are some implications of ICT in higher education:
- Time, space and socio-economic factors are no longer major barriers to learning.
- Decentralized nature of the new technology frees the learner from the technology provider.
- Learners have access to variety of learning resources.
- Up-to-date knowledge from any part of the world.
- New media allows interactive, learner need not be a passive recipient of knowledge.
- New technology allows the learner to receive information in a variety of formats [22].

Challenges of ICT in Higher Education:

The high expense of purchasing, setting up, using, maintaining, and replacing ICTs comes first. The use of ICTs into teaching is still in its infancy, although having a lot of potential. Since implementing ICT systems is frequently more expensive in absolute terms than in industrialised countries, and other investments (such buildings) are generally less expensive, introducing them for teaching in poor countries has a particularly high opportunity cost. In particular, if the pirated software varies in common formats, using unlicensed software can be exceedingly challenging both legally and financially. Even while well-made educational materials can be of great value to students, teaching online poses some special difficulties because not all professors are ICT-literate and capable of using ICT tools.

The four most common mistakes in introducing ICTs into teaching are:

- Installing learning technology without reviewing student needs and content availability;
- Imposing technological systems from the top down without involving faculty and students;
- Using inappropriate content from other regions of the world without customizing it appropriately;

- Producing low quality content that has poor instructional design and is not adapted to the technology in use.
- Lack of support from management;
- Unclear division of function and power;
- Uncoordinated planning and implementation;
- Question of ownership;
- Shortage of trained staff to cope with the diversity of responsibilities and tasks;
- Resistance from staff and reluctance to be retrained;
- Insufficient funds for developing, purchasing and implementing ICT [20].
- Overcoming negative perceptions from early unsatisfactory experiences;
- Educational design and publishing standards;
- Timescale and workload;
- Getting take-up of the quality assurance processes;
- Maintaining momentum [24].

II. CONCLUSION

The findings for the Effectiveness of ICT in Higher Education Model make it clear that all the free components, including ICT availability, usage, knowledge, and cost, are very enormous and have a strong positive impact on ICT viability. It is also clear from the research that cost is the aspect that has the most influence on how well ICT is used in advanced education, with accessibility and learning coming in second. It is commonly assumed that ICT in education can support a few processes related to educating and learning through data transfer and information assistance. ICT facilitates learning and teaching since it is thorough and well-organized, and as a result, basic skills may be developed to further benefit from the process. In this way, it should be considered that changes in learning outcomes are typically related to the use of creative mechanical techniques in instruction. It is typical for teachers and administrators to create clear and appropriate rules in schools, businesses, and institutions in order to increase the use of ICT.

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P018

Sound velocity number, Free volume, Available volume, Relaxation time of 7-hydroxy-4-phenyl-2H-chromen-2-one in Acetone-water, DMF-water and DMSO-water

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Abstract:

The viscosity, ultrasonic velocity, and density of 7-hydroxy-4-phenyl-2H-chromen-2-one have been evaluated in a 70:30 (v/v) ratio due to the high pharmacological action of Coumarin derivatives. With various concentrations of 7-hydroxy-4-phenyl-2H-chromen-2-one at a temperature of 308.15 K, acetone is mixed with water, 70:30 (v/v) DMF, and 70:30 (v/v) DMSO. The different thermo acoustic parameters, including free volume, available volume, relaxation time, and sound velocity number, are computed using experimental data on ultrasonic velocity, viscosity, and densities in order to understand the various interactions. Numerous types of interactions, including solute-solvent, solvent-solvent, and dipole-dipole interactions, were discovered in the solutions when the values of this parameter were modified together with the solute concentration.

Keywords: 7-hydroxy-4-phenyl-2H-chromen-2-one, binary mixture, Thermoacoustical Parameters, Molecular Interactions.

P019

Room temperature ionic liquid promoted synthesis of 4-aryl substituted 5-alkoxy carbonyl-6-methyl-3,4-Dihydropyridones from aryl aldehydes and 1,2-diketones.

Ardhapure Suresh S., Jadhav Anilkumar G., Sirsat Shivraj B.
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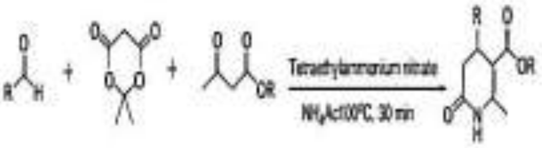
Abstract:

An improved one pot synthesis of 4-aryl substituted 5-alkoxy carbonyl-6-methyl-3,4-dihydropyridones in room temperature ionic liquid. The reaction does not require any additional catalyst. Substitutions on the dihydropyridone ring have been widely studied due to the important effect of substituents on their biological activities. This reaction bearing an excellent isolated yield in short reaction period. The reaction is characterized by simple work-up procedure, efficient recovery and recycling of ionic liquid, which acts as a promoter.

Scheme: Synthesis of 4-aryl substituted 5-alkoxycarbonyl-6-methyl-3,4-dihydro pyridones



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Contents

A FOCUS ON E-WASTE: EFFECTS ON HUMAN HEALTH AND ENVIRONMENT

Amit M. Surjushe

Smt. Vatsalabai Naik Mahila Mahavidyalya, Pusad, (MH), India

ABSTRACT

Today, e-waste, which is produced in enormous amounts by electrical and electronic gadgets, is a global environmental issue. E-wastes are thought to be dangerous because some parts of various electronic devices contain compounds that, depending on their density and circumstances, are hazardous. These materials' hazardous composition poses a threat to both the environment and human health. Its deadly compounds are combined with the soil, water, and air, posing harm to the biodiversity as a whole. The study's foundation is a survey of the literature on the subject of how electronic waste affects both the environment and human health. It was determined that there was a significant amount of e-waste generated without appropriate management practises. Furthermore, it has been proven that e-waste negatively affects both the environment and human health. E-waste, electrical and electronic equipment, or EEE, the environment, and human health are some index terms.

Keywords: *Electronic, Pollution, E- waste, Environment, Human Health*

1. Introduction

It's challenging to imagine a world without cell phones, GPS navigation systems, laptops, and other digital devices because technology has grown so swiftly in recent years. E-waste reduction has become a major concern for environmental activists, municipal and state governments, and even the United Nations due to the constantly growing amount of obsolete electronics being wasted. Electronic waste, also known as "e-waste," is increasingly a serious problem. India's waste management industry has a lot of space for expansion because currently only 30% of the country's recyclable garbage is recycled. A few of the many issues behind the nation's ineffective waste management include a lack of appropriate legislation for the collection, storage, and recycling, as well as outdated infrastructure.[1]

E-waste, commonly known as "electronic garbage," is any abandoned electrical or electronic device. It is produced from the materials used in electronic devices used for data processing, including computers, computer hardware such speakers, keyboards, printers, etc., and such as CD players, DVD players, and televisions. Used electronics that will be recycled, resold, salvaged, or discarded are also regarded as e-waste[2]. telephones, landlines, fax machines, and other communication devices, as well as domestic appliances such as a vacuum cleaner, a microwave, a washing machine, and an air conditioner. India is the 5th position in the generation of e-waste. Source of E-waste is shown in Fig.1 and in Fig.2 shown in growth of E-wastes in India.

The scenario is concerning since India produces over 1.5 lakh tonnes of e-waste each year, and almost all of it ends up in the unorganised sector because there is currently no organised alternative. E-waste is responsible for 40% of the lead and 75% of the heavy metals discovered in landfills.[3] E-waste has negative effects on human health in addition to the environment. Pollution and other environmental effects are thought to be responsible for about 23% of all deaths in the country.

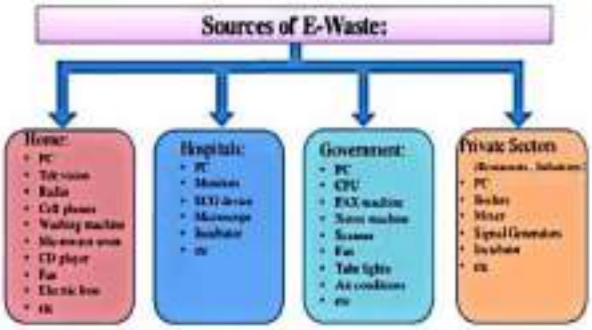

Figure-1

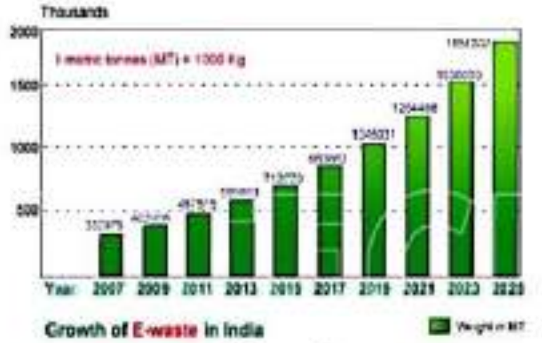

Figure-2

A) Health Impacts

Lead, cadmium, beryllium, and brominated flame retardants are only a few of the dangerous metals pollutants found in electronic equipment (see Table 1). Over 60% of e-waste is made up of metals like iron, copper, aluminium, gold, and other metals. Plastics make up approximately 30% of the garbage, while hazardous pollutants make up just about 2.80%. (10) Of the numerous harmful heavy metals, lead is the one that is utilised in electronic equipment the most frequently for a range of uses, posing a number of health risks owing to environmental contamination. [11] Lead gets into living things through food, water, air, and soil. Since children take more lead from their environment than adults do[12], their neurological system and blood are impacted, making them more susceptible to lead poisoning. It was discovered that the recycling of e-waste in China, one of the main e-waste destinations, has contributed to the increasing blood lead levels in children. [13] This was a result of the extremely rudimentary methods and procedures used during recycling activities.

Numerous studies have documented the alarmingly high concentrations of hazardous heavy metals and organic pollutants in samples of Guiyu, China's dust, soil, river sediment, surface water, and groundwater. Skin damage, headaches, vertigo, nausea, persistent gastritis, and stomach and duodenal ulcers were all common among the locals in the same places.[14] Further it was found that the blood lead levels of children were higher than the mean level in China, and there was no significant difference between boys and girls. [15]

E-waste recycling activities were discovered to be increasing the amounts of polychlorinated dibenzo-p-dioxins and polychlorinated dibenzofurans (PCDD/Fs) in both the environment and people. Polychlorinated dibenzo-p-dioxins and polychlorinated dibenzofurans (PCDD/Fs) were found in much higher concentrations in human hair, human milk, and placenta from the e-waste processing site than from the non-processing site. [16,17]

Data on the effects of heavy metal exposure on humans in India are scarce. Many workers, including young children, are exposed to various e-waste disassembly tasks. Although the results of these studies cannot be applied universally to India, they are alarming enough to warrant replication in Indian workplaces.

No information is provided regarding the effects of these employees on their health.

They can be damaging their life because they lack the necessary information.

In a different Chinese investigation, samples of human scalp hair were taken to determine the level of heavy metal exposure for workers at high-intensity e-waste recycling facilities. Metal concentrations of Pb, Cu, Mn, and Ba were found to be higher in exposed group hair than in control group hair. [18]

a. Sources of E-Waste and Effects on health & Environment :-

E-waste sources	Constituents	Health effects
Solder in printed circuit boards, glass panels, and gaskets in computer monitors	Lead	• Damage to central and peripheral nervous systems, blood systems, and kidney damage
		• Adverse effects on brain development of children; causes damage to the circulatory system and kidney
Chip resistors and semi-conductors	Cadmium	• Toxic irreversible effects on human health

		• Accumulates in kidney and liver
		• Causes neural damage
Relays and switches, and printed circuit boards	Mercury	• Chronic damage to the brain
		• Respiratory and skin disorders due to bioaccumulation in fishes
Galvanized steel plates and decorator or hardener for steel housing	Chromium	• Causes bronchitis
Cabling and computer housing	Plastics and PVC	• Burning produces dioxin that causes reproductive and developmental problems
Electronic equipment and circuit boards	Brominated flame-retardants	• Disrupt endocrine system functions
Front panels of CRTs	Barium, phosphorus, and heavy metals	• Cause muscle weakness and damage to heart, liver, and spleen
Copper wires, Printed circuit board tracks.	Copper	• Stomach cramps, nausea, liver damage, or Wilson's disease
Nickel–cadmium rechargeable batteries	Nickel	• Allergy of the skin to nickel results in dermatitis while allergy of the lung to nickel results in asthma
Lithium-ion battery	Lithium	• Lithium can pass into breast milk and may harm a nursing baby
		• Inhalation of the substance may cause lung edema
Motherboard	Beryllium	• Carcinogenic (lung cancer)
		• Inhalation of fumes and dust causes chronic beryllium disease or beryllicosis

Table 1: Various e-waste sources, their constituents and health impacts

B) Public health, Environment, and E-Waste:-

E-waste disposal is becoming a global public health and environmental concern, as electronic waste has become the world's fastest-growing portion of the conventional municipal solid waste stream. E-waste is any electronic or electrical device that has been thrown, surplussed, obsolete, or broken. The majority of discarded electronic gadgets are kept in households because people do not understand how to dispose of them properly. This ever-increasing trash is extremely complicated in nature, and it's also a rich source of commodities such as gold, silver, and copper that may be recovered and reintroduced into the manufacturing process. The global e-waste management segment was worth $49,880 million in 2020 and is expected to grow at a CAGR of 14.3% from 2021 to 2028, to reach $143,870 million by 2028 – according to research conducted by allied market research. The market growth for rare metals, coupled with their rarity, has led to a sharp increase in their price.

In 2021, an estimated of 57.4 Mt of e-waste was generated globally. According to estimates in Europe, where the problem is best studied, 11 of 72 electronic items in an average household are no longer in use or broken. Annually per citizen, another 4 to 5 kg of unused electrical and electronic products are hoarded in Europe prior to being discarded. [23]

In 2021, less than 20 percent of the e-waste is collected and recycled. [24]

Source of e-wastes components	Constituent	Environmental effects
Electronics which includes wires, blenders etc	Copper	• Open air burning which can release hydrocarbons into the air. • Hydrocarbons can contribute to the greenhouse gas effect
Mobile phone and computer batteries	lead, barium, mercury, lithium	these heavy metals leach through the soil to reach groundwater channels which eventually run to the surface as streams or small ponds of water
Computer monitors	lead, arsenic, and cadmium	electronics are thrown in landfills, these toxins may leach into groundwater and affect local resources
Cathode ray tube used in TVs, ATM and video camera	Lead, barium and other heavy metals	these heavy metals leaching into the ground water and release of toxic phosphor
Chips and other gold plated components	Brominated substance, tin, hydrocarbons, heavy metals	Rivers acidifying fish and flora, contamination of surface and groundwater

Table-2 Effects of e-waste components on environment

C) Research on E-Waste Management:-

To evaluate the current state of India's e-waste management system, to determine the precise scope and amount of the issue in Indian cities, and to build links with the unofficial recycling industries, many more environmental epidemiology studies are needed. These studies will produce useful information that will aid in creating an e-waste management action plan. India needs to start monitoring diseases and the effects of e-waste on human health. The collection and recycling mechanisms must be improved in order to guarantee the sustainability of e-waste management systems. Establishing public-private partnerships would be ideal when opening buy-back or drop-off locations. Another method for guaranteeing the sustainability of waste management is to charge upfront recycling fees. [25]

Finding the best e-waste management technologies worldwide and successfully implementing them might be essential for a sustainable, futuristic growth. Many nations have adopted the Restriction of Hazardous Substances (RoHS) Regulations in the manufacture of these items in order to reduce the use of hazardous materials in electronic and electrical equipment and to encourage the use of safer alternatives. There should be an increasing number of these safer alternatives that can be employed in electrical devices.

2. Suggestion

1. Don't throw the waste cell phones, dumped systems into the landfills. Properly, deliver them to the organizations where recycling is carried out.
2. Get the electronic goods from the vendors who can take back for recycling.
3. Take care of the lifetime of your hardware equipments and so that e waste can be efficiently decreased
4. Big Industries may buy recyclers that can be used for long time.
5. Citizens should turn their interests to use the recycled products
6. Support green engineering.

In industries management of e-waste should begin at the point of generation. This can be done by waste minimization techniques and by sustainable product design. Waste minimization in industries involves adopting:

☐ inventory management,
☐ production-process modification,
☐ volume reduction,

□ recovery and reuse.

3. Conclusion

E-waste are everywhere in our society at local and international level. It's caused by their irregular management. It needs reduced and reuse of the environmental impacts of technological artifacts by increasing their life spans and thereby reducing the demands for new equipments.

One of the world's most serious environmental challenges is the toxic nature of e-waste. The issue is getting worse due to the rising volume of e-waste brought on by a lack of knowledge and the necessary skills. There is an urgent need to develop a preventive strategy in relation to the health risks of handling e-waste among these workers in India because a large number of workers in this country are involved in the crude dismantling of these electronic items for their livelihood and their health is at risk. These employees should receive the necessary training on the safe management of e-waste and personal safety.

There are various technical options for managing e-waste, but before they can be used in the management system, certain criteria must be met. These include legislation, a collecting system, logistics, and labour. This may require operational research and evaluation studies.

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