PREPARATION AND CHARACTERIZATION OF CASTOR OIL BASED POLYURETHANE AND SPECTROSCOPIC CHARACTERIZATION OF CASTOR OIL BASED POLYOL

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Abstract

The uniqueness of castor oil is due to the presence of "naturally occurring fatty acid with hydroxyl functional group in its structure. In this current work, castor oil is modified with blended phenolic resin and reacted with diethanolamine (DEA), phthalic anhydride (P.A) and diethyleneglycol (DEG) to prepare the polyol. Different physico-chemical properties of synthesized polyol for example acid value, hydroxyl value and moisture content were checked. UV-VIS, FTIR and NMR spectroscopic studies has also been done. The variation in physical and chemical properties were found to be comparable in pure and modified only signifies the uses of polymers future.

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Paper Identification

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Introduction:

Due to versatility of polyurethane (Pus) are extensively used in both industries and everyday life. Their chemical diverseness allowed polyurethane with very different physical properties like adhesive strength and abrasion resistance [1,2], solvent resistance [4-8], rigidity and many more. Polyurethanes provide shielding to many materials like bridges, tanks, buildings and so many.

The coatings are widely used due to following factors like their very long life span, qualities, chemical resistivity towards environment and chemicals. Due to enormous use polyurethanes are promising polymer.

In the field of polyurethane at present time vast research work is performed due to its low-cost and environment-friendly nature [10,12]. The urethane linkage gives great support to the modified Polymer in providing huge resistance towards chemicals and bonding of hydrogen.

At present time scientist are more interested in vegetable oil based polyurethane as oils provide a large fatty acid chain, they are low in cost, more eco-friendly and easily available [14,16]. In present work castor oil is used to modify polyols due to its easy availability, renewability.

Castor oil has ingrained qualities like carbon - carbon double bond, free- hydroxyl group and carboxyl group. These characteristics made the polyurethane synthesis easy and use of aliphatic compounds make it non-toxic as well.

Previous work have proved the excellent strength for castor oil in polyurethane industry applications like flame retardancy foam [6], adhesive surface coating [7,8].

Phenolic resin provides electric resistance, temperature resistance[13,18]. Phenolic resin is significantly used as thermosetting polymers due to its features. Thses can be easily bind with low-molecular-weight polymer to improve the flexibility of polymer [15 ,11]. In current work modified modified polyol are synthesized from varying concentration of castor oil, phenolic resin and diethylenglycol, pthalic anhydride and diethanolamine [9]. The aim of the word is to synthesize polyurethanes from easily available, low-cost renewable resource that is castor oil for the desired properties[16,14].

Experimental:

Materials:

Castor oil, pthalic anhydride, phenolic resin, diethylene glycol are supplied by Central drug house pvt. Ltd. Delhi.

Diethanolamine are provided from Qualigens fine chemicals ,Mumbai.

Ethanol and acetone from Qualigens fine chemicals, Mumbai

Preparation of modified polyol:

For the presentation of modified polyols the chemical reaction was performed in a three neck round bottom flask in which one mouth was fitted with thermometer, and second mouth was fitted with nitrogen inlet and third mouth was treated with reflux condenser.

Three different series of polyols were prepared each series having different composition of polyols. In first series of polyol castor oil is first heated at certain temperature three round bottom flask then slowly with rise of temperature phenolic resin was added into the castor oil with different concentration of diethylene glycol. In second series of polyol castor oil and phenolic resin kept constant and concentration of diethanolamine is changed with each set.

The reactions were carried out around 6-7 hour keeping temperature 120-160 °C after this the sample was dried and poured into air tight glass jar for study of various physical and chemical properties of these synthesized polyol was done like calculation of OH value, moisture content and acid value for the study of spectral properties like FTIR and UV was carried out and from this study we will found out the changes in molecular structure [17].

Result:

'Table 1 Physico-Chemical properties of prepared phenolic modified polyol '

	Polyol series	Acid value (mg KoH/g)	OH value (mg KoH/g)	Moisture content (y. moisture)
1.	C.O + DEG+ P.An			

a)	80+1	42.12±10	167±10	0.079
b)	80+2	54.11±10	174±10	0.087
c)	80+3	69.42±10	190±10	0.091
2	CO+DEA+P.R			
a)	70+5	39.2±10	154±10	0.039
b)	70+7	47.2±10	173±10	0.049
c)	70+10	51.1±10	187±10	0.053

Physico - chemical properties:

Two different types of polyol are prepared with castor oil. In first type of polyol castor oil, DEG and phthalic anhydride all taken with different amount [18]. While in second set castor oil along with DEA and phenolic resin are taken as shown in table 1. There acid and hydroxyl value were checked for confirmation of completion of reaction. Moisture content were also checked keeping polyol in lack of moisture environment.

Spectroscopic characterization:

FTIR Study:

Synthesized polyols are characterized using FTIR spectrometer the obtained spectra provides descriptive result in order to prove the presence of different functional groups and variation in the modified polyol[20].

'In figure 1 and 2, 'a broad peak at 3422.00 and 3407.50 cm-1 proves the formation of polyol in IR spectra due to presence of the free hydroxyl group .while in figure 3 and 4 peaks at 3852.26 and 3626.28 cm-1 also proves the formation of polyol . Peaks at 3009 cm-1 is due to C-H stretching vibration of aromatic ring. At 2928, 2906 and 2850 cm-1peaks have been obtained for all the C-H stretching of CH¬2 group present in the compound. At 1731 cm-1, 1743 cm-1 and 1747 cm-1 formation at 1469cm-1 shows peak for CH2 Bending vibrations within the compound. While at 724 cm-1 is due to Aromatic ring " [21,19]. In all the synthesized polyol nearly indistinguishable pattern has been observed.'

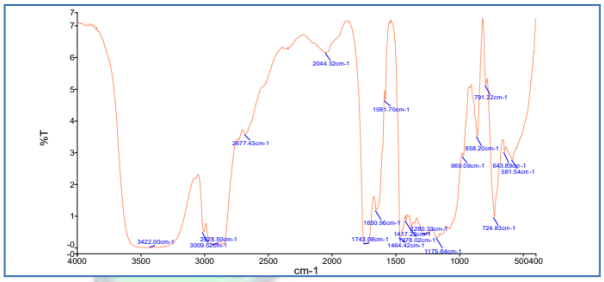
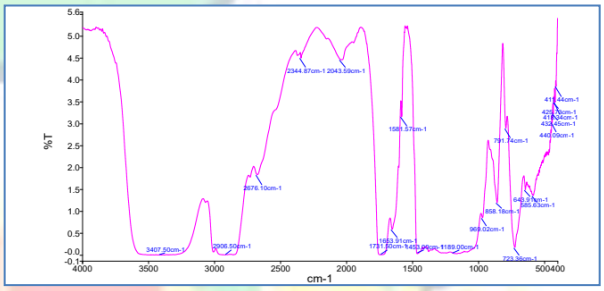


Figure: 1



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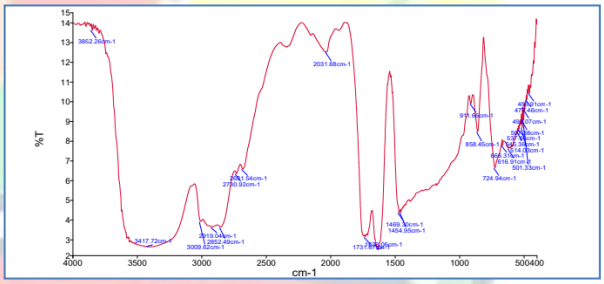

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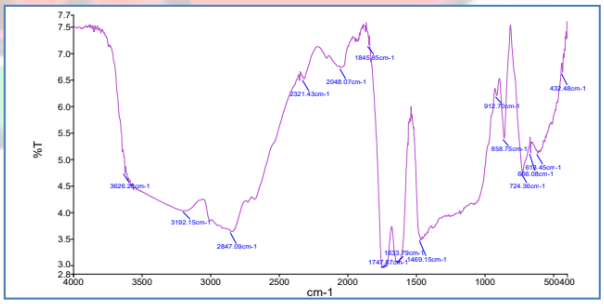
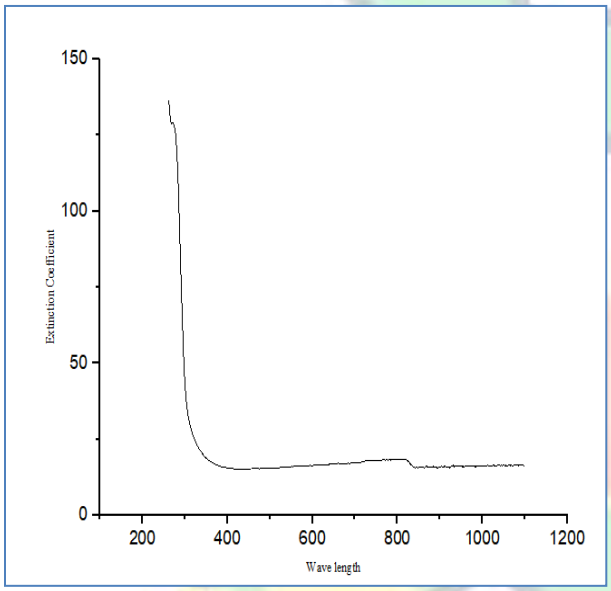


Figure: 4

Optical characterization–

Polyol samples	absorption coefficient (α)	extinction coefficient (k)

C.O+DEG+P.AN		
a.80+3	1.75	26.82
b.80+2	1.67	25.49
c.80+1	1.15	17.62
C.O+DEA+PR		
a.80+3	1.63	24.82
b.80+2	1.82	27.43
c.80+1	1.93	54.21



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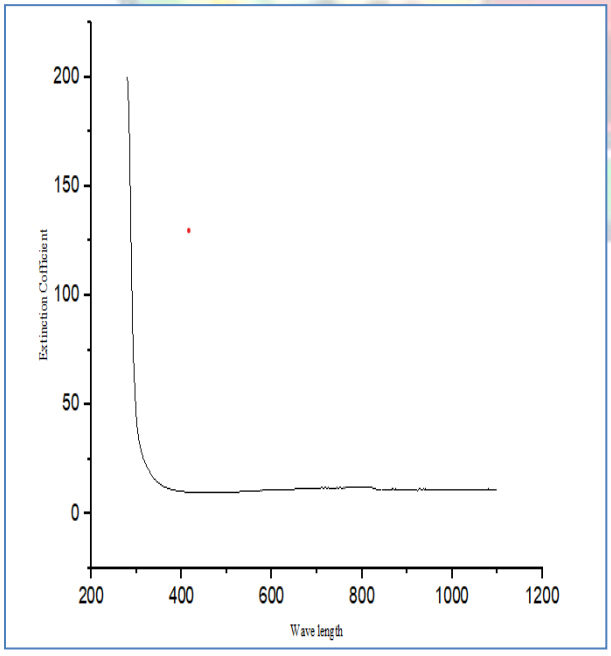

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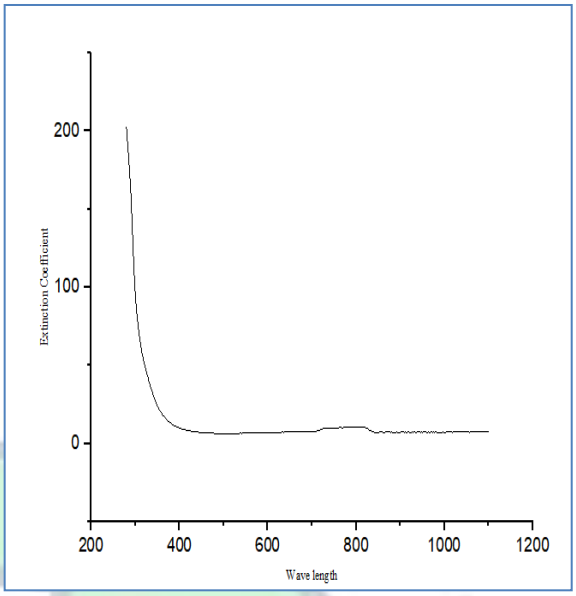

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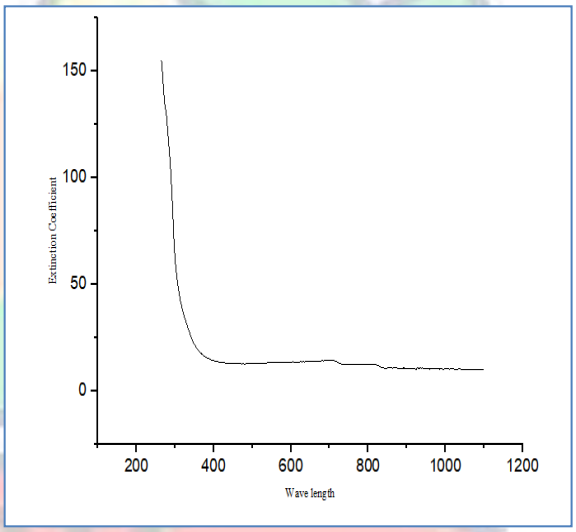

Figure: 8

For optical characterization of prepared sample UV-VIS spectrophotometer the optical properties like absorption coefficient (α), extinction coefficient (k) have been studied for all the prepared samples.

The extension coefficient (k) and absorption coefficient (α) which are determined by using equation given below [12 ,17].

$K=a\lambda/4\pi$

shows almost similar trend as shown in figure optical parameters absorption coefficient (α) and extinction coefficient(k) have been given in table 2 respectively

extinction coefficient and observation coefficient shows decreasing trend and increasing concentration[20] . In both the phenolic in case of DEG modified polyol increase in extinction coefficient and absorption coefficient with decreasing concentration has been observed .

Conclusion:

In this study moderation of castor oil based polyol has been carried out by blending castor oil with phenolic resin phthalic anhydride , diethyleneglycol and diethanolamine. Physico-chemical characterstics like acid value, hydroxyl value shows almost similar trend. Moisture content is also measured it also shows similar trend.

By studying FTIR spectra of prepared polyol sample shows the presence of all appropriate functional groups UV-vis spectra's of prepared polyol samples extinction coefficient and absorption coefficient of all the polyols shows indirect kind of transitions.

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