HEAT DISTORTION TEST ON POLYMER MATRIX COMPOSITE

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Abstract: Thus we manufactured polymer matrix composites of different combinations of vinyl ester and polyurethane successfully. And also the heat distortion test is done. The heat distortion temperature for every specimen is found by using the warmth distortion kit and therefore the readings are tabulated and compared by graph. The proportion 40:60 and 20:80 doesn't formed as perfect IPN hence it's found that 80% vinyl ester and 20%polyurethane have good elasticity and toughness as compared with other proportions.

Keywords - **polymer matrix, ester and polyurethane order.**

1. INTRODUCTION

A fiber-reinforced composite material contains fibers of high strength and modulus embedded in or bonded to a matrix with distinct interfaces (boundaries) between them. In this form, both fibers and matrix retain their physical and chemical identities, yet they produce a mixture of properties that can't be achieved with either of the constituents acting alone. In general, fibers are the principal load-carrying members, while the encompassing matrix keeps them within the desired location and orientation, acts as a load transfer medium between them, and protects them from environmental damages thanks to elevated temperatures and humidity, for instance . Thus, albeit the fibers provide reinforcement for the matrix, the latter also serves variety of useful functions during a fiber reinforced material.

The principal fibers in commercial use are various sorts of glass and carbon also as Kevlar 49. Other fibers like boron, carbide, and alumina, are utilized in limited quantities. All these fibers can be incorporated in to a matrix either in continuous length or in discontinuous lengths. The matrix material could also be a polymer, a metal, or a ceramic. Various chemical compositions and micro structural arrangements are possible in each matrix category.

2. MATRIX:

The roles of the matrix during a fiber -reinforced composite are:

 (1)   To keep the fibers in place.

 (2)   To transfer stresses between the fibers.

 (3)   To provide a barrier against an adverse environment, such as chemicals and moisture.

 (4)   To guard the surface of the fibers from mechanical degradation (e.g. ., by abrasion).

The matrix plays a minor role in the tensile load -carrying capacity of composite structure. However, selection of a matrix has a major influence on the compressive inter laminar shears as well as in-plan e shear properties of the composite material. The matrix provides lateral support against the likelihood of fiber buckling under compressive loading, thus influencing to an outsized extent, the compressive strength of the material.

For example, for epoxy polymers used as matrix in many aerospace compo sites, the processing characteristics.

2.1 Interpenetrating polymer network:

An Interpenetrating polymer network (IPN) may be a polymer comprising two or more networks which are a minimum of partially interlaced on a polymer scale but not covalently bonded to every other. The network can't be separated unless chemical bonds are broken. The two or more networks are often envisioned to be entangled in such how that they're concatenated and can't be pulled apart, but not bonded to every other by any chemical bond. Simply mixing two or more polymers doesn't create an interpenetrating polymer network (polymer blend), nor does creating a polymer network out of quite one quite monomers which are bonded to every other to make one network (heteropolymer or copolymer). There are semi-interpenetrating polymer networks (SIPN) and pseudo-interpenetrating polymer networks.

To prepare IPNs and SIPNs, the various components are formed simultaneously or sequentially. A combination of two polymers, in network form, of which a minimum of one is synthesized and/or cross-linked within the immediate presence of the opposite with none covalent bonds between them. These polymers are closely associated with other multi-component materials, containing completely entangled chains, like polymer blends, grafts and blocks. But, the IPN can swell in solvents without dissolving and may suppress creep and flow. Most IPNs are heterogeneous systems comprised of 1 rubbery phase and one glassy phase which produce a synergistic effect yielding either high impact strength or reinforcement, both of which are dependent on phase continuity. There are four types of IPNs, including sequential IPNs, simultaneous IPNs, semi-IPNs and homo-IPNs.

2.2 Polyurethane resin:

- To prepare polyurethane resin take polyol & isocyanate in equal ratio

- Add ethanol to polyol in which ethanol must be 60% of polyol weight and stir

- Add ethanol to isocyanate in which ethanol must be 60% of isocyanate weight and stir until the exothermic reaction is felt

- Now mix both in paper cup until the foam gets reduced to resin

- Apply the resin for the surface before 10mintues

2.3 Vinyl ester resin:

- The vinyl ester resin is taken in a cup for required proportion

- Add promoter of 1.5% of vinyl ester weight

- Stir the mixture well

2.4 IPN Formation:

- The vinyl ester resin which is already taken by adding promoter is now mixed with polyurethane resin in required proportion

- Add accelerator of about 2% of total weight of resin and stir it well

- Add hardener of about 2% of total weight of resin and stir it well until it forms as a dense liquid

- This formed mixture is called as interpenetrating polymer network.

2.5 Catalysts:

MEKP catalyst is standard methyl ethyl ketone peroxide used for the cure of unsaturated polyester resin at room temperature in combination with cobalt accelerator Typical concentrations for MEKP catalyst run from 1to 3% by weight supported resin and for cobalt accelerator from 0.25% to 4% supported 1% metal content solution. MEKP is recommended for the curing of ortho and isophthalic, Bisphenol-A or vinyl ester resin at temperatures between 15 and 50^0C.

2.6 Various Proportions:

A faster reaction and shorter demold times can be obtained by the action of promoter such as dimethyl aniline to the resin. Cobalt accelerator chemical present in some polyester resin systems that reacts with meek catalyst to start the hardening process. adding extra cobalt to pre accelerated systems may result in very quick gel cure times, caution is suggested . Not for epoxy resins.

We have tried five different proportions of vinyl ester and polyurethane which are listed below

- Specimen1:100%vinyl ester
- Specimen2:80% vinyl ester&20%polyurethane
- Specimen3:60% vinyl ester&40%polyurethane

3. MATERIAL CALCULATION:

Glass fiber	-	60%
Resin	-	40%
Woven roving's	-	6 layers (for 3mm)
Mass of 6 layers of glass fiber	=	100 grams
Density of glass fiber	=	2.55 g/cc

3.1 Specimen 1: (100% VER):

Density of resin	=	density of vinyl ester	=	1.21g/cc
Mass of resin	=	[(100/60)*40] * (density ratio)		
Density ratio	=	density of e glass/ density of VER		
	=	2.55/1.21 = 2.1		

Hence,

Mass of resin	=	[(100/60)*40] * 2.1
	=	140 grams
Promoter	=	1.5% = 0.015*140=2.1g
Accelerator	=	2% = 0.02*140=2.8 g
Hardener	=	2% = 0.02*140= 2.8 g

3.2 Specimen 2 (80% VER + 20% PU):

Density of resin =		density of vinyl ester / density of poly urethane
	=	1.15 g/cc
Density ratio	=	density of e glass/ density of resin
	=	2.55/ 1.15 = 2.2
Mass of resin	=	[(100/60)*40] * (density ratio)
	=	146 g

In this,

VER 80%	=	0.8 *146	=	116 g		
Promoter	=	1.5%	=	0.015 *116	=	1.74 g
PU 20%	=	0.2*146	=	29 g		

Accelerator and hardener	=	2.8 g
PU	=	polyol (50%) + isocyanate (50%)
29 g	=	14.5 g +14.5 g

(***ethanol 60% added to isocyanate and polyol while mixing)

(***ethanol 60% 0.6 * 29 = 17.4 g)

3.3 Specimen 3: (60% VER and 40% PU):

Density of resin	=	density of vinyl ester / density of poly urethane		
	=	1.15 g/cc		
Density ratio	=	density of e glass/ density of resin		
	=	2.55/ 1.15 = 2.2		
Mass of resin	=	[(100/60)*40] * (density ratio)		
	=	146 g		

In this,

VER 60%	=	0.6 *146	=	87.6 g
Promoter	=	1.5%	=	0.015 *87.6 = 1.3 g
PU 20%	=	0.4*146	=	58.4 g

Accelerator and hardener	=	2.8 g	
PU	=	polyol (50%) + isocyanate (50%)	
58.4 g	=	29.2 g +29.2 g	

(***ethanol 60% added to isocyanate and polyol while mixing)

(***ethanol 60% 0.6 * 58.4 = 35 g)

4. FIGURES AND TABLES

The process of forming an uncured thermo set resins, then completing the curing after the article has been removed from its forming mold or mandrel.
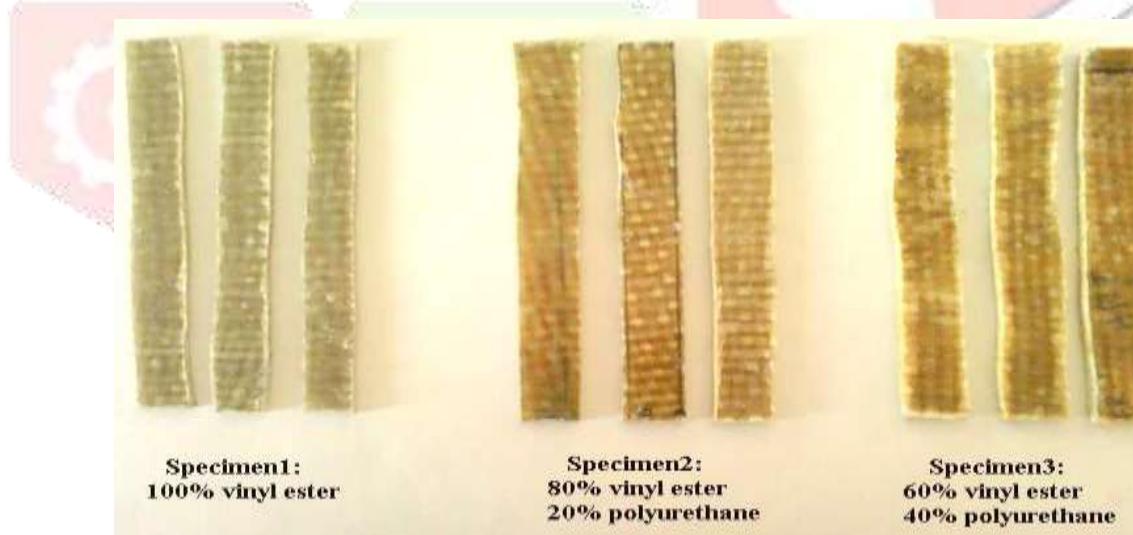
Figure 1 Standard Specimen modals

Figure 2 Experimental setup

Table-1 Tabulation For Specimen 1, 2 and 3

| S.No	Temp (1)	δ (1)	Temp (2)	δ (2)	Temp (3)	δ (3)
1	60	0.02	50	0.01	40	0.02
2	62	0.02	52	0.04	42	0.08
3	64	0.04	54	0.07	44	0.13
4	66	0.09	56	0.11	46	0.18
5	68	0.19	58	0.16	48	0.25
6	70	0.25	60	0.20	50	0.31
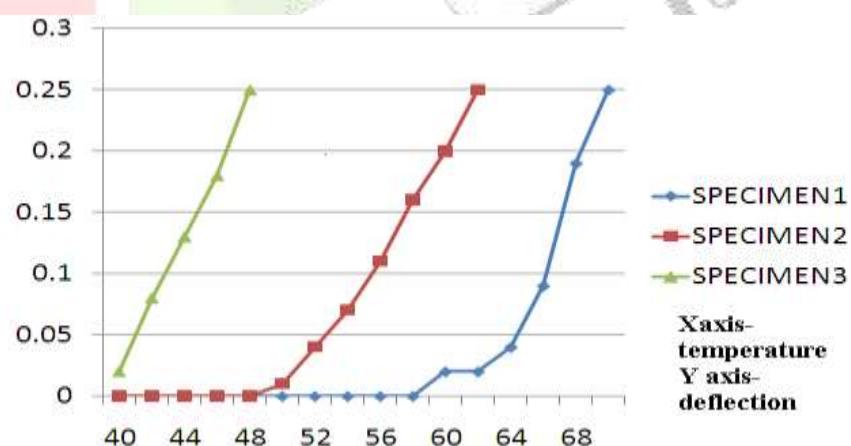
Figure 3 Graph

5. CONCLUSION

Thus we manufactured polmer matrix composites of different combinations of vinyl ester and polyurethane successfully. And also the heat distortion test is done. The heat distortion temperature for every specimen is found by using the warmth diastortion kit and therefore the readings are tabulated and compared by graph. The proportion 40:60 and 20:80 does not formed as perfect IPN hence it is found that 80% vinyl ester and 20% polyurethane have good elasticity and toughness in comparison with other proportions.

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