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RESEARCH AND DEVELOPMENT OF ADVANCED POLYMER MATRIX COMPOSITE MATERIALS AND PROPERTIES

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ABSTRACT - The continuous growth of composite Advanced Polymer Matrix Materials Composite (APMMCs) the advance polymer matrix materials composite is also known as plastics based materials. It is the popular PMMC Matrix composite materials, to makes the composite materials generally resistance to adverse the environments. The advanced polymer matrix materials composite more than two-thirds of the polymer matrices used in aerospace applications is epoxy based in this paper main reasons epoxy is the most used polymer matrix materials composites. Polymer matrix materials composite in plastics based matrix materials constitute more than 95% composites materials is used to day both thermo sets as well as thermoplastics are used as matrix materials as thermo sets mostly exit in liquid state before cross linking convenient to combine reinforcements in the required proportion, shape the product and core it into solid. The Advanced Polymer Matrix materials composites (APMMCs) is the Applications as Aircraft, Space, Sporting goods, Medical devices, Marine, Automotive, and Commercial.

Key Words (APMMC), Production of (APMMC), Properties of (APMMC), Applications of (APMMC), Environments factors.

INTRODUCTION The advanced polymer matrix materials composite in plastics matrix based composite materials constitute more than 95% composite materials is used today both thermo sets as well as thermoplastics are used as matrix materials. As thermo sets mostly exist in liquid state before cross linking convenient to combine reinforcements in the required proportions, shape the product and core it into solid. The Advanced polymer matrix materials composites (APMMCs) is also known as a plastics based materials composites in thermoplastics Soften upon heating and can be reshaped with heat and pressure other is thermosetting because cross linked during fabrication and do not soften upon heating.

Thermoplastics: the thermoplastics presented more form Polypropylene (PP), Polyvinyl chloride (PVC), Nylon, Polyurethane, Poly-ether-ether Keaton (PEEK), Polyphenylene Sulfide (PPS), Polysulpone these materials is best Mechanical properties higher Toughness, higher Volume and low cast processing Temperature range $\geq 225^{\circ}C$. Thermoplastics are increasingly used over thermo sets because of the following reasons Processing is faster than thermo sets composites since no curing reaction is required thermoplastics composite required only heating, shaping and cooling **Batter Properties** high toughness (delaminating resistance) and damage tolerance, low moisture absorption chemical resistance they have low toxity and cast is high.

Thermo sets: The thermo sets plastics Presented more form Polyesters, Epoxy, Polyimide other resins **Polyimide:** excellent mechanical Strength, and Excellent strength retention for long term in $260^{\circ}C$ - $315^{\circ}C$, (500 - $600^{\circ}F$) range and short terms in $370^{\circ}C$, ($700^{\circ}F$) range and excellent electrical properties and good fire resistance and low smoke emission hot molding under pressure and currying temperature is $175^{\circ}C$ ($350^{\circ}F$) and $315^{\circ}C$ Polymers using matrix materials composite limited temperature range Susceptibility to environmental degradation due to moisture, radiations atomic oxygen (in space) low transfer strength and high residual stress due do large mismatch in coefficients of thermal expansion. Both fibers and matrix polymer matrix cannot be used near or above the glass transition temperature. The fiber matrix adhesion (park et. al. 2004) favorer et.al (2010a), studied the mechanical, chemical, and morphological aspects of different composite compositions (polymer/ fiber) they incorporated the sisal fibers to modified PE (Oxidation)the modification was carried out by immersing PE in a 0.25 mol^{-1} $KMnO_4$, and 0.5 $mol.l^{-1}$ HCl at $25^{\circ}C$ for 8h. The composite presented in increase of 40% in impact strength comparatively to values obtained to pure (HDPE).

Additional investigation was carried out on incorporate of acetylated lignocelluloses fiber into the polyethylene matrix materials composite this treatment increased the tensile and flexural modulus of the composite prepared with10 wt% of acetylated lingo cellulosic material and unmodified polyethylene matrix appreciable by 5% and 15% respectively. This composite presented an increase mechanical comparatively to that of the pure matrix. Advanced polymer matrices composite carpool 8339: unsaturated polyester resin dissolved in styrene (% by weight 40- 50%) was supplied from Saudi industrial Resins limited. This polymer advanced matrix materials composite was used together with catalyst (copper twee) and initiator (methyl ethyl Kenton peroxide), MEKP, also supplies from the same company.

Polypropylene: PP (MEI4) was used in compilation with coupling agent scone Tp8112 from Kometra GMBH).

2. POLYMERS BASED MATRICES MATERIALS COMPOSITES AND PRODUCTIONS

2.1 Thermosetting Advanced polymer matrix material composites

The thermosetting advanced polymer matrix material composites (APMMCs) once cured, a tightly bound three-dimensional Network structure is formed in the resin and hence the resin cannot be melted, reshaped and reprocessed by heating therefore, during composite manufacturing, the impregnation process followed by the shaping and solidification should be done before the resin begins to cure.

Fig. 1 Experiment set-up of (APMMC)

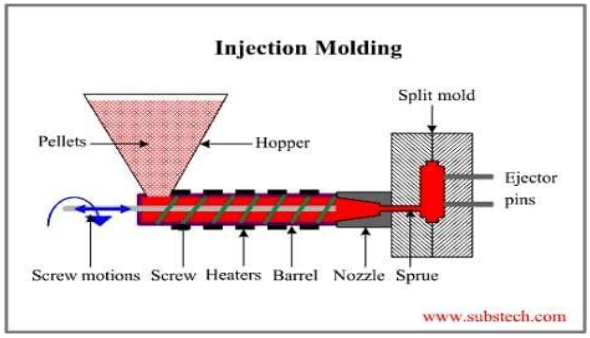

Fig. 2 production of (APMMC)

Thermo sets polymer are brittle at room temperature and have low fracture toughness on the other hand, owing to its three dimensional cross- linked structure thermo sets resin high thermal stability, chemical resistance, high dimensional stability and also high creep properties.

Unsaturated Polyesters, Epoxy, Epoxies, vinyl esters and phenol ices are among the most common thermosetting resins used in composite manufacturing. Several types of polymers have been used as matrices for natural fibers composites the reinforcement of polyesters with cellulosic fibers has been widely reported.

2.2 Properties of thermosetting advanced polymer matrix materials composites

Thermosetting become cross-linked during fabrication & do not soften upon reheating **Epoxy:** high strength and flexibility, better chemical properties, Resistance to chemical and solvents, better adhesion between fiber and matrix, Adjustable curing range, low shrinkage during curing, Somewhat toxic in nature, limited temperature Application range up to 175°C, Moxiture absorption affecting dimensional properties, high thermal coefficient of expansion, slow curing. **Polyimide:** Excellent mechanical strength, Excellent mechanical strength, good fiber resistance and low smoke emissions, Hot molding under pressure, curing temperature is 175°C (350°F) and 315°C, Retention for long term in 260°C - 315°C (500 - 600°F) range and short terms in 370°C (700°F) range.

Polyesters: Low cast, good mechanical strength, low viscosity and versatility, good electrical properties, good heat resistance, cold and hot molding, curing temperature is 120°C.

2.3 Thermoplastics polymer Advance matrix material composites

Thermoplastics are polymers that require heat to make them easy for molding after cooling, such materials retain their shape. The thermoplastics have been used as matrix for nature fiber reinforced composite are as follows: poly ethane (PE), high density poly ethane (HDPE), and low density poly ethane (LDPE), chlorinated Polyethylene (CPE), Poly propylene (PP), Normal polystyrene (PS), and recycled thermoplastics (Sin ha, 2000). Only those thermoplastics are useable for natural fibers reinforced composite, those processing temperature (Temperature at which fiber is incorporated into polymer matrix) does not exceed 230°Csuch as most of all, polyolefin's, e.g., polyethylene and polypropylene.

Fig. 3 testing set-up of (APMMC)

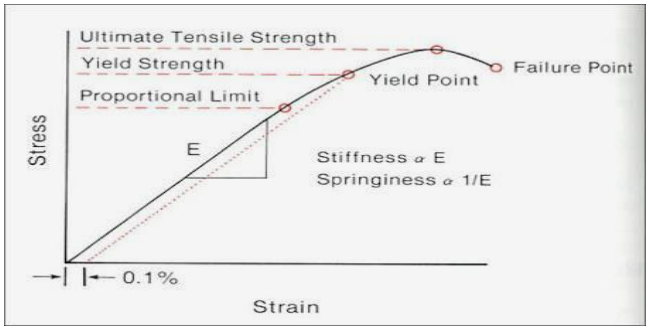

Fig. 4 Stress/ Strain Relation of (APMMC)

Scanning electron microscope (SEM) studies of tensile fracture surfaces of the composite indicated the poorer interfacial adhesion of polypropylene rise husk composite compared to talc composite (premolar etc.2002).

The relatively poor compatibility between the counter parts is a drawback thus coupling agents are generally used to modify the fiber-matrix interface and there by enhance the fiber matrix adhesion (Park. et al. 2004).

2.4 Properties of thermoplastics advanced polymer matrix materials composite

Thermoplastics: soften upon heating and can be reshaped with heat and pressure Thermoplastics advanced polymer matrix materials composites require only heating, shaping and cooling, processing is faster than thermo sets composite since no curing reaction is required. High toughness (delimitation resistance) and damage tolerance, Low moisture absorption, chemical resistance, they have low toxity, cast is high, higher Toughness, high Volume, low cast processing, Temperature range≥225℃.

3. RESULT AND DISCUSSON

The Advanced polymer matrix materials composite (APMMCs) these composites were demonstrated to have improved mechanical properties over pure PHB, where as offering some hindrance to crystallization of the polymer matrix (Avalla.et.al. 1993). The suggesting a significant effect of the filler on reducing crystallization of the polymer matrix composite hence also lowering the melting Temperature of the polymer (Zhao. et.al.2008).

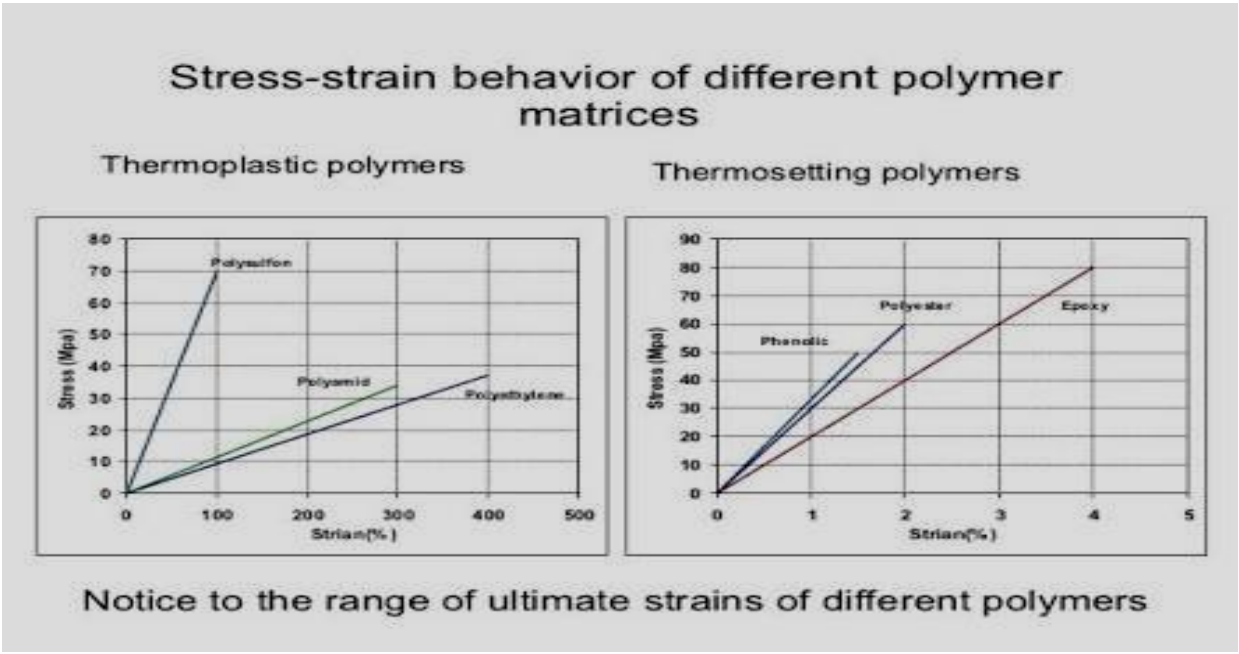

Fig. 5 properties of (APMMC)

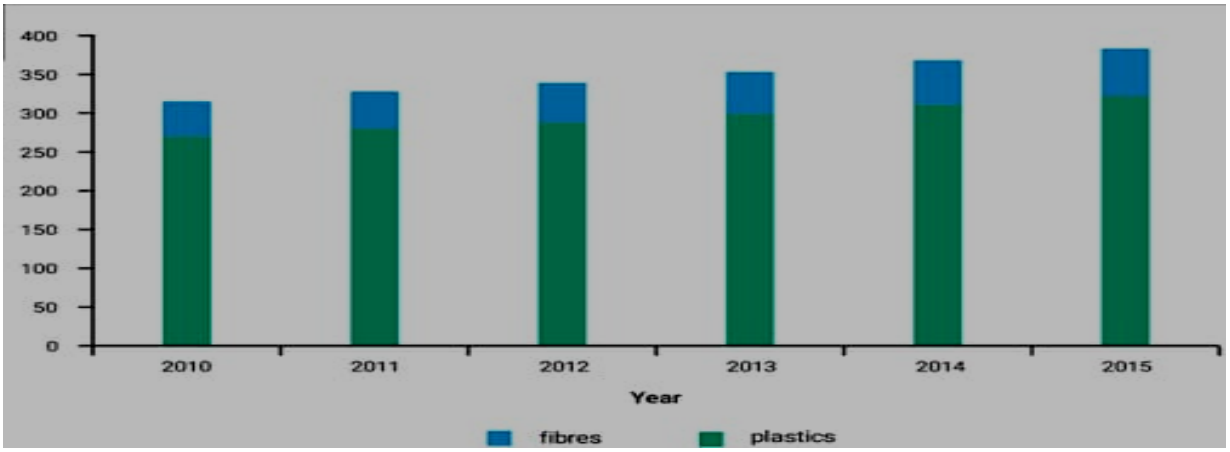

Fig.6 Production Rate of (APMMC)

Mechanical Properties of Advanced Polymer Matrix Materials Composites

Materials	Density ρ g/cm^3	Elongation %	Tensile Strength MPa	Young's Modulus GPa	Specific Stiffness E/ρ	Specific Strength $\sigma u/\rho$
ABS	1.05	10	55	2.8	2.66	52.38
Polycarbonate	1.22	100	62	2.3	1.88	50.81
Polyetherimide	0	----	105	2.8	2.8	105
Nylon	1.12	29	66	3.5	3.12	58.92
(HDPE)	0.95	39	28	1.04	1.15	29.47
Polypropylene	0.9	200	35	0.83	0.92	38.88
Polystrene high impact	1.05	15	35	2076	1977.14	33.33
Epoxy resin	----	6.2	32	0.5	0.5	32

4. CONCLUSION

The research and development of Advanced polymer matrix composite materials the highlighted concerns included key materials and their processing technology, these Advanced polymer matrix composite materials (APMMCs) is light weight structure Advanced polymer matrix composite materials. the main purpose of production cast is reduce and Engineering utilization expanding of Advanced polymer matrix composite materials increasing the Applications of this composite Aircraft industries, Space industries, Sporting goods, Medical industries devices, Marine industries, Automotive industries , and Commercial applications Electrical industries and electronics domestic applications.

5. AKNOWLEGEMENT

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