Experimental Study on Polymer Composite Structure- A Review

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ABSTRACT: A new type of polymer concrete obtained using epoxy polyurethane acryl and aggregates. Mechanical properties, such as: compressive strength, flexural strength, elasticity modulus, pullout stress and adherence stress between cement concrete and polymer concrete were experimentally determined. Polymer Concrete (PC) composites posses a unique combination of properties that depend upon the formulation. This study reviewed the variations in polyester polymer concrete mixture components that affected the properties. The effect of resin content, aggregates, fibers and coupling agents were critically reviewed. It was found that the optimum polymer content varied from 12% to 14% (w/w).LitratureVahabToufigh et al (2016)., had studied the compressive and tensile behaviors of polymer concrete have been investigated. A series of tests were performed on polymer concrete (PC) specimens with different amounts of epoxy resin to investigate the effect of epoxy resin content on behavior of PC. For prediction of this behavior the disturbed state concept (DSC) has been used. The proposed model was then verified by predicting laboratory compressive tests used to find parameters along with independent data sets from other researchers. Moreover, the applicability of existing cement concrete models for predicting the behavior of PC was assessed since they are basically phenomenological, based on experimental observation of the cement concrete testing.

Leon Agavriloaie et al (2012)., had investigated a new type of polymer concrete obtained using epoxy polyurethane acryl and aggregates. Mechanical properties, such as: compressive strength, flexural strength, elasticity modulus, pullout stress and adherence stress between cement concrete and polymer concrete were experimentally determined. Thermo-physical properties, such as: bulk density in natural and dry state, relative and absolute mass humidity, thermal conductivity, linear thermal dilatation, thermal shock strength, chemical resistance, frost-thaw resistance and water adsorption resistance were studied to establish the durability properties of the epoxy polyurethane acryl concrete. The experimental results have shown that epoxy polyurethane acryl concrete is a high performance, lightweight concrete with properties that recommend it as a possible replacement material for classical building materials.

Huichao Yao et al (2018)., have investigated multiwalledcarbon nanotubes (MWNTs) and vapor-grown carbon nanofibers (VGCNFs) were grafted with poly(styrene-co-maleic anhydride) (SMA) and poly(glycidyl methacrylate) (PGMA) by free radical polymerization, and used as the secondary reinforcing agent for multiscale carbon fiber (CF) reinforced epoxy composites. The polymer-grafted VGCNFs and MWNTs were simply suspended in ethanol and spray-coated onto the surface of CF fabrics to fabricate the multiscale composites. The structures of the polymer-grafted VGCNFs/MWNTs were characterized and their effect on the mechanical properties of multiple composites was compared. Interestingly, polymer-grafted VGCNFs with much larger diameters and lower grafting ratios are more effective than polymergrafted MWNTs for the reinforcement; and SMA-grafted VGCNFs are more effective than PGMA-grafted VGCNFs.Addition of only 0.4 wt% (on the basis of CF fabrics) of SMA-grafted VGCNFs increases interlaminar shear strength (ILSS) by ~73% and flexural strength by ~21%. The increase of ILSS exceeds those of previously reported functionalized nanotubes/nanofibers, graphene oxide or organoclaynanoplatelets as the secondary reinforcement. The high straightness and large aspect ratio of SMA-grafted VGCNFs and the strong interaction with the matrix play the key roles in the reinforcement.

Victor Y. Garas et al(1995).,had studied the Polymer Concrete (PC) composites posses a unique combination of properties that depend upon the formulation. This study reviewed the variations in polyester polymer concrete mixture components that affected the properties. The effect of resin content, aggregates, fibers and coupling agents were critically reviewed. It was found that the optimum polymer content varied from 12% to 14% (w/w). Using fibers and coupling agents showed further enhancement of the mechanical properties of PC. Also, a new database was designed to document different properties of PC.

Guruprasad Alva et al(2018).,had studied the polymers have the ability to be easily molded in to any shape, they have a wide range of applications in industry. Composites prepared by dispersing ceramics in to polymer matrix have higher thermal conductivity than the original polymer, and they still retain their high electrical resistance. In this work, polyvinylbutyral (PVB) is chosen as the polymer matrix. Ceramic nanoparticles like boron nitride (BN), zinc oxide (ZnO) and silicon carbide (SiC) are used as fillers. Polymer composites with different filler loading ratio (wt %) are prepared and their thermal and electrical properties are analyzed. FTeIR, XRD and TGA characterizations are also performed on the composites. The results indicated that PVB composite with hexagonal boron nitride (heBN) showed the best improvement in thermal conductivity which is an increase of 131.87%, and volume resistivity of composites remained high, above the 1010 Uecm level.

BilimAtli-Veltin et al(2018).,had investigated main objective of the experimental study detailed in this paper is to investigate the performance of fully recyclable, lightweight, low-cost, thermoplastic Polypropylene (PP) composite tapes at low temperatures. Coupons made of [±45] and [0/90] laminates are subjected to tensile and 3-point bending tests at room temperature as well as at −196 °C. In addition to that, cryogenic low velocity impact tests at 268 J and 777 J impact energies are performed on tubular structures. The results are indicating that the laminates made of PP tapes have sufficient ductility for cryogenic applications. Low velocity impact tests showed that the viscoelastic behaviour of the material is preserved, even at such low temperatures and more than 72% of impact energy is absorbed by the material.

MasoudBozorgBigdeli et al(2017).,had studied the Graphenenanoribbons (GNRs) can be added as fillers in polymer matrix composites for enhancing their thermo-mechanical properties. In the present study, we focus on the effect of chemical and geometrical characteristics of GNRs on the thermal conduction properties of composite materials. Configurations consisting of single and triple GNRs are here considered as representative building blocks of larger filler networks. In particular, GNRs with different length, relative orientation and number of cross-linkers are investigated. Based on results obtained by Reverse Non-equilibrium Molecular Dynamics simulations, we report correlations relating thermal conductivity and thermal boundary resistance of GNRs with their geometrical and chemical characteristics. These effects in turn affect the overall thermal transmittance of graphene based networks. In the broader context of effective medium theory, such results could be beneficial to predict the thermal transport properties of devices made of polymer matrix composites, which currently find application in energy, automotive, aerospace, electronics, sporting goods, and infrastructure industries.

Yuan Fang et al(2018).,had observed foam core polymeric sandwich structures have been widely used in structural engineering due to their advantages such as lightweight, high strength, and so on. However, the mechanical properties of face sheets and foam cores, and the interfacial bond strength of sandwich structures are affected by the combined hygrothermal conditions, which is common in the most civil engineering applications. In this study, the mechanical properties of face sheets and foam cores in the combined hydrothermal conditions were investigated. Meanwhile, a series of sandwich double cantilever beams were tested at different ageing time to evaluate the effect of ageing time on interfacial fracture of polymeric sandwich structures. Furthermore, an analytical model, considering the effect of hydrothermal ageing, was proposed to predict the strain energy release rate of mode I interfacial fracture of the polymeric sandwich structures at different ageing time.

Garces et al(2018).,had studied the shape Memory Polymers (SMPs) and their composites (SMPCs) offer great properties, such as low cost and tailor ability. Heat-activated SMPs and SMPCs are widely studied under controlled laboratory conditions, but their field applications did not receive thorough attention because manufacturing them with integrated heating elements for this use is very challenging. This work proposes and demonstrates an alternative novel solution to manufacture and activate a SMPC through resistive heating by using extrusion based additive manufacturing. Successful manufacturing of these materials can lead to broader use in strategically critical applications (biomedical stents, sports equipment, and unmanned air vehicles (UAVs)).

Yan-Fei Huang et al(2017).,had investigated hierarchically ordered structure of natural bones with the integration of outstanding strength and toughness, we made an endeavour to engineer ultra-high molecular weight polyethylene (UHMWPE)/hydroxyapatite (HA) biocomposites with bone-like structure. The gradiently oriented architecture is constructed via ingenious control over the flow field during the injection molding. In theouter layer, intense shear induces a plenty of highly oriented UHMWPE lamellae, which mimic the aligned collagen fibers in the natural bone. In the inner layer, chain relaxation gives rise to relatively disordered lamellae, contributing to a tough core that shares the similarity with the soft internal layer of natural bones. Such a unique spatial architecture remarkably strengthens the mechanical performance of structured UHMWPE/HA biocomposites. Strikingly, tensile strength and impact toughness are significantly increased by 170% and 85%, climbing up to 63.4 MPa and 103.9 kJ/m2, respectively, which is hardly achieved in the previous studies. Meanwhile, structured UHMWPE/HA exhibits good biocompatibility and bioactivity. Our work offers an efficient, time-saving and scalable approach to fabricate high performance UHMWPE/HA biocomposites, where the simultaneous enhancement of strength and toughness makes the structured UHMWPE/HA a promising candidate of replacements for cortical bones.

Oana M. Istrate et al(2018).,had studied the clay (montmorillonite) based method of reintroducing plastics back into the market without subjecting them to extended processing methods. We have prepared montmorillonite/recycled polymer materials with recycled polystyrene (R-PS) and recycled polyethylene (R-PE). R-PS was melt mixed with as-received organomodifiedmontmorillonite or blowing agent treated organomodifiedmontmorillonite which led to intercalated exfoliated clay/polymer Nano composites. Similarly, R-PE was melt compounded, with or without the addition of a compatibiliserwith the above mentionedorganomodified clay minerals which resulted in conventional composite formation. In the case of R-PS, the thermal degradation temperature of the materials increased with the presence of clay minerals, whereas for R-PE based materials it was observed that the thermal degradation temperatures decreased with the presence of clay minerals. Overall it was observed that the presence of clay minerals improved the stiffness of the materials. The use of blowing agent treated organ modified clay minerals in R-PS led to nearly doubled impact strength compared to organ modified clay/R-PS Nano composites.

CONCLUSION

- In this research, a series of compressive and tensile tests were performed in order to study the stress–strain behavior of PC.
- The strain at peak for PC was two to three times higher than that of conventional concrete corresponding to the epoxy resin content.
- It was observed that with the increase in the amount of epoxy resin, the compressive strength increased, while the tensile strength was relatively constant.
- Polymer concrete was obtained from resin type epoxy polyurethane acryl with two sorts of aggregate: 0–1 mmand 1–3 mm. Two types of tests were done for characterizing the properties of this new material: mechanical tests and thermo-physical tests.

- Based on the reviewed literature, it is concluded that using certain polymer content.
- Well graded aggregates, fibers and coupling agents strongly improve different properties of polyester polymer concrete.
- A large number of silica/polymer composite materials have recently developed in various application fields due to their composites' unique properties combining the advantages of the inorganic fillers and the organic polymers. In the development of these composites, the overcome of draw backs such as the incompatibility of silica with organic polymer and nanosized levelhybridization, and the understanding the interfacial interaction become critical issues.

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