ME Seminar

Natural composites based on thermoplastic resins: An eco-friendly solution for structural applications

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ABSTRACT

The advancements of technological innovations and the creation of new engineering structural components have led to the degradation of the earth notwithstanding the vast benefits of such technologies. Now, with the changing global scenario towards sustainable development goals, we are in search of eco-friendly materials for all purposes especially structural applications to leave a better environment for future generations. This led to the development of thermoplastic composites reinforced either partially of fully with natural fibres (NF) which have been a hot topic recently due to the increasing environmental awareness. NFs are considered as one of the best eco-friendly materials and best alternative to synthetic/organic fibre reinforced composites due to their better formability, abundant, renewability, biodegradability, lightweight, low cost and eco-friendly features. Also, the known advantage of thermoplastics (TPs) is their recyclability that made them sustainable. Past research proved that the tailoring of TPs with high performance fibres gained the attention of many industries including defence, aerospace, food, marine, etc. Major portion of the presentation will discuss the implementation of NF based thermoplastic composites in armour applications. Based on the research experience in thermoplastic composites, two different applications will be presented: (i) Body armours: The need for lightweight sustainable composites is desirable nowadays due to the changes occurring in the ecosystem. The use of natural composites is highly desirable to save the environment. Hence, a novel materials system for body armours from inception to the final prototype using in-house facilities with a combination of synthetic and natural fibres. This involved preparation of 3D fabrics, blending of natural/synthetic fibres, improvement in the interfacial properties, hybrid composites (intraply and interply hybridisation with synthetic and natural fibres), static/dynamic characterisation and ballistic impact. The developed lightweight material system was able to confront 9mm FMJ bullet (NIJ.STD.Level IIIA velocity (426±15m/s)). The hybridisation and fabric architectures improved the mechanical performance while maintaining the lightweight. (ii) Aerospace: The demand for out-of-autoclave automated manufacturing techniques is increasing, LATP technique. The LATP technique has the potential to produce high-quality components without the requirement for a secondary consolidation processing step. A novel implementation of LATP was used to produce a representative skin-stiffener of a wingbox from new carbon fibre (CF) reinforced polyether ether ketone (PEEK). The interface was characterised through interlaminar shear and fracture toughness tests. The interfacial properties of new CF/PEEK material were in close agreement with the equivalent aerospace certified CF/PEEK material (APC-2).

ABOUT THE SPEAKER

Dr. Aswani Kumar Bandaru is a researcher in composite materials with a PhD in armour technology. Currently, he is an Assistant Lecturer (Assistant Professor) in Mechanical Engineering at the Department of Mechanical, Biomedical & Manufacturing Engineering, Munster Technological University, Ireland. He received Ph.D from Indian Institute of Technology Delhi on the implementation of thermoplastic composites in body armours. His Ph.D was recognised through many awards such as FITT best industrial Ph.D award, IITDA-Research and Innovation Award, Selected as 2nd best Ph.D thesis, etc. In addition, 15 journal papers were published solely from Ph.D work. After Ph.D joined as a postdoctoral researcher at the University of Limerick under the supervision of Professor Paul M. Weaver in VARICOMP project (€5million). While doing postdoctoral research, he received Marie Skłodowska-Curie Career-FIT Fellowship of €278,400 (approx. INR 2,43,16,670) to work on PTFE coated glass fabrics for the food industry. His scientific interests are mainly, development of materials system, armour technology, impact (low/ballistic), composites, high strain rate, tailoring of composites, additive manufacturing (Laser Assisted tape Placement), sustainable composites and abrasive wear. He has authored 25 (19 as the first author) refereed journal articles and 15 conference proceedings. His h-index on Scopus is 12 and google scholars is 14. He supervised 12 master's research projects and currently mentoring 6 Ph.Ds. Recently applied for Royal Society University Fellowship in collaboration with the Cranfield University and Ulster University, United Kingdom.

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