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A novel method for determining the mechanical strength of wastes-embedded concretes using the principles of photonics

Fracture toughness is a measure of the resistance of a material to fracture. This fundamental property is used in diverse engineering designs including mechanical, civil, materials, electronics and chemical engineering applications. The evaluation of this remains challenging for extremely heterogeneous materials such as concretes. This talk will focus on how the principles of photonics can be applied innovatively for evaluating the fracture toughness of composite concretes using polymeric particulates derived from Qatar municipal wastes. Different grades of particulates derived from the municipal wastes are used as a partial replacement of natural aggregates in fabricating the concretes. Then, inspired by the stress-displaying properties of human cornea, and by applying a thin cornea-like birefringent coating on the surface of opaque, notched composite concrete beams, the evolution of the maximum shear stress (/strain) distribution on the beams is sensed under the external loading. The location of the maximum deviator stress is tracked ahead of the crack tip (fracture processing zone) on the concrete samples under the ultimate load, and hence the effective crack length is characterised. Using this, the fracture toughness of the heterogeneous composite beams is evaluated and the results compare favourably with other conventional methods using combined experimental and numerical/analytical approaches. Hence the current photonics-based study could help in evaluating the failure strength of new materials using wastes more effectively in future.

Speaker Biography

S Joseph Antony is Associate Professor at the School of Chemical and Process Engineering, University of Leeds, U.K. He is an expert in the area of photonic stress analysis and multi-scale mechanics of discrete and continuum materials. His research area covers a wide range of inter-disciplinary problems using advanced computational and experimental technologies. His current research includes particulate mechanics (MD, DEM, FEM modelling), nano, micro and macroscopic properties of powders and grains, force transmission patterns in materials subjected to mechanical, electrical and combined loading conditions and developing composites for constructions from municipal wastes.

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