World Academy of Science, Engineering and Technology
International Journal of Mechanical and Industrial Engineering
Vol:8, No:11, 2014

Bridging Stress Modeling of Composite Materials Reinforced by Fiber Using Discrete Element Method

Authors : Chong Wang, Kellem M. Soares, Luis E. Kosteski

Abstract : The problem of toughening in brittle materials reinforced by fibers is complex, involving all the mechanical properties of fibers, matrix, the fiber/matrix interface, as well as the geometry of the fiber. An appropriate method applicable to the simulation and analysis of toughening is essential. In this work, we performed simulations and analysis of toughening in brittle matrix reinforced by randomly distributed fibers by means of the discrete elements method. At first, we put forward a mechanical model of the contribution of random fibers to the toughening of composite. Then with numerical programming, we investigated the stress, damage and bridging force in the composite material when a crack appeared in the brittle matrix. From the results obtained, we conclude that: (i) fibers with high strength and low elasticity modulus benefit toughening; (ii) fibers with relatively high elastic modulus compared to the matrix may result in considerable matrix damage (spalling effect); (iii) employment of high-strength synthetic fiber is a good option. The present work makes it possible to optimize the parameters in order to produce advanced ceramic with desired performance. We believe combination of the discrete element method (DEM) with the finite element method (FEM) can increase the versatility and efficiency of the software developed.

Keywords : bridging stress, discrete element method, fiber reinforced composites, toughening
Conference Title : ICAMME 2014 : International Conference on Applied Mechanics and Materials Engineering
Conference Location : Venice, Italy
Conference Dates : November 13-14, 2014