 ISSN 2362-0412

Structural Integrity Analysis of Blade Profiles for Fibre Reinforced Plastic (FRP) Waste Shredder

A.D.H.T. Wijerathne, M.T.T. Ranjan*, U.I.K. Galappaththi

Department of Mechanical and Manufacturing Engineering, Faculty of Engineering, University of Ruhuna, Sri Lanka

*Corresponding author: *ranjan@mme.ruh.ac.lk*

ABSTRACT

Fibre Reinforced Plastic (FRP) structures and components are widely used in the modern world as they offer significant advantages compared to traditional raw materials. As a result, leading sectors such as aerospace, automobile, marine, naval architecture, civil, and energy have adopted FRP manufacturing techniques to produce required structural components. However, FRP products negatively affect the environment since they add harmful waste materials to nature in different stages of their lifespan. The wastages generated at manufacturing and disposal phases become significant and a proper mechanism is required to manage them. Therefore, the applicability of the waste management hierarchy was considered and the mechanical shredding technique was finalized as the most practical and reliable method to recycle the FRP wastage. Then, a prototype machine was designed by integrating the shredder mechanism. The blade profile used for the shredder mechanism was identified as the most critical component of the machine as it directly related to the properties of recyclates. As a result, structural integrity analyses were undertaken for five different blade profiles which were developed varying the hook angle of the cutting tools (0°, 13°, 18°, 16°, and 0°) and three teeth were considered for the blade profile. The selection of hook angles was based on the experiences of the authors. The maximum working stress and the deformation pattern of the blade profile were the main criteria considered and Finite Element Analysis (FEA) was conducted for all the blade profiles to identify their structural integrity for selecting the most suitable blade profile. Based on the FEA results, it was able to observe lower working stress and deformation pattern from the blade profile which consisted of body part and tool tip and has a 0° hook angle as it was selected to manufacture 24 blade profiles to fabricate the shredding section of the machine.

Keywords: *Blade profile, Finite Element Analysis, FRP waste shredder, Structural integrity*