World Academy of Science, Engineering and Technology
International Journal of Materials and Metallurgical Engineering
Vol:13, No:09, 2019

Different Processing Methods to Obtain a Carbon Composite Element for Cycling

Authors : Maria Fonseca, Ana Branco, Joao Graca, Rui Mendes, Pedro Mimoso

Abstract : The present work is focused on the production of a carbon composite element for cycling through different techniques, namely, blow-molding and high-pressure resin transfer injection (HP-RTM). The main objective of this work is to compare both processes to produce carbon composite elements for the cycling industry. It is well known that the carbon composite components for cycling are produced mainly through blow-molding; however, this technique depends strongly on manual labour, resulting in a time-consuming production process. Comparatively, HP-RTM offers a more automated process which should lead to higher production rates. Nevertheless, a comparison of the elements produced through both techniques must be done, in order to assess if the final products comply with the required standards of the industry. The main difference between said techniques lies in the used material. Blow-moulding uses carbon prepreg (carbon fibres pre-impregnated with a resin system), and the material is laid up by hand, piece by piece, on a mould or on a hard male. After that, the material is cured at a high temperature. On the other hand, in the HP-RTM technique, dry carbon fibres are placed on a mould, and then resin is injected at high pressure. After some research regarding the best material systems (prepregs and braids) and suppliers, an element was designed (similar to a handlebar) to be constructed. The next step was to perform FEM simulations in order to determine what the best layup of the composite material was. The simulations were done for the prepreg material, and the obtained layup was transposed to the braids. The selected material was a prepreg with T700 carbon fibre (24K) and an epoxy resin system, for the blow-molding technique. For HP-RTM, carbon fibre elastic UD tubes and ± 45º braids were used, with both 3K and 6K filaments per tow, and the resin system was an epoxy as well. After the simulations for the prepreg material, the optimized layup was: [45°, -45°,45°, -45°,0°,0°]. For HP-RTM, the transposed layup was [± 45° (6k); 0° (6k); partial ± 45° (6k); partial ± 45° (6k); ± 45° (3k); ± 45° (3k)]. The mechanical tests showed that both elements can withstand the maximum load (in this case, 1000 N); however, the one produced through blow-molding can support higher loads (≈1300N against 1100N from HP-RTM). In what concerns to the fibre volume fraction (FVF), the HP-RTM element has a slightly higher value (> 61% compared to 59% of the blow-molding technique). The optical microscopy has shown that both elements have a low void content. In conclusion, the elements produced using HP-RTM can compare to the ones produced through blow-molding, both in mechanical testing and in the visual aspect. Nevertheless, there is still space for improvement in the HP-RTM elements since the layup of the braids, and UD tubes could be optimized.

Keywords : HP-RTM, carbon composites, cycling, FEM
Conference Title : ICCMST 2019 : International Conference on Composites Materials, Structures and Technology
Conference Location : Lisbon, Portugal
Conference Dates : September 19-20, 2019