

Integrated Structures for Aerospace Applications Via Resin Transfer Molding

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During the past decades, composite structures have been used for a wide spectrum of indications. Their utilization for the structural aspects of aerospace applications are becoming more and more widespread due to their preferable weight-specific strength and stiffness properties along with their excellent fatigue performance when compared to metallic structures. However, requiring significant amount of time for production, high material cost and qualified and expensive labor cost are among some of the unfavorable reasons concerning their usage in various industrial sectors. Reduction in weight, reducing labor and material cost and eliminating the process steps and thereby decreasing fabrication time are the key parameters and demands for aerospace industries. These necessities direct the aerospace industry to resort to new cost-effective production methods. This trend shows that the newly-adapted methods will involve automation and step by step control, that are untouched by labors and executed via computers and finalized in production plants.

Up till now, pre-preg composite materials have been used as the traditional composite production method, also known as the "hand lay-up into autoclave" method. Experience with the pre-preg hand lay-up process has shown that this method is not adequate for complex and integrated shapes demanded by the aerospace industry. Recent developments have presented new production methods to the industry for performing complex and integrated structures. The RTM (Resin Transfer Molding) production method is based on the injection of resin into a closed and two-sided mould containing dry fibers. While the injection process takes place, air in the mould is replaced by resin and the fibers are wetted sufficiently. After the injection period finalizes, cure cycle is applied according to the characteristics of the resin. RTM provides high surface quality on both sides of the manufactured parts, better dimensional tolerance, repeatability and reduced labor cost on complex structures with a high level of integration.

Integrated structures are a challenging issue for aerospace industries. Integration of skin and stringer, spar and fitting, skin and rib, skin and spar etc. are all various examples of integrated structures. The number of parts and steps required in the production of such integrated structures decrease with the utilization of the RTM production method. For integrated structures, the dry fibers used in the RTM process can be tailored, stiched, braided, knited or woven three-dimensionally via pre-shaping using textile techniques before they are layed out into the mould.^[1] Pre-forming near-to-net shaped dry fibers and reducing the

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amount of scrap material post-production are among the advantages of these fiber prefabrication techniques.

The aim of this paper is to give a general overview about the complex and integrated shapes of aerospace that have been manufactured utilizing the RTM composite production method via using different textile techniques in the TURKISH AEROSPACE INDUSTRIES, INC. Utilizing the RTM method along with textile prefabrication techniques has proven to be of advantage for creating high-quality complex and integrated structures with better dimensional tolerance while reducing labor cost and production time. In this respect, the authors aimed to discuss innovative, in-house automated molding technologies, along with key design and process parameters and some results of product development activities during RTM. In addition, an evaluation of the different textile techniques of dry fiber that are used in integrated complex aerospace structures with the RTM method was undertaken.

REFERENCES

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