RESEARCH PAPER | Engineering | Volume : 4 | Issue : 4 | Apr 2014 | ISSN - 2249-555X

Investigate on Manufacture of Advance Composite Material with Three Dimensional Braiding Technology

KEYWORDS: Advanced composite material, Three- dimensional braiding technology, manufacture

Mohan Singh
Ph.D Scholar, Department Of Mechanical Engineering, PTU Campus,G.Z.S.C.E.T. Bathinda

Dr. Balwinder Singh Sidhu
Department Of Mechanical Engineering, PTU Campus,G.Z.S.C.E.T. Bathinda

ABSTRACT *Three dimensional braiding processes have been recognized for their outstanding advantages in fabricating integrated and near net-shape preforms for advanced composite materials. Three–dimensional braided composite material, a new material type of composite material is a combined product of the three-dimensional braiding technology and advanced composite material technology. It is now gaining their usage in aerospace, automotive and biomedical industries because of their inherent properties like high strength to weight ratio, low wear rate etc. As the fiber bundles extend along a plurality of spatial directions and cross with each other, the integrity of the composition is good and the drawbacks of low intensity is overcome.*

INTRODUCTION

Technologically, most important composites are those in which the dispersed phase is in the from of a fiber. Hybrid composites are relatively new and obtained by using two ors more fibers in single matrix and they find applications such as light weight land, water and air transport structural components and light weight orthopedic equipments. The combination is made so as to achieve improved mechanical is made so as to achieve improved mechanical property and maintain low cost. In the present paper, the aluminum silicon carbide fiber composite material is manufactured by the four steps three-dimensional braiding technology, and the three-dimensional braided flange specimen is developed in combination with the RTM process. Also, advanced composite material is used to substitute the aviation aluminum alloy. As tested by tensile and bending tests, under the condition of same quality, the tensile and bending property of the former is better than latter, so that the expected result is reached. The whole manufacturing process is divided into five Steps: manufacture of three-dimensional braided perform, manufacture of the RTM process mold, injection, curing and release of the resin.

Manufacturing technique

A track plate is kept at the bottom of the machine. Packages, which supply axial yarns, are kept beneath the track plate. Bobbins are mounted on the carrier which moves over the track plate. Braiding yarns are fed from these bobbins. The relative motion of the braiders and the axial yarn determines the pattern and the micro-structure of the braid. 3D braiding process is a minor modification of 2D braiding process in which the standing ends are added to the braiding yarns that are moving.

The most important 3D braiding techniques are as follows:

- Circular braiding and Over braiding
- Four step braiding process
- Two step braiding process
- 3D rotary braiding

Circular braiding and over braiding

In circular braiding, the bobbins (with opposite direction of rotation) move in two concentric orbits. The two orbits interfere with dephased sinusoidal oscillations to produce the thread crossing. At this crossing point, the bobbins change their path to produce the upper and inner side of the braid. Generally, circular braiding process produces braids with rotational symmetry. Over braiding process follows the same principle as the circular braiding process, but the only modification is that the crossing point is located at the center.

Four step braiding process

In this process, the bobbins move on X and Y axis that are mutually perpendicular to each other. In each step, the bobbins move to the neighboring crossing point in two ways and stops for a specific interval of time. Basic arrangement of the braiding field is obtained after a minimum of four steps. This method produces braids which have a constant cross section.

Two step braiding process

In two step braiding process, the bobbins move continuously without any stoppage. They move on the track plate through the complete structure, around the standing ends, so the movements of bobbins are faster, compared to four step braiding process. The bobbins can move only in two directions, so the process is called two step braiding process. [4]

3D rotary braiding

The 3D rotary braiding process consists of base plates with horn gears and mobile bobbins arranged on it. Switches are used to control the threads and horn gears. They are also controlled by a special control technique.

GEOMETRY OF BASIC 3D BRAIDS

A selection of braiding patterns demonstrates the flexibility of the braiding technology. The patterns range from traditional line/lace or circular braiding to complex three dimensional braiding patterns like triangle, diamond or even star shape.

As illustrated in Figure 1 the basic 3D Braids arrangement allows, in addition to the current braided structures as described in [8-11], the production of double tubular fabrics and various beams like Y-beams. Other tubular or beam structures are for example: X-beam, -beam, barbell-shape, multi-tubular, or hex-beam with strands. Furthermore because of the hexagonal ring arrangement of the cams it is possible to braid with mul-tiple different materials at the same time by using multiple “circular braiders” at the same time and thereby manufacturing a multi-layer tubular or otherwise shaped braided structures. In addition the realization of multiple ramifications is also possible. By switching between different braiding setups shapes can be joined and split in various combinations.

Volume : 4 | Issue : 4 | Apr 2014 | ISSN - 2249-555X

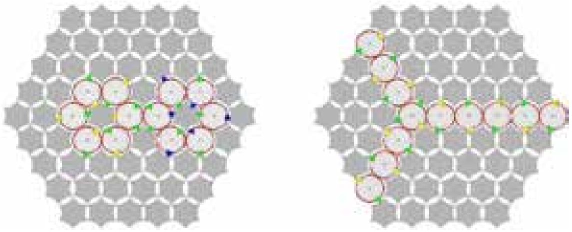

Figure 1. 3D-braiding patterns: Double-tubular (left) and Y-beam (right).

Applications and utilizations
Composites are the primary contender for following applications. In each of these fields, the work is at a very early stage of development, but progress will be greatly assisted by the results attained in the aircraft and aerospace sectors.

Automobile and Automotive industry
There are basic differences in the approach adopted when considering the application of composites in the aerospace and automobile industries. This is primarily due to the production requirements of the two activities. In aerospace and defense, the design of the structure is optimized to provide the required performance and the manufacturing process is subsequently selected on the basis that it is capable of achieving the desired design. In contrast, the automotive industry requires a rate of manufacture, which is capable of producing components within a specified unit cost. Therefore, manufacturing processes, which are suitable for volume output, are the primary consideration and design of component must be tailored for that fabrication process. In the case of high-performance spots car, the cost of manufacture is high in the first place owing to advanced design, better workman-ship and small production runs. Hence the concept of increased performance due to the increased of composite material makes sense in racing cars, the picture is again different; a racing car is built to win races and if this can be helped by weight saving, increased structure strength, the possibility of a more advanced aerodynamic design or better road-holding, then the use of carbon-fiber reinforced plastics is fully justified. Today, much thought is being given by the makers of racing cars to the possibilities of new materials including advanced fiber composites.

Power Transmission Industry
A number of possibilities exist for utilizing the outstanding mechanical properties of carbon-fiber. In one of these used is uses is uses of carbon-fiber to reinforce a metal; thus, in electrical transmission lines, the fiber strengthens the copper or aluminum conductors and allows greater distances to be used support towers. It is very doubtful whether normal transmission lines will ever justify carbon-fiber incorporation, but, in cases where extra long spans are necessary as in rivet crossings, its use may prove advantageous and justify the extra cost.

In the development of super high speed electric trains, the overhead conductors must be as free as possible from sagging and from deflection by the upward force of the pantograph; otherwise excessive wear and arcing will take place. In this case, there is a very real incentive to provide overhead lines of the maximum rigidity and carbon-fiber may be used to reinforce the copper conductor, the latter also acting as the matrix material. It is likely to be many years, however before widespread use is made in these areas. In the area of electronics and sound productions, one possible application is for high quality loud speaker cons, where the combination of high stiffness and low weight are ideal for improved frequency response.

Mechanical Engineering
Aspects of Mechanical Engineering which are of particular interest at the present time are:-

1) Bearings.
2) Components and structures for fast surface transport, example railway.
3) Gears, high-speed rotating machines
4) Structures such as towers, cranes, etc.
5) Machine tools and medical applications.

CONCLUSIONS
This paper has presented the review specific for the advanced composite material .By this mean these consist the following;

The mechanism of the processing of advanced composites, which is different by the mechanism of the metal processing This review is determined by the structure and by the mechanical, thermal ,etc characteristics of the composite material.

The mechanical properties of advanced composite material are superior to their ingredient materials and thus their high strength to weight ratio (specific strength) makes the more suitable for automotive components requirement. Reduction in overall weight of vehicle enhances its load carrying capacity, improves fuel efficiency, improves acceleration; reduce emission, vibration and noise. Advanced composite material is widely used for the manufacture of brake drum, piston, connecting rod, and cylinder liner.

REFERENCE
1. Subramanian Senthil Kannan, and Kumaravel S (2008). "A Comprehensive Look at 3-D Fabrics." The Indian Textile Journal. | 2. Branscomb, David, David Beale, and Royall Broughton(2013). "New Directions in Braiding." The Journal of Engineered Fibers and Fabrics (JEFF) 8.2: 1-24. | 3. Du, G.-W., and F. K. Ko(1993). "Unit Cell Geometry of 3D Braided Structures." Journal of Reinforced Plastics and Composites 12.7: 752-68. | 4. Wulfhorst, Burkhard, Thomas Gries, and Dieter Veit (2006). "Braiding Processes and Machines."Textile Technology.188-204. | 5. Drechsler.K (1999). "3-D Textile Reinforced Composites for the Transportation Industry." 3-D Textile Reinforcements in Composite Materials. 43-66. | 6. Tong, Liyong, Adrian P. Mouritz, and Michael K. Bannister (2002). 3D Fiber Reinforced Polymer Composites.137-146. | 7. Schreiber, F., F. K. Ko, H. J. Yang, E. Amalric, and T. Gries (2009). Proc. of 17th International Conference on Composite Materials, UK, Edinburg. | 8. Branscomb, David, David Beale, and Royall Broughton. (2013). ("New Directions in Braiding") ("Journal of Engineered Fibers and Fabrics 8.2.") | 9. Mouritz, A.p., M.k. Bannister, P.j. Falzon, and K.h. Leong(1999). ("Review of Applications for Advanced Three dimensional Fiber Textile Composites") Composites Part A: Applied Science and Manufacturing 30.12: 1445-461. |