Different method of Fabrication of composite material- A review

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Abstract

Nowadays demand of the composite material increased due to the tremendous physical and mechanical properties. For development of new product, fabrication process is extremely important factor. Due to the mixture use of metal, ceramic and polymer in composite material the biggest challenge is to maintain the less cost and high production rate process in composite material. In this chapter basic manufacturing processes for composite materials are discussed. These fabrication process of composite material provide the basic knowledge regarding for production composite.

Keywords:- composite material, manufacturing process,

1. Fabrication of Metal Matrix Composite

Nowadays Different techniques are used to manufacture metal matrix composite manufacturing. Selection of manufacturing process in metal matrix composite mainly depends upon reinforcement informality, quality, and matrix metals. By altering the manufacturing method and variation of reinforcement components we can produce different type of composite with different characteristics [17].

1.1. Powder Metallurgy

Manufacturing techniques are broadly classified into two types, liquid state manufacturing and solid state manufacturing. Powder metallurgy manufacturing techniques is the part of solid state manufacturing. Fabrication by powder metallurgy system comprised the three main preparation steps. Initially, powdered metal and reinforcement are mixed. In second stage powder is inserted into the die for development of conservative structure. In last stage, an end formation of the structure is done with applying pressure and sintered at a proper temperature. This compact some time, further experience an optional manufacturing method just as a extrusion/rolling for development of an ideal shape as per need[18].

1.2. Diffusion Bonding

In diffusion bonding, various metal foils layer are bonded in elongated fibres and consecutively squeezed throughout for obtaining a composite. Also, the technique is used for making multi-layer metal sheets. One

of the applications is the bi-metal. With the help of this method, two diverse thin sheets are carried with one another into elective way. This might be squeezed emphatically to the significant time at marginally higher temperature. This facilitates the metal particles for diffusion in a neighbouring metal. The measure of inter diffusion of the metal particles will be chosen by an estimation of dispersion coefficient of a metal particle into another. Consequently, sheets will remain as one very strongly[19].

1.3. Impregnation Process

In impregnation process, the bunch of cylindrical fibers inundated under the liquid metal having lower temperature than conditioning purpose of a fibers. The package remains in the molten metal until the molten metal fills all the voids. Usually this occurs moderately brief period of time. So the fibers are not going to harm and their form not change. It is conceivable to expel or draw a structural metal matrix which change an external form or cross area or to lessen a radius required which experience these auxiliary procedures for more than one go to guarantee last measurement and great quality. [20].

1.4. Electrochemical Forming

Long continuous fibres metal matrix composite manufacturing is done with electrochemical forming. In this process normally long and eclectically conductive fiber is used for manufacturing of metal matrix composite. The process depends on aligning the long fibres in a (non-conductive frame) such as plastic frame to hold the long and electrically conductive fibres. A long fibers frame is drenched within the shower with the solution of the chemical compound. Such compounds are used in electroplating, where metallic layers are precipitated onto metal surfaces, like Ni-plating, Chrome-plating, or copper plating. Electrochemical forming is widely used in the industry.

1.5. Stir Casting

Stir casting is conventional as a mainly promising route, currently practiced commercially, amongst the variety of manufacturing processes available for discontinuous metal matrix composites. Its benefits are its simplicity, flexibility and applicability for large quantities production. It is also appealing as it requires the use of a traditional metal processing route in theory and thus minimizes the product's final cost. This liquid metallurgy technique is largely practical of every accessible route for the production of metal matrix composite and allows the manufacture of heavy components. Because of all these benefits, the current research work uses the stir casting process.

Mostly, fundamental variables for consideration while researching such phenomenon are a mechanical stirrer utilized for the mixing, melting temperature, size of particles, the volume and the quality of the particles.

The vortex technique is amongst the best used technique used to make and keep up the better matrix alloy distribution into the reinforcement material. This process is vigorously shaken after melting of the matrix material to create the vortex on melt surface and then reinforced material is put on vortex side. Until casting slurry, the mixing must continue for the couple of time. Several of listed methods have limitations and disadvantages.

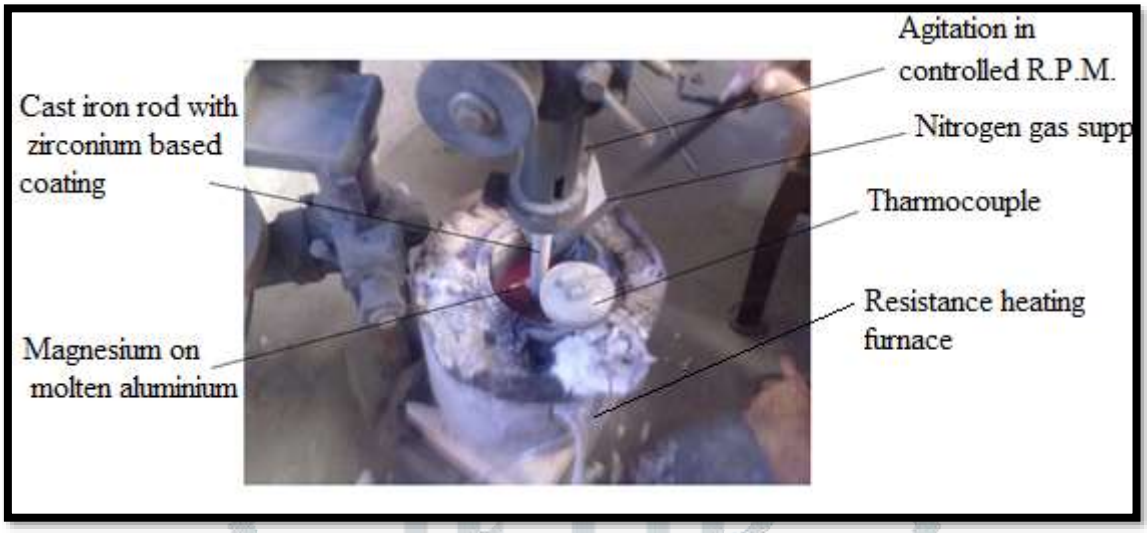

Fig. 3.1 (a) Set up for mixing the Gr and SiC particle in al.

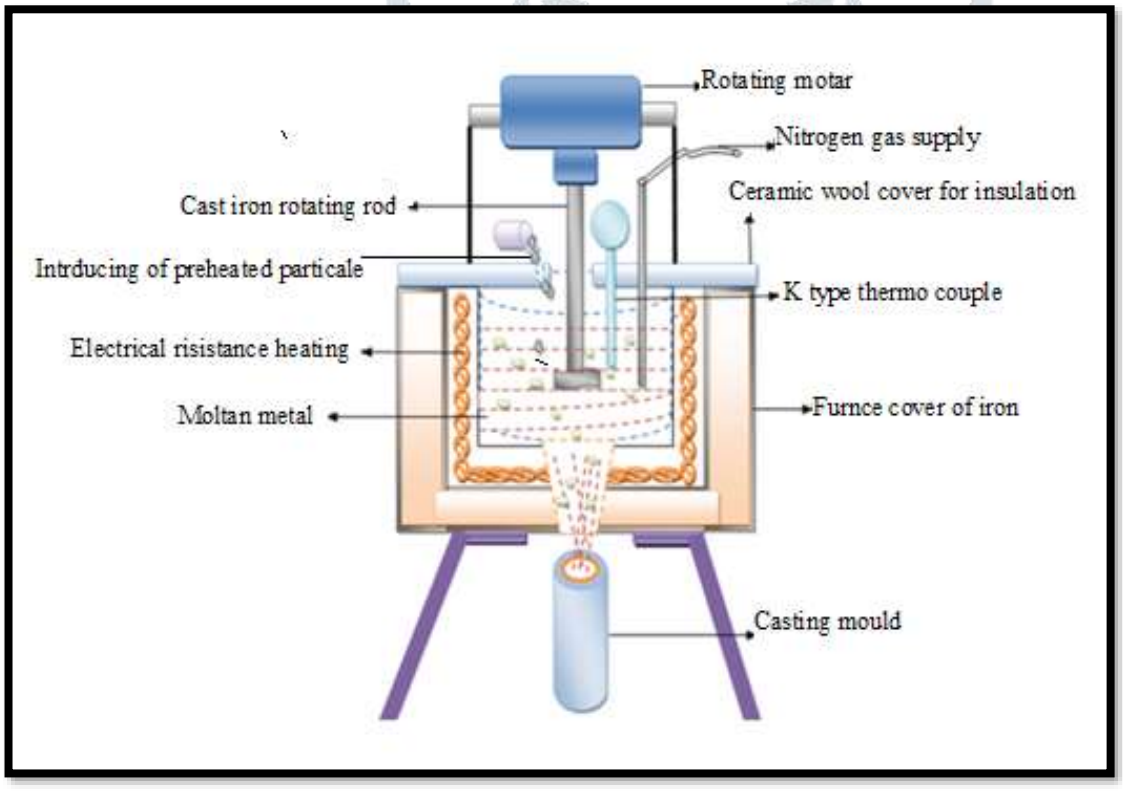

Fig. 1 (b) The representation of experimental setup for reinforcement mixing

2. Types of fabrication process for polymer composite:

2.1. Hand/ Wet Lay Up:

The fibers are placed into the mould for a first time. Fibers can ostiched, woven, or bonded. The resins are impregnated and rollers, brushes or other impregnators are used to impregnate the resins. Under normal atmospheric conditions, the laminates made up by this process are then cured. The method of wet / hand

lay-up is shown in Figure. No restriction can be applied to the general materials even when combining fibernad resins such as epoxy, vinyl ester and polyester etc. The process is low costing and used at room temperature and method is very simple. In this process any mixture of matrix and fibers can be used. Basically in this process higher fiber content and longer fibers are used while comparing with another process. This is hand worked process so more care must be taken. In this technique less viscous resin are preferred to work easily. The quality of the product dependents on the worker, so highly skilled worker is required. Homogeneous resin distribution is unable in the fiber lead to voids. This procedure is appropriate to produce the wind-turbine blades, boats, etc.

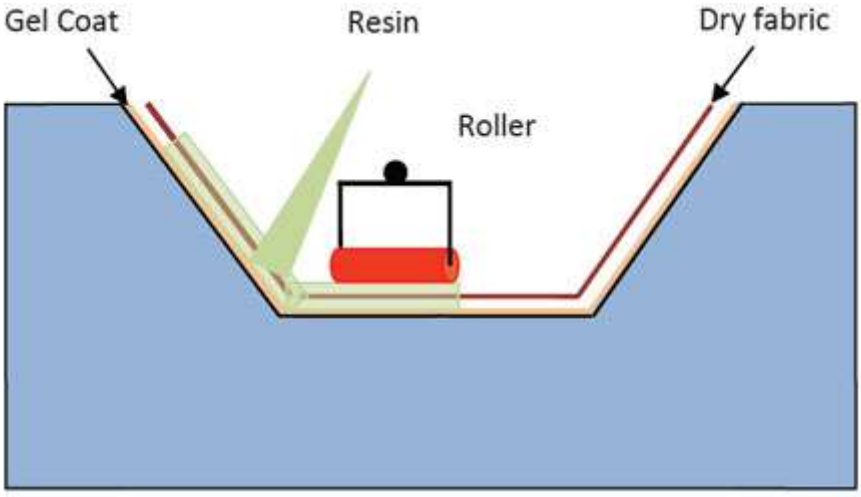

Figure 1.6: hand lay-up or wet fabrication

2.2. Spray Lay-Up

Fiber is cut with hand and filled with weapon and resin spray is applied to the mould. Under normal atmospheric conditions, the products are held to heal. Method of the fabrication is illustrated into fig. Polyester resins which are glass roved are suitable for this process.

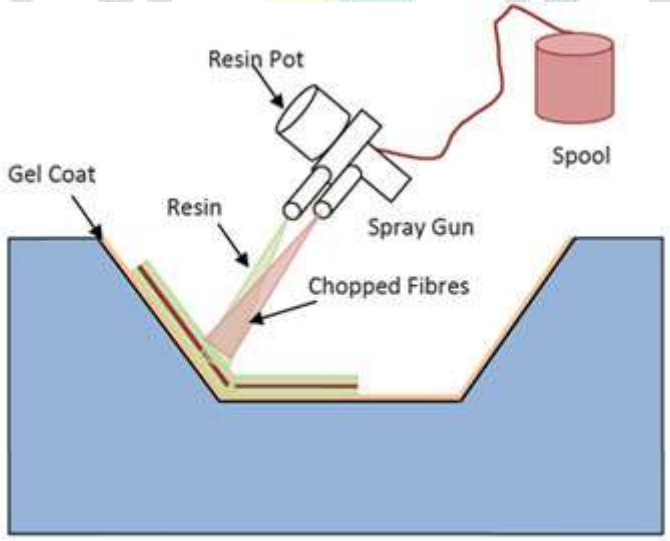

Figure 1.7: spray lay upfabrication

This method of manufacturing is not suitable for higher structural parts. Controlling of the fiber volume fraction and thickness is also difficult. Quality of a product is depends on worker skills. In this technique styrene emission takes place due to open nature. It Provides good surface finish only one side. spray layup fabrication is not suitable for high dimensional accuracy parts. Low viscosity resin are preferred same as hand layup. Light stacked basic boards, e.g., baths, shower trays, few little dinghies and truck fairings.

2.3. Filament Winding:

This is the fully automatic technique mostly utilized for production of flexible fibres components/ structures. This technique is utilized for hollow circular type parts. Fiber orientation is controlled by fiber feeding devices, and mandrel rotational rate. The wound part is restored inside the oven. Resins like polyester, vinyl ester, epoxy, and phenolic alongside any fibre can be used. Filament winding process is shown in Figure. In this process nips and dies are used for resin control. Filament winding process is quick and economical. Complex fiber patterns can be used for structure load bearing. In this process also just like hand layup technique low viscosity resin are preferred. In this process only convex shaped components can be fabricated. Fiber cannot be laid easily along the length of a component.

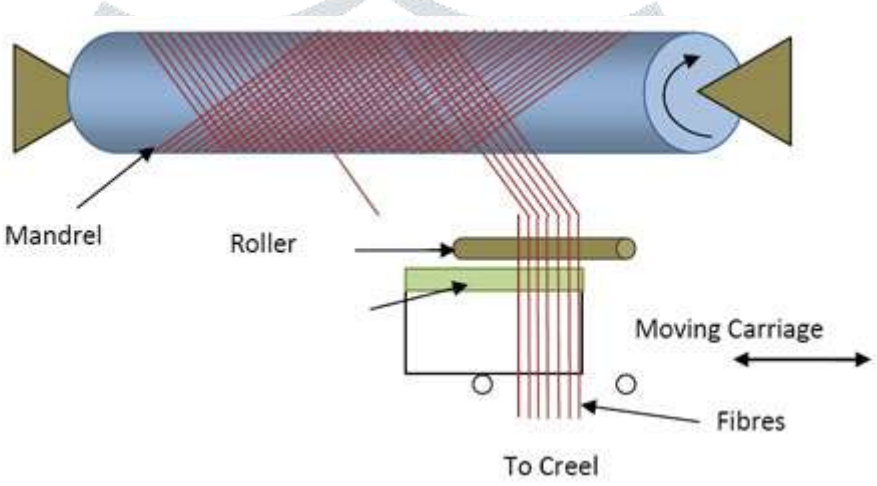

Figure 1.8: Filament winding

Pipelines, Pressure bottles, storage for chemicals, fire-fighters, rocket engine packaging, gas cylinders, etc.

2.4. Pultrusion:

In this process composites are as a fiber and fabrics are extracted from the liquid resin bath. Fiber wetted resins are pulled by warmed die. Finally material is cure to its desired size and shape. The die is not a copy of last required item. At last the completed item is cut along its length. Textures may likewise be presented in die directly. Fibers are used with resin like epoxy, polyester, and vinylester. This technique is best process for large scale production. Additionally, it is quick and economical process. Resins are accurately controlled and obtained finishing of surface is better. But there is restricted to particular type of cross section components. Cost of heated die is high and smaller cross section products are fabricated by pultrusion, beams and girders which are used in bridges, frame work.

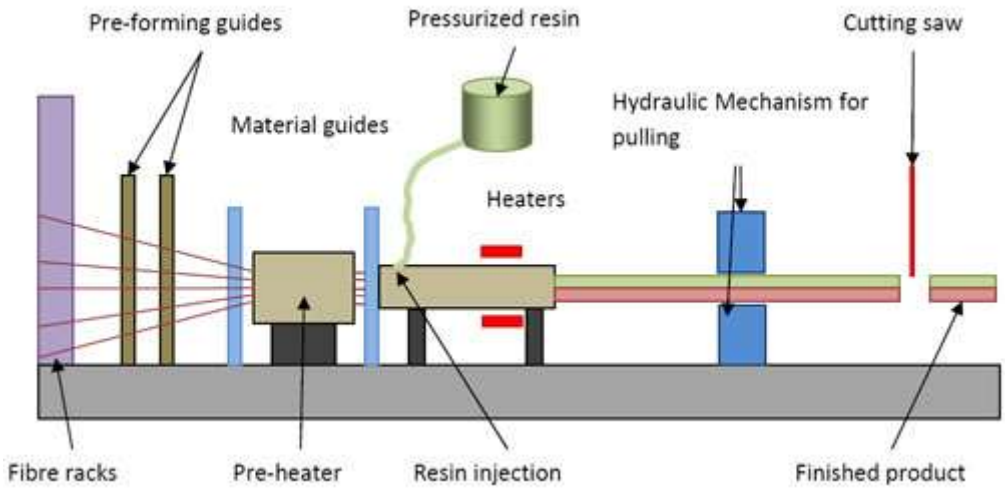

Figure 1.9: Pultrusion

2.5. Braiding:

Braiding is a programmed method of fabrication. The toes are entwined with each other to get the desired form. Mandrel has finished form of product on which there is interlacing. The toes need to be impregnate with a resin. Then the item is restored in normal atmospheric conditions or in the autoclave.

Further, this interlacing may be over the mandrel which has the final form of the product. The toes want to be impregnate with a resin. Then the object is restored at room temperature or in the autoclave

2.6. Vacuum Bagging:

This procedure is the extended version of a wet lay-up procedure. To improve its consolidation, pressure is provided for lamination. This can be accomplished via fixing the plastic firm on a wet laid up laminates. One atmosphere pressure is applied to the laminates by vacuum pump heavy fibers and resins like epoxy and phenolic are used. High fiber content laminates are achieved in vacuum bagging. Lower voids are achieved and fibers are wetted properly due to pressure. Safety is more and t he vacuum bag reduces the amount of volatile.

2.7. Resin Transfer Molding - RTM

The procedure comprises of positioning the fibres or cloth fabrics in the favored course of action. These are pre-squeezed upto formation of shape and hold with each other with the help of binder. A second coordinating mould instrument is after clinched on a first one. At that point pressurized resin is infused inside a cavity. This technique is called as Vacuum Assisted Resin Transfer Moulding / Resin Injection (VARTM/VARI). The laminate is after restored. Both infusion and fixing can occur either at elevated or ambient temperature. This method is cost efficient process and best for complex shapes. But this technique tooling is very expensive and limited to smaller components. This technique is used for manufacturing tube shaped components as casing of motor, covers for engine, etc.

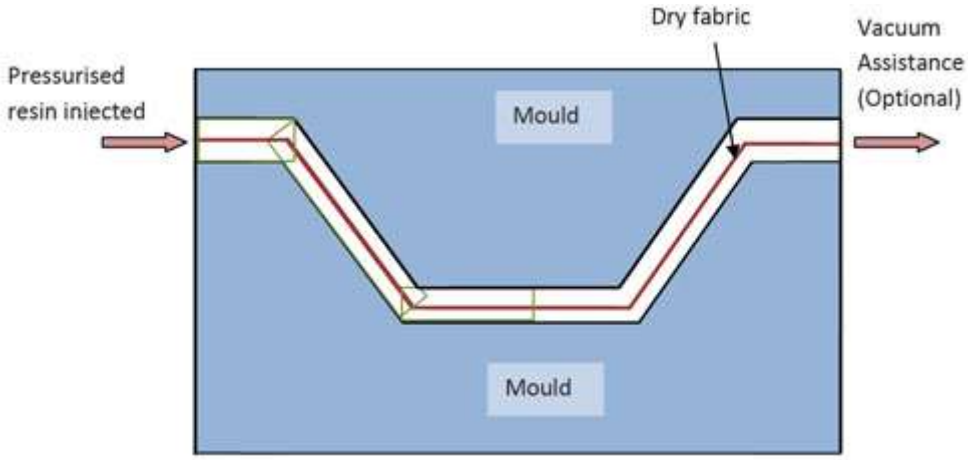

Figure 1.10: Resin Transfer molding c

2.8. Centrifugal Casting:

In Centrifugal Casting method, cleaved fibres and resins are sent to cylindrical moulding under the pressure. A moulding is rotated continually. Because of centrifugal motion, a blend of resin and cleaved fibres deposits over moulding wall. In this manner, the blend acquired a finished shape of a component. This techniques is very economical and best for hollow cylindrical products. But in this process complex shapes cannot be fabricated and low viscosity resin is required.

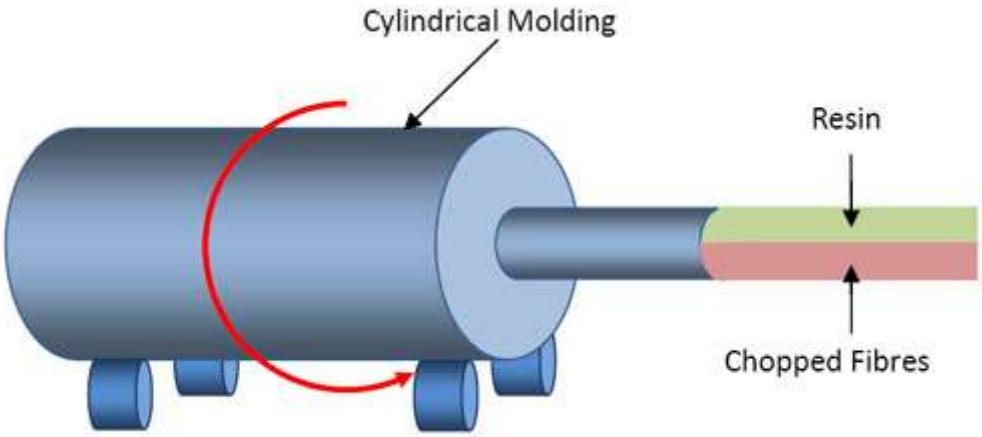

Figure 1.11: Centrifugal casting

The applications incorporate hollow cylinder shaped components as casing for motor, covers for engine, etc.

3. Conclusion

In last two decade use of composite increased rapidly and the same time manufacturing of the composite also dominate market of advance material. Coast of the product is mainly depend of upon the two major part, material and manufacturing.

In this chapter basic information of deferent type of manufacturing techniques is discussed. This chapter helps to understand the basic concept of composite material manufacturing Nowadays we are looking for less human afford and less human skill techniques, so this chapter help reader to select best technique to their work.

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