Glass (Fiberglass) Reinforcements

Glass Fiber (Fiberglass) is the most commonly used fiber to reinforce thermoset and thermoplastic resins across a wide variety of applications and processes.

Glass fiber is made from silica-based raw materials combined with metal oxides and is available in several formulations to meet application demands. A laminate produced with fiberglass reinforcement offers an excellent balance of cost and performance, producing good mechanical and chemical resistance properties. Fiberglass reinforced laminates make up a bulk of all composites production across a wide range of manufacturing processes. Fiberglass reinforcements are available in various forms that include gun roving, textile fabrics, woven roving, chopped strand mat, continuous strand mat, single end roving, and chopped fiber.

Versions of Fiberglass Reinforced Products

Single End Roving: Single-end roving is the primary reinforcement for filament winding and pultrusion applications and is the input fiber used to produce woven roving and knitted fabrics.

- Single-end continuous rovings are produced by pulling glass fibers directly from the furnace bushing, applying sizing to the cooling fibers, and winding them into a roving package or doff. Because of its excellent dry tensile strength, single-end rovings are ideal for high glass content applications like pultrusion and filament winding. Because the fiber is used as input for woven roving and knitted fabrics, single-end rovings are also widely use in open mold and infusion applications when configured into fabrics.

Pultrusion: An automated high-volume continuous process where glass roving is “pulled” through a heated die creating a profile shape.

- Pultrusion is a continuous and highly automated process, that is cost-effective in high volume production runs of constant cross section parts. Pultruded standard shapes include I-beams, channels, angles, beams, rods, bars, tubing, and sheets and have penetrated virtually every market. The pultrusion process relies on a caterpillar tread-like puller system which pulls fiber through a catalyzed resin bath, and into a heated metal die. As the wetted fiber passes through the die (formed in the shape of the desired profile) it is compacted and cured. The cured profile is then cut to length with automated saws that are synchronized to the line speed. Alternative wet-out systems inject the resin directly into the heated die and multiple fiber streams can be pultruded in a single die with several cavities. To form hollow or multiple-cell parts, the wetted fiber wraps around heated mandrels that extend through the die. If off-axis structural strength is required, mat and/or stitched fabrics may be folded into the material package before it enters the die. Pultrusion applications typically uses fiberglass and thermoset resins such as polyester, vinyl ester, epoxy, and phenolic. Carbon fiber and other knitted and hybrid reinforcements can also be used depending on the performance requirements of the end product.

Chopped Strand Mat (CSM): is a widely used traditional reinforcement solution.

- Chopped Strand Mat (CSM) is a random fiber mat that provides equal strength in all directions and is used in a variety of hand lay-up and open-mold applications. Chopped strand mat is produced by chopping continuous strand roving into short 1.5 to 3 inch lengths and dispersing the cut fibers randomly over a moving belt to from a “sheet” of random fiber mat. A binder is applied to hold the fibers together and the mat is trimmed and rolled. Because of is random fiber orientation, chopped strand mat conforms easily to complex shapes when wet-out with polyester or vinyl ester resins. Chopped strand mats are available as a roll stock product produced in a variety of weights and widths to suite specific applications.

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Continuous Filament Mat (CFM): is a reinforcing mat composed of continuous fiber strands that are spun to produce a random fiber orientation and bulk for closed molding applications.

- Continuous Filament Mat (also known as continuous strand mat), is a randomly orientated fiber that differs from chopped strand mat because of continuous long fibers rather than short chopped fibers. Continuous filament mat is produced by dispensing molten glass strands directly onto a moving belt in a looping fashion. As the glass fiber cools and hardens and a binder is applied to hold the filaments in place. The mat is then trimmed and rolled. Continuous filament mat is most commonly used in closed molding applications such as, vacuum infusion processing, resin transfer molding, cold molding, and compression molding. With properties similar to those of chopped strand mat, the bulk nature of CFM is advantageous in filling the mold cavity in closed molding processes.

Fiberglass Tapes: is a specialty product required in some applications.

- Fiberglass tapes are available in many forms, from narrow width textile fabrics with seamed edges to slit widths of CFM or CSM for specific applications. They are used to provide additional reinforcement to laminate edges, laminate seams and in pipe winding applications.

Woven Roving: Woven Roving is used in laminating open mold fiberglass parts where strength and laminate bulk is required.

- Woven Roving is single-end roving in thick fiber bundles that are woven in a 00/900 (warp and weft) orientation much like standard textiles on a weaving loom. Woven roving is a staple of open mold applications commonly used in conjunction with chopped strand mat or gun roving. It is produced in a variety of weights and widths and can be balanced with the same number of rovings in each direction or unbalanced with more rovings in one direction. Other fibers like carbon or aramid can also be produced in a woven roving form and fibers can mixed into hybrid reinforcements. Woven roving is very drapable and conforms to complex shapes.

Gun Roving: is used in the spray-up (chopping) molding process and is the reinforcement of choice for high production open mold manufacturing.

- Gun Roving (also known as continuous strand roving) is comprised of many small diameter fiberglass filaments that are combined to form a roving fiber bundle that is wound into a doff or a creel. In the spray-up process, the continuous roving strand is fed into a chopper gun that chops the strands into short lengths and deposits the fiber into a resin spray pattern for application on the mold surface. In this way, the wet-out glass laminate is created from the spray gun. The laminate is then rolled to remove entrapped air and the laminate cures. Gun Roving used in the chopping process provides fast production of larger parts like boat hulls, RV parts, and swimming pools and is the most common reinforcement used in open mold manufacturing.

Knitted Fabric: reinforcements providing customized fiber placement and design flexibility to increase part strength and durability.

- Knitted Fabric reinforcements are produced on large looms where fibers are directionally oriented (X and Y axis, or sometimes referred to as the 00, 900, or ±450 orientation) in multiple layers and then stitched together to keep the fibers in place. The resulting fabric is trimmed and rolled. This production process allows for a multitude of fiber orientation patterns, thickness, weight distribution and the incorporation of different types of reinforcements like carbon fiber or aramid fiber. Fabrics can be balanced, with the same amount of fiber used in both the X and Y axis or unbalanced with addition fiber in one axis to provide more reinforcement strength in that direction. Using knitted fabrics allows for significant part or laminate design flexibility and is widely used in boat building, transportation, wind blades and recreational products where specific strength orientation in the laminate is optimal.

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Non-Woven / Veils: Non-woven mats, also known as Surfacing Veils, are lightweight reinforcements made from randomly dispersed glass or polyester fibers and bonded into a thin sheet.

- These thin mats are used in multiple applications including the pultrusion process to improve the surface characteristics of pultruded parts. Surfacing veils are also used in corrosion applications to create a resin rich surface on the laminate to improve the corrosion resistance performance of the part. Produced in several roll widths and thicknesses, non-woven veils are used to improve specific laminate characteristics.