FRP Project

in

Bangladesh

Prepared By

Mozammel Hoque Hero

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1. Executive Summary:

Fibre-reinforced plastic (FRP) (also fibre-reinforced polymer) is a composite material made of a polymer matrix reinforced with fibres. The fibres are usually glass, carbon, oraramid, although other fibres such as paper or wood or asbestos have been sometimes used. The polymer is usually an epoxy, vinylester or polyester thermosetting plastic, and phenol formaldehyde resins are still in use. FRPs are commonly used in the aerospace, automotive, marine, and construction industries. Composition of FRP: Composites are composed of Resins, reinforcements, fillers and additives. The primary functions of the resin are to transfer stress between the reinforcing fibers, act as a glue to hold the fibers together, and protect the fibers from mechanical and environmental damage. The most common resins used in the production of FRP grating are polyesters (including gorthophthalic ortho and isophthalic iso), vinyl esters and phenolics. The primary function of fibers or reinforcements is to carry load along the length of the fiber to provide strength and stiffness in one direction. Reinforcements can be oriented to provide tailored properties in the direction of the loads imparted on the end product. The largest volume reinforcement is glass fiber. Fillers are used to improve performance and reduce the cost of a composite by lowering compound cost of the significantly more expensive resin and imparting benefits as shrinkage control, surface smoothness, and crack resistance. Additives and modifier ingredients expand the usefulness of polymers, enhance their process ability or extend product durability. Each of these constituent materials or ingredients plays an important role in the processing and final performance of the end product. Market Scenario: The global market for Reinforced Plastics is forecast to reach 7.9 million tons by the year 2017, bolstered by renewed demand from major end-use sectors and robust demand from European and Asia Pacific markets. Further, rapidly evolving renewable energy markets such as wind energy are emerging as the most promising growth areas for Reinforced Plastics. Demand for natural fiber composites are largely driven by increasing environmental awareness. Due to low cost, low density, acceptable specific properties, ease of separation, enhanced energy recovery, CO2 neutrality, biodegradability and recyclable properties, natural fiber use in composites is gaining as demand grows for component materials that are durable, reliable, and lightweight, with mechanical properties better than those of traditional materials. To know about the top continent in terms of total NFC consumption; the emerging, future markets, emerging applications with significant growth potential, industry challenges, etc, read Total global natural fiber composite market expected to grow at 11% CAGR till 2016. At the end of 2010, the market for composite products reached an estimated US$50 billion.

2. About FRP

The FRP is an abbreviation of Fiber Reinforced Plastics; that is, composite materials of fibers and plastics. Fibre-reinforced plastic (FRP; also called fibre-reinforced polymer, or in American English fiber) is a composite material made of a polymer matrix reinforced with fibres. The fibres are usually glass (in fibreglass), carbon (in carbon-fibre-reinforced polymer), aramid, or basalt. Rarely, other fibres such as paper, wood, boron, or asbestos have been used. The polymer is usually an epoxy, vinyl ester, or polyester thermosetting plastic, though phenol formaldehyde resins are still in use. FRPs are commonly used in the aerospace, automotive, marine, and construction industries. They are commonly found in ballistic armour and cylinders for self-contained breathing apparatuses.

A polymer is generally manufactured by step-growth polymerization or addition polymerization. When one or more polymers are combined with various agents to enhance or in any way alter their material properties, the result is referred to as a plastic. Composite plastics refers to those types of plastics that result from bonding two or more homogeneous materials with different material properties to derive a final product with certain desired material and mechanical properties. Fibre-reinforced plastics are a category of composite plastics that specifically use fibre materials to mechanically enhance the strength and elasticity of plastics. The original plastic material without fibre reinforcement is known as the matrix or binding agent. The matrix is a tough but relatively weak plastic that is reinforced by stronger stiffer reinforcing filaments or fibres. The extent that strength and elasticity are enhanced in a fibre-reinforced plastic depends on the mechanical properties of both the fibre and matrix, their volume relative to one another, and the fibre length and orientation within the matrix.[1] Reinforcement of the matrix occurs by definition when the FRP material exhibits increased strength or elasticity relative to the strength and elasticity of the matrix alone.

Types of FRP

A general FRP is a combination of a glass fiber and a polyester resin. There are several types according to combinations of fibers and resins.

Types of Fibers

- Glass Fibers
- Carbon Fibers
- Aramid Fibers
- Polyethylene Fibers
- Zairon Fibers
- Boron Fibers

Types of Resins

- Polyethylene Resins
- Vinyl ester Resins
- Epoxy Resins
- Phenolic Resins
- Thermoplastics

As above, FRP has diverse kinds because it is a composite material of fibers and resins. The following two types are representative.

- GFRP（Glass Fiber Reinforced Plastics）
- CFRP（Carbon Fiber Reinforced Plastics）

3. GFRP（Glass Fiber Reinforced Plastics:

CFRP (Carbon Fiber Reinforced Plastics) has higher strength and hardness but lighter than metals such as steel or aluminum. This is used in diverse industries from sports and leisure to aerospace industry.

GFRP（Glass Fiber Reinforced Plastics:

GFRP has the following features.

- It can make freely diverse shapes.
- It is highly weatherproofed.
- It is lighter comparing to a metal.
- It has super corrosion resistance.
- It has super electric insulation.
- The effect of insulation is excellent.
- Penetrability of radio wave is excellent.
- It has high water-proofing.

That is, it is a proper material for cases which require strength but light weight. But this is more expensive than GFRP.

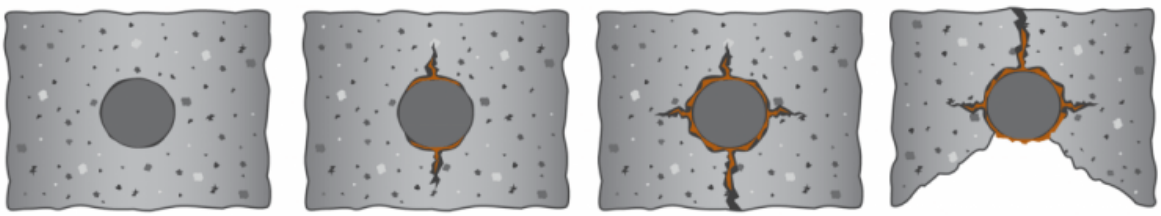
- Light Weight (about 1/5 of steel)
- High Hardness (about two times of steel)
- High Strength (same as or more than steel)
- High Thermal Conductivity (1/2~1/3 of steel)
- Low Heat Expansibility (1/10 of steel)
- X-ray Penetrability
- Vibration damping characteristic

The fibreglass reinforcement (also known as glass-fibre reinforced plastic or composite rebar, mesh) is steadily replacing conventional steel rebar in construction across the world. FRP rebar is made out of a mix of ultra-strong glass or basalt fibres and a connecting resin, resulting in a construction grade rebar with prevailing benefits over steel. Synthetic resins are used as a binding agent for fibres, protecting the fibres from mechanical effects and from the harmful affects of the environment during manufacturing of the product and its operation.

Fibreglass reinforcement manufacturing process consists of several main stages. First, fibreglass in the form of continuous strands is impregnated in a special container with a polymer resin, which contains a curing composition, as a result of which the so-called roving is obtained. When the fibreglass is completely soaked, the roving is fed into the forming die to obtain a bar of a given diameter. Without waiting for the bar to harden, the source material is pulled through the polymerization chamber and heated to a certain temperature. Finally, the stock is wound and secured to create a ribbed surface. The bar with the rib woven onto it, enters the drying chamber, where the resin is polymerized. After polymerization, the finished reinforcement enters the cooling unit and then the rebar is cut into sections of a predetermined length or wound into coils.

There are 2 main components used in the production: the armouring material (roving) and binding mixture (epoxy or polyester resin). The ratio of these components is about 80/20. In the finished reinforcement, the roving perceives mechanical loads, and the resin acts as a matrix, evenly distributing the load along the entire length of the bar and protecting the reinforcement from the external factors.

The production line must be set up in a warehouse with specific characteristics. Its length shall be at least 50 meters (recommended length is 70 meters), ceiling height shall be at least 2.5 meters (recommended height is at least 3 meters), the height difference in the equipment location area shall be not more than 4-5 cm. Ventilation with air outflow must be of at least 200-250 litres per minute. Indoor air temperature shall be at least 16-18 °C.



FRP/BASALT REBAR VS STEEL REBAR COMPARISON

SPECIFICATIONS	METAL CLASS A-III	FIBERGLASS
Material	Steel	Based epoxy resin
Strength at stretching, MPa	390	1300
Relative extension, %	25	2,2
Coefficient the rmal conductivity, W / (m0 C)	46	0,35
Elastic modulus	200000	55000
Linear coefficient extensions, ax 10-5 / 0C	13-15	9-12
Density, t / m	7,8	1,9
Corrosion resistance to aggressive environments	Corrosive	Non-corrosive
Thermal conductivity	Heat conductive	Non-conductive
Electrical conductivity	Electrically conductive	Non-conductive is a dielectric
Released profiles	6-80	4-20
Length	Rods 6-12 m long	According to the buyer's request
Durability	According to building codes	Predicted durability not less than 80 years

4. CFRP（Carbon Fiber Reinforced Plastics）

Carbon fiber-reinforced polymers (American English), carbon-fibre-reinforced polymers (Commonwealth English), carbon-fiber-reinforced plastics, carbon-fiber reinforced-thermoplastic (CFRP, CRP, CFRTP), also known as carbon fiber, carbon composite, or just carbon, are extremely strong and light fiber-reinforced plastics that contain carbon fibers. CFRPs can be expensive to produce, but are commonly used wherever high strength-to-weight ratio and stiffness (rigidity) are required, such as aerospace, superstructures of ships, automotive, civil engineering, sports equipment, and an increasing number of consumer and technical applications.The binding polymer is often a thermoset resin such as epoxy, but other thermoset or thermoplastic polymers, such as polyester, vinyl ester, or nylon, are sometimes used. The properties of the final CFRP product can be affected by the type of additives introduced to the binding matrix (resin). The most common additive is silica, but other additives such as rubber and carbon nanotubes can be used. Carbon fiber is sometimes referred to as graphite-reinforced polymer or graphite fiber-reinforced polymer (GFRP is less common, as it clashes with glass-(fiber)-reinforced polymer).

Aerospace engineering

An Airbus A350 with carbon fiber themed livery. Composite materials are used extensively throughout the A350.

The Airbus A350 XWB is built of 52% CFRP[14] including wing spars and fuselage components, overtaking the Boeing 787 Dreamliner, for the aircraft with the highest weight ratio for CFRP, which is 50%.This was one of the first commercial aircraft to have wing spars made from composites. The Airbus A380 was one of the first commercial airliners to have a central wing-box made of CFRP; it is the first to have a smoothly contoured wing cross-section instead of the wings being partitioned span-wise into sections. This flowing, continuous cross section optimises aerodynamic efficiency.[citation needed] Moreover, the trailing edge, along with the rear bulkhead, empennage, and un-pressurised fuselage are made of CFRP. However, many delays have pushed order delivery dates back because of problems with the manufacture of these parts. Many aircraft that use CFRPs have experienced delays with delivery dates due to the relatively new processes used to make CFRP components, whereas metallic structures have been studied and used on airframes for years, and the processes are relatively well understood. A recurrent problem is the monitoring of structural ageing, for which new methods are constantly investigated, due to the unusual multi-material and anisotropic nature of CFRPs. In 1968 a Hyfil carbon-fiber fan assembly was in service on the Rolls-Royce Conways of the Vickers VC10s operated by BOAC.[18]

Automotive engineering

CFRPs are extensively used in high-end automobile racing.[19] The high cost of carbon fiber is mitigated by the material's unsurpassed strength-to-weight ratio, and low weight is essential for high-performance automobile racing. Race-car manufacturers have also developed methods to give carbon fiber pieces strength in a certain direction, making it strong in a load-bearing direction, but weak in directions where little or no load would be placed on the member. Conversely, manufacturers developed omnidirectional carbon fiber weaves that apply strength in all directions. This type of carbon fiber assembly is most widely used in the "safety cell" monocoque chassis assembly of high-performance race-cars. The first carbon fiber monocoque chassis was introduced in Formula One by McLaren in the 1981 season. It was

designed by John Barnard and was widely copied in the following seasons by other F1 teams due to the extra rigidity provided to the chassis of the cars. Many supercars over the past few decades have incorporated CFRPs extensively in their manufacture, using it for their monocoque chassis as well as other components. As far back as 1971, the Citroën SM offered optional lightweight carbon fiber wheels. Use of the material has been more readily adopted by low-volume manufacturers who used it primarily for creating body-panels for some of their high-end cars due to its increased strength and decreased weight compared with the glass-reinforced polymer they used for the majority of their products.

Civil engineering

Further information: Structural applications of FRP

CFRPs have become a notable material in structural engineering applications. Studied in an academic context as to their potential benefits in construction, CFRPs have also proved themselves cost-effective in a number of field applications strengthening concrete, masonry, steel, cast iron, and timber structures. Their use in industry can be either for retrofitting to strengthen an existing structure or as an alternative reinforcing (or pre-stressing) material instead of steel from the outset of a project. Retrofitting has become the increasingly dominant use of the material in civil engineering, and applications include increasing the load capacity of old structures (such as bridges) that were designed to tolerate far lower service loads than they are experiencing today, seismic retrofitting, and repair of damaged structures. Retrofitting is popular in many instances as the cost of replacing the deficient structure can greatly exceed the cost of strengthening using CFRP.

In the United States, pre-stressed concrete cylinder pipes (PCCP) account for a vast majority of water transmission mains. Due to their large diameters, failures of PCCP are usually catastrophic and affect large populations. Approximately 19,000 miles (31,000 km) of PCCP have been installed between 1940 and 2006. Corrosion in the form of hydrogen embrittlement has been blamed for the gradual deterioration of the pre-stressing wires in many PCCP lines. Over the past decade, CFRPs have been used to internally line PCCP, resulting in a fully structural strengthening system. Inside a PCCP line, the CFRP liner acts as a barrier that controls the level of strain experienced by the steel cylinder in the host pipe. The composite liner enables the steel cylinder to perform within its elastic range, to ensure the pipeline's long-term performance is maintained. CFRP liner designs are based on strain compatibility between the liner and host pipe

Carbon-fiber microelectrodes

Carbon fibers are used for fabrication of carbon-fiber microelectrodes. In this application typically a single carbon fiber with diameter of 5–7 µm is sealed in a glass capillary.[26] At the tip the capillary is either sealed with epoxy and polished to make carbon-fiber disk microelectrode or the fiber is cut to a length of 75–150 µm to make carbon-fiber cylinder electrode. Carbon-fiber microelectrodes are used either in amperometry or fast-scan cyclic voltammetry for detection of biochemical signaling.

Sports goods

A carbon-fiber and Kevlar canoe (Placid Boatworks Rapidfire at the Adirondack Canoe Classic)

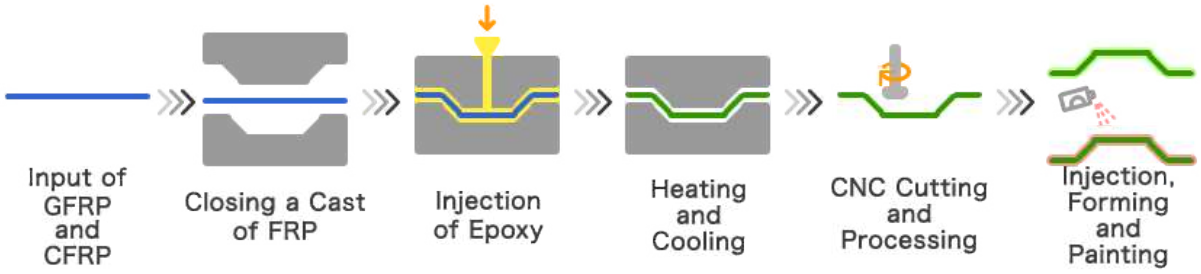
CFRPs are now widely used in sports equipment such as in squash, tennis, and badminton racquets, sport kite spars, high-quality arrow shafts, hockey sticks, fishing rods, surfboards, high end swim fins, and rowing shells. Amputee athletes such as Jonnie Peacock use carbon

5. Manufacturing Process of FRP

In the FRP, the sizes, shapes, mechanical characteristics and expenses are changed much according to a forming method. Therefore we need to review the forming process in order to effective forming method of resins. Autoclave, RTM (Resin Transfer Molding), Hot Press, Foaming and so on are representative forming methods. GEO Nation adopts 'RTM (Resin Transfer Molding)' and 'Foaming', which receive attention lately due to high productivity and low cost.

RTM Method

RTM Method is an abbreviation of Resin Transfer Molding, which is a forming method injecting a resin into a mold. That is, it is a forming method injecting a resin in a closure of mold after a fabric type fiber is installed in a cast of mold like an injection molding method.



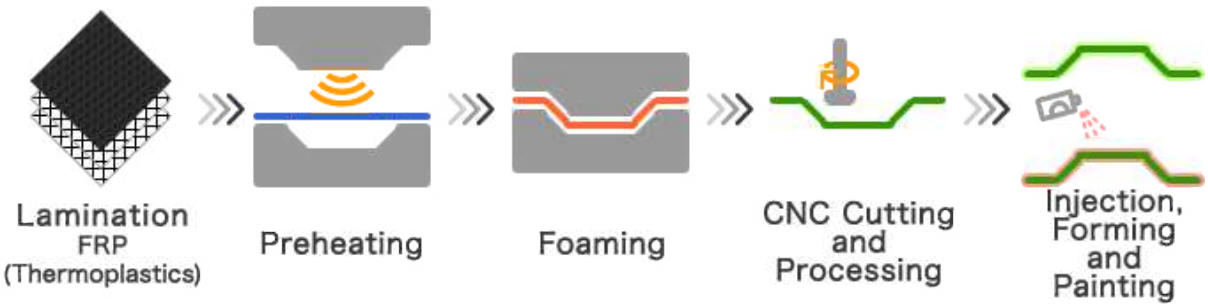
Advantages

- It is an enclosed forming method, which leads to good working conditions.
- It has a low investment of facilities comparing to SMC.
- The quality is stable because it is a mechanical molding.
- It is suitable to mass production.
- It can form even a complicate shape.

Foaming Method

It is a forming method with a foaming mold after laminating and preheating TPU and thermoplastics to a reinforced textile fabric.

<u>Process of Foaming</u>



Advantages

- It can produce products having complicate shapes in quantity.
- Appearance is good.
- The forming cycle is short.

Glass fiber (GF) and carbon fiber (CF) reinforced polymer composites have revo- lutionized important manufacturing sectors, such as transport (automotive, aircraft, boats) and construction (building and infrastructures, plants, wind turbines), due to their lighter weight and intrinsically better corrosion resistance with respect to metals. The composite market by volume is dominated by glass fiber reinforced plastics (GFRP), with around one third of the whole production volume manufac- tured for the transport sector (cars, commercial vehicles, boats and to a lesser extent, aircraft), and another third for the construction industry (buildings, infrastructures, and wind turbines) [1]. Carbon fiber reinforced plastics (CFRP) are mainly adopted within the aerospace industry, with 32% of the total CFRP global demand, followed by the automotive industry which currently makes up around 21.8% of the total demand [1]. In the light of the above, the relevance of composite materials in many strategic industrial sectors appears significant. Therefore, the development of sustain- able Circular Economy solutions to the post-use management of composite materials represents one of the key challenges of the modern manufacturing industry.

This chapter introduces the issues and the possibilities of the implementation of Circular Economy principles in this sector, starting with a general discussion about circular economy, introducing composite material features, the current market situation and the current composite waste treatments, with reference to existing legislation.

Circular Economy

In 1989 Pearce and Turner, introduced the concept of Circular Economy (CE). In their book they underlined the limitations of the traditional "take, make, dispose" approach, in view of the exploitation raw materials and the generation of increasingly relevant quantities of waste. They proposed the idea of a new closed-loop concept in which fractions from End-of-Life products can be reinserted as raw materials for new productions. The final goals are waste reduction and improvement of environmentally friendly processes, creating new adaptable and resilient systems.

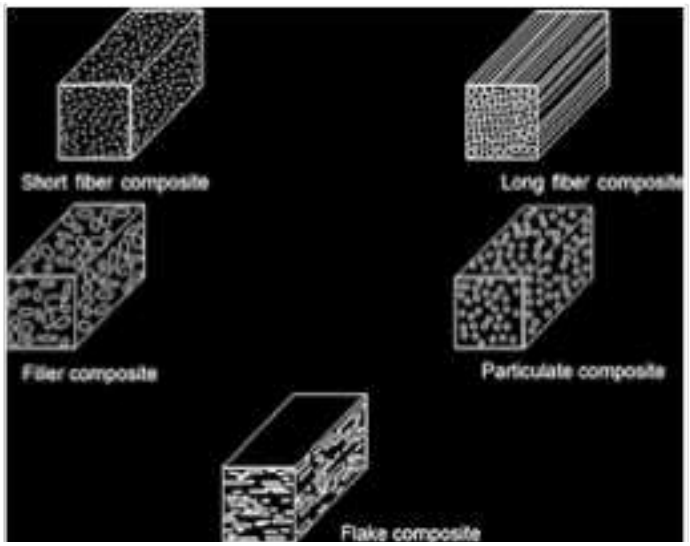
This idea has been further enforced in the last years by the Ellen MacArthur Foun- dation [3], outlining the opportunities of Circular Economy: "*A circular economy is restorative and regenerative by design, and aims to keep products, components, and materials at their highest utility and value at all times. The concept distin- guishes between technical and biological cycles. As envisioned by the originators, a circular economy is a continuous positive development cycle that preserves and enhances natural capital, optimizes resource yields, and minimizes system risks by managing finite stocks and renewable flows. It works effectively at every scale*". Value-chains should ensure not only environmental but also economic sustain- ability. The three fundamental pillars of Circular Economy have been defined as

(i) preserve and enhance natural capital; (ii) optimize resource yields; (iii) foster systems effectiveness.
In practice, different Circular Economy options have been introduced to regain and re-use material fractions and component functions from post-use products, i.e. reaching the end of the first use cycles. The European Waste Framework Directive 2008/98/EC, introduced these options as the five-step hierarchy shown in Fig. 1 [4]. Solutions in the upper parts of the pyramid, which consider End-of-Life products as a resource, are preferable than those in the lower part. Prevention is considered as the most preferrable option, while disposal should be avoided whenever possible. The study identifies the role of legislation and policies in promoting and prioritizing the adoption of the most attractive Circular Economy options.

Current Circular Economy Solutions for Composite Materials

The Composite Material Market

Composite materials are a wide family of heterogeneous materials composed by two or more phases, with different physical properties. The resulting properties of composite materials are better than those of the constituting phases. The reinforce- ments could be in the form of short fibers, long fibers, filler, particulate and flakes, leading to different behaviors depending on the shape (see Fig. 2 [5]). Some exam- ples of composite materials could be seen in nature. Wood is composed by cellulose fibers in a lignin matrix. The result is a flexible material with high elastic module. In the same way, bones are composed by collagen fibers in an apatite phase, leading to a material with low specific gravity and high mechanical properties.
Focusing on artificial composites, also called fiber-reinforced plastics, it is a wide group of materials mainly composed by fibers, resin matrix, additives and fillers.
4 M. Colledani et al.



The two-phase composition results in high mechanical properties together with low weight, high corrosion resistance and, as a consequence, low maintenance needs. Different types of fibers are used in composite materials. More than 99% of the products currently on the market are composed by glass fibers, carbon fibers, natural fibers, aramid fibers and basalt fibers. Among them, glass fibers show the largest adoption rate, with 95% share of the worldwide production volume of composites [1]. This is due to the good mechanical properties that they bring, combined with their reasonable market price. For these reasons Glass Fibers Reinforced Plastics use is widespread in several sectors as wind blades, sports equipment, construction, marine and automotive (and transportation in general) and electronics.

The second largest share of composite materials includes Carbon Fiber Reinforced Plastics. Carbon fibers present higher mechanical properties with respect to glass fibers, with higher cost (from 4 to 40 times the price of glass fibers depending on the specific application [6]). Due to their remarkable properties, CFRPs find application in high added-value sectors such as wind energy, sports equipment, sports car, construction, aircraft and aerospace.
In addition to the constituent material, fibers could be classified by their length. In particular, they could be short fibers, long fibers and endless fibers. Short fibers have a maximum length of 2 mm, long fibers are between 2 and 50 mm, while endless fibers are longer than 50 mm. The GFRPs market share shows a predominance of short fibers with respect to long and endless ones. Indeed, the European production volume of short fibers in 2021 has been of 1.51 million tons, while that of long and endless fibers has been of 1.1 million tons [1]. Even more, fibers are not only used
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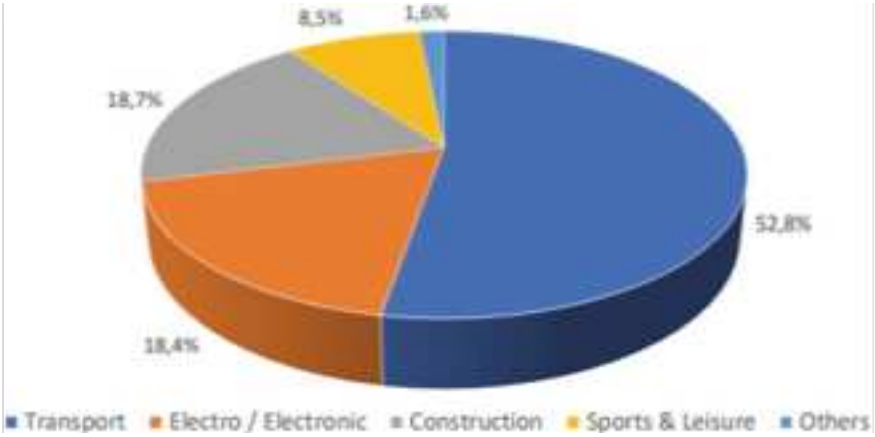
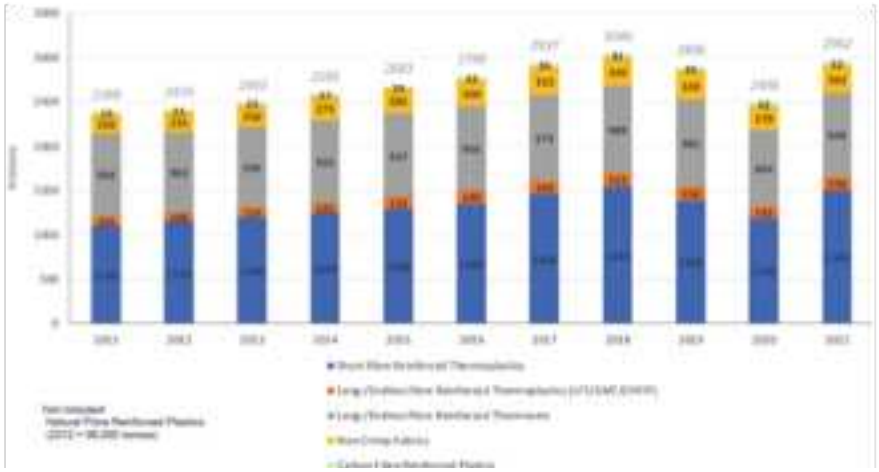


as single chopped fiber or strand but also as semi-finished product as mats, textiles fabrics, knitted fabrics, non-woven and fiber pre-forms depending on the specific application.
Regarding the matrix, a spread variety of resins could be used. In the first analysis, they can be divided in thermosets, that could not be melted and reshaped once hard- ened, and thermoplastics, that can be reshaped several times through temperature. In particular, 86% of composite products made with long and endless fibers have a thermoset matrix [1]. Among thermosets plastics, the most used are unsaturated polyester, vinylester, epoxy and polyurethane, while regarding thermoplastics the most used in composites are polypropylene, polyamide, polystyrene, polyphenylene sulfide and polyetherether-ketone (also known as PEEK). Finally, several fillers could be used to give specific characteristics to the final composite products. They are inert materials of mineral nature as calcium carbonate, frequently used as coating, aluminum trioxide and silica, as in piping and in polymer concrete.
In 2021 the production volume of CFRPs was approximately 52.000 tons, natural fibers reinforced plastics had a volume of more than 92.000 tons, while the volume of GFRPs was 2.910.000 tons. Aramid fibers and basalt fibers, with other types of fibers, have very low production volumes due to their very specialized applications. While the worldwide composite growth rate has been of about 8% in the last years, European composites production volume increased by 18.3%, returning to the pre-pandemic level [1]. In Fig. 4, the situation of composite production shares and volumes in Europe is reported.



Composite Waste Current Situation

Composite waste streams can be mainly divided into three groups. The first is composed by small components as consumables, sport and leisure equipment and design products, which are not systematically separately collected on a national or European level. Sorting of composite materials from mixed municipal waste streams is not performed due to technical and economic issues. This results in a high loss of composite materials and, as a consequence, of economic value.

The second group is composed by large infrastructures as wind blades, aircrafts, boats, construction structures and vehicles. The current situation and related oppor- tunities of these groups will be better detailed in Chap. 2. As an example, the amount of End-of-Life wind blades, composed by GFRP, CFRP, steel and aluminum (in addi- tion to other minor materials) is predicted to reach 30.000 tons per year in Europe by 2026, while it will increase up to 50.000 tons by 2030, as shown in Fig. 5 [7]. EoL leisure boats were also identified as significant GFRP waste stream with an estimated volume of up to 10.000 tons per year [8].

The third group of composite waste streams is formed by composite production waste. The collection and sorting of these materials is less problematic with respect to End-of-Life products. Moreover, in this case, the materials composition and the location are known. However, challenges are represented by the classification of these streams as “waste” and the related management challenges, as discussed in Sect. 4.

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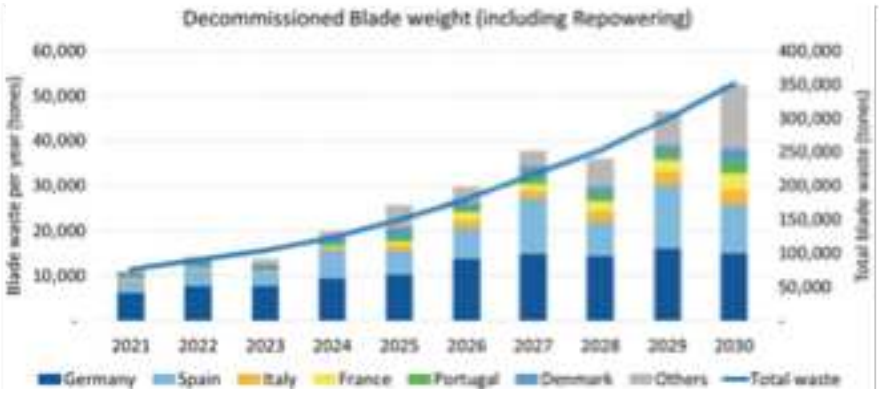

Expected amount of End-of-Life wind blades in tons per year in different European Countries

Recycling of Composite Materials

Recycling is the most widely investigated solution for the sustainable treatment of post-use composite products. Existing technologies and recycling methods are of three main types, namely mechanical, thermal or chemical. In this section, a brief overview of the currently investigated solutions is reported.

Mechanical recycling: Mechanical recycling typically consists in one or more size-reduction stages (or shredding stages, also preceded by a coarse cutting step, if needed) to obtain particles, that remain composed of mixed fibers and resin, featuring desired dimensional distributions. The objective is to directly reuse the obtained fraction into new composite material formulations. To facilitate downstream repro- cessing stages, the material flow in output from the size-reduction process can be sieved and divided into two or more fractions, with controlled characteristics [9]. The composite shredding powder residue instead can be used both as filler and as reinforcement. While the use of this powder as filler is possible in terms of physical and chemical properties, the costs are generally higher if compared to the costs of alternative virgin fractions, such as calcium carbonate or silica. In addition, in most applications, the weight fraction of composite powders that can be incorporated as a filler is limited, typically less than 10% [10]. This is mainly due to an increase in the viscosity of the compound, resulting in extended processing problems. For these reasons, powder fractions are usually incinerated to obtain energy due to their high content in resin. The possibility to use these materials for additive manufacturing has also been discussed and preliminarily demonstrated.

Concerning the reuse of granular fractions composed by fibers embedded within the resin, different studies have been performed both for thermosets and thermo- plastics composite materials. As an example, up to 50% in weight of carbon fiber particles obtained through shredding have been successfully incorporated into new products with virgin PEEK resin through injection molding. In addition, ther- moplastic polymers could be subjected directly to reforming processes. Fiber-rich fractions of mechanically recycled thermoset composites are usually more complex to be reused as reinforcement, since the mechanical properties of the resulting mate- rials are reduced due to poor bonding between recycled particles and the new resin.

Several works dealt with these issues finding innovative and promising solutions to use increasingly large fractions of recyclates, in particular focusing on Sheet Molding Compound (SMC) and Bulk Molding Compound (BMC) production techniques. As an example, it has been proven that longer mixing time of the paste with the recycled particles results in improved interface between recycled material and new resin. This leads to increased mechanical properties that are similar to those of the material obtained with virgin fibers.

In addition to the classical mechanical recycling processes, the possibility and potentiality to use an innovative process based on high-voltage fragmentation has been shown. The product is placed in a dielectric ambient as de-ionized water and a high-intensity and fast growing voltage (80–200 kV, <500 ns) is induced. As a consequence, a high electric field is generated, resulting in a dielectric breakdown and in the generation of a spark plasma channel with high pressure (1010 Pa) and temperature (104 K). After up to 1.000 discharge cycles the product is disintegrated. Working directly on the interfaces between different materials, this technology is able to clean the fibers from resin. Some works showed that applying this method to GFRPs it is possible to obtain lower amount of residual resins in comparison with comminution and a wider fibers length distribution. The main disadvantages of this process remain the high cost and the low throughput.

Thermal recycling: Thermal processes used for composite materials recycling are
pyrolysis, fluidized-bed pyrolysis and microwaves-assisted pyrolysis. These tech- niques work between 450 and 700 °C (depending on the resin), eliminating the matrix in controlled atmosphere. They are optimized to recover fibers and fillers but the resin is volatilized into lower-weight molecules, producing waste gases as carbon dioxide, hydrogen and methane and possible combustion residues on the fibers. Exceeding the specific resin temperature, the process will concern combustion with energy recovery. This is typical in cement kilns in which the composite waste is converted into energy and fillers and fibers for the concrete.
Pyrolysis is a well-known process in which the temperature is higher than 450 °C in absence or in presence of oxygen, in a controlled atmosphere, to degrade the resin matrix. The output will be composed by solid products (in particular fibers, fillers and char), oil and gases. The char is stuck on the fibers, that need a post- treatment in a furnace at 450 °C, leading to more degraded fibers. This effect is visible in particular for glass fibers. As an example, at the minimum temperature of 450 °C, mechanical properties of glass fibers are reduced by at least 50% of the original ones. In addition, as pyrolysis is an energy intensive and expensive process, the cost to recover glass fibers is higher than the market price of the virgin ones. For these reasons, pyrolysis process is mainly used to treat CFRPs. Furthermore, they are less sensitive to high temperatures, while char is still present on the surface
of the fibers. To eliminate it in standard conditions, a post-treatment process with temperature up to 1300 °C is needed, resulting in significantly loss of strength of the fibers. As a consequence, a compromise between resulting mechanical properties and the amount of remaining resin residues is needed. As an example, high tenacity carbon fibers after a two-steps process, the first one at 550 °C in nitrogen the second one at the same temperature in oxidant atmosphere, retained more than 95% of their tensile strength without resin residue on the surface. A pyrolysis temperature between 500 and 550 °C seems to be the upper limit of the process in order to maintain acceptable strength of carbon fibers.
Fluidized-bed process pyrolysis uses a bed (e.g. composed by silica sand) made fluid by hot air, obtaining in this way oxidant conditions. In this way, it is possible to rapidly heat the materials and to release the fibers from the resin by friction. The organic fraction of the resin is then degraded through a second step at 1.000 °C for energy recovery. Glass fibers treated with this process showed a reduction in tensile strength up to 50%, while carbon fibers of about 25% [19], probably due to damages from the fluidized sand. The added value of this process is the possibility to treat mixed and contaminated materials as products with painted surfaces or foam cores.
Microwave-assisted pyrolysis heats composite materials in an inert atmosphere, resulting in degradation of the matrix into gases and oil as for traditional pyrolysis. The main advantage is the energy savings due to the fast thermal transfer as the composites are heated directly in their core through microwaves. This process has been used to treat both GFRPs and CFRPs. On the other hand, this process needs small particles in input. This results in an output composed by a wide length distribution of the fibers and in a reduction of resulting mechanical properties of the final product, with a limited percentage of recycled material that can be used (less than 25%).
Chemical recycling: Chemical recycling of composite materials is performed
through solvolysis, a chemical treatment to degrade a resin using a solvent. This technique has been widely used in the last 20 years, starting from the degradation of polyurethane into its monomers, carboxylic acids and glycols, and a styrene-fumaric acid copolymer [22]. Since this

first positive attempt, several processes based on different solvents and techniques have been tried to recycle both thermoplastics and thermosets composite materials [9].
Solvolysis factors include the solvent, the working temperature, the pressure and the presence of a catalyst, depending on the resin to degrade. The reactive solvent diffuses into the composite and breaks specific bonds. In this way, it is possible to recover monomers from the resin, avoiding the formation of char residues.
To start the process, the activation energy of the polymer has to be reached. This could be achieved increasing the temperature or using a catalyst. The main advantage is that lower temperatures are required with respect to thermal treatment. On the other hand, reactors could be expensive, in particular for solvolysis in supercritical conditions (that is the process with best results), as they have to withstand high temperatures and pressures and corrosion due to modified properties of the solvents. As an example, polyester resins are easier to degrade through solvolysis than epoxy resins, leading to lower required temperatures.
The most used solvent is water, both alone and with co-solvent (e.g. alcoholic, phenolic, amine). Typical catalysts are alkaline catalysts as sodium hydroxide and potassium hydroxide or, less frequently, acidic catalysts (used in case of more resis- tant resins or lower temperatures). Other solvents are alcohols as methanol, ethanol, propanol and acetone or even glycols

Existing Barriers

Despite the mature development phase of some of the reported technologies, key barriers exist bounding the systematic transition of the composite industry to a Circular Economy approach, including:

- *Governance*: significant fragmentation of stakeholders in different sectors, leading to poor-communication and inter-sectorial alignment of policies, thereby creating barriers to innovation; low priority of composite waste in the political agenda, thereby limiting stakeholder engagement; incomplete understanding of barriers to innovation, thereby limiting leadership and formation of an effective integrated innovation strategy;
- *End-users perception*: industry perception of composite waste as a cost to be minimized rather than a resource to be valorized;
- *Commercial uptake*: negative consumer and industry perception of products derived from recyclates and safety concerns;
- *Finance and regulation*: poor mobilization and alignment of finance across the sector; poor alignment of pricing methodologies and legislation, lack of suitable business models that support EoL composite valorization;
- *Technology development*: limited synergistic use of available inspection, repair and reprocessing technologies due to the different specialization areas.

Current Composite Waste Management Practices and Legislation

The following paragraphs provide a brief overview of the EU legislations concerning composite waste treatment and waste management. End-of-Life GFRP and CFRP products are usually not systematically collected separately on a national or European level. Furthermore, sorting of composites from commercial or municipal mixed waste streams is not practiced due to technical challenges and economic considerations. Compared to other materials, the proportion of composites in residual waste as well as the commercial value of mixed GFRP and Introduction, Context, and Motivations of a Circular Economy ... 11

CFRP waste are both relatively low, making manual or automated sorting unprofitable in practice. As a result, once composites have entered a mixed or residual waste stream, they are not sent to recycling processes, regardless of the further treatment of the entire waste stream (as landfill, incineration or co-processing). This applies, in particular, to small scale consumption products, as sports equipment, consumer electronics or design objects, which are generally disposed by consumers via municipal residual waste.

Compared to small consumption products, EoL composite waste streams derived from large-scale consumption products, as leisure boats and vehicles, or large installa- tions, as wind energy systems and construction waste, are significantly more attractive for centralized recycling approaches.

Despite the large amount of potential EoL-waste from these sectors, an estimation of the annually generated amount of waste is quite difficult and data about presence and treatment in different European countries are rare. Additionally, vehicles, as airplanes, cars, trucks and boats, as well as wind energy systems are assumed to have a relatively long lifecycle. Although the actual production capacities of these sectors are known quite well, the exact time of decommissioning is hard to predict. Furthermore, some products as vehicles underlie a massive exportation after their standard life-time, losing the possibility to be recycled and reused. Contrary to composites EoL products, production waste appears as more reliable source of high-quality materials suitable for reuse and recycling processes. Their collection produces non-mixed waste fractions with well-known material properties and compositions. In addition, the amount of waste is constant or predictable and in a limited number of locations. Finally, databases elaborated for the estimation of current and future waste streams are easily accessible and precise. Today, approximately 30.000 tons of post-consumer GFRP and CFRP-waste are produced annually in Europe. Additionally, 40–50.000 tons of commercial produc- tion waste are generated [24]. Due to an increasing use of composites in various applications, a steady increase of these amounts is expected.

Compared to other waste streams, the total amount of composite waste produced within Europe is relatively small. Therefore, this could lead to the assumption that an international collection and a centralized recycling could be economically beneficial. However, for the transportation of waste across borders—also within the European Union—some legal aspects must be considered. According to the European Waste Framework directive, establishments and undertakings which carry out waste treat- ment must obtain a permission from their corresponding competent authority. Within the EU, the import, export and transit of waste to, from or through EU Countries are subjected to approval procedures (called notifications), which are regulated in detail in the European Waste Shipment Regulation [25]. Transboundary movements of waste require not only a notification by the Country of waste origin, but also by the Country of destination and all others the transport will travelling through.

An exemption from notification can apply for non-mixed and non-hazardous waste. A final decision about an obligation for notification concerning a specific waste stream is up to each single national authority.
12 M. Colledani et al. A single waste management company which intends to perform centralized GFRP and CFRP waste treatment using waste from different European countries, would have to arrange transport notifications with each single waste generator, independently from the type of the intended waste treatment (fiber/polymer recycling or thermal recovery in cement kilns). Since every notification procedure is time consuming and accompanied by considerable financial efforts, such a procedure for international waste collection does not seem practical. A more realistic approach could be a cooperation of waste management companies, which collect GFRP and CFRP waste on a national level and coordinate notifications for transboundary shipment to a centralized large-scale recycling plant.In contrast to externally collected composite waste, an in-house reuse of residual materials from production processes is legally possible. Materials obtained from treatment of scraps (as recycled glass or carbon fibers), could be considered as product and not as waste, and would not be affected by the scope of waste management laws. However, also in this case a final decision about the classification of recovered materials as product, by-product or waste rests with the corresponding competent authority.
The already presented European Waste Framework Directive 2008/98/EC [4] sets the basic concepts and definitions related to waste management. It explains, through the so called "end-of-waste criteria", in which cases waste ceases to be waste and becomes a secondary raw material, and how to distinguish between waste and by- products. Although the Waste Framework Directive gives a lot of hints, explanations and definitions, a high degree of uncertainty is still present and different approaches concerning the handling of GFRP and CFRP waste in the EU Countries can be highlighted, mainly due to the absence of a clear classification of GFRP and CFRP.
Some examples from the different Countries are exemplified described in the following list.

- In the Netherlands LAP3 is the formal document of the Dutch Authorities regarding management of waste in general [26]. The document describes the waste stream plans for 85 sectors in Netherlands, including Plastics and Rubbers (considered in the Sector Plan 11). In this plan, for the first time, composites are mentioned, even if through a remark that specifies the difficulties to recycle fiber reinforced plastics. LAP 3 indicates for thermoplastics (including composites) that the minimum standard for waste management is reuse (or recycling). For ther- mosets plastics (including composites) the minimum standard for waste manage- ment is thermal recycling. Any further recycling technology "above" thermal recycling is acceptable, including the use in cement production. As in Netherlands most of the waste incinerators are qualified as thermal recycling installations, this means that landfill is not accepted anymore.
- In Belgium there is no specific rule for GFRP or CFRP. There are some companies collecting composite waste from the industry after waste sorting but there are no specific disposal rules.

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- An interim solution concerning landfill can be found in Finland. There is a contro- versial situation in Finland regarding GFRP and CFRP. The landfill ban is in force as no more than 10% of organic content is allowed to be disposed. In the mean- while, few landfills maintained a special exemption for GFRP to support the transition to a complete landfill

ban. On the other hand, as there are not many real recycling processes for GFRP and CFRP, waste is processed by incineration (with energy recovery).

- Considering Europe (and not only EU), the situation is even more complex. As an example, in the UK landfill is still an opportunity. Landfill tax now stands at £98.60/ton (2022 rate), making the cost of landfill, including gate fees and transport, typically £140 to £150 per ton [27]. On the other hand, while sharp increases in landfill taxes are not expected, Germany and several other European countries have already largely banned landfill.

This small list shows the heterogeneous European situation that can affect the implementation of robust recycling and reuse of composites and the related circular value-chains. A common legislation at EU level is needed to coordinate actions and to promote best practices all around Europe.

Historically, rebar appears to be the most commonly used raw material in construction and the way we see it, there is no clear substitute to it. Whatever the built structure is, it must include concrete blocks, walls or foundation and all concrete must be reinforced. Steel rebar has long been the only option of concrete reinforcement but given that the construction landscape continues to evolve, there is now a substitute to steel and it is overwhelming. This substitute comes in the form of composite rebar and mesh. Such rebar is manufactured either from fiberglass or basalt and today, as an introductory post, we would like to go over the main benefits that frp rebar carries and just how much more advanced it is compared to steel.

The basics behind FRP rebar and mesh

As mentioned earlier, frp rebar and mesh is manufactured from a mix of fiberglass and resin. Then comes basalt. It serves as a great substitute to fiberglass and usually the final raw materials to be used in frp rebar production are decided based on the accessibility of these products. Some opt for fiberglass, others go with basalt, although the characteristics of the end frp product are not that much different. As mentioned earlier, frp rebar and mesh is manufactured from a mix of fiberglass and resin. Then comes basalt. It serves as a great substitute to fiberglass and usually the final raw materials to be used in frp rebar production are decided based on the accessibility of these products. Some opt for fiberglass, others go with basalt, although the characteristics of the end frp product are not that much different.

Introduction to the world of FRP rebar production

Nevertheless, these characteristics are mind blowing. Frp rebar and mesh have already undergone a large variety of tests worldwide and are now becoming the new standard of concrete reinforcement. Such tests were executed by the renowned universities and construction certification institutions and the results make it apparent that frp rebar is here to stay. Only question that remains, is how quickly it will become the new product of choice, but we believe that based on the lower price and much more advanced characteristics, it won’t be long.

FRP rebar and mesh advantages and traits

Although we have already covered the frp rebar and mesh advantages on the technical page of our website, let's quickly run through them once again as a reminder of what composite products are all about. Corrosion free. Unlike steel rebar, frp rebar does not rust. This makes it perfect for application in structures that are located in coastal zones, near the water or even in it. Steel on the other hand is prone to rust and once this process begins, concrete cracks and it is when you need to refurbish the construction. In other words, structures built with steel rebar require further investments as the time goes by.

Strength. Frp rebar is much harder than steel. It doesn't bend the way steel rebar does but at the same time it can take a much greater strain. Nevertheless, the bend factor is already resolved by the right way of connecting two rebars at their linking points. Based on the test conducted by several institutes, such structures withstand earthquakes like no steel rebar construction can, whilst a mix of steel and frp rebars also show outstanding results.

Price. Being a factor that is closely related to running an frp rebar production, price plays an incremental role in its success. Simply put, steel rebar grows in price according to the increase in steel price and this exponential growth sees no signs of stopping. Fiberglass rebar production on the other hand, benefits from constant price levels of raw materials. In fact, it is apparent that the greater the price increase of steel rebar will be, the more frp rebar will be in demand. Moreover, high prices of steel rebar allow fiberglass rebar manufacturers to benefit from high margins, as most price their end product so that it matches its main competitor.

Weight. Fiberglass rods are nearly 8 times lighter than steel rebar and this once again benefits the production process and rebar delivery. More so, when rebar manufacturing equipment produces fiberglass rods, the engineers that monitor the process can easily carry it around and same cannot be replicated with steel. Transportation comes as an added benefit if you run an frp rebar production, as it allows to minimize the delivery costs.

Signal, electricity and waves. The fact that fiberglass rebar does not conduct electricity and doesn't interfere with signal makes it perfect for concrete reinforcement of airports, hospitals, underground projects, military structures, research centres and many more. Same cannot be said about steel but due to the late appearance of composite technology, many construction companies are faced with the task of changing steel reinforced concrete to composites.

Setting up fiberglass rebar production equipment

A great benefit of frp rebar equipment is that it is easy to set up. We have been manufacturing and perfecting our lines for over a decade now and made them practically turn key and fully automated. Therefore, if you believe that it is time for you to start frp rebar production, the process of production control will be as easy as running a calculator app on your PC.

An issue we faced at some point along this development, was that sometimes, the fiberglass rebar that comes in rods of 4 and 6 was not of consistent quality. But, we managed to resolve this early in our growth and achieved such results, that our clients now make the most of continuous production quality, not harmed by inconsistency that would imply additional rebar production costs.

The whole manufacturing process can be described as pultrusion of fiberglass or basalt roving that when mixed with resin, turns into composite rebar. Over the course of our production lines advancements we have conquered this technology and even implemented know-how, that is now globally considered to be the best in class.

The future of frp rebar in construction

We believe that the future of wide composite rebar application is imminent. Given that its advantages greatly outweigh everything that steel rebar imposes on the market it is a no brainer that construction companies across the world already show high demand for the product. Variety of applications also serves as a great reason why the demand is set to only increase. Moreover as a company that manufactures frp pultrusion equipment, we constantly get requests for the end product and the volume of requests is overwhelming to say the least.

As an additional example, the clients that order our fiberglass rebar production lines, usually have a fully booked production at the time of an order placement. What more is there to say? Not much, given how hot this construction market is.

Final words on frp rebar production he benefits of composite rebar are not limited by the aforementioned facts. Still, the ones that you are now acquainted with, have proved themselves as push strong enough for the industry to change. Today, we see frp rebar being applied in concrete reinforcement all over the world already and the trend is set to only expand further. Construction companies use composite rebar and mesh in civil engineering, industrial grade structures and everywhere else where there is concrete. Resultantly, the future is bright for composite rebar and the only

6. Main Usages of FRP

FRP is light and its durability, impact resistance and wear resistance are excellent. It is applied to diverse industries such as building materials, boat, skiing accessories, home bathtub, helmet, tennis racket, chair or parts of aircraft.

Usages of GFRP

GFRP (Glass Fiber Reinforced Plastics) is used at diverse industries as below because it is easy to process to several shapes and it enables to produce at a low cost.

• Cases and Covers of Smartphone • Cases and Covers of Tablet PC	
• Body of Automobile	
• Railroad Car	
• Ship	
• Parts of Aircraft	

• Home Facilities such as bathtub	
Scares of Golf Club	
Printer Board	
Cover of MRI and CT	
Cold Reserving Container	

Cold Reserving Box	
Overpass and Underground Water Tank	
Antenna for Communication	
Radar Dome	
Facilities and Benches of Playground	
Surfing board	

Skiing board	
Tennis Racket	

Usages of CFRP

CFRP (Carbon Fiber Reinforced Plastics) has solidity and hardness but is light. It is used at diverse industries as follows.

Industrial Machines :

Hand of Carrier
Arm, Frame
Parts of Robot

Aviation :

Aircraft
Rotor Blades of Helicopter

Space :

Parts of Rocket and Satellite
Medical Devices :
Image Board for X-ray unit
X-ray Film Cassette

Sports & Leisure :
Scares of Golf Club
Tennis Racket
Fishing Rod

Residential construction and civil engineering
Construction foundations;
Repair & reinforcement of bearing capacity in brick and reinforcement concrete structures.
Highway construction:
Reinforcement of roadbed
Road, airfield & gray Portland cement slabs.

Industrial engineering

- Reinforcement of concert tanks, storages of treatment facilities, sewage well's covers;
- Elements of chemical manufacturing facilities;
- Reinforcement of concrete floor;
- Water development facilities.

Bridge building & reconstruction:

- Bridge deck slabs
- Bridge enclosures
- Footways
- Reinforcement of onshore facilities

BENT REBAR / CURVED REBAR
Bent rebar is used in construction of civil and industrial projects and serves as an addition to straight rebar and other concrete reinforcement agents. Curved rebar retains all the benefits of straight composite FRP/GFRP rebar and just like standard rebar rods is a much more technologically advanced construction product for concrete reinforcement.

APPLICATION OF BENT/CURVED REBAR:
– Civil projects
– Industrial grade projects
– Concrete reinforcement (foundations, concrete blocks, dolos and more)

– Structures located in coastal areas, airports, hospitals, military bases and more

FRP Rebar

Fiberglass (Fiberglass Reinforced Plastic) rebar is made of high strength glass fibers along with an extremely durable resin. Developed as a superior alternative to steel in concrete reinforcement, FRP Rebar is used to reinforce concrete in applications where concrete is exposed to water, salt water, or chemical environments.

Advantages:

- Non-Corrosive – will not corrode exposed to a wide variety of corrosive elements including chloride ions.
- High Strength-to-Weight Ratio – provides good reinforcement in weight sensitive applications.
- Non-Conductive – provides excellent electrical and thermal insulation.
- Excellent Fatigue Resistance – performs very well in cyclic loading situations.
- Good Impact Resistance – resists sudden and severe point loading.
- Magnetic Transparency – not affected by electromagnetic fields; excellent for use in MRI and other types of electronic testing facilities.
- Light Weight – easy to be transported, no need for lifting equipment, saving high machine and manual cost.

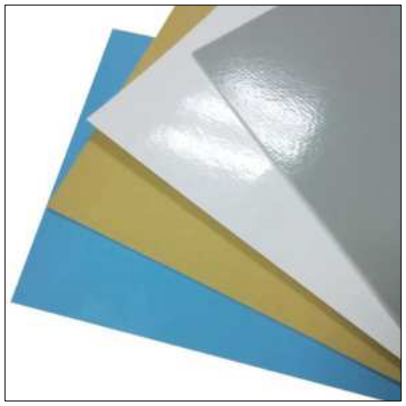
Application: Rock reinforcing underground like mining, sub-way, etc

Technical data:

Type / Properties	MG-16	MG-18	MG-20	MG-22	MG-24
Diametre(mm)	16	18	20	22	24
Tensile strength(Mpa)	500	500	550	550	600
Shear strength (Mpa)	110	110	110	115	120
weight (g/m)	300	450	600	680	920
Rod Torque (N.m)	45	50	55	60	65
anti-tensile ability of nut (kN)	80	80	80	80	90
Load ability of plate (kN)	80	80	80	80	90
Static ESD (Ω)	$\leq 10^7$				
Flame retardant property (S)	According to standard requirement ASTM-184				

FRP Plain Sheet

We have with us highly functional and aesthetically appealing FRP Transparent Sheet. These are available in transparent, semi transparent, decorative sheet. Our range is known for its quality features such as corrosion resistance, high durability and UV resistance. We fulfil the application needs of various industries, homes, malls, offices etc.



FRP Ladder / Scaffolding

Fiberglass insulated ladder is made of insulating fiberglass, with withstand voltage level of 220kV. FRP ladder/scaffoding are mainly used for power supply engineering, telecommunication engineering, electrical engineering, hydropower engineering and other emergency repair, substation maintenance, meter reading and other Fiberglass Ladder. Uncompensated ladders, scaffolding and ladder cage systems are produced using a premium grade polyester resin system with flame retardant and ultraviolet (UV) inhibitor additives. A vinyl ester resin system is available upon request for additional corrosion resistance. Standard side rails and cages are pigmented safety yellow. The rungs are a pultruded fiberglass polyester tube with a fluted, non-skid surface.

The Fiberglass Self Supported Ladders are quite popular in recent days and customers from different sectors are placing orders with us for this product. We are able to manufacture this product with all required features and make it suitable for the perfect use and application. We are asking for an extremely reasonable price to fit the budget of the customers. Materials are sourced from the vendors who are panelled with us. Quality check is done at multiple stage of production to avoid any manufacturing defects.

FRP electric insulators

These are widely used in electrical insulation, electrical, machinery, civil transportation, and many other industries.

FRP electric insulators / composite insulators are composed of three parts: insulating mandrel, silicone rubber sheath, and connecting fittings at both ends using SMC / BMC processing. FRP electric insulators can be divided into rod-shaped suspension composite insulators, pin-type composite insulators, cross-arm composite insulators, pillar composite insulators, wind-deflection composite insulators, etc. Not easy to be eroded, small in size and light in weight, not afraid of collision, easy to install and maintain.

What are Sheet Molding Compounds (SMC)

Sheet molding compound (SMC) is a type of composite material made from a mixture of resin, glass fiber reinforcement, and various additives. It is typically used in the manufacturing of automotive parts and other complex-shaped components.

What are Bulk Molding Compounds (BMC)

Bulk molding compounds (BMC) are first processed by mixing resin, glass fiber reinforcement and additives together to form a dough-like mixture. This mixture is then placed in a mold and subjected to high pressure and temperature, allowing it to cure and form the shape of the mold. Once the material has cooled and solidified, it can be removed from the mold and used as a finished component. It is similar to sheet molding compound (SMC), but processed differently. The main advantage of the SMC/BMC process is that it can produce the very complex shapes and large size profile by easy way and lower cost. Different from pultruded profiles, when designing the SMC molded products, not only take the quality requirement and work under maximum load into account, but also make sure the structure meets the requirements according to the analysis of process and factors in the actual production.

BENEFITS OF FRP BENT REBAR COMPARED TO STEEL BENT REBAR:

Corrosion resistant – FRP rebar, mesh, BE do not rust and are immune to salt ions, chemicals and concrete inherent alcalines. This is important when you build concrete structures in coastal areas near seas, oceans, lakes and rivers. FRP is not affected by corrosion and this means that concrete won't crack as rebar will not expand like steel.

Sustainability – Composite bent rebar is a sustainable solution to steel curved rebar. Its lack of corrosion and use of oil&gas industry waste in manufacturing processes makes for an environmentally friendly product that outperforms steel bent rebar in every test.
Zero decay – FRP rebar eliminates cracks in the concrete blocks and consequent breaking of structure. Therefore, we extend life expectancy of the blocks and eliminate the need for refurbishment.
Our tests show that concrete structures will remain intact for over 80 years without critical cracks and deformation of the structures that contain FRP rebar.
Price – Steel has doubled in price since mid 2020, whilst the general market suffers from constant fluctuations. This makes it hard to forecast your steel rebar production prices.
Opposingly, FRP Rebar raw materials have historically been decreasing in price and maintain a stable price behaviour.
Strength and temperature resistance – The end product of our production lines withstands -70 to +150 degrees Celsius range of temperatures and is 5 times stronger than its steel counterpart.
Transportation – FRP rebar is over 5 times lighter than steel. This multiplication factor means that you can transport at least 5 times more FRP rebar using the same machinery and transportation techniques as with steel rebar.

This then becomes an integral part of your cost and profitability calculations, decreasing these factors to minimum. Fiberglass rods represent an evolution of steel rebar and make the gfrp composite technology applicable in construction in practically every of its deviation. Composite reinforcement is sustainable and shows prevailing results when you choose the right FRP rebar supplier. Alb-Rebar has become the leader in fiberglass rebar equipment manufacturing and now boasts a network of gfrp rebar manufacturers across the globe, which allows us to cover all your composite rebar needs and more.

ADVANTAGES OF COMPOSITES

Application of composite rebars ALB-REBAR increases construction's life time and time between repairs by means of:

- Excellent corrosion resistance in acid, alkali and other aggressive environment
- High tensile strength; 2 times higher compared to steel 1100-1300 MPa.
- Low weight; ¼ the weight of an equivalent size steel bar (savings on transportation).
- Durability
- No electrical conductivity
- Anti-magnetic
- Eco-friendliness and fire safet

HM-20 Unidirectional Carbon Fiber Wrap

Weight: 200g/sqm
Thickness: 0.111mm
Density: 1.8g/cm³
Packing: 100 meters/roll
Width: 100mm, 200mm, 300mm, 500mm or to be customized
Manufacturer of unidirectional carbon fiber wrap for concrete repair and structural strengthening

Key Features of Unidirectional Carbon Fiber Wrap

• Flexible
• High strength
• High modulus
• Easy to install
• Long shelf life
• Light self weight
• High toughness
• Anti high temperature
• Environmental-friendly
• Unidirectional carbon fiber wrap used for shear strengthening, confinement strengthening, flexural strengthening.

Application Range of Carbon Fibre Strengthening

• Load increases
• Seismic reinforcement
• Improve structural state
• Damage of structural parts
• Change the structural function
• Remit mistakes in design and construction.

Affordable organ sheets for mass-customised FRP components in multiple sectors

According to our latest report, close to one in five heavy manufacturing businesses in the UK could be at risk of going under without an extension to the government's Energy Bill Relief scheme. We conducted a poll with more than 100 senior decision makers within the heavy manufacturing industry, in advance of the Chancellor's Autumn Statement, resulting in 18% saying they weren't confident in continuing to trade through the next 12 months without an extension to the scheme, which comes to an end next April.

With more than half (53%) of firms in the sector expecting creditor pressure this year, around a quarter (28%) held similar concerns for the financial health of their supply chains.
Almost all of the businesses we surveyed had utilised the emergency funding during the pandemic, with just a third currently paying loans back on the original terms. Meanwhile, one in 10 are failing to pay back anything at all at a time of rampant inflation and increased operating costs. Despite the challenges the sector faces, manufacturers can get ahead by proactively reviewing their operations, costs and pricing, whilst staying in close contact with their stakeholders. They are confident that the vast majority will make it through this period and will emerge fitter and stronger. I hope this report helps shine a light on some of the most pressing issues for manufacturers. The results of the report highlight that despite the sector seeing a number of issues to overcome in the coming months, there are opportunities to be seen and steps manufacturing businesses can take to remain resilient.

Composite-Tech FRP Production Lines: Products and Areas of Application

Since 2012, Composite-Tech has been manufacturing a variety of FRP products production lines. The brand has rightfully earned its reputation as one of the industry leaders given the top-notch products and unsurpassed customer service. The highest quality of deployed FRP is ensured by the ongoing collaboration with international research labs focused on further improvement of industrial-grade composite materials.

FRP Rebar.

The company offers one type of rebar lines: CT4 with an output of 4 simultaneous bars. As of now, civil engineering relies heavily on FRP technology in the construction of roadbeds, bridges, coastal, aeronautical and military bases, as well as industrial facilities. Being 8 times lighter and 3 times tensile stronger, composite rebars are used more and more extensively across all industries.

FRP Mesh.

Reinforcing mesh lines from Composite-Tech ensure continuous process manufacture. FRP mesh lines are engineered to produce 1m or 2m wide composite mesh used in industrial, military and civil construction, including foundations of all types, concrete walls, blocks, and joint elements.

Bent (or curved) rebar.

These are used in residential, industrial, and military construction together with straight rebar and rebar mesh. Proper employment of FRP production lines requires minimal maintenance costs and ensures cost-effective output. The cost-effectiveness of production lines is based on the superior performance of fibreglass.

FRP Products: Areas of Application

Concurrent with the development and improvement of the fibre-reinforced composite technology, the world witnesses the expansion of FRP products' applications:

Automotive, marine, and aerospace industries. Thermal shock, corrosion and chemical resistance of FRP rebar and mesh makes these products increasingly required in aerospace and mechanical engineering. Fibreglass replaces steel elements in radiosensitive elements of aero- and medical industries, so that performance of the high-tech equipment wouldn't suffer from interference.investments in FRP production lines. Resistance to mechanical and chemical damage, lightweight, thermal insulation, lower production costs and durability are among the most marketable attributes of fibreglass products.

The impeccable reputation of the brand is based on the excellent quality of products and unrivalled customer service: an FRP line will be installed and adjusted for the specific facility. At extra cost, Composite-Tech's experts can supervise and manage the launching process. Composite-tech stands out in the market not only by the superior quality of its FRP lines and FRP products but by the full range of services and continuous support in fibreglass products' manufacturing, expansion of sales, and further market promotion.

Rail – an evolving market for FRP components

The front exterior panel over the bumper guards on the Regio shuttle train utilises sandwich composite construction with core from DIAB.On the Siemens Desiro train, FRP interior components using Menzolit's SMC 2400 meet high FST standards through the addition of aluminium trihydrate. Today's performance requirements for the global rail industry demand that trains travel faster and carry more passengers and freight. Improved fire, smoke and toxicity (FST) properties are also desired for enhanced safety as rail systems carry more people on a daily basis. In the United States in 2007, 10.3 billion people rode the rails in 34 billion trips per week, reflecting a 50 year high. Market estimates for FRP in exterior and interior rail components vary, but overall, demand is seen as steady and positive for growth over the next few years. Stronger emphasis on environmental stewardship is also driving this industry to materials with greener chemistry as an alternative to traditional materials, such as composite cross ties, called 'sleepers', as a replacement for creosote-treated wood rail ties.Getting onboard big time

Greater application of fibre reinforced plastics (FRP) within even a portion of these train set designs could be an important indicator of the eventual scale of growth possible in this market. A representative of Siemens tells *Reinforced Plastics* that the rail market is growing "as a result of infrastructure demands by the increasing world population, with composites offering significant weight advantages compared to other materials." FRP components on the Velaro RUS will be used in the interior and front end coverings. In wall claddings, window frames, door and seat structures, SMC 2400 is easily moulded in large panels. A key FST ingredient is aluminium-trihydrate (ATH), a mineral filler that acts as a quenching element in the SMC by releasing water at elevated temperature up to 200° C (392° F), "like a built in fire extinguisher," Stachel explains. Menzolit is using up to 350 parts ATH and 30% fibre loading in SMC 2400.

Advantages for FRP Door:

The fixing is simple as conventional wooden doors and can be fixed on any door frame
The doors are free from swelling, warping or splitting & have good impact resistance

The doors have no effect of water, insects or termites and have excellent weathering properties

FRP doors have a significantly lower coefficient of thermal expansion compared to PVC/ wooden doors, allowing doors and frames to be manufactured to a tight tolerance. Fiberglass doors are extremely eco-friendly, and most of the fiberglass panels are Energy-Star compliant. Fire-resistant to a great degree, these fiberglass doors have become something of a structural necessity in India in recent years. Affordable, stylish and extremely compact, fiberglass doors in India are now expertly-produced and crafted to give that niche feel to the room.
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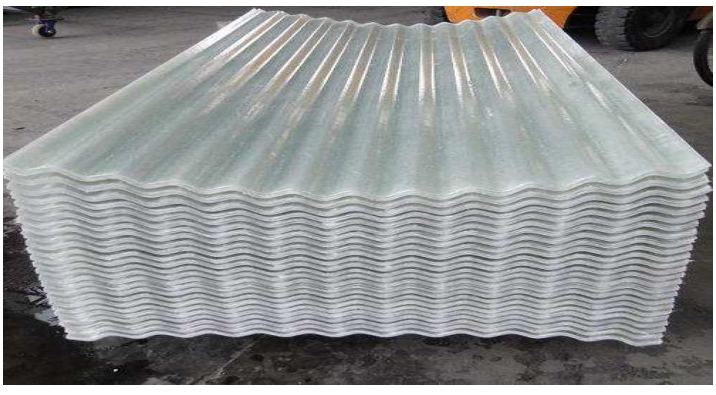
FRP Transparent Sheet

We specialize in manufacturing and supplying wide range of FRP Transparent corrugated Sheets. These sheets are widely acknowledged for the features like high tensile strength, fire resistance, corrosion resistance and light weight. Manufactured using optimum quality material which are procured from trustworthy vendors of the market.



FRP Roofing sheets are best chosen material for roofing, where controlled light transmission is required with maximum 90% light transmission as FRP are much stronger and stiffen material which are duly reinforced with glass fibre unlike other plastics and polycarbonate sheets which

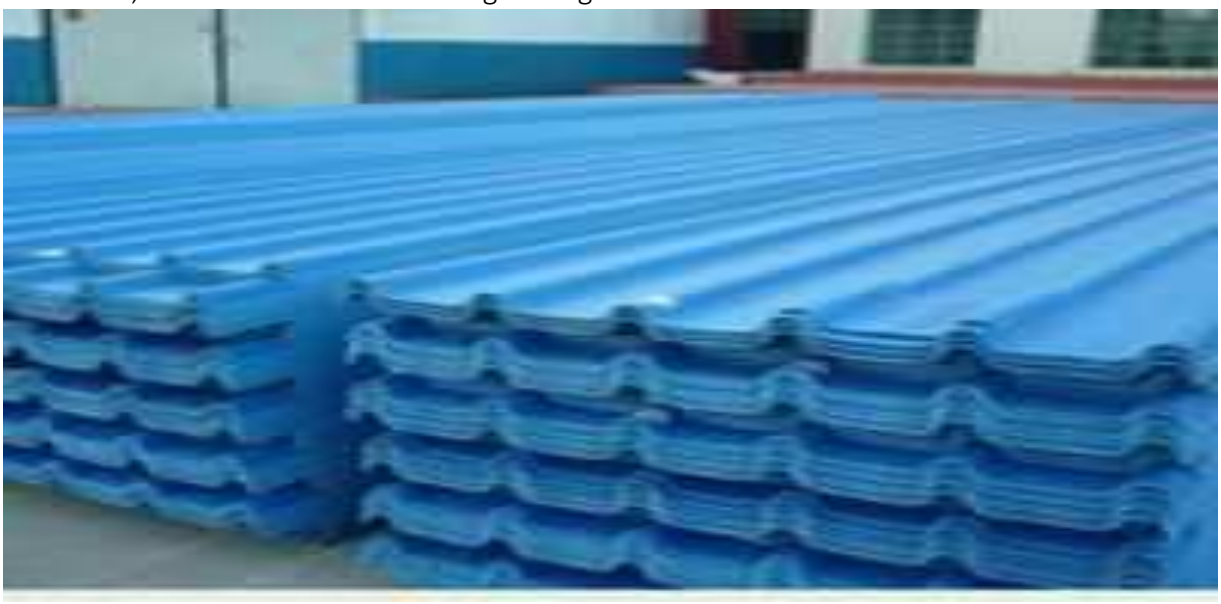
has no insitu reinforcement material. The corrugated profiles created in FRP is moulded process, whereas in other plastic or polycarbonate sheets is cold bending process which makes all the edges at bending a permanent weak point.

FRP Corrugated Sheet

Due to this moulded process in FRP Sheet, it gives better flexural rigidity reducing the deflection under high wind velocity and extremes of weather as well as other incidental loads. With the availability in various standard thickness, sizes and lengths, these sheets are one of the most favoured selections of our clients. besides, our sheets are admired for their fire resistance and rough and tough usage. Also, these roofing sheets can be availed in numerous customized options as per the demand of customers. Being a quality oriented organization, we stringently check the quality of these sheets on the parameters of colors and transparency

FRP Industrial profile sheet

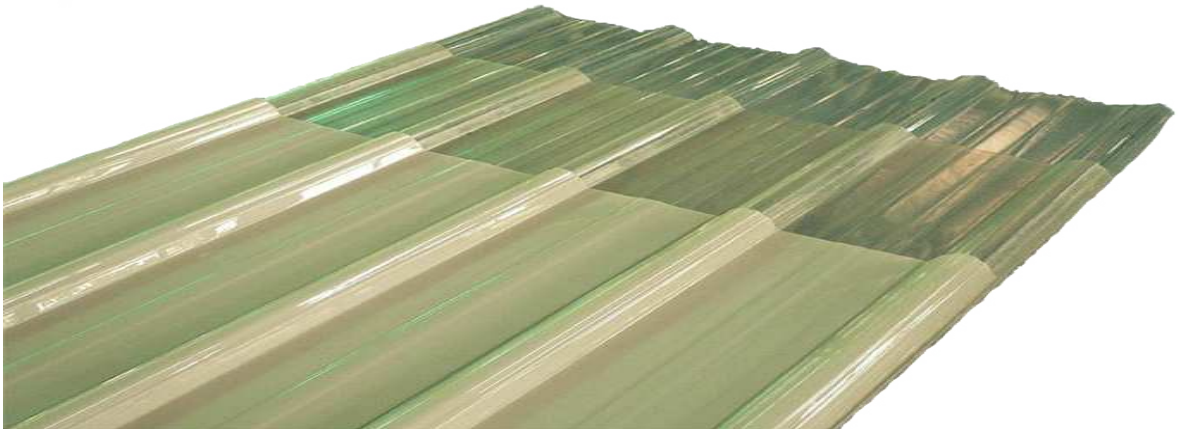
We specialize in manufacturing and supplying wide range of FRP Transparent corrugated Sheets. These sheets are widely acknowledged for the features like high tensile strength, fire resistance, corrosion resistance and light weight.



Manufactured using optimum quality material which are procured from trustworthy vendors of the market. FRP Roofing sheets are best chosen material for roofing, where controlled light transmission is required with maximum 90% light transmission as FRP are much stronger and stiffen material which are duly reinforced with glass fibre unlike other plastics and polycarbonate sheets which has no insitu reinforcement material. The corrugated profiles created in FRP is molded process, whereas in other plastic or poly carbonate sheets is cold bending process which makes all the edges at bending a permanent weak point. Due to this molded process in FRP Sheet, it gives better flexural rigidity reducing the deflection under high wind velocity and extremes of weather as well as other incidental loads.

FRP Sky Light Profile Sheet

We specialize in manufacturing and supplying wide range of FRP Sky light profile Roofing Sheets. These sheets are widely acknowledged for the



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FRP Canteen Table

School Bench

FRP Chair

We are one of the known names of the market engaged in offering excellent FRP Chair to the customers. These chairs are are manufactured using high quality Fibre Glass Reinforced Plastic, procured from some of the trusted vendors of the industry. These chairs are widely used in households, schools, offices and various other places, thus, are highly demanded in the market.

FRP Pipe / Tube

FRP (Fiber Reinforce Plastic) or GRP (Glass Reinforced Plastic) piping systems are available in a variety of standard diameters ranging from 15mm to 4200 mm. Combining the strength of FRP (GRP) and the chemical compatibility of plastics provides customers with a superior alternative to costly metal alloys and rubber-lined steel.

Application Areas Due to their excellent properties, FRP (GRP) or Dual Laminate piping systems can be used perfectly in several environments. Real Fibre Glass Ind: can also supply insulated piping systems for cooled water conduits used in tropical and subtropical regions or in cold environments. These include heat tracing to prevent the medium from freezing. The use of polyurethane insulation finished with a FRP (GRP) laminate ensures 100% vapour-tight insulation. Real fibre Glass can comply with any requirements relating to product identification.

Paddle Boat

Specifications: Main materials : Glassfiber & Polyester resin. PADDLE BOAT Material: F.R.P Boat Size 11' x 5' Height : 2' Capacity : 4 parson. Operate : by paddle. Weight: .....kg Capacity: 5 Person Color: White,Blue,yellow,Red.

FRP Round Tank

Diameter: Any
Height: Any
Size: 300, 500, 800, 1000, 1500 liter
Color: Any

Description: FRP Round Tank is very popular product. We also provide the acid proof Tank. These FRP round tank often use for households, factory, fisheries business, water treatment plant etc.

Bio gas Tank

Product Description Organic waste such as dead plant and animal material, animal faces and kitchen waste can be converted into a gaseous fuel called Biogas. ... Biogas is produced by the anaerobic digestion or fermentation of biodegradable materials biomass, manure, sewage, municipal waste, green waste, plant materials and crops.

FRP Chemical Tank

FRP Chemical Storage Tank Introduction: Our company produce a variety of FRP tank, such as FRP horizontal storage tank, FRP vertical tank, FRP transportation tank, and a series of tank. We can according to every customer's specific usage(storage or transporting),the medium can use epoxy furan resin, modified or polyester resin, phenolic resin to serve as adhesives. It has corrosion resistant inner layer, transition layer, filament winding strengthening layer and the outer protective layer. Horizontal tank use saddle support, etc.

Fibreglass FRP Kids Playground Slide

For Park, Water Parks Etc, Age Group: 5 To 13 Year

FRP Trolley Tank / Basket

Color: Red, Green, Blue, Yellow, Orange. Usage: Textile, Dyeing, Washing, Finishing, Knitting, Garments, Jute Weaving and Other Industrial Purposes.

FRP Mobile Toilet

Support FRP Mobile Toilet
Item code: 820661
Brand: Support
Product Type: Mobile Toilet
Size: L-2230 x W-1030 mm
Elegant outlook
Made of FRP (Fiber Reinforced Plastic)
Portable
Rust free
Lightweight & highly durable
Hygenic & Environment friendly
Color: Mixed (As given picture).

7. FRP Rebar vs. Steel Rebar

When it comes to rebars used universally in industrial and civil fields, you might have been wondering about the differences between the FRP rebar and its steel counterpart. Despite obvious trends in various industries shifting to FRP rebars, some companies are still doubtful and conduct multiple pieces of research on FRP vs. steel prospects, characteristics, and performance.Steel Rebar and Its Properties Steel is known for its great qualities deployed across various industries. The downside of steel is that it is prone to moisture and, consequently, corrosion. All sorts of chemical reactions, such as oxidation, generate a negative impact on steel properties eventually. Thus, steel rebar applications are restricted in some industries. The advantage of the low initial cost is overlapped by higher transportation and on-site installation costs given its heavy weight. On a long-term horizon, corroded steel rebar requires costly maintenance and results in increased tensile load on concrete structures.

FRP Rebar and Its Properties

FRP, or fibre-reinforced polymer, has been replacing steel across diverse industries. Being resistant to corrosion and various chemical processes and reactions, FRP has become the preferred material for marine and open-air exposed applications.

Various additives used for enhancing some properties can increase the overall tensile capacity and endurance of FRP products, including rebar, silos, tanks, etc. The tensile strength of fibre rebar is 20% higher in comparison with a steel bar.

The material bonding force of fibre reinforcement is considerably stronger compared to steel; this explains better operational endurance of FRP rebar.

Customizable manufacturing allows tailoring resins used for the FRP rebar production to meet niche-specific requirements, for instance, enhancing abrasion or corrosion resistance. Another crucial advantage of FRP vs steel is its lightweight. FRP rebar weighs only ¼ of steel rebar of the equivalent size. Hence, the use of FRP rebar lowers costs for shipping and installation. One more important factor is impact resistance. Under heavy working load FRP won't deform permanently because the polymer matrix intensified by resins is capable of distributing the impact load, preventing the surface from being damaged. In similar conditions, particularly in lower temperatures, steel products might be deformed. Despite having a similarly wide range of applications, FRP differs from steel in terms of electrical and thermal conductivity. Steel is a good conductor of electricity and heat, while FRP has lower thermal conductivity and null electrical conductivity. In an environment with thermal fluctuations, FRP demonstrates more stable properties than steel whose characteristics may vary as a result of external temperature impact.

Properties	Frp rebar	Steel rebar
Weight	¼ of steel weight	10mm, 0.617kg/m (or 0.188 kg/ft)
Strength	206.5 mpa	248.2 mpa
electrical conductivity	Non-conductive	Conductive
Thermal conductivity	Low	High
Corrosion resistance	High (unaffected by water)	Low (without expensive galvanisation treatment bars of steel are subject to oxidation)
Heavy load resistance	No permanent deformation	Can be permanently deformed
Costs	Lower manufacturing costs, maintenance costs, and transportation expenses (related to lightweight)	Lower material costs but higher overall costs of production, transportation, installation, and technical maintenance

Industrial and commercial applications of FRP rebar include shield tunnels, bridges, airports, highways, water stations, waste conservancy, sewage and chemical plants, as well as all sorts of coastal projects.

Final thoughts

When it comes to a choice of FRP rebar vs. steel rebar, FRP wins in many applications due to its superior thermal, corrosion, and chemical. Add here a much lighter weight that facilitates transportation by further cost reduction, the choice seems pretty obvious. Yet still, steel rebars are irreplaceable by FRP in industrial applications that require electrical conductivity as a mandatory attribute. Other than highly-specialised applications, FRP rebar is rightly seen as a cost-effective alternative to steel rebar.

8. FRP MARKET: PROSPECTS, MARKET SIZE AND FORECASTS

The FRP market is growing at a rapid pace and is expected to continue doing so in the coming years. The main drivers of this growth are the increasing infrastructure development activities and the growing construction industry in the country. As a result, there is a growing demand for composite construction materials. Not only are composite materials lighter and easier to work with, but they are also corrosion-resistant and have a much longer lifespan. As a result, more and more builders and contractors are specifying FRP rebar for their projects. This presents a great opportunity for manufacturers of FRP rebar production equipment to expand their businesses or jump start their operations.

The construction industry is expected to grow at a CAGR of 20%. This is attributable to the increasing investments by both the government and private players in infrastructural development projects, such as smart cities, roads & highways, airports, and railways.

ADDITION TO THE FRP PRODUCTION LINE RANGE

To add to an already existing range of rebar production lines, we have recently unveiled an additional line of FRP pultrusion machines that manufacture pipes, tanks, profiles and silos. We believe that the benefits of switching to fiberglass composites are obvious and do not require any additional praise. As a result, all major construction companies have already switched or are in the process of implementing composites into construction. And this is where Composite Tech comes in, allowing these companies not only to increase business profitability, but also turn construction towards a highly sustainable and cost effective level, unmatched by conventional raw materials.

Running at the forefront of this change Ithas historically shown high demand for fiberglass rebar, mesh and other composites. Once again, this is down to the advantages that these products bring and it is exactly where our FRP pultrusion machines slot in. In addition to initial advisory that we offer to our clients, each rebar production line is complemented with on site assembly, engineers training and turnkey launch of production. This is why even those companies that have never dealt with this type of production before, have a paved way of entering the industry. Join the Composite Tech family today, and start your sustainable FRP production as early as three months!

FRP PRODUCTION EQUIPMENT TECHNOLOGY BENEFITS

Following the aforementioned facts, we reach the benefits of the FRP technology over steel rebar, mesh and bent elements. Although these are already widely known in the construction industry, we would like to go over them once again, and outline the key factors that serve as the reason why the world is shifting to FRP rebar.

Corrosion resistant - FRP rebar, mesh, BE do not rust and are immune to salt ions, chemicals and concrete inherent alcalines. This is important when you build concrete structures in coastal areas near seas, oceans, lakes and rivers. FRP is not affected by corrosion and this means that concrete won’t crack as rebar will not expand like steel.

Zero decay - FRP rebar eliminates cracks in the concrete blocks and consequent breaking of structure. Therefore, we extend life expectancy of the blocks and eliminate the need for refurbishment. Our tests show that concrete structures will remain intact for over 80 years without critical cracks and deformation of the structures that contain FRP rebar.

Price - Steel has doubled in price since mid 2020, whilst the general market suffers from constant fluctuations. This makes it hard to forecast your steel rebar production prices. Opposingly, FRP Rebar raw materials have historically been decreasing in price and maintain a stable price behaviour. Strength and temperature resistance - The end product of our production lines withstands -70 to +150 degrees Celsius range of temperatures and is 5 times stronger than its steel counterpart. Transportation - FRP rebar is over 5 times lighter than steel. This multiplication factor means that you can transport at least 5 times more FRP rebar using the same machinery and transportation techniques as with steel rebar. This then becomes an integral part of your cost and profitability calculations, decreasing these factors to minimum.

There are a number of key factors were considered prior to formulating the business plans of G-FRP. Briefly such plans were considered for the following areas:

- Market opportunity, industry attractiveness and competition.
- The company's resources, technology expertise, plant and machinery, financial Backing and manpower.
- Performances, aspirations and visions of The Board of Directors, Shareholders as well as its Employees.

Accordingly, based on the above, G-FRP's long term business objectives would include The following:-

To equip and upgrade all facilities through research and development, which include owning numerous factory premises, state of the art (technology advanced) plant and machinery and a competent staff force be it at production, operational or administrative levels to increase further the company's productivity levels. Expansion of market share to overseas, especially, ASEAN region, third world Countries and accordingly diversification of business activities towards property Development and others. Acquisition or merger with other identified corporate, which contributes synergy.

9. FRP Vessel In Bangladesh

FRP (Fibreglass Reinforced Plastic) is a modernized composite material used for vessels and tanks as well as other equipment and appliances in chemical plants. There are several beneficial uses for FRP tanks and vessels, including industrial and commercial water treatment systems. FRP tanks and vessels are less expensive, strong, flexible, lightweight, and corrosion resistant. As a result, these vessels are frequently seen as a genuine substitute for SS vessels.
If you are looking for FRP vessels in the country, Green Dot Limited is your best option. They are the best FRP vessel supplier in Bangladesh.

What Are FRP Vessels?

FRP (Fibreglass Reinforced Plastic) is a modernized composite material used for vessels and tanks as well as other equipment and appliances in chemical plants. There are several beneficial uses for FRP tanks and vessels, including industrial and commercial water treatment systems. FRP tanks and vessels are less expensive, strong, flexible, lightweight, and corrosion resistant. Therefore, these vessels are frequently regarded as the best substitute for copper vessels.

Why Are FRP Vessels Used?

FRP is a widely recognized and utilized material that is often used to create tanks and vessels for use in chemical plants and water treatment systems. The manufacture of the key is carried out using filament winding. FRP fundamentally resists rusting. It doesn't corrode even when in contact with liquid. Additionally, it can successfully tolerate both significant tensile and hydrostatic forces. In many cases, it is superior to stainless steel and stronger. As a result, FRP is frequently used to create water vessels and storage tanks.

FRP Vessel Supplier In Bangladesh

FRP vessels are currently the most often used in water treatment facilities in Bangladesh. GRP, or glass reinforced plastics, are other names for fiberglass reinforced plastics (FRP). The industrial RO water purifier, jar water purifier, small bottle water plant, iron removal plant, water softener plant, desalination plant, central water treatment plant, dm plant, battery water plant, mineral water plant, and so on are examples of devices in Bangladesh that utilize FRP vessels. One of Bangladesh's oldest and largest manufacturers of FRP vessels is Green Dot Limited.

Features Of FRP Vessels

Flexible Design

By changes in resin and reinforcement material, the physiochemical property of FRP containers can be adjusted to fulfill the requirements of different media and working conditions. The carrying capacity of containers can be modulated employing adjusting the thickness, wrapping angle, and process Larry structural design of structural sheets, and FRP container or devices with different tension and some certain special performances can be manufactured, which isotropic metal materials can't achieve.

Light Weight And High Strength

The high tension and high content of fiber enable the FRP vessel to have a much higher intensity than other metal materials such as steel and cast iron.

Food Grade Performance

To meet the operating requirements of the brewage and food industry, food resin may be selected.

Excellent Corrosion Resistance

FRP is endowed with a special performance of resisting chemical corrosion and therefore unparalleled advantage over the other materials in storing corrosive media including kinds of sour, alkali, salt and oil, and organic solvent.

Stable Performance

The computer controls the winding equipment to achieve ultra-stable performance and products.

Wide Application Fields

Composite having complex performances indicates that FRP vessels can be used in many fields: storage, transportation, environmental protection, chemical anti-corrosion, brewage, and so forth.

Benefits Of FRP Vessels

There are many advantages to using FRP vessels provided by Green Dot Limited. These include:

- There is no need for recladding or painting because they don't rust.
- Stress, heat, conductivity, and weather-related problems with FRP vessels are quite rare.
- Compared to their metal equivalents, they are more and better able to resist corrosion.
- The weight of FRP tanks and vessels is incredibly low. They weigh only 2/3 as much as aluminum and 1/4 as much as steel. FRP equipment can therefore be handled more effectively.
- Items made of FRP are less expensive than metal competitors; in fact, their cost is approximately half that of steel. Even in the most severely corrosive situations, FRP lasts at least 5 to 10 times longer than stainless steel.
- Equipment made of FRP is less likely to slide than metal equipment.

- Modern FRP vessels have improved resin treatment for impact, heat, and crack resistance. And this undoubtedly pushes the top FRP horizontal tank manufacturer to use it extensively instead of metal substitutes.
- Their design options are very flexible.
- Since FRP is electrically non-conductive, there is no danger of shorting out electronic devices.
- Brominated compounds are added to make FRP containers more resistant to igniting.
- FRP is a powerful insulator with good thermal expansion properties.
- Heat may be effectively traced from the bottom of FRP vessels.
- There are no issues with flammability when welding.
- Shampoos and deodorants are not contaminated with any trace metals.
- Its adhesive quality and resin's elongation assist in dampening equipment vibrations.

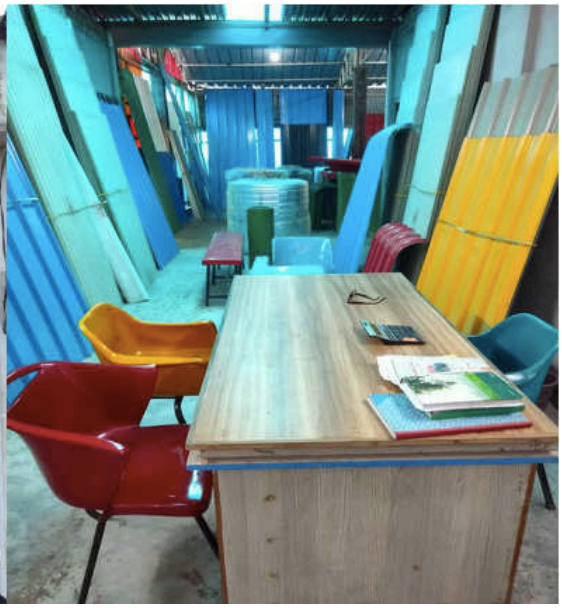
Considering the aforementioned pros, an FRP vessel is worth investing in.

How Do FRP Containers And Tanks Aid In The Purification Of Water?

As was already noted, FRP is resistant to both corrosive chemicals and liquids, including water. As a result, every top manufacturer of FRP horizontal vessels favors their use in water treatment facilities. Since FRP is leak-proof, water flows freely and easily through it. Additionally, because of its flexibility, it can take on any shape (vertical or horizontal) and size (big or small).

10. Competitor in Bangladesh

FRP Product Manufacturer Companies in Bangladesh. A wide range of products they provide to their customers. They believe that our products will be a great choice for Bangladeshi People As they are one of the best fiberglass product manufacturer companies in Bangladesh, They can assure you about our quality.



Corporate Office

Meherunnesa Tower, Hazi Belayet Hossen Road, Kodomtoli (Bondho Dakpara), Keranigonj,Dhaka-1310.

Showroom Address

Anwar Ahmed Siddiquee Market, Near Dhanbari Upazilla Parishad, Dhanbari, Tangail.

Factory

Kalindi Bus Stand, Keranigonj.

11. Price Idea of FRP Products

FRP Product Price in Bangladesh

SL	Item	Speciality	Manufacturer	Exclusive Price	Price
	FRP Tank				225,000
	FRP VESSEL	1252 SIZE	Hydrotech		17,999
	FRP Garden Bench				185,00
	FRP Canteen Bench		MASK		21,500
	FRP Fishing Boat		RFL		16,150
	FRP Conventional Boat 32' F		RFL		750,000
	FRP Mobile Toilet		RFL	105,000	27,500
	FRP Penguin Dustbin				16,500

FRP Product Price in India

SL	Item	Manufacturer	Price (INR)
1	 Modcon Spiral Slide	**Modcon Industries Private Limited.** New Delhi.	95,000
2		**G.N. Enterprises** Vaishali Nagar, Jaipur.	25,888
3	Multicolor Straight FRP Playground Slides for Hotel Garden, For Outdoor, Age Group: Up To 12 Years. 	**Royal Play Equipments.** Gala No. 17, Dewan & Shah Industrial Estate No. 6, Navghar, Vasai East, Vasai East, Thane - 401210, Dist. Thane - Maharashtra	98,999
4	**FRP Wave Slide**	**Riza Sports** 25 Futa Road, Near Jama Masjid Samar Garden, Meerut - 250002, Dist. Meerut - Uttar Pradesh	25,000

			
5	FRP Play Playground Slides, For Outdoor 	**Flow Tech Enterprise.** Plot No 418, Shyam Industrial Park-2, Nr Satya Ind Park, Bakrol Road, Bakrol Bujrang, Gandhinagar - 382423, Gujarat	1,50,000
6	Custom FRP Play ground Slide For Outdoor Playground, Age Group: 3-12 Yrs 	**Bhawani Industries** Plot No. 1238, Modern Industrial Estate, MIE B, MIE Part-A, Bahadurgarh - 124507, Dist. Jhajjar, Haryana	3,50,000
7	Elephant Slide FRP, Outdoor Playground Equipment, Playground Elephant Slide 	**Ankidyne** No. 46, 1st Main Road, New Colony, Chromepet, Chennai - 600044, Dist. Chennai - Tamil Nadu	4,50,000
8	Red FRF HipBath Tub 	**Shadow Group** Agra- A1 Athiyannoor Nandanam Balaramapuram NANDANAM, ATHIYANNOOR, Balaramapuram, Thiruvananthapuram Kerala	2,800
9	Vega White FRP Bathtub 	**Hightide Buildtech International Private Limited.** No. 1/4, Rangappa Industrial Estate, 80 Feet Ring Road, Mallathalli, Annapurneshwari Nagar, Bengaluru, Karnataka	55,000

10	FRP Pultruded Profile 	Devasya Engineering Industry. B/101, Nd 2 Residency Complex, Opp Ghuma Bus Stand Ghuma Bopal Road, Ghuma 380058, Ghuma, Ahmedabad - 380058, Dist. Ahmedabad, Gujarat	180/Kg
11	FRP Section 	Ercon Composites F-123, MIA, Phase ll, Basni, Basni, Jodhpur - 342005, Dist. Jodhpur, Rajasthan	400/KG
12	FRP Red Plastic Basket Shopping Trolley 	Modcon Industries Private Limited. New Delhi.	1500
13	Frp Wheel Dustbins 	Priya Cooler And Steel Industries. 3 Co Opp, Industrial Estate Takiya Road, Bhandara - 441904, Dist. Bhandara, Maharashtra	
14	FRP Table 	Nageshwar Fiber And Fabrication. Pune- Nashik Highway, Chimbli Fhata, Near By Om Logistics, Pune - 412105, Dist. Pune - Maharashtra	450/SFT
15	Mini Bus Frp Ac Cover	Faser Engineering Poongavanam building Rammurthy Nagar, Ramamurthy nagar, Bengaluru - 560016, Dist. Bengaluru – Karnataka.	450/kg

12. FRP Machining Process

General cutting: fiberglass pultruded profiles can be cut by handy cutting machine, which is more flexible. For frp profiles with big cross section, automatic cutting machines will be used. The standard profile length tolerance is 1.0mm~2.0mm.

Custom shiping cutting: most of products Unicomposite pultruded are general cutting, but some customers need special cutting, for example, curved cutting or jagged shape. As we all know, standard cutting machine is for smooth cutting, so it'll take time to design and manufacture customized cutting equipment.

Drilling: there are several types of drilling can be offered by Unicomposite, hand drill is general and cost saving, that's for standard drilling. If you have high requirement on the holes shape, holes distance, urgent leading time and don't want to waste more labor cost to clean holes edge, punch is better choice.

Surface: painting, golden leaf, gritting, peel off, sanding. The painted products can be metallic paint, gloss paint and matt paint. Main advantage of gritting products is anti-slip. For more details of peel ply and peel off information, please click here.

Foam: urethane foam can be inserted into fiberglass tubes, the main target is to keep temperature at a certain degree.

Sealing glue: fiberglass pultruded profiles cross section can be sealed glue to increase service time in the corrosive liquid.

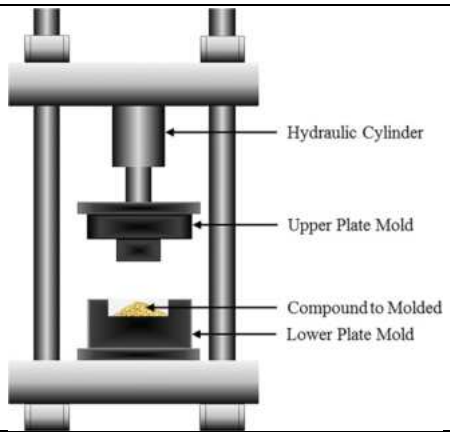
Slot and Assembly: Uncompensated offers not only separated pultruded profiles but also assembled products with several profiles joint together at request.

FRP Machineries

- Both hydraulic and caterpillar types are available.
- Pulling force from 1000kg to 50000kg!
- Combining advanced machines/moulds with turn-key technology and excellent services

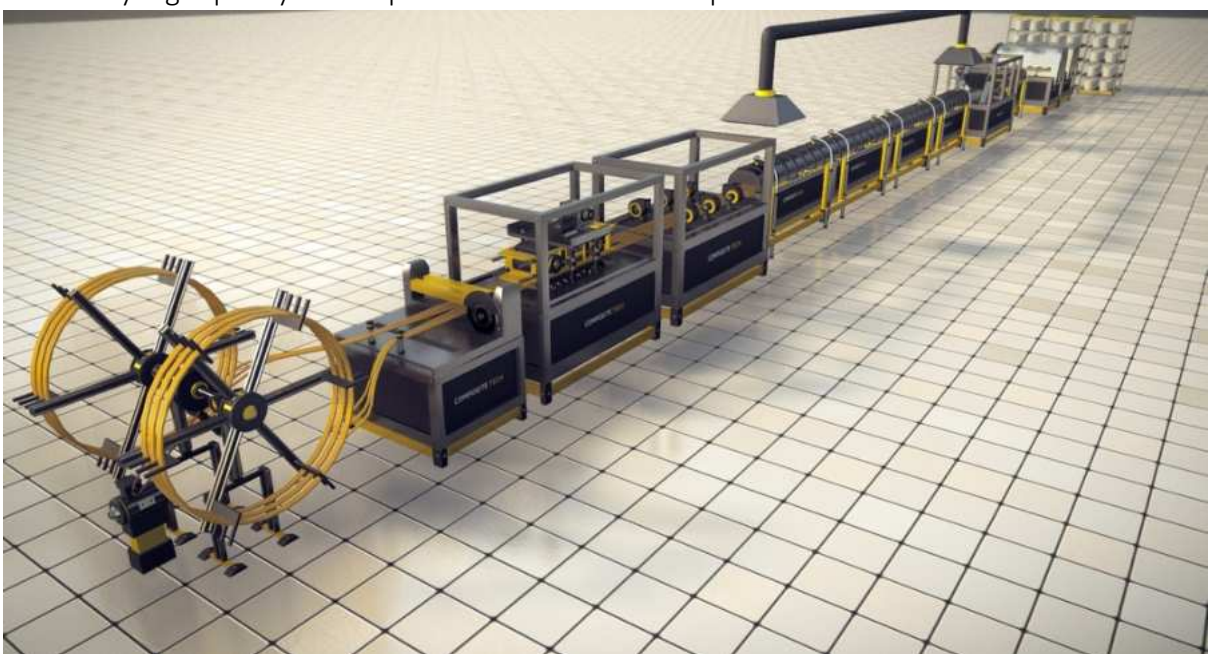
Grating In addition to normal molded gratings, we also design and manufacture machines, moulds and turn-key solution according to customer requirements.	
Hydraulic	

	
Commissioning of molded grating machine	
FRP Rebar Pultrusion Line： The machine is used to produce FRP rebar with different specifications. It can finish distributing yarn, dipping glue, pre-molding, winding, heating and hardening, traction, set-length cutting and pile up automatically.	
Slitter (mat cutter)In pultrusion factories, rolls of mats or cloth must be cut into strips of required width. This machine is slitter.	

Compressing moulds We design and manufacture various moulds for compressing process	
Injection Machines and Moulds	

High-quality FRP rebar production line

Our FRP Rebar production line has been perfected over the course of the last 10 years and has now reached its peak product stage. Resultantly, we have achieved non-stop production process flow and made sure that it requires zero to none upkeep input, whilst producing a constantly high quality of end product at maximum output.



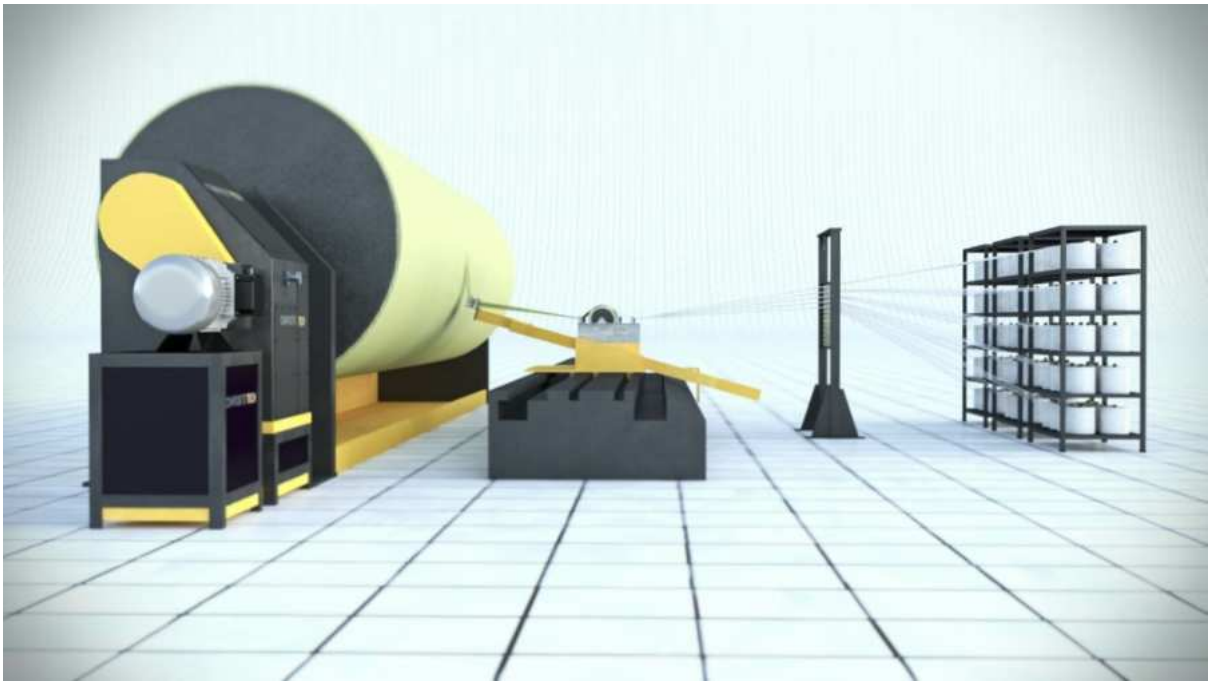
CT4 has simultaneous output of 4 bars, CT6 has simultaneous output of 6 bars

Our equipment is designed to be reliable, highly productive and unique in the technology we utilise! All our developments and innovations are patented, which guarantees not only high effectiveness of your investment, but also a competition free market. Moreover, to ensure

reliability of all production line modules we use only those components that have passed our rigorous tests and performance evaluations.
By acquiring Composite Tech FRP rebar production equipment, our clients also have following deliverables:
– Assistance in the selection of special premises
– Our specialists carry out installation of equipment and perform commissioning works
– Staff training
– Ongoing advice to your technical experts

PROFESSIONAL PRODUCTION LINE FOR FIBREGLASS OR BASALT FIBRE REINFORCING MESH.

FRP Mesh Rebar production line has been perfected over the course of the last 10 years and has now reached its peak product stage. Resultantly, we have achieved non-stop production process flow and made sure that it requires zero to none upkeep input, whilst producing a constantly high quality of end product at maximum output.



We manufacture 2 different FRP Mesh production lines: CT1M outputs 1 meter wide mesh CT2M outputs 2 meter wide mesh, Equipment is designed to be reliable, highly productive and unique in the technology we utilise! All our developments and innovations are patented, which guarantees not only high effectiveness of your investment, but also a competition free market. Moreover, to ensure reliability of all production line modules we use only those components that have passed our rigorous tests and performance evaluations.
By acquiring Composite Tech FRP mesh rebar production equipment, our clients also have following deliverables:
– Assistance in the selection of special premises
– Our specialists carry out installation of equipment and perform commissioning works
– Staff training
– Ongoing advice to your technical experts

Technical characteristics

Technical characteristics of the composite mesh production line:

Purpose:	fiberglass or basalt composite mesh release
Production Diameter:	2 mm to 10 mm.
Voltage:	380 V / 50 Hz
Grid Cell:	50×50, 100×100, 150×150, 200×200, 300×300

We produce two types of equipment for the production of composite mesh:

Purpose:	Equipment for the production of composite mesh **1m wide**
Grid Cell	50×50, 100×100, 150×150, 200×200
Available diameters:	2-8
Machine Length	18m
Height	1,8m
Width	1,2m
Power	35 kW
Line Performance:	3-8 meters per minute
Purpose:	Equipment for the production of composite mesh width 2 **m**
Grid Cell	50×50, 100×100, 150×150, 200×200, 300×300
Available diameters:	2-12
Machine Length	28m
Height	1,8m
Width	2,4m
Power	45 kW
Line Performance:	

High-quality FRP Pipes production line

Composite Tech is a global supplier of FRP rebar and Mesh production lines. This time, we take the composites industry even further by introducing our newly developed FRP pipes production line. Similar to FRP rebar and mesh, the pipes made out of fiberglass boast a plethora of advantages over conventional steel, cement, copper and iron heavy duty pipes, elevating the industry to a new level of sustainability and effectiveness.

Composite Tech FRP pipe production lines offer:

- Full automation
- Pipe diameter production of up to 1000mm
- Cost effective production technology
- Sustainable production process

Our equipment is designed to be reliable, highly productive and unique in the technology we utilise! All our developments and innovations are patented, which guarantees not only high effectiveness of your investment, but also a competition free market. Moreover, to ensure reliability of all production line modules we use only those components that have passed our rigorous tests and performance evaluations.

By acquiring Composite Tech FRP rebar production equipment, our clients also have following deliverables:

– Assistance in the selection of special premises
– Our specialists carry out installation of equipment and perform commissioning works
– Staff training
– Ongoing advice to your technical experts

Technical Characteristics of the FRP pipes production line

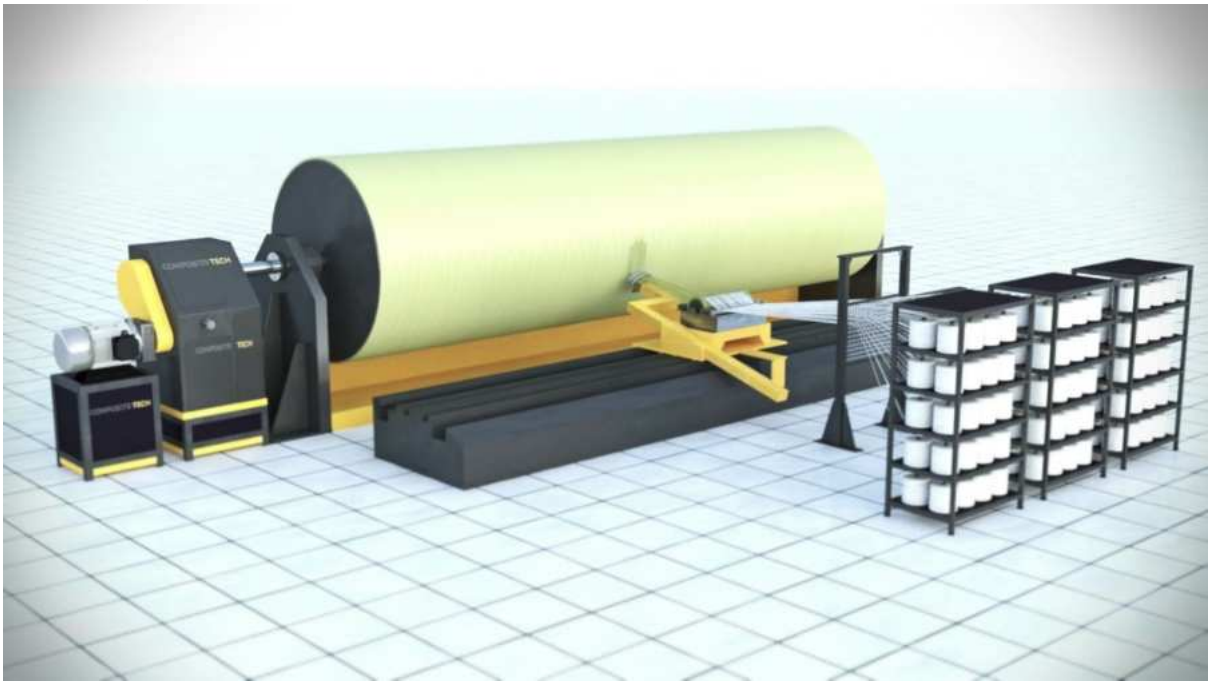
Purpose:	production of fiberglass pipes
Production Diameter:	Up to 1000mm
Voltage:	380 V / 50 HZ
Power:	30 kw
Line Performance:	Depends on the diameter
Equipment Length:	12m
Width:	2.5m
Height::	2.8m

Advantages of FRP pipes compared to conventional pipes:

- Corrosion resistance – FRP pipes are resistant to corrosion resultant from sea water, chemicals, oil, gas, heat, UV rays and extreme environmental conditions.
- Sustainability – The end product of our FRP pipe production lines aids the sustainability in construction, turning the industry towards a more eco friendly solution.
- Strength and Lightweight – FRP pipes boast high tensile strength, whilst application of such pipes does not require bonding agents, bolting or welding. FRP pipes are lightweight as compared to ductile iron, mild steel and HDPE pipes. The light weight ensures easy handling, transportation and installation. These qualities make FRP pipes much more durable, reliable and economical than conventional pipes.
- Pressure resistance – The high stiffness and high compressive load capacity of FRP pipes prevent bursting of pipes due to water pressure fluctuations. They come with a lesser wall thickness which simplifies placement and installation of such pipes. FRP pipes are resistant to abrasion and cracking, boast zero infiltration, low treatments and no groundwater pollution. An additional advantage of GRP pipes is the pressure absorption: they are designed to absorb 40% of the surge pressure, without increasing the pressure class.
- Hydraulic efficiency – FRP pipes have a smooth internal surface which aids excellent hydraulic characteristics and high flow capacity and low friction. This also stipulates low head losses and pumping costs. The internal temperature of GRP pipes remains constant due to their unique thermal properties. Ordinary GRP pipes do not conduct electricity and have much better electrical properties than their steel counterparts. However, if electrical conductivity is required, it is possible to add conductive reinforced fiber or fillers during the fabrication process.

Professional FRP Silo production line

Composite Tech takes the composites industry further than ever before by introducing our newly developed FRP silo production line. The composite silos made out of fiberglass boast a plethora of advantages over conventional metal heavy duty silos, elevating the industry to a new level of sustainability and effectiveness.



Composite Tech FRP silo production lines offer:

- Full automation
- Wide range of silo types and application (see below)
- Cost effective production technology
- Sustainable production process

Composite Tech FRP composite silo types are used in:

- Oil & Gas industry
- Agriculture industry (grain storage and more)
- Water storage
- Waste and sea water
- Chemicals storage
- Low oxygen / High pressure

Possible FRP silo shapes made possible with our production line:

- Standard silo
- Flat bottom
- Hopper (funnel bottom silo)
- Truck/train loading
- Variable dimension

Our equipment is designed to be reliable, highly productive and unique in the technology we utilise! All our developments and innovations are patented, which guarantees not only high effectiveness of your investment, but also a competition free market. Moreover, to ensure reliability of all production line modules we use only those components that have passed our rigorous tests and performance evaluations.

By acquiring Composite Tech FRP silo production equipment, our clients also have following deliverables:

Purpose:	production of fiberglass silos
Voltage:	380 V / 50 HZ
Power:	30 kw
Line Performance:	Depends on end product
Equipment Length:	12m
Width:	2.5m
Height:	2.8m

– Calculations tied to manufacturing a specific end product
– Our specialists carry out installation of equipment and perform commissioning works
– Staff training
– Ongoing advice by our technical experts

Technical Characteristics of the FRP silos production line

Advantages of FRP silos compared to conventionally used silos:

- Corrosion resistance – FRP silos are resistant to corrosion resultant from sea water, chemicals, oil, gas, heat, UV rays and extreme environmental conditions.
- Space saving – When it comes to agricultural grain storage, warehouses serve as another option for storage. Nevertheless, this is where silos save much more space by being vertically positioned.
- Zero waste of stored product – Vertical placement of silos means that it is easy to unload the stored product and there is no product waste resultant from lack of internal compartments, shelves, etc.
- Internal temperature, moisture and pressure – FRP silos are built with an internal management system in mind. As a result, all requirements tied to agricultural and oil&gas industry storage are not only followed but also eased, given better primary characteristics of FRP silo behaviour.
- Sustainability – The end product of our composite silo production lines aids the sustainability in construction, turning the industry towards a more eco friendly solution.
- Durability / Lightweight – High strength makes fiberglass silos resistant to vibration and other internal and external forces applied to the silo. FRP silos are lightweight as compared to ductile iron, mild steel and HDPE silos. Light weight ensures easy handling, transportation and installation. These qualities make FRP silos much more durable, reliable and economical than conventional silos.
- Inflammation resistance – Unlike its iron counterparts, FRP silos do not explode and do not catch nor sustain fire.
- Customization options – Suitable for practically every industrial requirement possible.
- Lack of contamination – FRP silos do not rust and therefore carry zero affect to the stored liquids, regardless whether it is water, liquid gas or chemicals.
- Minimal maintenance and repair – Long life expectancy eliminates additional costs ties to repairs.
- Pressure resistance – The high stiffness and high compressive load capacity of FRP silos prevent bursting pressure fluctuations.
- Hydraulic efficiency– FRP silos have a smooth internal surface which aids excellent hydraulic characteristics and high flow capacity and low friction.