Glass-fibre reinforced polyester (GRP) pipes

Trenchless reconstruction of sewer system:

- statically load bearing
- fast, simple, reliable
- perfectly impermeable
- adaptable for any profile
- barely affects the traffic
- five different types of resin
- adaptable under special circumstances as well
- no standstill

The BONEX method

Individual pipe insertion

When reconstructing accessible sewers, GRP pipes are first moved into the starting pits and then pushed into their final position by the use of rubber wheels. Under ideal conditions and in the case of straight sections the distance between two starting pits is 250-300 m.
The pipes are joint with a winch and fixed by wedging, after the height of each has been set with a levelling instrument.
Attachments are cut from the inside. Attachments of any shape or material can be connected to the main sewer with perfect impermeability. If a completely closed system is needed the cleaning shafts will also be relined.

Train-type pipe insertion

In case of non-accessible sewers, the pipes are lined up like trains and inserted into the existing sewer. From the starting pits sections of 25 to 250 m length can be relined. By the use of a winch, the "train" is then pushed and pulled, moving along from pipe to pipe.
The gaps between the old and the new pipes will be injected by a special material, in this way not only the existing gaps in the sewer but also the gaps in the environment of the sewer will be filled.

Production of GRP pipes

Glass fibre polyester pipes (GRP) and other different bodies of rotation have been produced for more decades in many countries of the world. Thanks to the applied technology and the raw materials of excellent quality, these products – especially the pipes – represent top quality in the field of civil engineering.

Principally the pipes can be produced in any size and form, the only requirement is that they are bodies of rotation.

The necessary raw materials are glass-fibre, resin and sand and some other filling materials.

The pipes – inspite of having a small wall thickness – are of big load-carrying capacity, their weight is accordinly insignificant. In order to avoid environmental effects and the corrosive effects of waste waters, different types of resins are being applied, thus the GRP products are applicable not only for the purpose of sewers but also for food industry applications.

There are two basic technologies for the production of the pipes:

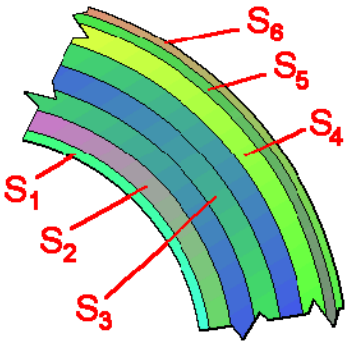
1. Continuous manufacturing process or
2. Centrifugal casting process

Continuous manufacturing process:

The main principal is the following: the raw materials will be added to the outer wall of the body of rotation in many layers and the ready product – the pipe – will be taken down after curing from the rotating mold.

Three program-controlled filament winding equipments and mechanical or hydraulic tools are used to manufacture the pipes.

In the first phase, the external surface of the tools is coated with a parting compound, followed by a layer of gelatinous coat free from glass-fiber. Finally, a layer of glass-fiber fleece saturated with resin is added. The useful wall-thickness is constituted by several layers of stranded and spun glass-fiber roving, complete with quartz sand filler material spread between the layers.



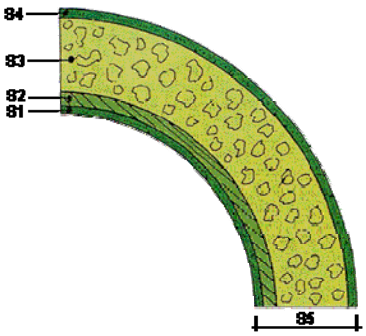
S_1 - ECR fleece
S_2 - glass-mat
S_3 - radial winding
quartz sand
fleece used to fix the sand
S_4 - angle-adjusted winding
S_5 - external fleece
S_6 - sand

building up of the layers

manufacturing facility

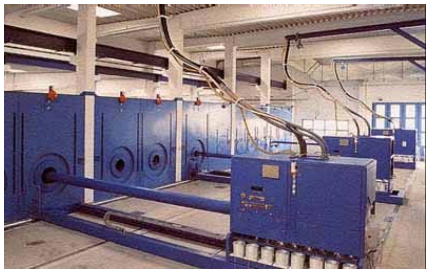
Centrifugal casting process:

The main principal of this process is the following: the materials will be sprayed onto the inner wall of the rotating pipe, then the pipe will be rotated at high speed for some minutes and in the end the ready pipe of circular section will be pulled out from the mold.



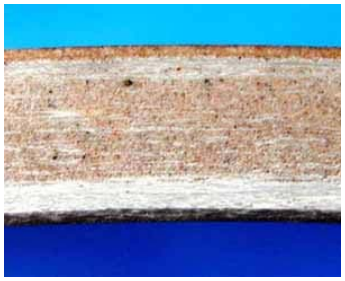
S1 - Resin layer filled with quartz sand
S2 - Closing layer ca. 1,5 mm
S3 - Structural layer (filler + glass fibre + resin)
S4 - Outer layer rich in resin sprayed with sand
S5 - Wall thickness

Building up the wall will be made from the outside in direction inside. After the mold has been filled with materials, the rotation speed of the mold will be increased until the materials – under the influence of the centrifugal force – will be pressed with high pressure to the wall of the mold. This is followed by the deareation and a dense compaction. The curing of the pipes happens during the rotation of the form which guarantees a steady wall thickness and a precise bending throughout the whole surface of the pipe. After the process is finished, the ready pipe will be pushed out of the mold.



manufacturing facility

finished pipe



building up of the layers

In case of both technologies the inside wall of the pipe is totally smooth. After the process has been finished, no temperature can ever make the resin liquid. This is one of the advantages of the thermosetting plastic material.

Comparing of the two processes:

	Centrifugal casting process	Continuous manufacturing process
Advantages	• very compact, homogenous wall structure • big pressure tightness • very precise joints • good price	• other than circular cross sections can be produced • smaller weight • smaller wall thickness can be produced • bigger flexibility of the pipe wall
Disadvantages	• only circular section can be produced • bigger weight	• higher price

Most important properties of the GRP pipes:

- thanks to the small weight and simple joints quick insertion
- high abrasive resistance
- little incrustation and silting
- very smooth inner wall surface
- not sensitive for frost and high temperatures
- insertion is possible indepent of whether circumstances
- high resistance against ultraviolet lights
- very good statical load carrying capacity
- excellent chemical stability
- good durability and long lifetime
- complete range of fittings, including shafts, inside and outside very resisting
- simple processing

Quality assurance

German standards taken into consideration during production:

- DIN 16868
- DIN 19565
- DIN 16946
- DIN 61853
- DIN 61854
- DIN 61855
- DIN 4188

Nowadays all producers have of course a quality assurance system of ISO.

Classification of GRP pipes

Classification according to strength

Under strength we understand resistance against deformation. The bigger the wall thickness of a pipe, the bigger the wall stiffness and thus bigger the resistance against inside and outside loading.

GRP pipes belong to the pipes of flexible walls, where the deformation of the pipes highly influences the loading and the pressure distribution in the soil, so the ground is an important part of the carrying system.

As to the structure it is expedient to classify the GRP pipes according to their stifness.

Classification according to stifness

Nominal stifness of SN 2500

These pipes will be applied first of all as liner pipes or will be layed in open space.

Nominal stifness of SN 5000

These pipes will be chosen in case of middle loading, for example for laying into mixed soil, in a depth of 3 m, with a rolling load of SLW 60.

Nominal stifness of SN 1000

These pipes are produced for higher loads, for example for laying into mixed soil, in a depth of 4 m, with a rolling load of SLW 60 and a small overlapping.

Higher stifnesses

For special purposes it is possible to produce pipes of a stifness more over 500.000 N/m^2.

Lower stifnesses

In the case of laying in open space or in the case of concrete casing the pipes can be produced with lower stifness as well.

Classification by geometry

According to their shape, the GRP pipes can be classified into three categories:

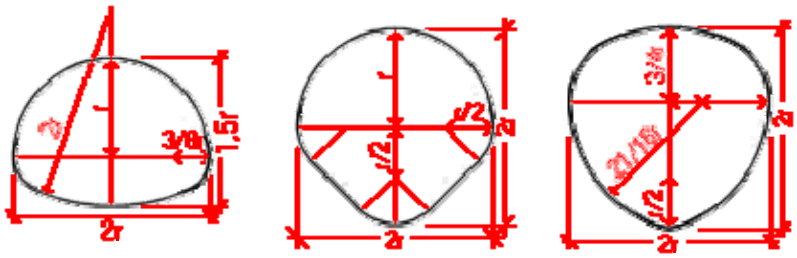
circular

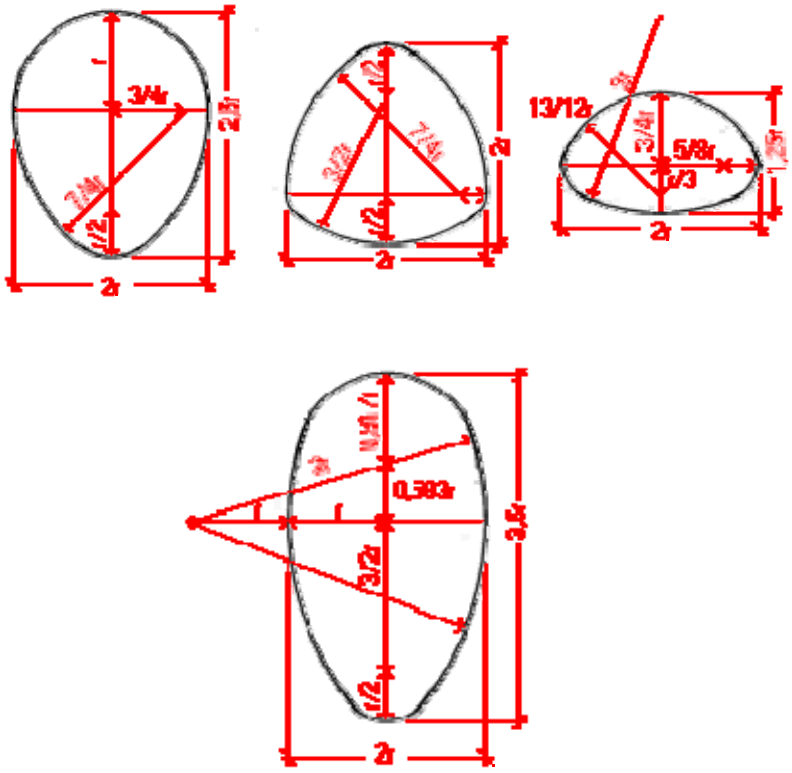
standard egg-shape

special geometry

Pipes/shapes of special design/cross-section

The technology offers a particular advantage, namely that any sort of rotation-symmetric shape can be manufactured provided that the workpiece's profile has no undercut section (i.e. it does not bend back to take a negative meniscus profile) and does not feature curves of excessively different radius.





Classification according to chemical resistance

The chemical resistance depends directly on the applied resin quality.

In special cases, for higher requirements other types of resin will be produced.