GRP PIPE MANUFACTURING MACHINE
INDICE

1  CFW –TECHNICAL CHARACTERISTIC 4

1.1 PRELIMINARY PIPE TECHNOLOGICAL PROCESS DESCRIPTION......4
1.2 CFW PRODUCTION LINE: N° 1 UNIT .................................................................4
1.3 CFW CONTINUOUS FILAMENT WINDING, FOR THE PRODUCTION
    OF GRP PIPE: PICTURES BOOK ......................................................................8
    1.3.1 Machine Assembly Cycle ...........................................................................9
    1.3.2 Plant description ........................................................................................14

2  CFW MACHINE PRODUCTION CAPACITY 29

2.1 CFW MACHINE PRODUCTION CAPACITY FOR THE
    MANUFACTURING OF GRP PIPE. ...................................................................29
2.2 FACTORY HUMAN RESOURCE NECESSARY, AT FULL PRODUCTION
    RATE ..............................................................................................................30

3  WORKS 31
1 CFW - TECHNICAL CHARACTERISTIC

1.1 PRELIMINARY PIPE TECHNOLOGICAL PROCESS DESCRIPTION

The undersigned company has an experience of over thirty years in piping production by the CFW technology.

Scope of the work is the description of one machine for the of n.1 manufacturing unit for the production of about 250,000 meters GRP pipe of an average 500 mm diameter pipe on three shift in one year. The pipes will be employed in pressure aqueduct and gravity sewage application. The machine is capable to production a range of diameter from DN 250 to DN 2200.

The technology supplied is known under the name of “Continuous Filament Winding” (CFW) since it allows the production of the pipe in a continuous way. The pipe length depends only on the trucks transportation capacity which normally is maximum of 13 meter.

The automatic production cycle consists on the settling on a rotating mandrel (of a preassembled pipe diameter) of a designed raw material quantity (polyester resin, filament and chop roving glass fiber, catalyst, silica sand etc.).

The mandrel by means of an axial movement allows the raw material to be polymerized in the oven section. At the completed polymerized pipe production the pipe section will be grinded and cut in plain end, by means of the cutting and grinding system, placed on line in the CFW machine.

CFW operator during the production shift (3 shift of 8 hours for 6 days a week) will monitor the machine running and provide the raw material machine inlet and produced pipe outlet.

Description of the relevant machine and equipment to be supplied:

1.2 CFW PRODUCTION LINE: N° 1 UNIT

The production line will be provided of different pipe diameter capacity as follows:

CFW/A PRODUCTION LINE: N° 1 UNIT

- This machine is designed to produce pipe from 250 mm up to 2200 mm diameter
- This machine is equipped so as to manufacture pipe of 250 mm, 300 mm, 400 mm, 450 mm, 500 mm, 600 mm, 800 mm, 900 mm, 1200 mm, 1400 mm, 1600 mm, 1800 mm, 2000 mm, 2200 mm.

The CFW line production are equipped as follows:

- CFW Mandrel discs for CFW: ND 250, 300, 400, 450, 500, 600, 800, 900, 1000, 1200, 1400, 1600, 1800, 2000, 2200
- CFW Steel band return apparatus for ND 250, 300, 400, 450, 500, 600, 800, 900, 1000, 1200, 1400, 1600, 1800, 2000, 2200 for the machines
- CFW aluminium beams supporting bearings
- CFW Machine electric and instrument equipment for the machine
- CFW Machine automation and monitoring system for the machine
- CFW Electric switchboard and machine control for the machine
- CFW Feeding stabilizer 2200 VA
- CFW Roving chopper for each machine
- CFW Set of chamfering, grinding and cutting tool for the machine
- CFW N° 3 lifting, table for the machine
- CFW N° 3 lifting table transducer for the machine
- CFW structural resin/catalyst pump and electric motor for the machine
- CFW liner resin/catalyst pump and electric motor for the machine
- CFW Resin and catalyst piping for the machine
- CFW N° 4 resin mixer, for the machine
- CFW curing oven for the machine
- CFW Optical pyrometer to control and monitor the oven temperature for each machine
- N° 1 steel band winder
- CFW Dust suction indoor system (including cowl, dust, fun etc..) on the machine
- structural support

Pipe technological process description

The continuous production of GRP pipes through the filament winding process, avails itself of a mandrel which surface is made of a steel band moving longitudinally with a speed depending on the band width.
The band is helicoidally wounded on suitable aluminium beam supporting bearing placed along the mandrel.

A defined number of pushers, driven by a suitable shaped cam plate, supplies the longitudinal movement to the steel band.

A special mylar release film, protecting the surface of the mould and useful during extraction operations, is applied to the mandrel. Then, a ply of chemical resistant “C” glass is laid up the mandrel. This glass reinforcement, suitably impregnated with liquid resin, will be the chemical-resistant inner liner of the pipe, being rich in resin and having a predetermined thickness.

The final layer (external liner) will have the same characteristics as the first one.

Two other layers are applied between the first and the last layer:

- an anti-diffusion barrier made of resin and of chopped glass (second liner)
- a mechanical resistant layer which thickness, composition and glass yarns disposal depend on the mechanical characteristics required for the pipe

These internal layers consist of the following raw materials:

- polyester resin
- chopped glass yarns (roving)
- silica inerts, if needed
- other chemicals.

The continuous roving, circumferentially wound, assures the required circumferential resistance, while the function of the chopped glass (chopped glass yarns 25-30 mm length randomly applied) is to grant an axial resistance resulting from the axial resistance contribution of each glass yarn.

The silica inert, when required, should increase the stiffness characteristics and the pipe wall thickness, without exceeding the glass quantity.

The chopped roving is applied to the pipe under production through the slit of a hopper placed upon the mandrel. The glass yarns delivered from the feeding units are then chopped using a suitable cutter. The required quantity of chopped glass applied to the pipe wall will be achieved by combining the cutter rotating speed (quantity of chopped glass produced) with the mandrel surface translating speed (being finally the rotating speed of the mandrel).
The continuous glass yarns supplied by the feeding units, are hoop –wound on the manufacturing pipe by driving the rovings through some tensioning devices, thread guides and distributing rack. The required quantity of continuous roving can be obtained by defining the suitable number and substance of yarns, while the yarns disposal in the different pipe section layers can be suitable arranged by modifying the position of the yarns in the thread guides and the distribution rack.

The silica inert, if required, is applied through the slit of a hopper placed upon the mandrel and is batched by modifying the rotating speed of a knurled cylinder placed peripherally to the hopper.

The resin is supplied and applied to the mandrel surface by means of two special feeders equipped with suitable gauged holes. Polymerization of the resin (hardening of the pipe product) is carried out in an oven with 4 differentiated areas with radiant heating units. For each area the heat to be supplied can be controlled so that to assure the maintaining of the required values of jellification, isothermal peak and post-polymerization in the oven.

The production line is equipped with gauging and automatic cutting device.

The pipe cutting at the required length is made by means of a diamond disc tool following the progress of the product.

After cutting, the pipe bar is automatically moved away through three lifting tables, to be random hydraulically tested on the hydraulic GRP pipe test equipment.
1.3 CFW CONTINUOUS FILAMENT WINDING, FOR THE PRODUCTION OF GRP PIPE: PICTURES BOOK
1.3.1 Machine Assembly Cycle

Following are shown the relevant mechanical part of the CFW machine,

<table>
<thead>
<tr>
<th>Part</th>
<th>Picture</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Dropping row material plant</td>
</tr>
<tr>
<td>2</td>
<td>Roving storage frame</td>
</tr>
<tr>
<td>3</td>
<td>Mylar and “C” veil dispenser</td>
</tr>
<tr>
<td>4</td>
<td>Dosing elevator platform</td>
</tr>
<tr>
<td>5</td>
<td>Main Shaft Driver</td>
</tr>
<tr>
<td>Part</td>
<td>Picture</td>
</tr>
<tr>
<td>------</td>
<td>---------</td>
</tr>
<tr>
<td>6</td>
<td>Camplate</td>
</tr>
<tr>
<td>7</td>
<td>Steel return band apparatus</td>
</tr>
<tr>
<td>8</td>
<td>Pipe polymerization oven</td>
</tr>
<tr>
<td>9</td>
<td>On line chamfering and cutting device</td>
</tr>
<tr>
<td>10</td>
<td>Electric switch board</td>
</tr>
<tr>
<td></td>
<td>Part</td>
</tr>
<tr>
<td>---</td>
<td>----------------------</td>
</tr>
<tr>
<td>11</td>
<td>Structural Beam</td>
</tr>
<tr>
<td>12</td>
<td>Elevator Frame</td>
</tr>
<tr>
<td>13</td>
<td>Supporting Bridge Frame</td>
</tr>
<tr>
<td>14</td>
<td>Elevator Platform</td>
</tr>
<tr>
<td>Part</td>
<td>Picture</td>
</tr>
<tr>
<td>---------------</td>
<td>----------------------------------</td>
</tr>
<tr>
<td>15 Curing Oven</td>
<td><img src="image" alt="Curing Oven" /></td>
</tr>
<tr>
<td>16 Mandrel Support</td>
<td><img src="image" alt="Mandrel Support" /></td>
</tr>
<tr>
<td>17 Shaft Deflection Monitoring</td>
<td><img src="image" alt="Shaft Deflection Monitoring" /></td>
</tr>
<tr>
<td>18 Antitorque Support</td>
<td><img src="image" alt="Antitorque Support" /></td>
</tr>
<tr>
<td>19 Lifting Table</td>
<td><img src="image" alt="Lifting Table" /></td>
</tr>
<tr>
<td>Part</td>
<td>Picture</td>
</tr>
<tr>
<td>------</td>
<td>---------</td>
</tr>
<tr>
<td>20</td>
<td>Structural Beam</td>
</tr>
<tr>
<td>21</td>
<td>Roving Storage Frame</td>
</tr>
<tr>
<td>22</td>
<td>Chop Glass Storage Frame</td>
</tr>
</tbody>
</table>
1.3.2 Plant description

1.3.2.1 Motor Driver

Pict. 1-1 Motor driver

Pict. 1-2 - Tensioning device Tape Steel
Pict. 1-3 - proximity sensors

Pict. 1-4 - Steel band tensioning control
Pict. 1-5 - Steel band return apparatus

Pict. 1-6 - Emergency detention
Pict. 1-7 - Main machine shaft

Main machine shaft

Pict. 1-8 - Discs for the construction of the mandrel and aluminum bars for the sliding of the band

Aluminium beam

Discs for aluminium
Pict. 1-9 - Steel band return apparatus

Pict. 1-10 - Main CFW Shaft Flange
1.3.2.2 CFW Bridge

Supporting bridge frame, chop-roving storage frame and dosing elevator view.

Pict. 1-11

Pict. 1-12 - Dosing Elevator Platform
Pict. 1-13 - Roving Chopper

Pict. 1-14 - Detail of the cutter for glass fibers (CHOP)
Sand Dosing System

Pict. 1-15 - Detail of the cutter for glass fibers (CHOP)
Pict. 1-16 - Sand Dosing System
1.3.2.3 Apparatus for the distribution of raw materials

Pict. 1-17 - Resin dosing system

Pict. 1-18 - Mylar and “C” Veil dispenser
1.3.2.4 GRP pipe polymerization oven

Pict. 1-19 - polymerization oven

Pict. 1-20 - Heating system and optical pyrometer to control and monitor the oven temperature
1.3.2.5 Finishing pipe

Pict. 1-21 - GRP pipe Antitorque Device (for heavy GRP pipe production)

Pict. 1-22 - Adjustment system for antitorque device
Pict. 1-23 - On line chamfering, and cutting device

Pict. 1-24 - On line grinding device
Pict. 1-25 - chamfering, grinding and cutting regulation devices

Pict. 1-26 - Lifting table for the GRP Pipe support during production
Pict. 1-27 - Lifting table for the regulation devices