

GRP pipes in excellent condition after 33 years in seawater

In 1975, 1500 m of Flowtite pipes were installed as subaqueous marine outfall of the Enga wastewater treatment plant in the Norwegian town of Sandefjord. In 2008, one pipe section was brought ashore to evaluate its condition. The result: A fully functional pipe with very good mechanical properties.

The outfall of the Enga wastewater treatment plant in Sandefjord was installed and commissioned in 1975. Built of Flowtite GRP pipes, the outfall is entirely installed underwater and consists of three different parts:

- The first part is 400 m long and consists of pipes DN 800, buried in the seabed at an average depth of 2 to 2.5 m.
- The next 1055 m of GRP pipes DN 800 are laid directly on the seabed. Flowtite GRP pipes do not float as they have a specific gravity of approximately 2. Horse-shoe anchors are used for additional stability.
- The 67 m long suspended GRP diffuser, DN 700 and DN 500, was installed floating at an elevation of up to 3 m above the seabed and 38 to 42 m below sea level. The diffuser consists of a 45 m long initial section DN 700 and a 22 m long final section DN 500. Both sections are fitted with 180 mm circular ports every 3.25 m along the diffuser's spring lines. The sections are joined with a DN 700/500 eccentric reducer, and all parts connected with GRP butt-wrap joints. A DN 800/700 eccentric reducer joins the diffuser with the main outfall line DN 800 with a rubber bellow. For floatation, the GRP diffuser is fitted with foam-filled buoyancy elements. The buoyancy elements are moored to concrete anchors resting at the seabed.

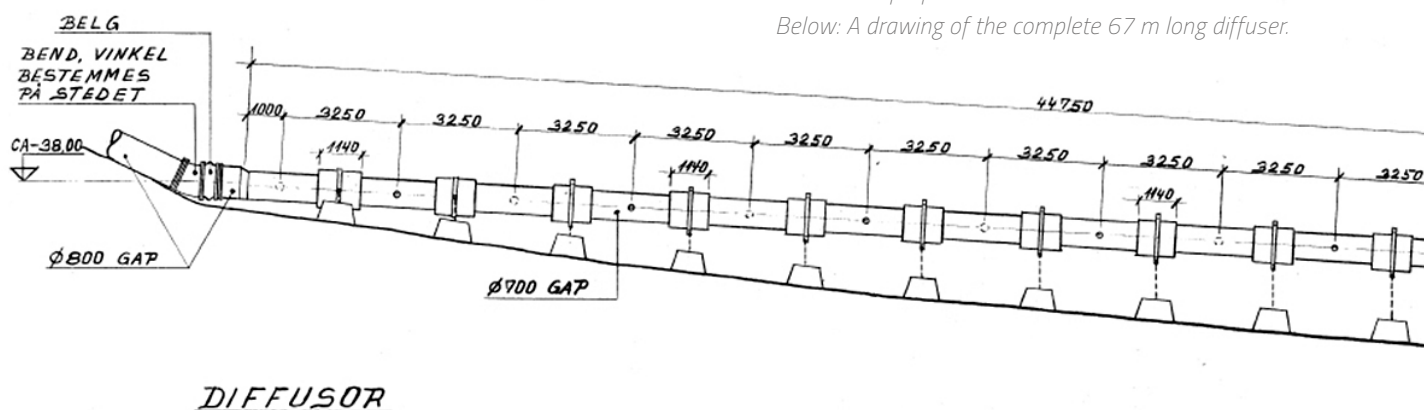
The outfall was constructed by joining GRP pipes to 50-100 m long pipe strings using GRP butt-wrap joints. The strings were fitted with GRP collars and steel loose flanges at the ends, installed by means of a float-sink procedure, and joined on site using the flanges.

In 2008, a section of the DN 500 diffuser was brought ashore for analysis of its condition and mechanical properties after 33 years of exposure to treated sewage and seawater. Even though there was no chlorination, the pipes showed only very



Above: After 33 years of service in seawater, a section of the GRP diffuser was brought ashore to have its mechanical properties tested.

Below: A drawing of the complete 67 m long diffuser.



limited biological growth. Samples were cut from the pipe and cleaned. A visual inspection did not reveal any signs of ageing, the internal surface of the samples was as shiny as of a new pipe.

The key mechanical properties of the 33-year-old pipe were measured at the Amiblu laboratory in Sandefjord and compared to the design requirements from 1975. The results are listed below:

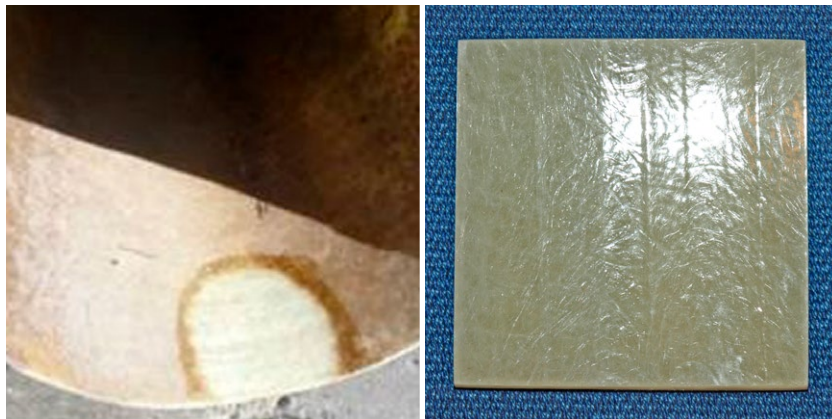
Mechanical properties	Design requirement 1975	Measured result 2008
Specific initial tangential stiffness	1280 Pa	1377 Pa
Axial tensile strength	70 MPa	95.4 MPa
Hoop flexural strength	140 MPa	168.3 MPa

In addition, a pipe section was pressure tested to burst. The pipe busted at 25 bar, which is a very good performance for a PN 2.5 pipe.

Bottom line: The GRP pipes have proven to be totally resistant to corrosion and had retained the mechanical properties that applied to the products when they were initially manufactured.

PROJECT DATA

Country Municipality	Norway Sandefjord
Year of construction	1975
Application	Seawater outfall for WWTP
Installation	Subaqueous
Technology	Flowtite FW
Total length of pipe	1500 m
Nominal diameter	DN 500, DN 700, DN 800
Nominal pressure	PN 2.5
Nominal stiffness	SN 1280
Client / investor	Sandefjord Municipality
Designer	Vlak AS



Left: After cleaning the pipe with soap and water, it looked brandnew. There were no signs of ageing. The test results confirmed the excellent condition also with regard to the pipe's performance.

