Experience with GRP Pipe in Desalination Plants and Cooling Systems

Past Experience and Current trends

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Future Pipe Industries
Brief History of the FPI Group

• As of 2008, Group was the largest GRP (Fiberglass) pipe manufacturer in the world

• 10 Manufacturing Units around the world: USA, Holland, Egypt, Saudi Arabia, Qatar, Dubai, Abu Dhabi, Oman. Group 2008 Sales: > $ 800 million

• Over 32 years of successful experience in manufacture of Fiberglass pipe
Brief history of Fiberglass pipe

• The first ASTM specification for Fiberglass sewer pipe was published in 1973 (37 years ago!).
• The first ASTM water pipe specification was published in 1976 (34 years ago).
• The first AWWA (American Water Works Association) specification for Fiberglass water pipe was published in 1981.
• The Oil industry started using pipe in 1960’s.
• First used in power plants in the USA in the early 1970’s.
WHY FIBERGLASS?
Corrosive Soils + Ductile Iron Pipe
External Corrosion of Cement Lined Steel Pipe
Corrosion of Metal Piping
External and Internal Corrosion of Pre-stressed Concrete Pipe carrying Sea Water after 9 Years
The Solution to Corrosion Problems is Fiberglass Pipe!

- Long life 50 yr design life
- Low maintenance costs (none)
- Lowest lifecycle costs
- No coatings or linings to maintain
- No need for cathodic protection
- No need for chemical soil analysis
Advantages of Fiberglass Pipe

- Unaffected by long term UV exposure
- Unaffected by salt water
- Unaffected by chlorides & sulphates
- Unaffected by stray currents
- Unaffected by soft water
- Corrosion Proof throughout
Advantages of Fiberglass Pipe

Smooth bore ‘C’ = 150
→ Low friction losses
= Big Savings on initial pump costs and energy costs EVERY YEAR
Advantages of Fiberglass Pipe

Light weight + Long lengths = Lower installation costs onshore and offshore

Weight

¼ of steel

1/10 of Concrete

12M Lengths

→ Low Transport Cost
→ Easy to install

Requires Small Equipment
Advantages of Fiberstrong FRP Pre-Fabrication of Spools

Standard Pipe

Spool
Overview of Product Range

GRP [Filament wound]

Diameter Range: 80 – 4000 mm (3”-158”)
Standard pressure classes: up to 20 bars
Standard lengths: 6M up 300mm, 12M for larger sizes

Standard Joints: Gasketed coupling, Lamination or flanges
Standard temperature range: - 40 → + 60 C (GRP)
(GRV up to 83 C, and GRE up to 100 C)
Standard GRP Joints

- Gasketed Coupling
- Lamination
- Flanges
Gasketed Coupling joints - Standard for underground use Onshore and Offshore
Advantages of Fiberglass Coupling Joints

- Reduces installation time
- Internal joint testers available
- Can take up angular deflection up to 3 degrees
- No welding or X-rays required
- No skilled labour required
Coupling Joints
Lamination Joint
For above ground use or underground without thrust blocks
Lamination Joints Underground

→ Allows pipelines to be designed without anchor blocks underground.
Underground Seawater Supply Pipe System
2.5 m x 10 bars Fully Restrained (no thrust blocks)
Lamination Joints Aboveground
Flanged Joints
Part I - Mega Cooling Water Systems
Al Jubail II Sea Water Cooling System
Kingdom of Saudi Arabia
The sea water cooling system for the Jubail Industrial City, KSA

Original system installed by the Royal Commission (Project manager: Bechtel) from 1981 to 1984 consisted of 12 km of open canals and 100 km of pipe of Diameter 1.6 m, 2.0 m and 3.0 m used as inverted siphons and pipe laterals feeding the industrial parks. Pipe material selected was Pre-stressed Concrete pipe.
1981-1984
Installation of 1.6 m coal tar Epoxy Coated Pre-stressed Concrete Pipes

This section of the Jubail Industrial City seawater cooling system in Saudi Arabia utilizes six barrels of 1600-mm-diameter prestressed concrete cylinder
The Sea Water Cooling System for the Jubail Industrial City, KSA

• In less than 7 years, severe internal and external corrosion started appearing in some of the pipe and on some of the open canals.

• The Royal Commission started looking into repair methods to keep the cooling system in operation. For the Canals, 4800 Aluminum-zinc sacrificial anodes connected to the R-bars were installed during 1987. Many concrete pipe sections were relined with GRP pipe!
New Extensions of the Jubail Cooling System

- The largest extension of the Jubail system was started in the design phase in 2004 with the announcement of Al Jubail II city (a 16 Billion Riyal government investment; Project Manager: Bechtel) covering around 45 million m$^2$. This extension of the system was done with GRP pipe only having a diameter of 3.0 m & 4.0 m (!). After the extension, it is now the world’s largest single sea water cooling system with a design capacity of 30 million m$^3$ per day.
Piping

• 4 m for East West Piping 55 km
• 3 m for North South Laterals 21 km

• 2 m for industry connection

• Valves 4 m (31) / 3m (21) / 2m (66)
Trenching Detail

TYPICAL TRENCH FOR 5 - DN 4000 SWC PIPES
UNPAVED AREAS
5 Barrels of 4.0M pipe installed in 34M wide common trench
KRT Area

4.0M Lines – 4 Parallel Lines

Long curves achieved with deflection of coupling joints

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500 mm (20”) air valve connection on 4M pipe

Coupling joints
4M Equal Tee with Flanged 4M Branch on site
4M Butterfly Valve Installation
Bobcats being used to place backfill on sides on pipe
Power & Desalination Plants using GRP pipe for Cooling and Plant Process Piping

A Visual Reference List
Desalination Plans using GRP Pipe – Fujairah F1

2004 -  Cost $ 802 Million. EPC : Doosan Heavy Industries
Fujairah Combined Cycle Power Plant (660MW) + Desalination Plant (450,000 m³/day)

5 Flash Distillation Units each producing 49,000 m³/d + One RO unit producing 140,000 m³/d of water
Fujairah F1 Combined Cycle Power Plant (660MW) + Desalination Plant (450,000 m³/day)
Marafiq Al Jubail III 2750 MW Power & 800,000 M3/Day Water IWPP
This is currently world largest combined power and desalination plant

27 MED desalination unites x 30,000 M3/day
EPC : GE Power/Hyundai/Sidem - Cost 3.4 Billion $
27 MED desalination units x 30,000 M3/day
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Ras Abu Fontas B - Qatar

Ras Abu Fontas ‘B’ (ABB-Ewbank Preece ) Qatar
609 MW Power & Desalination Plant-1997-Cost $1.1 Billion
Ras Abu Fontas B - Qatar

2.5 m pipe (100”) x 3 sea water supply lines
pipe system is restrained – no thrust blocks
Ras Abu Fontas B - Qatar

Main Sea Water Pump House Header 2.5 mm dia. Length = 66M
Desalination Plants Using GRP Pipe

Ras Abu Fontas B (ABB) Offshore Installation– 36M Pipe sections pre-assembled onshore

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Desalination Plants using GRP Pipe

1.9M Intake Pipe L=36M – Ras Abu Fontas B (ABB) On barge – Notice DN 900 mm flanged access man-ways
Desalination Plants using GRP Pipe

Ras Abu Fontas B (ABB) offshore- 36M installed in one dive = large $ savings, 4 Parallel Lines; each 2 km deep
Jebel Ali G station, Dubai, United Arab Emirates

Areal view of Jebel Ali G Station (400 MW) Power & 270,000 M3 / Day Water Production
2.4m & 2.7m GRP Pipe

Jebel Ali G station – Dubai

400 MW + 270,000 m3/day water- Cost $ 1000 million

Engineer: Ewbank Preece
EPC: Siemens (Power)
Weir Westgarth (Desal) – 1992
2.4m supply & 2.7m Return Pipe – Jebel Ali G station 270,000 M3/day-1992
Jebel Ali G station – 1200 mm GRP Product water at MSF evaporators
Power Plants using GRP Pipe for Cooling Water
Jebel Ali G station – 1800mm GRP Sea water supply piping to MSF evaporators
Ras Laffan 2 - Qatar

EPC: Siemens PG (CCGT) and Doosan Heavy Industries, Owner’s Engineer: Mott MacDonald

Ras Laffan “2” power/Desal plant 2008, 1025 MW, 273,000 m³ water/day-IWPP-Cost 900M$

Desalination EPC: Doosan Heavy Industries, Process: MSF – 4 units
Fujairah F2 Power & Desalination plant

2000 MW Combined Cycle Power Plant + 600,000 M3 Water/day – EPC: Alstom – Sidem

Cost : 2.8 Billion $ - Work started on site Jan 2008 To be completed in end 2010

Contract type IWPP – 20 year agreement with Abu Dhabi water & Electricity

This will be the largest Power and largest Desalination plant built in the United Arab Emirates when completed and second largest IWPP project in the world
Fujairah F2 Power & Desalination plant (600 0000 M3 / day water)

• 455 000 M3 per day produced by MED (supplied by Sidem)
• 136 000 M3 per day produced by Reverse Osmosis (Supplied by OTV) Total Desal cost $ 750 M$
Fujairah F2 – 2000 MW Combined cycle power plant + 600,000 M3 Water/day – EPC: Alstom – Sidem - 2008
4M GRP Intake pipe

Fujairah F2 – 2000 MW Combined cycle power plant + 600,000 M3 Water/day – EPC : Alstom – Sidem - 2008
Fujairah F2 - 2000MW Combined Cycle Power Plant + 600,000 M3 Water/day – EPC: Alstom – Sidem
12 MED Desalination units + RO unit
Largest RO plant in Africa – Hamma supplies the Capital of Algeria – Algiers – Build by GE Water at a cost of 250 M $

Plant produces 200,000 M3 of drinking water per day which is 25% of the water needs of the capital Hamma Desalination Plant – Algeria
Largest RO plant in Africa – Hamma supplier the Capital of Algeria – Algiers – Build by GE Water at a cost of 250 M $

Plant produces 200,000 M3 of drinking water per day which is 25% of the water needs of the capital

Hamma Desalination Plant - Algeria
Abutaraba Desal plant in Libya – completed in 2007

Plant produces 40,000 M3 of drinking water per day from 3 desalinations units, EPC: Sidem
MED process with Thermal Vapor compression
Abutaraba RO plant in Libya – completed in 2007

Plant produces 40,000 M3 of drinking water per day – EPC: Sidem

6 Stage MED – TVC process
Al Hidd IWPP power and Desalination plant – Bahrain – Commissioned in 2007 – Added to existing 1000 MW plant

Plant produces 272,000 M3 of drinking water per day (60 MIGD) – EPC: Sidem
10 Desalination units using MED with Thermal Vapor Compression – Cost $336 M
Al Hidd IWPP power and Desalination plant – Bahrain – Commissioned in 2007 – Added to existing 1000 MW plant

Plant produces 272 000 M3 of drinking water per day (60 MIGD) – EPC: Sidem
10 Desalination units using MED TVC Process
Al Hidd IWPP Power and Desalination plant – Bahrain – Commissioned in 2007 – Added to existing 1000 MW plant

Plant produces 272 000 M3 of drinking water per day (60 MIGD) – EPC : Sidem
10 Desalination units using MED TVC Process
Zuara Libya Desalination plant - extension – 2 x 20 000 M3/day units

Plant produces 40,000 M3 of drinking water per day – EPC: Sidem
2 Desalination units using MED TVC Process
Zuara Libya Desalination plant - extension – 2 x 20,000 M3/day units

Plant produces 40,000 M3 of drinking water per day – EPC: Sidem
2 Desalination units using MED TVC Process
Zuara Libya Desalination plant  III

Plant produces 40,000 M3 of drinking water per day – Completed in 2006
End of Session…Thank you

Head of maintenance after GRP pipe installation!

GRP