

Applications of Nonmetallic Piping in Utility Systems

Dr. Adel A. Badghaish
Saudi Aramco, CSD

February 18, 2015

Table of Contents

- Objective
- Introduction
- Utility Piping Materials
- Utility Applications
- Polyvinyl Chloride Pipe
- High Density Polyethylene Pipe
- Polypropylene Pipe
- Reinforced Thermosetting Resin Pipe
- Conclusion

Objective

To provide an overview on nonmetallic piping materials and their applications in utility systems.

Introduction

Piping System:

A network of pipes, fittings and valves intended to perform a specific job i.e. to carry or transfer fluids from one equipment to another.

The plumbing network supplying water at your home is a common example of a piping system.

Introduction

Piping Materials:

- **Metallic**
- **Nonmetallic:**
 - **Thermoplastics**

Soften under heat and harden with cooling

- **Thermosetting**

Harden after the first heating and form links with other plastic molecules that never soften again

What the difference between process piping and utility piping?

Process piping contains the product or piping integral to the process of creating the product.

Utility piping is supporting the process but is not integral to the process, typically fresh water, cooling water, sanitary sewer, oily water drain, storm water drainage,etc

Utility Piping Materials

Different types of composite pipe are used in utility piping systems. They all have advantages and disadvantages related to cost, installation, strength, and corrosion. The most common types of pipe are:

- Reinforced Thermosetting Resin (RTR) Pipe
- Polyvinyl Chloride (PVC) Pipe/ Chlorinated Polyvinyl Chloride (CPVC) pipe
- High Density Polyethylene (HDPE) Pipe and Liner (repair)
- Polypropylene (PP) Pipe

Utility Applications

Utility piping includes:

- Potable Water System (drinking water and raw water); refer to SAES-S-040;
- Raw/Fire Combined Water System; refer to SAES-S-040;
- Dedicated Firewater System; refer to SAES-B-017;
- Sanitary Sewers; refer to SAES-S-010;
- Industrial Drains and Sewers; refer to SAES-S-020;
- Storm Water Drainage Systems; refer to SAES-S-030;
- Plumbing Systems in Buildings, regardless of its locations, shall be in accordance with SAES-S-060.

Polyvinyl Chloride Pipe

- Polyvinyl chloride or PVC is the most popular pipe for small community water systems.
- PVC pipe is lightweight, easy to install and repair, available in a wide range of sizes and strengths.
- PVC is also unaffected by corrosive water and soil and, because it will not conduct electricity, is not subject to galvanic corrosion or electrolysis.
- The main disadvantage of PVC pipe is that it has a high rate of thermal expansion. It is also relatively fragile and must be protected by the use of select backfill material.



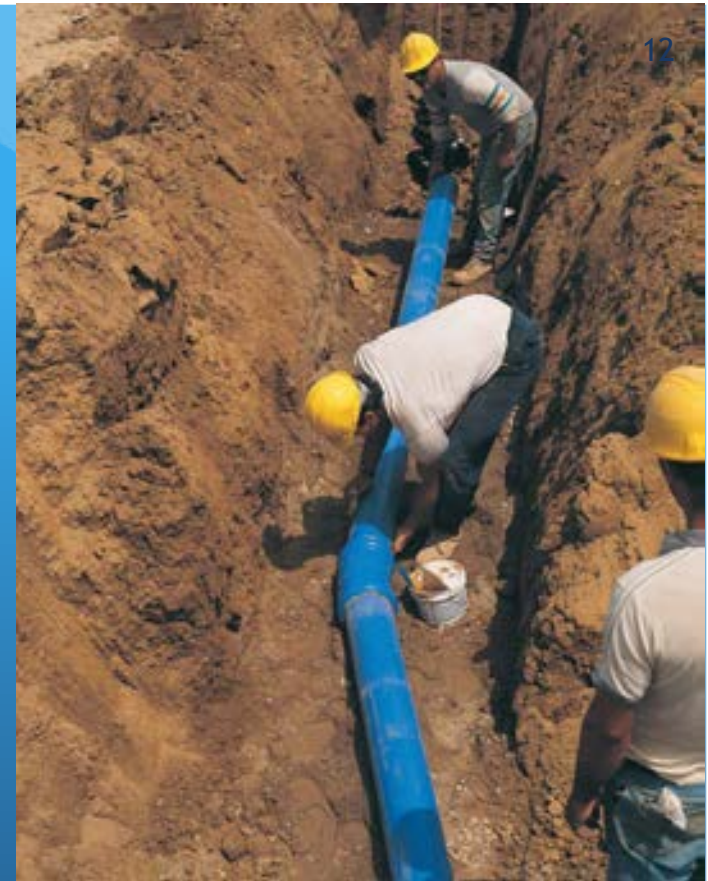
- Relevant product standards are:
- American Water Works Association (AWWA) C900 “Standard for Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 4 in. through 12 in., for Water Distribution”
- AWWA C905 “Standard for Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 14 in. through 48 in., for Water Transmission and Distribution”
- AWWA C907 “Standard for Injection-Molded Polyvinyl Chloride (PVC) Pressure Fittings, 4 in. through 12 in., for Water, Wastewater, and Reclaimed Water Service”
- AWWA C909 “Standard for Molecularly Oriented Polyvinyl Chloride (PVC) Pressure Pipe, 4 in. through 24 in., for Water, Wastewater, and Reclaimed Water Service”
- American Society for Testing and Materials (ASTM) D2241 “Standard Specification for Polyvinyl Chloride (PVC) Pressure-Rated Pipe (SDR Series)”

Handling, Installation and Testing

Follow the following precautions:

- DO NOT drop pipe off the truck.
- DO NOT insert a forklift fork into a pipe end to transport.
- Lower the pipe into the ditch. DO NOT drop.

All new joints shall be hydrotested at least 1.5 times the maximum design pressure of the piping system but not less than 150 psig for minimum two hours.



High Density Polyethylene

- HDPE has been developed internationally from PE 80 to today's PE 100 material which has shown a saving of approximately 30% on the wall thickness from the early days of Polyethylene.
- HDPE can carry potable water, wastewater, slurries, chemicals, hazardous wastes, and compressed gases.
- Polyethylene pipe has a long and distinguished history of service in the gas, oil, mining and other industries. It has the lowest repair frequency per kilometer of pipe per year compared with all other pressure pipe materials used.
- HDPE is generally used for high pressure applications ranging from 3.2 to 25 Bar, in conjunction with compression, buttweld or electrofusion fittings. HDPE piping conforms to ISO 4427 specification.

Polyethylene pressure pipe systems offer many advantages when compared to traditional products, namely:

- Weather resistance in above ground applications
- Highly corrosion resistant
- Ease of handling and installation
- Excellent abrasion resistance
- Manufactured in long lengths and coils
- Service performance in excess of 50 years





Saudi Aramco: Company General Use

HDPE Fittings



Joint Installation



HDPE Hydrostatic Test Procedure

- *Filling—Fill the test section slowly. Purge all air.*

To allow air to escape from the test section, flow velocities during filling should not exceed the capacities of air release devices or other openings used to release entrapped air.

- *Temperature Equalization—Allow the test section and the test liquid to equalize to a common temperature.*
- *Pressurizing—Initial Expansion Phase—When the test section is completely filled and purged of air, gradually increase pressure in the test section to the required test pressure*
- *Add make-up water if the test as necessary to maintain maximum test pressure for 4 h.*
- *Test Phase—Reduce test pressure by 10 psi (1.45 kPa) and monitor pressure for 1 h. Do not increase pressure or add make-up water.*
- *Pass/Fail Criteria—If no visual leakage is observed, and pressure during the test phase remains steady (within 5 % of the test phase pressure) for the 1 h test phase period, a passing test is indicated.*
- *Retesting—If retesting is necessary, depressurize the test section and correct any faults or leaks in the test section and repeat the procedure after allowing the test section to “relax” for at least 8 h before re-pressurizing.*

Polypropylene (PP) Pipe

- Polypropylene (PP) is the lightest weight piping material with very good chemical resistance, even to many organic solvents.
- The primary method of joining PP piping systems is with heat fusion, though mechanical joints can be used.
- PP pipe is available in standard 20' lengths in sizes ranging from ½" to 40".
- To accommodate different working pressures, PP is made both in schedule 80 and schedule 40.
- Typical applications include chemical drainage systems, industrial process, high purity water, hot and cold water distribution, and gravity sewer systems.

Polypropylene (PP) pressure pipe systems offer many advantages when compared to traditional products, namely:

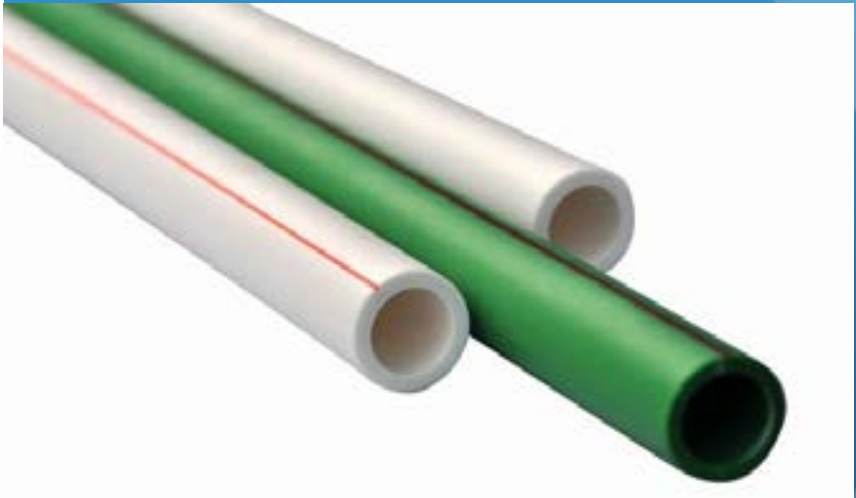
- Over 50 years service life in temperatures up to 80 C and operation pressure from 6 to 25 bar.
- **Perfect for hydraulic system**
- **Low thermal permeability**
- High resistance in chemicals
- **High mechanical resistance** even in very low temperature.
- Remarkable corrosion resistance
- Smooth surface ensure minimum friction

Relevant standards:

ASTM F2389 Standard Specification for Pressure-rated Polypropylene (PP) Piping Systems

ASTM F2764 / F2764M - Standard Specification for 30 to 60 in. [750 to 1500 mm] Polypropylene (PP) Triple Wall Pipe and Fittings for Non-Pressure Sanitary Sewer Applications

ISO 21138-1 Plastics piping systems for non-pressure underground drainage and sewerage -- Structured-wall piping systems of unplasticized poly(vinyl chloride) (PVC-U), polypropylene (PP) and polyethylene (PE)



Reinforced Thermosetting Resin (RTR) Pipe

- RTR is a thermosetting resin and it can be epoxy, vinylester or polyester reinforced usually with fiberglass.
- RTR pipe can be utilized in a wide range of utility applications such as oily sewer, potable water, process water, cooling water, fire water, seawater, sanitary fluid, desalination water treatment and agriculture.
- Advantages of RTR pipe are:
 - Corrosion Resistance
 - Lightweight
 - Low Pressure Loss
 - Low Installation Cost
 - Low Maintenance Cost
 - Excellent Abrasion Resistance

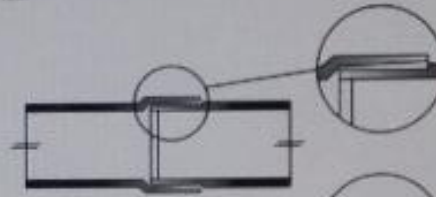


Joining Systems

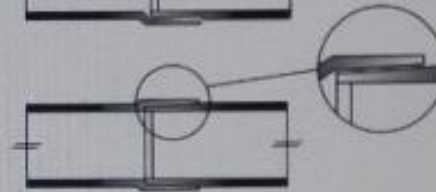
Our sales and manufacturing team provides you with a wide range of joints, developed for all types of applications. These joining systems can be divided into three basic categories:

1. Adhesive joints

- ▣ AB series, adhesive bonded straight-taper joint, max. pressure rating 16 bar.

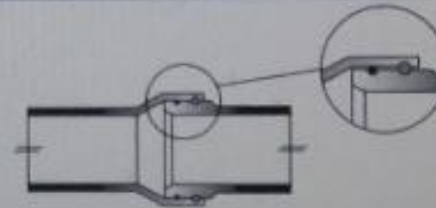


- ▣ AT series, adhesive bonded taper-taper joint, max. pressure rating 100 bar.



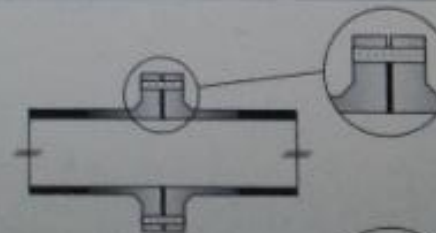
2. Mechanical joints

- ▣ ASL series seal-lock joint, O-ring with locking key, max. pressure rating 70 bar.

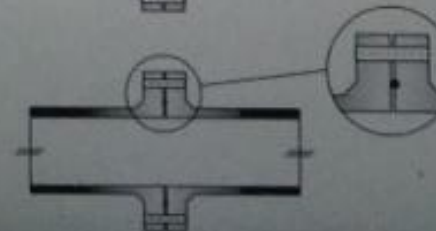


3. Flange joints

- ▣ Flange joint standard and heavy duty with 3 mm flat gasket, max. pressure rating 30 bar.



- ▣ Flange joint, with O-ring sealing, max. pressure rating 60 bar.



Conclusion

- Different types of nonmetallic piping systems for utility applications have been discussed
- The final selection can be made only after careful consideration of the following factors:
 - design conditions,
 - construction,
 - commissioning,
 - operation conditions,
 - and expected service life.

Thank You

PVC GLUE



BUTT FUSION

Our videos provide a visual illustration of the installation process. They do not exhaustively represent all health and safety requirements or consider every possible project circumstance.

Whilst every effort was taken to ensure the accuracy of the information contained within this video, the details are offered in good faith and GPS accepts no liability for matters arising as a result of errors.

The procedures described in this video must be observed in conjunction with any Code of Practice affecting a particular industry. Do work safely – safety clothing, gloves and glasses must be worn during the whole assembly process.

Always consult all supporting literature, including equipment manuals and instructions supplied with the fittings, before proceeding.

ELECTROFUSION

Our videos provide a visual illustration of the installation process. They do not exhaustively represent all health and safety requirements or consider every possible project circumstance.

Whilst every effort was taken to ensure the accuracy of the information contained within this video, the details are offered in good faith and GPS accepts no liability for matters arising as a result of errors.

The procedures described in this video must be observed in conjunction with any Code of Practice affecting a particular industry. Do work safely – safety clothing, gloves and glasses must be worn during the whole assembly process.

Always consult all supporting literature, including equipment manuals and instructions supplied with the fittings, before proceeding.

PP Fusion

