

COURSE NAME: INDUSTRIAL PIPING SYSTEM

LECTURE V-WEEK V: APPLICATIONS OF VARIOUS TYPES OF PIPES

LECTURER: HABANABAKIZE THEOPHILE

INSTITUTION: RWANDA POLYTECHNIC/IPRC TUMBA

OBJECTIVES

By the end of this session the learner/student will be able to:

- ✓ Identify the types of pipes
- ✓ Identify advantages and disadvantages of the type of pipes
- ✓ Identify the application of the types of the pipes.

V.1. Introduction

Different types of pipes are used in the industrial sector for different purposes. Common industries that find extensive use of pipes are oil and gas, process industries, chemical and petrochemical complexes, food and beverage industries, power sectors, steel industries, HVAC industries, plumbing industries, pipeline industries, refineries, etc. Today, the use of pipes is so wide that modern industrial plants can not be thought of without pipes. Types of pipes are decided based on various factors

V.2. Types of pipes

a. Based on the manufacturing method

Pipes can also be classified based on the method of manufacture.

✓ Seamless pipes

Seamless pipe is made from a round steel billet (solid cylindrical hunk of steel that is cast from raw steel). This billet is then heated, stretched out, and pushed or pulled over a form. It is then pierced through the center with a die and mandrel which increases the inside diameter and reduces the outside diameter.

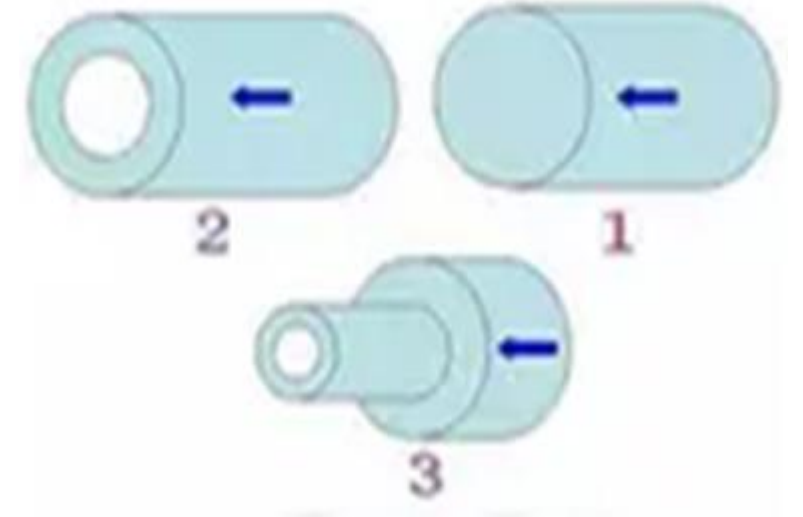


Fig.1: Seamless pipe manufacturing

Source: <https://whatispiping.com/seamless-vs-welded-pipe/>

Application of seamless pipe

Seamless pipes are frequently utilized in a range of industries. Seamless pipes are frequently used to carry fluids, thus it's important to understand how they work in different fields. Fluids including water, natural gas, waste and air are conveyed by seamless steel pipes. These pipes are used in heat exchangers, Fertilizer industry, Chemical and petrochemical industry, Oil and gas applications, automotive industries, etc

✓ Welded pipe

Welded pipes are manufactured from plate or continuous coil or strips to manufacture welded pipe, first plate or coil is rolled in the circular section with the help of plate bending machine or by a roller in the case of continuous process. Once the circular section is rolled from the plate, the pipe can be welded with or without filler material. Welded pipe can be manufactured in large size without any upper restriction. Welded pipe with filler material can be used in the manufacturing of long radius bends and elbow.



Fig.2: Welded pipe manufacturing

Source: <https://whatispiping.com/seamless-vs-welded-pipe/>

✓ **Application of welded pipe**

Welded pipes are widely used, mainly for self-contained construction, urban construction, water conservancy, petrochemical industry, power industry, agricultural irrigation, etc. The following are the concrete application of welded pipes:

Gas transportation: coal gas, steam, liquefied petroleum gas.

Liquid transportation: water supply, drainage, mud transportation, sewage treatment. Various agricultural machinery, scaffolds, wire threading pipes, high-rise shelves, containers.

Lightweight steel doors and windows for boilers, automobiles, ships, buildings, and furniture

✓ Difference between seamless and welded pipe

No	Parameter	Seamless Pipe	Welded Pipe
1	Strength	Seamless pipes are able to withstand more pressure and load as there is no weak seam.	Due to welding, welded pipes are believed to withstand 20% less pressure and load as compared to seamless pipes.
2	Length	Seamless pipes are relatively shorter in length due to manufacturing difficulties.	Welded pipes can be manufactured in long continuous lengths.
3	Size	Seamless pipes are usually manufactured for a nominal size of 24 inches or less.	There is no such size restriction on welded pipe production.
4	Corrosion Resistance	Seamless pipes are less prone to corrosion means more corrosion-resistant.	The weld areas of the welded pipes are more prone to corrosion attacks, which means less corrosion resistance.
5	Surface Quality	The surface quality of seamless pipes is rough due to the extrusion process	Welded pipes have a smooth high-quality surface as compared to seamless pipes.

Difference between seamless and welded pipe Cont'd

6	Economy	Costlier	More economic
7	Production Process	The production process of seamless pipe is quite complex with a long procurement lead time	The welded pipe production process is comparatively simpler with a short procurement lead time.
8	Tests	Seamless pipes do not require testing for weld integrity.	Welded pipes must be tested before use.
9	Application	Seamless pipes are widely suitable for high pressure, temperature, and corrosive environment	Welded pipes are normally used for less corrosive and low-pressure environments.
10	Availability	Less availability, limited material types, longer delivery time.	Readily available for various different materials; shorter delivery time.
11	Internal surface check	Checking not possible	The internal surface for welded pipes can be checked before manufacturing

b. Based on the fluid they transport

Depending on the type of fluid they transport, pipes are categorized as follows:

- ✓ Water Pipes those transport water.
- ✓ Gas pipes transporting gaseous substances.
- ✓ Vapour pipes carrying different vapours of products.
- ✓ Oil pipes transporting crude or processed oils.
- ✓ Steam pipes transporting steam.
- ✓ Hydrogen pipes carrying hydrogens.

c. Based on the industry where they are used

Depending on the type of industry there are three types of pipes.

- ✓ Pipes for Chemical and Power Piping industries.
- ✓ Pipes for the Plumbing industry.
- ✓ Pipes for the Pipeline industry.

i. Pipes for the Plumbing industry

Common plumbing pipes are PVC pipes, PEX pipes, Copper pipes, ABS pipes, Cast Iron and galvanized steel pipes, etc. They are mainly used for water distribution purposes.

Based on the industry where they are used Cont'd

ii. Pipes for Chemical and Power Piping Industries

These types of pipes are suitable for high-temperature and pressure applications. Mainly pipes made from ferrous materials are used in chemical, power, petrochemical, steel, oil, and gas industries. They are usually selected based on their ability to sustain pressure, temperature, corrosion resistance, etc.

iii. Pipes for the Pipeline industry

Pipes used in pipeline industries are usually known as line pipes and are designed by API 5L standards. There are various grades of API 5L (**standard** specification for the seamless and welded steel pipes for use in pipeline transportation systems in the petroleum and natural gas industries) pipes that are used to convey oil, gas, or water through pipelines. Other types of pipeline materials are SS, DSS, SDSS, GRE, FRP, etc.

d. Based on Material

Pipes are normally classified based on the material which is used to produce the pipe during manufacturing process.

i. Galvanized Iron (GI) Pipes

This type of pipe is used for water supply inside the building. These pipes are wrought steel pipes provided with zinc coating.

✓ Application areas:

Water and sewage

Fire fighting installations

Plumbing systems



Fig.3: Galvanized Iron (GI) pipes

Source: https://inspectapedia.com/plumbing/Galvanized_Iron_Pipes.php

Galvanized Iron (GI) Pipes Cont'd

✓ Advantages and disadvantages GI Pipes

No	Advantages	Disadvantages
1	Low installation and maintenance cost	Heavy to handle
2	Long life	Develops blockages
3	Toughness	Difficult to repair
4	Anti-rust pipes	
5	Useful for large construction projects	
6	Durable and large diameter	

ii. PVC/Plastic/Polythene Pipes

These pipes are being used increasingly today for supply of cold water In external and internal plumbing work. There are 3 common types of plastic pipes which are available at the market as given below:

- ✓ Unplasticized PVC (UPVC) or rigid pipes for use with cold water.
- ✓ Plasticized PVC pipes which are plasticized with addition of rubber. It has lower strength and lower working temperature than UPVC pipes.
- ✓ Chlorinated PVC (CPVC) pipes which can withstand higher temperatures up to 120 degrees (used to carry hot water).

Applications of PVC/Plastic/Polythene Pipes

- ✓ Supply of cold water in external and internal plumbing work
- ✓ For pipes used in soil and waste water discharge systems, the thickness of the wall will be larger than that of used for roof drainage
- ✓ Rigid PVC pipes are used for distribution of water with temperature below 45 degrees
- ✓ At higher temperature, the strength of the pipe decreases. Similarly ultraviolet radiation from sunlight as well as frequent changes in temperature reduces the life of PVC pipes.

Applications of PVC/Plastic/Polythene Pipes Cont'd

Advantages and disadvantages of PVC/Plastic/Polythene pipes

No.	Advantages	Disadvantages
1	Durable and usable	Heat constraints
2	Corrosion resistant	Cost
3	Insulation	Weight

iii. Steel Pipes

Steel pipes are comparatively expensive. However, even though they are expensive they are also strongest and most durable of all water supply pipes.

These pipes can withstand high water pressure, come in convenient (longer) longer lengths than most other pipes and thus, incur lower installation and transportation costs. They can also be easily welded.

Steel Pipes Cont'd

Advantages and disadvantages of steel pipes

Advantages

- ✓ Steel pipes are highly efficient, and it is possible to use a smaller diameter of pipe made from steel than pipes made from other materials.
- ✓ The mass flow rate for stainless steel pipes is much higher per diameter than many other materials. This can save on the cost of the pipes without sacrificing flow rate
- ✓ Steel is strong and will resist damaging factors that can run other pipes, such as tree roots, human error, and extreme weather conditions.
- ✓ Unlike plastic pipes, steel pipes are 100% recyclable, when they are no longer needed, they can be melted down and turned back into other useable metal pieces.

Steel Pipes Cont'd

Disadvantages

Difference of heat transfer; unless for bonded aluminium or copper base, thermal conductivity is very poor.

It is often more expensive many people think that this is a one-time purchase, worth the investment.

It is very difficult to fabricate and since it is not that much malleable as compared to other metals therefore it is difficult in case of repair or re-work being done.

Steel pipes are used in water mains, sewerage systems and industrial water lines, plant piping, deep tube-wells, casing pipes and pipe lines for natural gas

iv. Polypropylene Random Copolymer plastic (PRP) Pipes

Polypropylene Random Copolymer plastic, produced through a continuous extrusion process. They are commonly offered in green or white color, and in outer diameter sizes ranging from 20mm to 110mm making the pipe walls far thicker than PVC. PPR pipe is accompanied by a series of connection fittings, parts, and accessories available for every pipe diameter.



Fig. PPR Pipes

Source: <https://drts.com/blog-what-is-ppr-pipe-used-for/>

PPR pipes Cont'd

PPR pipe applications

Hot and cold potable water piping in residential, industrial, and public installations. Industrial piping for transferring water, sanitary liquids, liquid food products, compressed air, and aggressive chemicals eg. highly acidic or alkaline solutions. Building central radiator heating water, usually in a circular loop piping arrangement.

PPR pipes Cont'd

No	Advantages	Disadvantages
1	PPR Pipes are cost-effective and environmentally friendly.	The higher construction technical requirements.
2	It can be used as a cold water pipe, hot water pipe can also be used.	Need to use special tools and professionals to undertake construction in order to insure system safety.
3	Once installation done and pressure test passed, there are no the same as the aluminium pipe leaking a long time on the aging phenomenon.	It is still not that mush popular amongst the users and the consumers.
4	Moderate price, stable performance, heat insulation, corrosion resistance, smooth inner wall, safe and reliable, does not penetrate, use fixed number of year can be up to 50 years.	Moreover, companies involved in construction are not fully relying on it.

v. Asbestos-Cement (AC) Pipes

This kind of pipes are made of a mixture of 82-90 % cement and 10-18 % asbestos fibers. They are available in diameters ranging between 60-2000 mm, and can withstand pressure ranging between 6-20 atmospheric pressure. These pipes are connected with separate special fittings. The use of asbestos pipes to convey potable water over the last two decades, due to increasing concern with their health hazards. However, they are still used to convey irrigation and sanitary drainage water.



Fig. Asbestos- Cement Pipes

Source:

<https://www.pipsisland.com/what-is-asbestos-cement-pipe/>

Applications of AC Pipes

No	Advantages	Disadvantages
1	Cement pipes are corrosion resistant	Cement pipes are bulky, heavy and require careful transportation and handling.
2	Asbestos cement pipes have smooth internal face.	These pipes are rigid. So they require uniform and levelled bed for laying.
3	They can provide working pressures up to 1.25 Mpa	
4	These pipes are extensively used for water supply systems.	

Advantages and disadvantages of AC Pipes

No	Advantages	Disadvantages
1	Better higher tensile strength	Thins Over Time
2	Better Flow: Water – and gases too – can flow easily in AC pipes due to the latter’s high flow coefficient	Public Health Impacts: Although AC pipes have their unique advantages, it is no secret that they pose a lot of health risks as well
3	Long Lifespan: AC pipes can last for up to 70 years, according to the Chrysotile Institute. PVC, in contrast, only has 50	
4	Corrosion-Resistant: Compared to metal pipes, transite pipe is resistant to corrosion	

vi. Copper pipes

Copper Pipes and tubes are used widely in many industries across the nations. Copper Pipes are economical options with durability being one of the key features. These Pipes contain 99.9% Pure copper in it, with rest being silver and phosphorous. Copper Pipes are used to enable a smooth flow of substance through it. They are used in various machines, equipment, and other industrial appliances.



Fig. Copper Pipes

Source:

<https://www.copper.org/applications/plumbing/apps/>

Advantages and disadvantages of copper pipes

No	Advantages	Disadvantages
1	Copper is naturally corrosion resistant metal.	Copper pipes also encounter problems from water acidity, so they are not good to install for plumbing systems that draw water from a well.
2	Copper is durable metal (capable of withstanding 1000 psi of pressure), copper is also lightweight.	More expensive than plastic.
3	Easier to extend over long stretchers without supports.	Copper is flexible as for as metals go, but plastic pipes can bend to fit into almost any space necessary.

Applications of copper pipes

In mechanical systems of all kinds, copper does more than ever before. Today copper tube has proven superior for:

- ✓ Underground water and gas services
- ✓ Water distribution systems
- ✓ Chilled water mains
- ✓ Drainage and vent systems
- ✓ Heating systems (including solar)
- ✓ Fuel-oil systems
- ✓ Oxygen systems
- ✓ Non-flammable medical-gas systems

The type of the material a pipe is made from is very crucial, it from the material a pipe is decided where to be used. If the pipe will be exposed to high temperature it should be made from the material which has heat resistant property, if it is to be used somewhere it is to be exposed to moisture content it will have corrosion resistant property. Using a pipe in different application requires considering different parameters not only technical but also it involves cost implication and considering pipe life span.

References

1. ASPE, (2010). Plumbing Engineering Design Handbook: A Plumbing Engineer's Guide to System Design and Specifications (Vol 2). River Road. Retrieved www.pdfdrive.com.
2. Rutger, B.& Peter, S.(2008) Process Piping Design Handbook: Advanced Piping Design (Vol 2). Gulf Publishing Company.
3. Whatispiping (2022), Major differences between Seamless and Welded Pipe. [Online] Available at <https://whatispiping.com/seamless-vs-welded-pipe/>. Accessed on 30th March 2023.
4. Sanghvioverseas (2020), Stainless Steel Seamless Pipes: Uses and Applications. [Online] Available at <https://www.sanghvioverseas.com/blog/stainless-steel-seamless-pipes-uses-and-applications/>. Accessed on 01st April 2023.