Stainless Steel:

Water for a Growing World

worldstainless

Photo by Baskin Creative Studios via Pexels

Introduction

Water is mankind’s most precious resource.

Stainless steel is an ideal material to carry and contain this key element of life.

Let us take you on a guided tour of the known and more obscure applications of this material in a water context.

| Photo by Oliver Sjöström via Pexels

Water - Globally a scarce resource

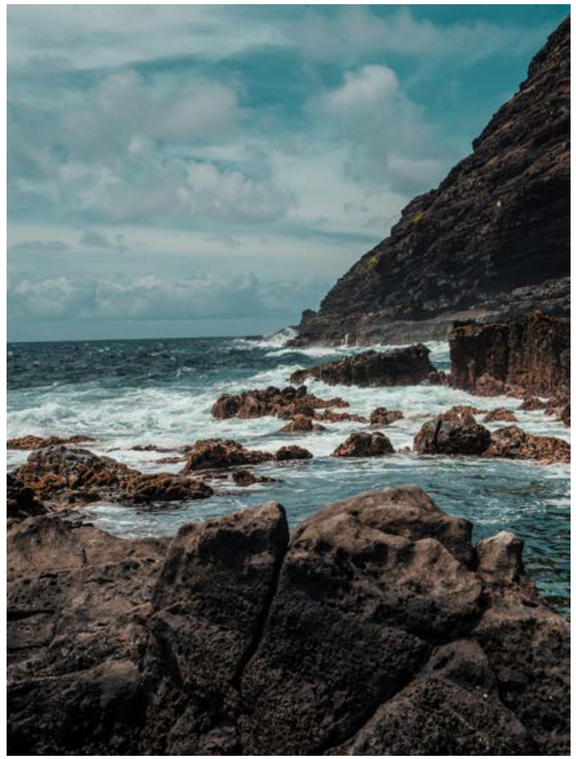
There is a lot of water on earth, around 1.4 million km³, but more than 97% of it is salty.

Just 2.5% is available as fresh water.

Of the fresh water, about 70% is frozen in polar icecaps and glaciers. Much of the rest lies deep underground in aquifers, currently beyond human reach.

Human civilisation essentially depends on less than one percent of the total water on our planet.

Stainless steel plays an increasingly important role in making water available to a growing population - and keeping the water cycle intact.



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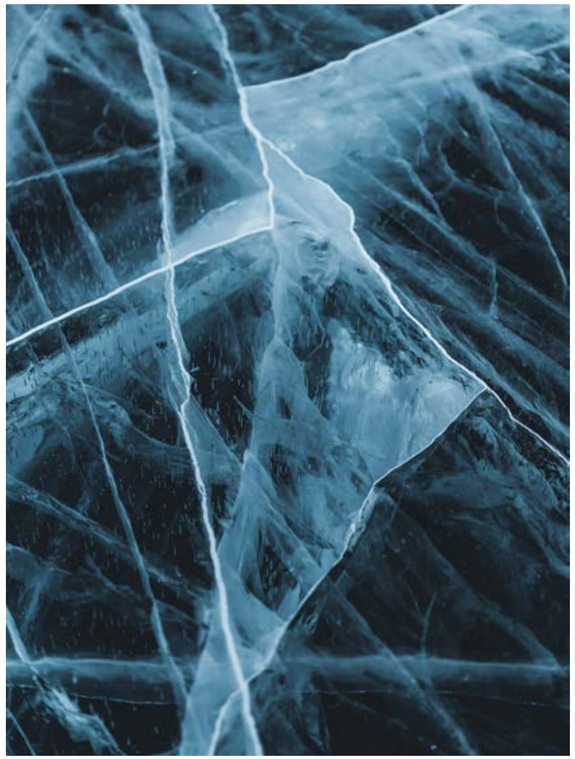

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Desalination: stainless steel brings life to the desert

A century ago, urban development in the desert was limited to oases and few places with access to fresh water.

Today, desalination technology has made it possible to build big cities on the coast.

Dubai Skyline
Photo by Zana Di Carvalho via Pexels

There are two simple ways to desalinate sea water:

- by evaporating sea water and condensing the steam. As the salt does not go into the steam, the resulting condensate is perfectly suitable for drinking
- Reverse osmosis. Sea water is passed through a special membrane that removes the salt.

Shuaibah Desalination plant in Saudi Arabia
Photo courtesy of Doosan Heavy Ind. Co

But these simple desalination methods require sophisticated technology in a large-scale industrial application. Succesful desalination requires a corrosion-resistant material that can withstand aggressive seawater and brine.

High-performance molybdenum-bearing stainless steels, including duplex stainless steels, are the perfect choice.

Read more about desalination and stainless steels

Photo by Markus Spiske via Pexels

Sanitisation: Healthy water for everyone

In remote, or less developed parts of the world, water may be available, but often contains germs or chemicals.

Small and rugged stainless steel units are available that can process contaminated ground and surface water and guarantee dependable water supply.

| Photo by Art_sinct Sinct_21 via Pexels

Pulp and paper production: A case in point

To create white paper it is necessary to bleach the brownish wood fibres. Traditional processes use chlorine.

Large amounts of pollutants are released into the wastewater. Sometimes this has disastrous effects on the immediate environment.

Some paper mills have now switched from chlorine to ozone bleaching. A typical medium-sized plant saves 17,000 tonnes of chlorine every year - that is the contents of 700 road tankers. The economic side-effect is a cost saving of about US$ 9 million.

Ozone is an extremely aggressive gas, so corrosion-resistant materials are required.

Stainless steel is the standard material for this application.

| Photo by Eva Bronzini via Pexels

| Picture courtesy of Wedeco

Water production and treatment

Stainless steel does more for us than we may know.

Most of the food we eat is prepared, transported and stored in stainless steel equipment.

So is much of our water.

Drinking water is gathered from wells, rivers or lakes using the natural biological cleaning and filtering process of the soil.

However, while this water is perfectly fit for human consumption, potable water can be quite corrosive.

Many waterworks have for material resilience and hygiene purposes switched to stainless steel for pipes, process equipment and reservoirs.

Detail of the drinking water treatment plant at Lake Como, Italy. Picture courtesy of Centro Inox.

Stainless steel in municipal waterworks. Picture courtesy of Schenke Anlagenbau

Storage: Refurbishment of water reservoirs

Many of our water reservoirs - whether they be underground reservoirs or water towers - are decades old.

Being made of concrete, they typically require repair and renewal of coatings at regular intervals - a time-consuming and costly operation. Chipped coatings and bubbles may create hygiene problems.

Welded stainless steel liners provide solutions that are made to last.

The availability of water is enhanced, and the hygienic conditions in the reservoir are improved.

Water reservoir before (on the left) and after (right) lining with stainless steel. Pictures courtesy of POSCO

Seismic design: Maintaining resilient public infrastructure

Earthquakes are among the most catastrophic events that shake the world.

Along with the possible collapse of building structures, an interruption to the water supply is one of the greatest dangers to public health after an earthquake.

This is why some countries have systematically introduced free-standing stainless steel water reservoirs.

Stainless steel is extremely ductile, so these reservoirs can stand considerable deformation without breaking or leaking.

It blends well with the urban environment.

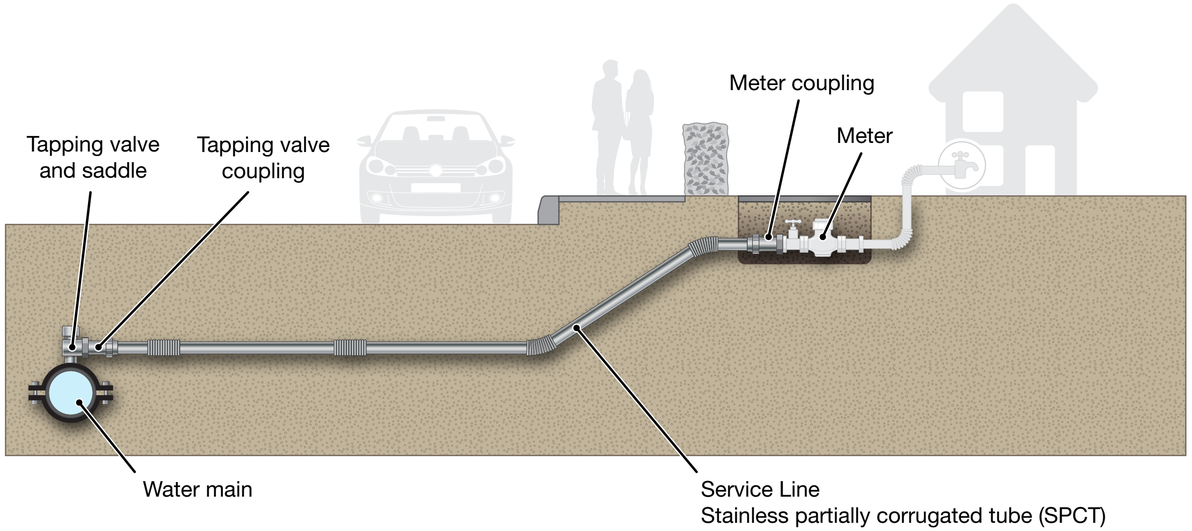
Ferritic stainless steel water tank.
Picture courtesy of Baowu Group

Distribution: underground pipework

Stainless steel is also used for underground pipework, especially the connection between the water mains and houses. Flexible joints enable the supply lines to remain intact during earthquakes.

But even without earthquakes, up to one third of the valuable drinking water is lost through leaks in distribution systems. About >90% of treated water losses occur in the last few meters between the mains pipework and the properties. This is a particular problem in dry countries, where water is precious. Stainless steel helps to minimise these losses.

More information on the stainless flexible service lines can be found here.



| Photo by Philippe De Putter

Plumbing: The arteries of our buildings

Corroding plumbing can be a concern to every home owner or tenant.

Some materials can also leach noxious substances into water and create serious health problems.

Stainless steel today has successfully made its way in a mass market like plumbing. An innovative joining technique, called press fittings, has enabled stainless steel to become a serious alternative in the field of domestic plumbing. With the help of easy-to-handle hydraulic tools, they make joining operations quick and safe.

Depending on codes of practice and regulations, also capillary fittings are successfully used with stainless steel.

Stainless steel press fittings
Picture courtesy of Rhinox

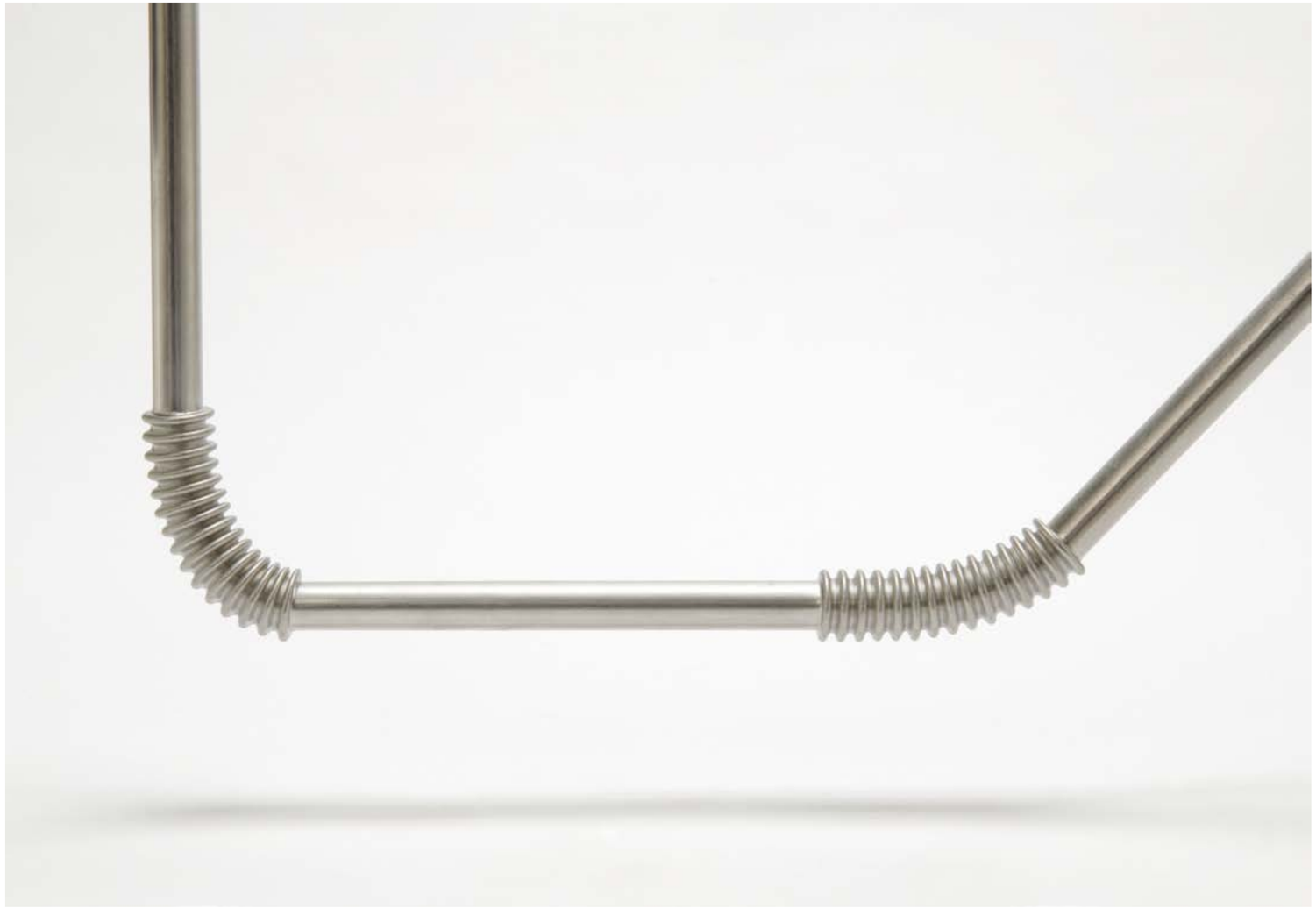
Stainless steel water pipe
Picture courtesy of Viega

Plumbing: the flexible option

The ductility of stainless steel makes it possible to produce flexible metallic tubes. They reduce the number of joints to an absolute minimum.

Bellows-type flexible tubes are a solution that has been derived from connectors in the process industry.

Composite tubes are made of an ultra thin stainless steel tube surrounded by a thicker outer polymer layer. The stainless steel provides hygiene, durability and safety. The polymer protects the inner layer against damage and wear.



Stainless steel flexible tube
Photo by Philippe De Putter

Hot water boilers

Hot water must have drinking water quality - despite the elevated temperatures. These temperatures can create favourable conditions for bacterial growth. It is important to avoid rough surfaces, corroded areas and cracks, where bacteria could breed. Leading manufacturers use stainless steel for the water contact surfaces for their hot water boilers.

| Pictures courtesy of Viessmann

Solar panels

| Pictures courtesy of Energie Solaire

Room heating absorbs a large proportion of our non-renewable fossil fuel resources.

With the sun being abundantly available, stainless steel solar panels can be used to heat water for domestic purposes.

The systems depend on black-chromated stainless steel. Specially embossed sheets are welded into a sandwich to form channels through which the water can flow. The black surface traps the heat so efficiently that the system even works in less sunny climates.

The solar panels also function as roofing elements. The absence of a conventional roof reduces costs and makes solar energy even more economical.

Other systems can easily be added to existing roofs.

Water heating - free of charge

Stainless steel rooftop tanks provide potable hot water. They are used in dry climates and other environments where a consistent level of pressure in the public system cannot always be guaranteed.

| Picture courtesy of suntank.com

Disinfection: Water under UV radiation

In some industrial processes, hygiene and purity requirements on water may exceed the usual drinking water standards, for example in the food processing and pharmaceutical industries.

Ultra-violet (UV) treatment of water efficiently neutralises germs. Stainless steel is ideal for hygienically demanding applications. It is the obvious material for this process.

| Picture courtesy of Evoqua Water Technologies LLC

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Swimming pools

Stainless steel is used for lining swimming pools - both in the erection of new pools and in the refurbishment of existing ones.

It is often the most economical long-term solution as it avoids the hygiene and cleaning problems associated with mortar joints.

In climates with cold winters, frost damage is avoided. Erection work can even be carried out off-season, when it would be too cold to work with conventional tiles.

Stainless steel liners are also used for indoor swimming pools. Usual grades are a perfect choice for applications in contact with the pool water, like pool liners and accessories. The atmosphere above the pool surface contains chlorides.

Repeated cycles of condensation and drying may lead to extreme levels of chloride concentrations on structural components inaccesible for cleaning, for example fasteners for suspended ceilings.

Even for these extreme corrosive conditions, suitable high-alloy steels are available. Specialist advice should be sought to select a suitable grade.

Sewage treatment

The composition of sewage may vary strongly. Along with corrosion, abrasion and biofilms affect the materials used in this harsh environment. Many waste water plants now include stainless steel for mechanical separators, pipework and submerged components to ensure a long service life and minimise downtime.

Special techniques are often used to clean industrial waste water before it is returned to the natural cycle. Ozone and UV treatment are current options.

Normal oxygen naturally occurs in molecules made up of two atoms. Ozone consists of three oxygen atoms per molecule. Ozone is unstable and tends to disintegrate quickly into O_2, releasing a “vagabond” oxygen atom. This atom is extremely reactive and aggressively oxydises organic substances. This propertyis used to remove dangerous contaminations from water.

As in the case of potable water, UV radiation can be used on waste water to remove germs.

Stainless steel withstands both the aggressive waste water and ozone.

For more information about the use of stainless steels in sewage water treatment, click here.

Stainless steel sewer pipe system
Picture courtesy of Ugitech GmbH, Renningen, Germany

Picture courtesy of Smith & Loveless, New Zealand

Trenchless repair and replacement

The sewage systems in our cities are typically decades old, many half a century or more. In an innercity environment, the renewal of defective sewage pipes can be a problem, generating unacceptable traffic disruptions.

Historical urban sites with narrow roads and sensitive historic buildings in the neighbourhood can make the situation even more difficult. Fortunately, stainless steel provides a solution.

The road is only dug up in a few - normally unobtrusive - places. Short pieces of stainless steel pipe are joined by orbital welding and pushed into the existing leaking pipe. With a minimum of disturbance for the local population, an efficient and lasting repair solution is applied.

Further information

There is a lot that stainless steel can do to ensure a safe supply of drinking water and the functionality of the water cycle. More detailed information is available from the stainless steel development associations that exist around the world.

Their advisors can provide you with information about stainless steel equipment suppliers, grades, fabrication techniques and regulatory requirements.

More information can also be found on worldstainless.org

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About worldstainless

worldstainless is a not-for-profit research and development association which was founded in 1996 as the International Stainless Steel Forum.

Its primary roles are to undertake stainless steel industry beneficial tasks that are better coordinated centrally in the fields of

- Promoting industry and material sustainability benefits
- Conserving resources and promoting the circular economy
- Providing economic and industry-leading statistics
- Support industry health & safety needs and developments
- Outlining market development and expansion opportunities
- Maintaining brand reputational positioning
- Materials education

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