IMOA
INTERNATIONAL MOLYBDENUM ASSOCIATION
THE VOICE OF THE MOLYBDENUM INDUSTRY

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MOLY REVIEW

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More than meets the Eye

Norway is the world's leading producer of farmed salmon. The Salmon Eye, a floating event center, is dedicated to the sustainable development of this industry. 6% molybdenum stainless steel is the secret behind the structure's unblemished metallic finish.

Floating in view of the rugged, mountainous coastline of Norway's Hardangerfjord, the Salmon Eye looks like it was warped in from another dimension. Silver, ellipsoidal, and 26 meters in diameter, it's been described as "UFO-like". In fact, the Eye is officially registered as a boat. Viewed from above, the structure is an anatomically accurate model of the eye of a salmon. Danish firm, Kvorning Design, brought the fjord-dwelling flying saucer to life.

Only accessible by boat from the nearby town of Rosendal, the Salmon Eye lives tethered to the seafloor with three long ropes. Molybdenum is indispensable in maintaining the iconic appearance of this installation in the great rust maker of the sea. Technically, Hardangerfjord is an inlet, carved by glaciers, connected to the open ocean. Its salinity varies seasonally, being low when snow and ice are melting, but comparable to seawater several months out of the year.

Two electric shuttle ferries are key to ensuring a sustainable expedition for all visitors.

© Kvorning Design

Inside the Salmon Eye, visitors experience an installation designed to explain the impact of aquaculture and its production techniques, with an immersive audio-visual display spanning four levels. At night the Eye becomes a restaurant featuring ingredients hand-foraged on dives just meters away.

Sustainable aquaculture

The world's stocks of wild fish are under extreme pressure. The share of fish populations that are overexploited has more than doubled since the 1980s. Nearly 90% of the world's fish stocks are fished at or beyond their limits. Farming seafood, or aquaculture, is a growing alternative. 50 years ago, aquaculture was uncommon. But now over half of all fish consumed are farm raised.

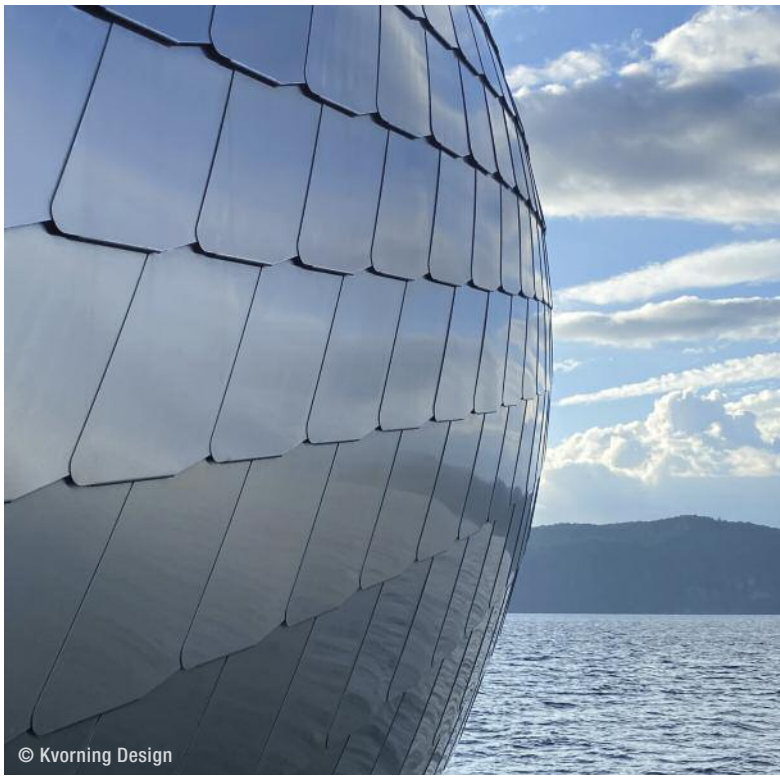
Of course, growing seafood as livestock isn't inherently sustainable: farmed fish raised in natural bodies of water often cause significant pollution, spread disease, and rely on wild fish catch for feed. With the spectacular visitor attraction and art installation, Eide Fjordbruk, the local aquaculture company that commissioned the Salmon Eye, wants to draw attention to all aspects of aquaculture and how it can be improved to feed more people with less impact on the planet.

Stainless salmon scales

To mimic the appearance of fish scales, the ellipsoid structure is clad with 9,250 overlapping shingles made of 6% molybdenum stainless steel (UNS S31254). This high addition of molybdenum helps make this stainless steel one of the most corrosion resistant available, able to withstand immersion in seawater. The grade is often used for extreme applications like desalination and chemical processing. In addition to supreme resistance against pitting and crevice corrosion, 6% molybdenum stainless steel offers at least 50% higher strength than standard austenitic grades. Despite being licked by salt-laden waves daily, these "scales" require minimal maintenance and will not loosen, warp, or rust over time.

The choice of materials for Salmon Eye also reflects the environmental intentions behind the project. The highly alloyed stainless steel will not release any harmful substances into the water and will last centuries in the marine environment. At the end of its long service life, stainless steel is also fully recyclable. As it stares forever unblinking into the sky, the Salmon Eye and its stainless steel scales call for a closer look into the future below the surface. (MH)

Overlapping shingles that follow the Salmon Eye's elliptical shape brave the harsh environment with minimal upkeep.



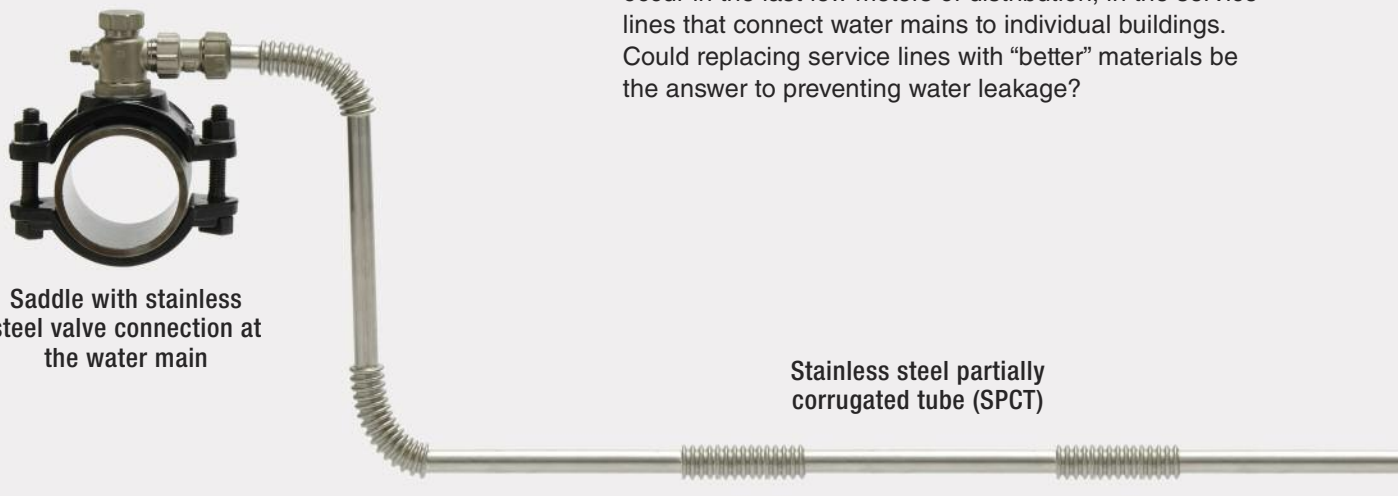
Better service lines with moly

Almost nothing is more important than water. Yet, water transmission systems worldwide lose billions and billions of liters of water a year to leakage. The solution to reducing this leakage is multifaceted but replacing existing service lines with molybdenum-containing stainless steel has proven highly successful.

On average, municipal water distribution systems lose a third of their treated supply to leakage, and many lose well over half. This leakage wastes billions of dollars each year in resources and makes communities worldwide vulnerable to drought and water scarcity. For instance, earlier this year in the US state of Arizona, lawmakers announced they will begin limiting building permits for new construction around the city of Phoenix due to lack of water. A four-year moratorium on building permits across southern France also went into effect this year because of drought.

Although methods for finding and fixing leaks are improving steadily, many are too small to locate. These tiny leaks often waste clean drinking water for years on end. Identifying and repairing leaks places stress on water utility resources, which are already stretched to meet other competing priorities. For areas with growing populations, drought or dwindling resources, leakage can reduce their resilience during times of crisis and affect whether there's enough water for continuous service.

Water-stressed areas serviced by municipal systems employ various techniques to preserve their precious supply – from recycling storm and wastewater to limiting plant watering, car washing, and even residents' bathing times. But what if these systems could reduce the loss of the water they are already paying to treat and distribute? Some utilities report that 95% of all leaks occur in the last few meters of distribution, in the service lines that connect water mains to individual buildings. Could replacing service lines with "better" materials be the answer to preventing water leakage?



Saddle with stainless steel valve connection at the water main

Stainless steel partially corrugated tube (SPCT)

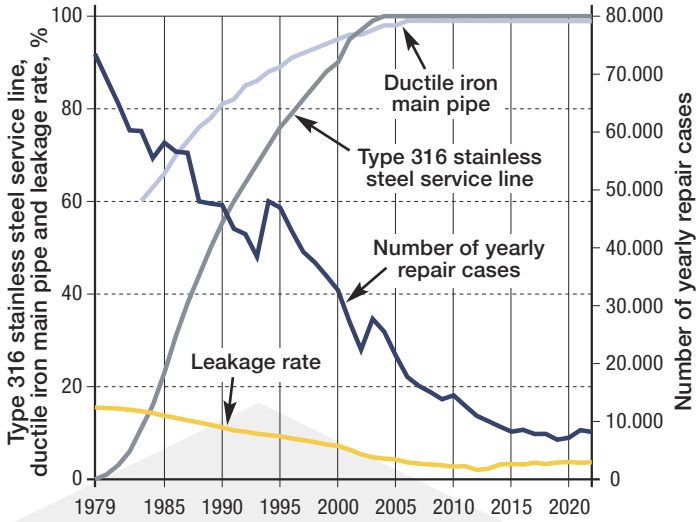
Stainless steel service lines: the beginnings

Tokyo was the world's first city to become aware of the difference a dramatically better material can make. Facing strong population growth and limited water supply, the Tokyo Bureau of Water Works (TBWW) decided to tap into its existing resources by eliminating leakage. TBWW wanted a strong, ductile, hygienic tube that could resist near-daily earthquakes with minimal upkeep. In 1980, after years of research, Tokyo began replacing its lead service lines with Type 316 stainless steel tubes.

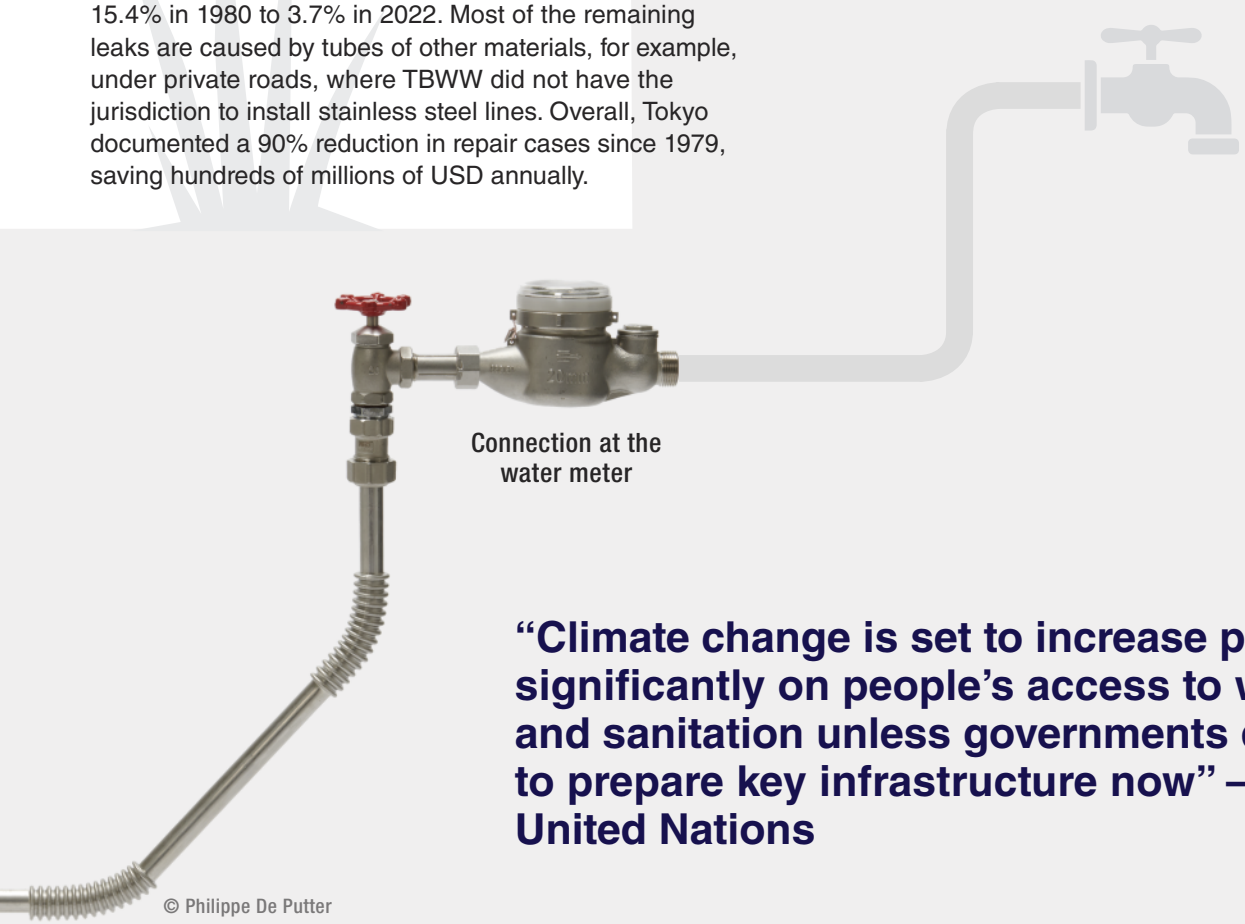
In the 1990s, the stainless steel tubes were improved by adding several sets of folds, known as corrugations, allowing hand bending. This flexibility reduces the number of fittings needed for many installations and increases resistance to ground movement and seismic activity. The product is known as stainless steel partially corrugated tubing, or SPCT.

More than 40 years since the project began, and with 100% of the service lines under its jurisdiction replaced with Type 316 stainless steel by the early 2000s, Tokyo has massively reduced leakage and maintenance needs. Together with ductile iron mains, leak detection, and rapid repair techniques, the leakage rate decreased from 15.4% in 1980 to 3.7% in 2022. Most of the remaining leaks are caused by tubes of other materials, for example, under private roads, where TBWW did not have the jurisdiction to install stainless steel lines. Overall, Tokyo documented a 90% reduction in repair cases since 1979, saving hundreds of millions of USD annually.

Repair cases and leakage rate in Tokyo (source: TBWW).



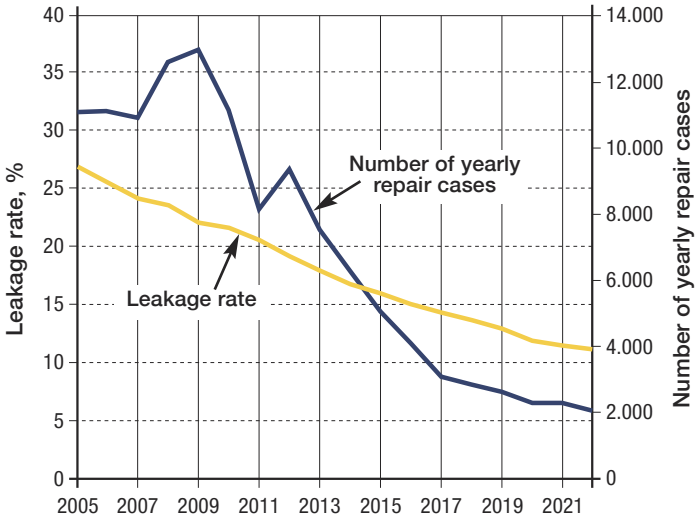
The capital of Taiwan, Taipei, has also achieved great results with SPCT. In 2002, the island suffered a severe drought that depleted its water reserves, resulting in 49 days of intermittent supply. Intermittent supply, where water use is restricted to certain hours of the day or week, risks public welfare and health and can damage the water distribution system.



Connection at the water meter

"Climate change is set to increase pressure significantly on people's access to water and sanitation unless governments do more to prepare key infrastructure now" – the United Nations

Repair cases and leakage rate in Taipei (source: TWD).



Taipei's system leaked 28% of its water at the time. Looking for ways to increase its resilience, the Taipei Water Department (TWD) trialed stainless steel service lines, given their superb performance in several Japanese cities and Seoul, South Korea. Following successful testing, the utility began installing SPCT in 2006 as part of a 20-year leakage reduction project. As of 2022, with 2/3rds of the system replaced with stainless steel service lines, leakage has more than halved to 11%. When a more severe drought overcame Taiwan in 2014, Taipei had no disruption to service, and TWD could even sell surplus water to their neighboring utility. Additionally, over the past four years, TWD had on average only 20 leakage cases/year related to the nearly 200,000 stainless steel service connections installed by now, an order of magnitude fewer than typical with competing materials.

What other materials are available for service lines?

Service lines are made from several materials, including plastics, copper, galvanized steel, and formerly lead. Among these, plastic tubing has enjoyed significant market growth due to its light weight, flexibility and low upfront material cost, jockeying to become the dominant material for system upgrades worldwide. However, the properties of plastics for water distribution, like high-density polyethylene (HDPE) and cross-linked polyethylene (PEX) differ from manufacturer to manufacturer and even from product batch to product batch. While formulations are continuously improving, this variation makes an accurate forecast of service life difficult. Despite a commonly stated durability of 50 years, premature failures occur frequently. They are often attributed to embrittlement and subsequent cracking caused by exposure to chlorinated water from the inside of the tube or longitudinal cracks, initiated on the outside by punctual pressure of sharp rocks, if the tube is not carefully embedded in a thick layer of fresh granular backfill.

Areas with contaminated soil, like former industrial sites, cannot use plastic pipes because it is susceptible to the penetration of harmful hydrocarbons like gasoline, which can contaminate the water supply. Herbicides and biocides can also migrate through the wall. Some plastic tubing, such as PVC, is outlawed in certain areas due to its high permeability. Service lines installed close to the surface or above ground can melt during a wildfire or burst during a freeze. Plastics also are less effective for identifying leaks with acoustic signatures and vibrations, as sound propagation is suppressed in these materials.

Copper is another popular material for service lines in some regions. Generally, copper tubing performs well and lacks many problems associated with PEX and other plastic tubing. However, some soils and waters react with copper and produce premature pitting, which results in hard-to-find pinhole leaks. Stainless steel offers the best strength, flexibility, longevity, and corrosion resistance for service lines. Inherent material ductility combined with corrugations means the tubing resists earthquakes, soil settling, traffic movement, and bursting during a freeze. SPCT is nearly three times as strong as copper and many times stronger than PEX.

Strength comparison

	Yield strength (annealed)	Ultimate tensile strength (annealed)
Type 316 stainless steel	205 MPa	515 MPa
Copper	70 MPa	220 MPa
Plastic (PEX)	19.3 MPa	26 MPa

Non-reactive: critical for hygiene and corrosion resistance

Stainless steel is prevalent in the food, beverage, and pharmaceutical industries because of its inertness. The combination of chromium from within the stainless steel with oxygen in the air forms a passive layer on the stainless steel surface, preventing any reaction with external media and avoiding corrosion. The result is a practically non-reactive material, safe for long-term contact with various potable liquids.

Although all stainless steels have an inert passive layer, different alloys offer different levels of corrosion resistance. Tokyo and Taipei use Type 316 stainless steel for their

service lines, an austenitic alloy containing 2% molybdenum that resists corrosion associated with chlorinated municipal waters and a wide variety of soils. In 10-year buried tests of various kinds of metal tubes, this alloy performed best at ten different test sites across Japan, some with very high chloride and sulfate concentrations.

Type 316 stainless steel service lines are more expensive than plastic lines and sometimes more expensive than copper – or so it seems. There are several reasons why the upfront material cost is not representative of the true cost: Materials are only a fraction of the total installation costs, which include digging trenches, backfilling around the tube with fresh aggregate and resurfacing the road. Some utilities require a protective outer tube to avoid puncturing by stray rocks. Corrugated stainless steel tubing is fitted similarly to copper or PEX lines, but installation is generally quicker, reducing labor costs. Thanks to its durability and longevity, stainless steel's maintenance and replacement costs are drastically reduced compared to competing materials. That also means fewer repairs, which often require road closures and movement of heavy vehicles, all of which stress the environment and people. Finally, saving water is not only a financial benefit, but with the accelerating effects of global warming, it also improves the resilience of water systems and reduces the pressure on an increasingly scarce resource.

SPCT finds new markets

SPCT has demonstrated that it can eliminate severe water loss and high maintenance burdens and protect against seismic activity and drought. Italy has both seismically active and drought-stricken regions serviced by degraded systems in many cases. Concern over water scarcity following years of low rainfall resulted in calls to upgrade the country's aging water distribution systems.

Over the last year, six Italian water authorities have tested SPCT and four utilities are currently evaluating the next step: "proof of concept" trials with several hundred SPCT connections. A supply chain is in place to service the market initially with imports until the demand is high enough for local production. Indeed, CPC Inox, the prospective Italian SPCT producer, received the BFWE Innovation Award for Materials at the H_2O trade fair in Bologna this fall.

A regional supply chain is also developing in Zhuhai, China, where a factory is now producing SPCT for both the local market and exports. Official guidelines were published for installers to support adoption of the technology. SPCT was also highlighted during a presentation at a prominent water conference with industry experts and decision-makers from across the country present. Several Chinese utilities, as well as Australian water authorities, are in the process of evaluating potential trials.

Stainless steel for service lines is not expensive; depending on the location, it adds only 10 to 20% to the initial project cost. Over an anticipated 100-year service life, savings from reduced maintenance repair cases, leakage, and energy usage easily afford stainless steel service lines a lower cost of ownership than competing materials. SPCT is also fully recyclable at the end of its life. As governments and organizations reconsider their water efficiency practices, stainless steel provides an unprecedented opportunity for more long-lasting, resilient, and sustainable distribution systems. (KW)

A trial installation in Italy.

Stainless home heating

Heating water and indoor spaces accounts for almost half of all building energy needs globally. Although electric heat pumps are increasing in popularity, the vast majority of heating relies on the burning of fossil or renewable fuels. Heating methods involving combustion can tax the equipment due to high temperatures and the formation of corrosive byproducts, potentially compromising not only efficiency but also safety. For this reason, modern heating systems increasingly rely on molybdenum-containing stainless steel.

As demographics shift and standards of living rise worldwide, the volume of heated indoor spaces has surged by almost 25% since 2010. Minimizing fuel consumption, thereby reducing greenhouse gas emissions, is imperative to reach our climate goals. For these reasons, heating systems must continue to become much more efficient.

There are a variety of traditional residential heating systems, depending on the climate, fuel availability, and prevalent technology. However, most systems work by burning some kind of fuel, heating either water in a boiler or air in a furnace. Hot water then circulates throughout the building across a system of tubes, heating the rooms via radiators or radiant floors. Hot air, by contrast, circulates through ducts into the living spaces.

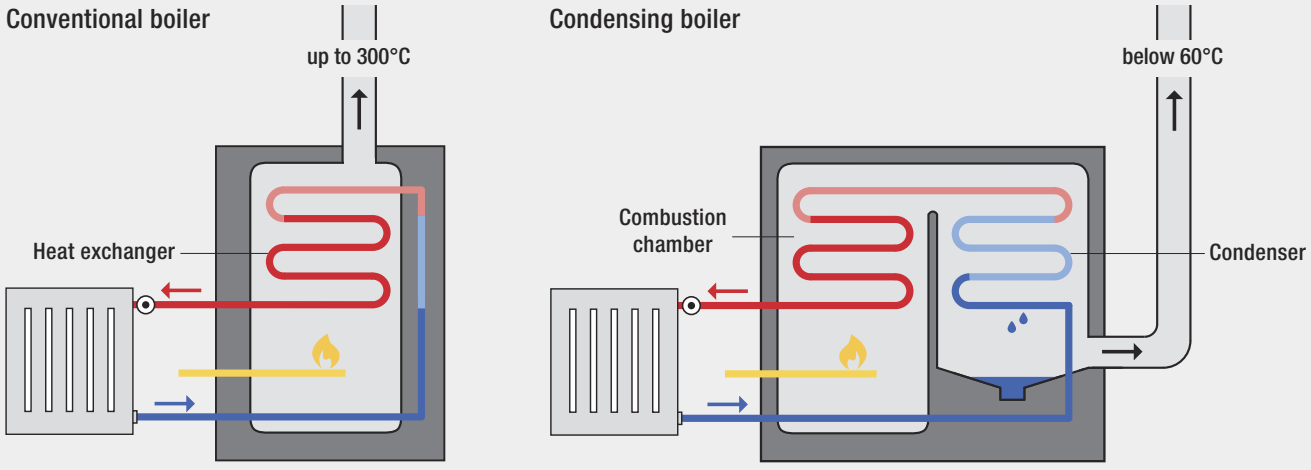
Most fuels, whether fossil, such as oil, gas and coal, or renewable such as wood or biogas, create emissions in the form of flue gases. Depending on the fuel, they consist predominantly of nitrogen, CO_2, and water vapor with small amounts of nitrogen oxides (NOx), SO_2, and particulate matter. These potentially noxious gases are vented to the outside through a flue pipe or chimney. When flue gases cool below their dewpoint at around 56°C, the water vapor condenses to form water, which in combination with the other compounds can create aggressive acids. Each heating system has its own particularities and requirements. At less than 60°C, the relatively cold flue gases from a gas condensation boiler are very different from those of a wood burning stove that are as high as 600°C. The former requires a flue that is resistant to acidic condensates, while the latter needs one that is heat resistant. Surprisingly, both can use the same molybdenum-containing stainless steels, to last a lifetime.

Besides flue gases, circulating and sanitary water can also pose a major corrosion risk in residential heating systems and affect their efficiency. The presence of aggressive substances, especially chlorides and free chlorine, found in treated water, can attack the surfaces of boiler water circuits. With hard water, calcium and magnesium can form insulating scale deposits that reduce thermal efficiency and can cause premature failure of components. Molybdenum-containing stainless steels with their smooth surface and high corrosion resistance provide complete solutions for all things combustive home heating: boilers, stoves and fireplaces, chimney flues and hot water tanks.

Boilers: stainless steel contributes to efficiency

The boiler is the heart of a hot water heating system. Depending on the technology, boilers burn gas, oil, wood, or even coal to generate heat. Much of the heat is then transferred through a heat exchanger to a water circuit while unused heat in the flue gases is vented to the outside. To increase efficiency and reduce the environmental impact of a boiler, it is essential to minimize the amount of heat lost this way to the outside and use it to heat the circulating water instead. The cooler the flue gas, the more energy has been used to heat the house and sanitary water for bathrooms and kitchens. Modern condensing boilers, as described in the illustration below, are therefore some of the most highly efficient heating units on the market today. A boiler's durability and performance depend also on the fuel type, how it is operated and maintained, and the material it is made of.

Schematic functioning of conventional and condensing boilers



Conventional boilers have a burner and a heat exchanger in the combustion chamber. The hot gas heats the water in the circuit and then when still hot, it escapes through the flue, losing a lot of the valuable energy to the outside. In contrast, condensing boilers are much more energy efficient, as they use a condenser after the combustion chamber to extract more heat from the flue gas by preheating the incoming water from the heating circuit. Through this, the gas temperature drops below 60°C, its "dew point", where it condenses and acids form. The combustion chamber and the condenser are designed to resist corrosive fumes and acidic condensate, respectively. The condenser allows the collection of the condensates, instead of releasing it into the air, reducing air pollution.

The materials used for the combustion chamber and the heat exchanger largely determine the longevity and performance of a boiler. These components, traditionally made from cast aluminum, ceramics, and steel are increasingly produced in Type 316L stainless steel. The 2% molybdenum in this alloy provides very good resistance to pitting corrosion and good high temperature strength. In the most recent high-efficiency condensing boilers, Type 316 Ti, and in some premium models, even 904L stainless steel are used. With its 4% molybdenum content, 904L has even better corrosion resistance, practically guaranteeing a long service life.

Stainless steel slips into chimneys

The hot gases from boilers, furnaces, and other combustive heating systems must be vented through a chimney. Traditional masonry chimney flues are rarely watertight and aggressive condensate and acidic flue gases attack and deteriorate the mortar joints, which allows wetness, dangerous gases, and smoke to get into the house. Therefore, they require a lining. However, many older heating systems have significantly deteriorated liners or no lining at all. Modern liners are often double walled, generally with an insulation between the walls. Type 316L stainless steel is now used as a high performance flue liner for the inner wall. This grade resists acid condensate as well as acidic flue gases and high temperatures. The outer liner can be of the same material or Type 304 stainless steel in mild environments. A stainless steel flue liner with its smooth surface finish makes it more difficult for soot to adhere to, allowing smoke to exhaust faster. Lessening soot build up also reduces the risk of fire.

Comparatively light and easy to install, stainless steel is suitable for lining both existing chimney flues and new installations. A wide range of shapes and diameters of sleeves and chimney outlets are possible with Type 316L stainless steel. Compatible with all fuels, the alloy is ideal for wood, oil, and gas-fired boilers, and allows dry or damp smoke to evacuate at high and low temperatures. Traditionally double walled stainless steel liners were used to avoid dangerously hot pipes in the house and to maintain the flue gas temperature to ensure a good draft and avoid condensation. However, with condensing boilers the insulation solves a different problem. The flue gas temperature is so low, that it has almost no natural draft, and therefore maintaining its temperature is extremely important to allow the gases to escape.

When replacing outdated heating systems in existing buildings, masonry chimneys must be retrofitted with a liner due to the lower flue gas temperatures. Stainless steel systems, which are installed from above, are not only durable and impermeable, but also avoid major construction work inside the building.

For old chimneys that are not completely straight, a flexible stainless steel liner can follow the required passage.

Double walled stainless steel pipes can also be used by themselves, without a traditional masonry chimney for support. This solution is cost effective, light and easy to install, it saves space, and can add a beautiful and dramatic element inside or outside the house.

Hygienic stainless steel hot water tanks

Hot water tanks store heated water, mainly for domestic use in bathrooms and kitchens. Type 316L stainless steel meets the highest requirements for hygiene and durability and can withstand most corrosion risks from all types of potable water. Unlike enameled steel tanks that require regular replacement of their magnesium anode, Type 316L stainless steel requires minimal maintenance. Just like with a chimney flue, a stainless steel tank lining is smooth, which mitigates scale build up and thereby reduces maintenance and prevents premature aging of the water tank. Heat exchange coils, also made of Type 316L stainless steel, offer the same advantages in addition to good thermal conduction. In chloride-containing hot water, stress corrosion cracking (SCC) is always a risk. To mitigate against SCC, Type 444 ferritic stainless steel with 2% molybdenum and 2205 duplex stainless steel with 3% molybdenum are also popular for the lining and heating coils of hot water tanks. Thanks to its high strength, duplex stainless steel hot water tanks are also much lighter than conventional tanks.

The most efficient heating systems available today are all moving towards designs with molybdenum-containing stainless steel. Type 316L stainless steel is used across a range of heating applications, improving the efficiency and durability of boilers, chimney fittings, sleeves, and outlets, flue pipes and liners, hot water tanks, and tank heat exchange coils. Additionally, in some models 904L austenitic stainless steel, Type 444 ferritic stainless steel, and 2205 duplex stainless steel are used for specific applications. Having said that, with emission-free electric heat pumps enjoying double-digit growth rates, home heating is now quickly moving away from burning fossil fuels – but not from molybdenum-containing stainless steels. Their corrosion resistance and hygienic properties are essential for heat pumps as well – however, that is for another article. (TP)

Hot water, coming from the boiler, enters the hot water tank through the coiled heat exchanger tube. It thereby transfers its heat to the water which is stored inside the stainless steel tank.

National Salt Satyagraha Memorial

In India's Gujarat province, two stainless steel beams rise 40 meters into the air, perching a "salt crystal". This sculpture is a symbol for a pivotal moment in India's struggle for independence. Molybdenum-containing stainless steel is the ideal material to stand up to the strong salty winds at this coastal location.

An international team of four dozen artists created 80 life-sized sculptures of the marchers, cast in silicon bronze.

Mahatma Gandhi once lifted a handful of salty sand from Dandi Beach and declared, “With this, I am shaking the foundations of the British empire!” At that moment, Gandhi and hundreds of protestors began making salt from seawater illegally. It was the culmination of a 24-day march in defiance of the British salt monopoly, which levied a 2400% tax on this daily necessity, and arguably the beginning of the end of British rule in India.

In 2019, the National Salt Satyagraha Memorial, a 6-hectare memorial park honoring the Dandi March, was opened in this remote coastal town. The park’s centerpiece is a 2.5-tonne glass cube cradled by a pair of “hands” capping the top of the stainless steel “arms.” On the ground below the towering structure is a 5-meter-tall statue of Gandhi. The glass cube represents a salt crystal, it and the stainless steel arms glow in changing colors at night, illuminated by carefully placed lasers.

Story of the Salt Satyagraha

Satyagraha loosely translates to “upholding the truth” and embodies Gandhi’s principles of nonviolent civil disobedience. In 1930, Mahatma Gandhi led a 390 kilometer march toward the sea to make salt in protest of British colonial rule, which controlled the country’s salt trade for decades. 80 men of every religion, caste, and region of India marched beside him, with more people joining each day until there was a 3-kilometer-long wall of protestors.

The march inspired millions of Indians to break the Salt Act and begin making and buying illegal salt. Although the march initially only involved men, women joined the protest by actually producing and selling tonnes of salt. Over 60,000 people were incarcerated as a result.

Although the Salt Satyagraha did not lead to an immediate concession of British rule, it was a watershed moment that made British leadership realize their authority was contingent on the acceptance of the Indian populace.

Memorial and sculpture design

The memorial’s design was the product of a sizeable interdepartmental collaboration at the Indian Institute of Technology Bombay. In addition to the great A-frame, the memorial park includes an artificial lake at its center, circled by a walking path. Visitors can stroll on the path towards the monument at the end of the artificial lake. The route symbolizes the road of the Dandi March. 24 bas-relief sculptural murals, one for each day of the March, tell its story along the way. At the far end of the lake, 80 magnificent life-size sculptures of the marchers recreate the sense of being frozen in that moment nine decades ago. On the other side of the lake, a grove of 41 stainless steel solar “trees” flanks the return path, allowing the entire park to be energy-neutral. At the visitors’ center, guests can make their own salt and take a pinch home as a memory.

24 narrative murals along the foot path tell the story of the Dandi March.

The top of the A-frame during construction, before installation of the glass salt crystal.

The main frame of the sculpture is made of 220 mm diameter 2205 duplex stainless steel tubes with 12 mm wall thickness. Its towering arms are structurally clad with laser-cut plates of varying thickness, ranging from 12 mm to 25 mm of the same material. The 3% molybdenum in this stainless steel provides the corrosion resistance necessary to avoid staining at the corrosive seashore location. Overall, 50 tonnes of duplex stainless steel were used in the monument.

The forest of solar trees powers the whole installation, including the salt-making pots for visitors. Each tree is made of Type 316 stainless steel. Besides the main trunk, they have 12 stainless steel "branches" positioned optimally to face the sun. Each branch supports a solar panel on a stainless steel "leaf", fabricated from square tubes. In total, this forest uses 70 tonnes of Type 316 stainless steel.

The National Salt Satyagraha Memorial sculpture is one of India's most famous duplex stainless steel sculptures. The fact that molybdenum-containing stainless steel was used to honor such a critical moment in the country's history exemplifies its beauty, longevity, and strength. Like the spirit of Satyagraha itself, this stainless steel sculpture will not be overcome by salt. (KW)

The solar trees power the memorial's lighting, facilities, and visitor activities.

IMOA news

Best attended AGM in over a decade

This September, 182 attendees from 56 member companies attended IMOA's 35th AGM in Santiago, Chile. This is the largest number of attendees since 2011's AGM in Pittsburgh, US. Sierra Gorda SCM kindly hosted the event.

From improving the sustainability of molybdenum mining to calculating carbon emissions and water preservation, environmental themes prevailed in the AGM presentations. These topics are especially pertinent considering the increasing accountability measures for industry in calculating, reporting, and reducing carbon emissions. Presentations given by Markus Moll of SMR on the *End Use of Molybdenum 2022* and Jim Lennon of Red Door Research on *The Outlook for Molybdenum Supply / Demand* were popular with members, as always.

In addition to presentations, panel discussions, and networking events, the AGM also included a tour of the Sierra Gorda mine in the Antofagasta region of northern Chile. After visiting the mining pit, attendees toured the control room and sections of the molybdenum concentrator plant.

Taenaka Kogyo Co Ltd, Taiyo Koko Co Ltd, Advanced Material Japan Corporation, and Kohsei Co Ltd will host IMOA's 2024 AGM in Tokyo, Japan. Please save the dates: September 11 – 12, 2024.

Panel discussion on critical material designation.

A visit to the Sierra Gorda Mine in Antofagasta.

Architectural & structural stainless steel webinars

Over the past year, IMOA partnered with the Nickel Institute to create a series of presentations on structural and architectural applications of stainless steel, given by our consultant Catherine Houska. Recordings of the six educational webinars, each an hour long, are available on IMOA's website. The value of these modules is evidenced by continuing requests to present them live to architectural firms for credit.

The Steel Institute of New York (SINY) and IMOA collaborated on a live Architectural Record Magazine webinar on October 25 on *Sustainable & Resilient Stainless Steel Structural Design* for an audience of 443. The recorded webinar can be viewed for continuing education credit until October 31, 2024. A second structural stainless steel design webinar is planned for January 25, 2024, which will be specification focused.

IMOA is delighted to welcome a further four new members in 2023:

Chaoyang Jinda Molybdenum Co., Ltd, China
MBR Metals OÜ, Estonia
Mitsubishi Corporation RtM International Pte Ltd, Singapore
Stuhini Exploration Ltd, Canada

The new members will now enjoy the benefits that IMOA membership offers, including access to market updates and research results, HSE guidance and regulatory liaison, the opportunity to influence global market development programs, and also networking at member events.

IMOA developing next Strategic Plan (2024–2028)

Every five years, IMOA's Executive Committee develops a strategic plan that informs the Association's activities. The aim of the five-year plan is to ensure the Association continues to meet the needs of its members and contributes positively to the progression of the global molybdenum industry. 2023 marks the end of the current plan and the beginning of a new one, which will guide IMOA from 2024 through 2028. Following a series of planning discussions, the Executive Committee will meet in April to finalize the next strategic plan.

PacRim Stainless 2023 conference

In October of 2023, IMOA Technical Director Nicole Kinsman presented at the PacRim Stainless conference on Australia's Gold Coast on Developments in Structural Stainless Steel Standards. The presentation, prepared by Team Stainless consultant Nancy Baddoo, discussed the advantages of using stainless steel over carbon steel in structures and gave an overview of the recently issued AISC and ASCE structural design standards. To further spread the use of these standards beyond North America, we promote them also in other jurisdictions, especially those like Australia that are already aligned with AISC/ASCE standards for carbon steel.

ASTM sustainability standards

Team Stainless consultant Catherine Houska chairs ASTM committee E60.80 on General Sustainability Standards. This committee develops uniform approaches to calculating recycled content, among other environment-related activities. Our leadership in the development of these standards is important to ensure that the sustainability credentials of stainless steel are represented accurately. The committee also organized the two-day online *Workshop on Decarbonization: A Gap Analysis of LCA Standards for Industry* in October 2023.

Save the date: Molybdenum Symposium 2024 – Mo4Steel

The Molybdenum Symposium 2024 – Mo4Steel will take place in Vienna, Austria on November 13–15, 2024. This IMOA supported event offers the opportunity to join producers, processors, researchers, policymakers, and end users to exchange experiences and insights around molybdenum in all kinds of steels and stainless steels. Molybdenum plays an important role as a versatile and indispensable alloying element in modern high-performance steels.

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Cover photo: Clad in 6% molybdenum stainless steel, the seaworthy art installation and event center 'Salmon Eye' floats in Norway's Hardangerfjord.
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