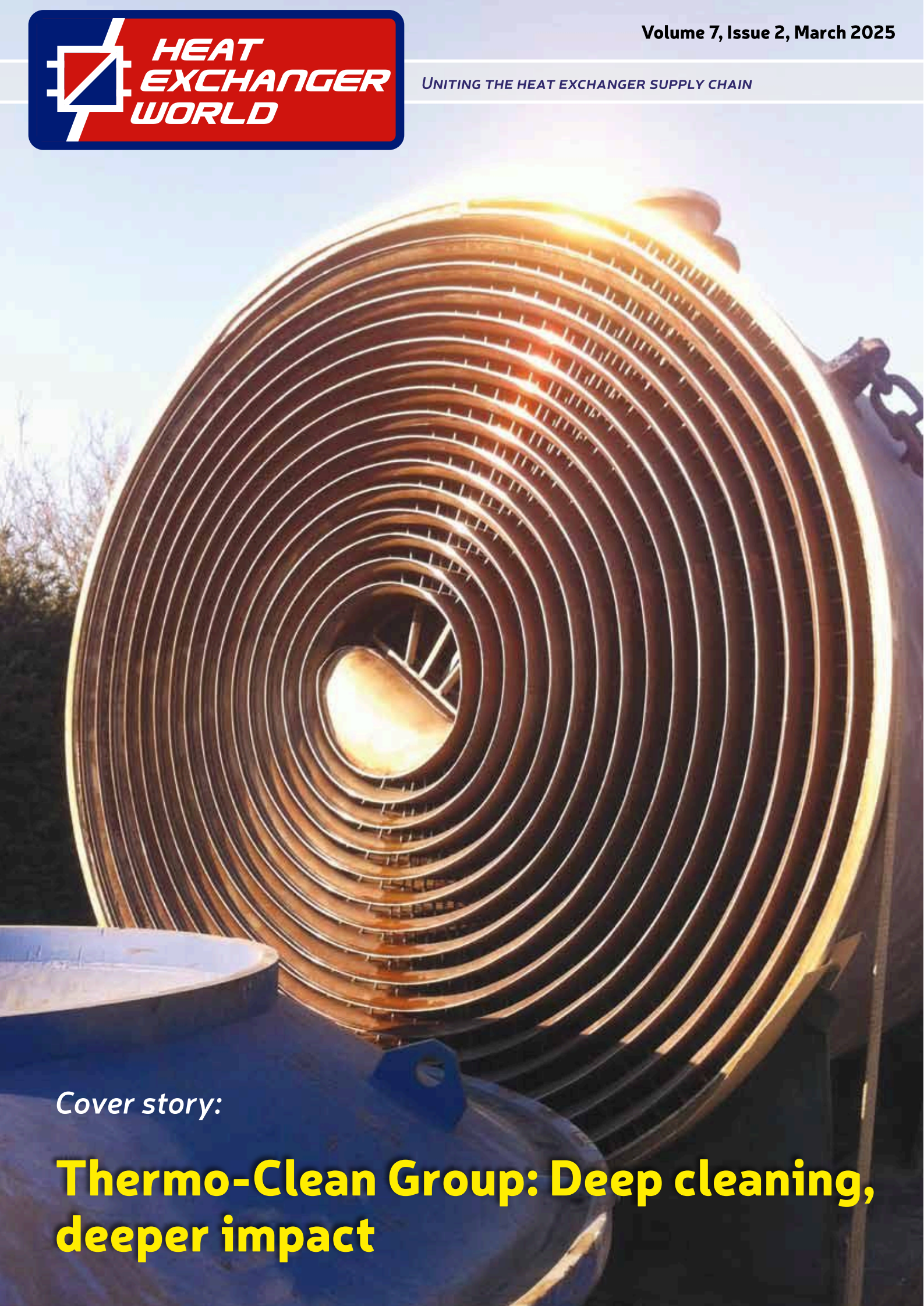
HEAT EXCHANGER WORLD

Volume 7, Issue 2, March 2025

UNITING THE HEAT EXCHANGER SUPPLY CHAIN



Cover story:

Thermo-Clean Group: Deep cleaning, deeper impact

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Group Director - KCI Media Group
Director - KCI Publishing B.V.
Elisa Hannan
e.hannan@kci-world.com
Tel: +31 575 585 291

Editor in Chief
Joanne McIntyre
j.mcintyre@kci-world.com
Tel: +31 575 585294

Editorial Team
Iryna Mukha (the Netherlands)
i.mukha@kci-world.com

Sarah Bradley (Canada)
s.bradley@kci-world.com

Shopia Ketheeswararajah (Canada)
s.ketheeswararajah@kci-world.com

Sonja Wingels (Germany)
s.wingels@kci-world.com

Laura Wang (China)
h.wang@kci-world.com

Lyndsey Denton-Fray
l.dentonfray@kci-world.com

Sales Enquiries and Marketing
Sjoerd Hesseling
s.hesseling@kci-world.com
Tel: +31 630 996 476

Subscriptions Coordinator
Renate Collet
r.collet@kci-world.com
Tel.: +31 575 789 269

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Publishing House
KCI Publishing B.V., Leeuwenbrug 113,
7411 TH Deventer, The Netherlands

Mailing Address
PO Box 825, 7400 AV Deventer, The Netherlands
info.deventer@kci-world.com
Tel.: +31 575 585 270
Bank Account: ABNAMRO 56.64.05.164
BIC: ABNANL2A IBAN: NL50ABNA0566405164

Canada Office
KCI Publishing Corporation
36 King Street East, Suite 701,
Toronto ON M5C 1E5, Canada
info.toronto@kci-world.com
Tel.: +1 416 361 7030

China Office
KCI Shanghai, Room 603, 6F, #400 Zhejiang Mid Road,
200001, Shanghai, China
info.shanghai@kci-world.com
Tel.: +86 6351 9609

German Office
KCI GmbH, Siemensstraße 32, 47533 Kleve, Germany
info.kleve@kci-world.com
Tel.: +49 2821 71145 0

Singapore Office
KCI GmbH, 12 Woodlands Square #13-85, Wood Square,
Singapore 737715
info.singapore@kci-world.com

Facebook: https://www.facebook.com/heatexchangerworld/

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Warming into spring

From the windows of the Heat Exchanger World office, we notice the first signs of spring making their appearance—the ground is still bare, waiting for the first signs of spring, and we can almost see the vibrant green about to spread across the trees.

March truly symbolises growth and new possibilities. With the heat transfer industry experiencing steady advancements, we're seeing an exciting blend of innovation and resilience shaping the market. Statistics from recent reports highlight continued growth in thermal exchange solutions globally, driven by demands for energy efficiency and sustainability—both pillars of our community.

This month's cover story sees the return of the Thermo-Clean Group diving into their 35-year legacy of pioneering thermal cleaning innovations. Under the leadership of Robert Mol, the company has developed cutting-edge technology to restore heat exchangers to peak performance while significantly reducing environmental impact. You'll find the full story on page 8.

Adding to this issue's highlights, our special feature by Robert B. Bender explores the applications of quantum mechanics technology to improve heat exchanger functionality. By addressing fouling and biofilm challenges, these advancements are poised to dramatically enhance efficiency and reduce greenhouse gas emissions across industrial applications. Catch this insightful piece on page 16.

In our technical spotlight this month, Miguel Gutierrez from Saudi Aramco shares a comprehensive guide on implementing an offline asset sparing strategy for shell-and-tube heat exchangers. Read his valuable insights on page 20.

Continuing to reflect on the Heat Exchanger World Conference Europe 2024, turn to page 32 for a paper from Neotiss exploring the main challenges in heat exchanger design. Find out how the right choice of material and tube design can help to achieve the optimal balance between layout/footprint, costs, weight and, of course, the thermal efficiency and longevity of heat exchangers.

We hope you enjoy the March issue, which profiles some of the finest innovations shaping the heat exchanger industry. Here's to spring's promise of growth and renewal driving us forward!

All the best,
Iryna Mukha
Editor
i.mukha@kci-world.com

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GREEN STEEL WORLD CONFERENCE & HYDROGEN TECH CONFERENCE

» *Location: Düsseldorf, Germany*
Url: https://greensteelworld.com/conference-information
Url: https://hydrogentechworld.com/conference

15 – 16 October 2025

HEAT EXCHANGER WORLD AMERICAS CONFERENCE & EXPO

» *Location: Houston, Texas, USA*
Url: https://heat-exchanger-world-americas.com/

18 – 20 November 2025

STAINLESS STEEL WORLD CONFERENCE & EXPO

» *Location: Maastricht, the Netherlands*
Url: https://stainless-steel-world-event.com/

6 – 7 May 2026

HEAT EXCHANGER WORLD EUROPE CONFERENCE & EXPO

» *Location: Rotterdam, the Netherlands*
Url: https://heat-exchanger-world-europe.com/

Community Update

Sharing good news from the heat exchanger community and wider industry....

Parker names Thomas Ottawa as new EMEA President as Joachim Guhe retires

Parker Hannifin, a global leader in motion and control technologies, announced the retirement of Joachim Guhe, President of its EMEA Group, after 32 years with the company. Guhe will step down on June 30, 2025, and remain until August 31 to ensure a smooth transition.

Thomas Ottawa, currently Vice President of Operations - Motion Systems Group Europe, will succeed Guhe as EMEA President, effective July 1, 2025.

"Joachim's leadership has driven operational excellence and significant growth in the EMEA region," said Andy Ross, President and COO. "We thank him for his remarkable contributions."

Ottawa, who joined Parker in 1995, has held key leadership roles, including General Manager of the Prädifa Technology Division. Since 2019, he has been instrumental in driving profitability in his current role. "Thomas's deep expertise and leadership will propel the EMEA region forward," Ross added.

In his new role, Ottawa will oversee nearly 14,000 employees across 22 countries.

Metalforms expands heat exchanger channel network

Metalforms Heat Transfer, a division of TransTech Group, announces four new channel partners to enhance customer support for Twisted Tube® and Brown Fintube® Heat Exchanger products. The new partners include:

- **Heat Transfer Specialists of Louisiana** – Serving Louisiana and Southern Mississippi.
- **Apogee Equipment Solutions** – Covering Texas.
- **Andersen & Associates** – Supporting the Western U.S.
- **Thermal Transfer Solutions Ltd.** – Serving Western Canada.

With extensive industry expertise, these partners strengthen Metalforms' ability to provide localized engineering support, faster response times, and superior customer service.

"This marks a pivotal expansion for Metalforms," said Greg Ezzell, Chief Growth Officer, TransTech Group. "Our new partners align with our mission to deliver innovative, high-performance heat transfer solutions."

To support this growth, Metalforms has appointed Alvin Jones as Regional Sales Manager to oversee the network and ensure top-tier service.

"We are excited to enhance our support network and advance Twisted Tube® and Brown Fintube® technologies to better serve our customers," added Clint Martin, Director of Commercial Operations.

CALGAVIN marks a milestone with new state-of-the-art facility

CALGAVIN, a leader in thermal design and process optimisation, has moved into a cutting-edge facility in Alcester, Warwickshire, marking a new chapter for the company. The 800-square-meter space houses the Centre for Flow Processing (CFP), CALGAVIN's research arm, and enhances its capacity for innovation in fluid dynamics and heat transfer technology. With nearly 45 years of expertise, CALGAVIN is poised to expand its impact on industrial process optimisation. The facility features custom rigs for heat transfer testing, Planar Laser-Induced Fluorescence (PLIF) for in-tube mixing analysis, and advanced Computational Fluid Dynamics (CFD) to refine and simulate solutions. Prototyping capabilities like laser cutting, CNC machining, and 3D printing will also accelerate the development of custom solutions.

The new facility strengthens CALGAVIN's collaborations with partners such as the University of Birmingham, bridging academic research with industrial application.

"This move reflects our commitment to addressing tomorrow's energy challenges and delivering sustainable solutions," said Managing Director Martin Gough.

CALGAVIN is focused on driving the future of energy efficiency and reducing carbon emissions across industrial sectors.

technotrans expands in Sassenberg for future growth

technotrans has acquired a 13,000-square-meter property adjacent to its headquarters to support anticipated growth. The site will house new production and logistics facilities, enhancing efficiency through the close integration of research, development, and manufacturing.

"This acquisition provides an ideal foundation for expanding our capacities," says CEO Michael Finger. The Sassenberg site is a key competence center for Energy Management, including advanced liquid cooling solutions for data centers.

Currently, the property features a warehouse and open space, which may be used temporarily for logistics before construction begins. The project is expected to take up to two years.

"This strategic step secures space for growth in a crucial sector," adds Finger. "It strengthens our competitiveness and supports Sassenberg's sustainable development."

Tubacex achieves A- rating in CDP assessment

Tubacex has earned an A- rating in the latest Carbon Disclosure Project (CDP) assessment, positioning itself as a leader in transparency and climate action. This rating places the company ahead of its competitors, demonstrating its commitment to sustainability and alignment with global decarbonization trends.

The CDP assessment highlights Tubacex's dedication to sustainability, as outlined in its Ambition 2030 project, part of the NT2 strategic plan. Key sustainability achievements include a 67% reduction in energy intensity since 2019, a 55% decrease in CO emissions (Scope 1+2), and 83% of electricity from fossil-free sources. Additionally, 88% of procurement volume is assessed under ESG criteria, ensuring sustainability throughout the supply chain.

While Tubacex acknowledges the ongoing journey to net-zero, the A- rating marks an important milestone, reinforcing its focus on decarbonization, energy efficiency, and innovation to create value for stakeholders.

Munters divests FoodTech equipment to focus on digital growth

Munters has agreed to sell its FoodTech Equipment division to Grain & Protein Technologies (GPT), owned by American Industrial Partners (AIP).

This move aligns with Munters' strategy to focus on digital solutions within FoodTech, including software, controllers, sensors, and IoT. The sale includes five production sites in Italy, Germany, China, and the U.S., plus an assembly hub in South Africa, and three sales offices. Around 400 employees will transfer to GPT.

"The sale strengthens our focus on digital FoodTech solutions. GPT is a great new home for the equipment business," says Klas Forsström, CEO of Munters.

The deal excludes CELdek production in the Americas, which will integrate into AirTech. The transaction, expected to close in H1 2025, will result in a BSEK 0.5 capital loss and is subject to regulatory approvals.

Worley and Shell achieve new milestone with Whale offshore platform

Shell's Whale platform, the company's second deepwater project in the Gulf of Mexico, has successfully launched with a simplified design based on the Vito project. The platform features a 99% replicated hull and 80% replicated topsides from Vito, which began production in 2023. Whale, weighing 25,000 tonnes, is one-third the size of Shell's Appomattox platform and designed to produce 100,000 barrels of oil equivalent per day. It also incorporates energy-efficient gas turbines, reducing carbon intensity by 30% over its lifecycle.

The project used lessons from Vito to improve design efficiency and operational predictability. Worley provided engineering, procurement, and construction services, utilizing a digital approach with 3D models for design and fabrication.

Whale was built in Singapore and transported to Texas before being towed to the Gulf of Mexico. Moving forward, Shell and Worley are collaborating on Sparta, an enhanced version of Whale, set for production in 2028.

Webco announces appointment of Tobin Pospisil to board

Webco Industries has appointed Mr. Tobin Pospisil to its Board of Directors, increasing the total number of members to six, with three being outside members. Dana S. Weber, Webco's Chairman and CEO, emphasized Mr. Pospisil's extensive experience in the steel industry. He holds a B.S. in Business Administration from the University of Nebraska and an MBA from Duke University. Throughout his career, Mr. Pospisil has held executive positions at GS Industries and Gallatin Steel Company and has worked as a strategic advisor for other companies in the sector. He currently serves on the board of a steel supplier.

Mr. Pospisil's deep expertise in finance and operations is expected to bring valuable insight to Webco's Board. The company remains committed to building a strong, innovative future, providing high-quality carbon steel, stainless steel, and specialty tubing products. With five production and eight value-added facilities across the U.S., Webco serves global customers and continues to focus on growth and operational excellence.

Thermo-Clean Group: Deep clean

For over 35 years, Thermo-Clean Group has been at the forefront of thermal cleaning innovation. Under the leadership of Robert Mol, the company has expanded from a small branch to cover multiple countries, offering cutting-edge, sustainable, and highly efficient cleaning technologies. In this interview, we learnt how with a commitment to continuous improvement and environmental responsibility, Thermo-Clean is setting new industry standards while preparing for future growth.

Thermo-Clean is equipped to cater to businesses across Europe with its comprehensive "10-step total care heat exchanger cleaning service" aka Total Cleaning.

By Iryna Mukha, Heat Exchanger World

Over 35 years of history

Thermo-Clean originated in 1989 as a branch of Jos Mol Coatings, a Belgium and Luxembourg-based powder coatings distributor. Since 2005, the company has been headed by Robert Mol. Through his relentless efforts spanning over three decades, Mol has successfully turned Thermo-Clean into one of the market leaders in the thermal cleaning industry, boasting 10 branches throughout Europe and sturdy plans for further expansion.

"I joined the company in May 1989 as the second employee. It was just us two initially," shares Robert. "We were propelled by inquiries from our Jos Mol Coatings customers about equipment cleaning and in response, we started Thermo-Clean by primarily serving the paint industry. The effectiveness of our strategies in dealing with other substances such as oil, plastic, and glue became evident later on."

Under Robert's leadership, the company has transformed into an expert in the fields of thermal heat exchanger cleaning, polymer removal, and filter cleaning. "Our proprietary thermal cleaning technique allows us to restore heat exchangers and parts to their original performance level. This translates into improved heat transfer, diminished energy costs, and a reduced environmental impact as a more efficient heat exchanger results in less fuel consumption and consequently, fewer greenhouse gas emissions."

In situations where customers are unsure about the type of fouling affecting their heat exchanger, Thermo-Clean performs a preliminary test using a sample to identify if the fouling is organic, inorganic, or a blend of both. "This test helps us understand the aftermath inside the pyrolysis oven such as by what percentage we can reduce this fouling," says Robert. "In case of any uncertainties, we conduct a further thermogravimetric analysis (TGA) test to delve into what the fouling comprises."

The team typically starts the process by understanding the weight, volume, and design of the exchanger to provide a quotation and a detailed cleaning schedule. "Once an agreement is reached, we arrange to collect the exchanger from the customer. The first and foremost task upon arrival is to arrange the appropriate support for the exchanger to prevent buckling or distortion during the cleaning process," adds Robert. "We then set up thermal components throughout the heat exchanger to monitor the temperature at various parts to ensure uniform heating."

According to Robert, compared to high-pressure methods, Thermo-Clean can pre-calculate the cleaning duration more precisely. "With our technology, we can let the client know beforehand whether 24 hours, 40 hours, or 60 hours are needed for cleaning. This optimizes planning for the client.

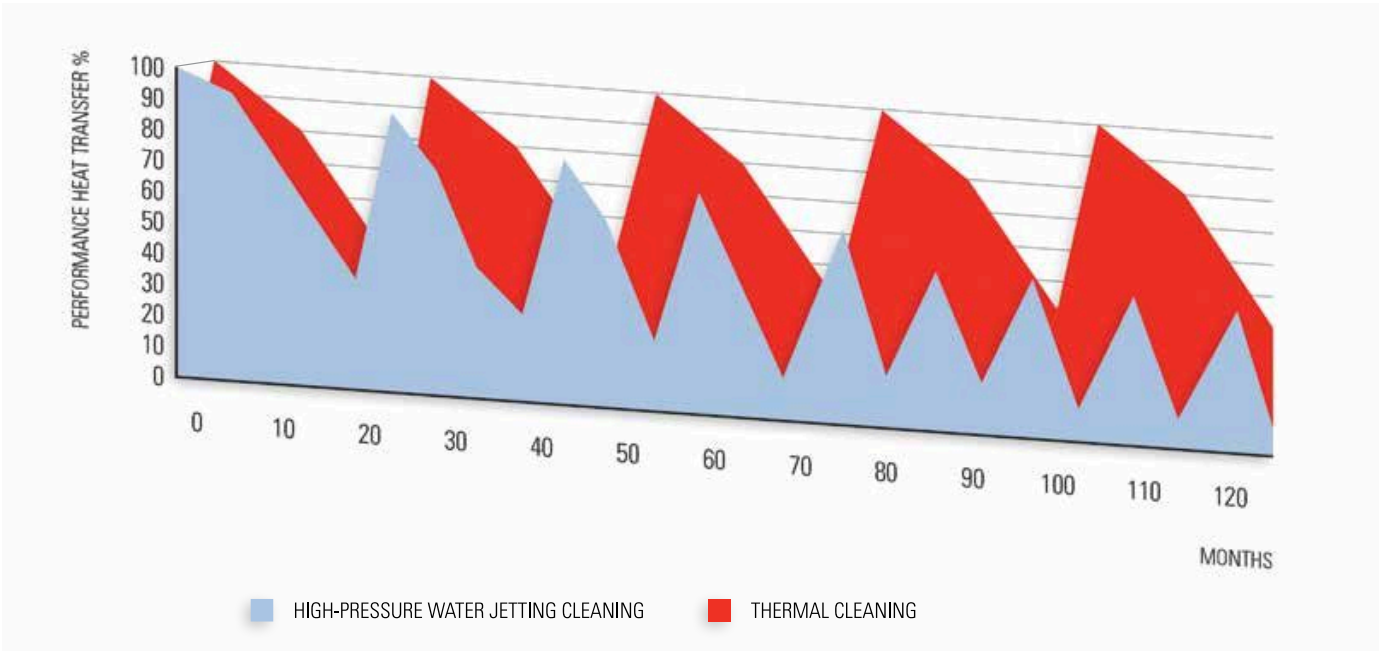
ing, deeper impact

Total Cleaning includes complete removal of heat exchanger and its shell for cleaning. Once the unit is properly maintenanced, it's returned to the customer ready for immediate installation and use.

In contrast, other methods may take up to 1-2 weeks resulting in lost time and even then, only 70% of the fouling is eliminated," Robert points out. "In our case, the cleaning duration is primarily dictated by the quantity of fouling and the weight of the part as we need to raise and reduce the temperature gradually to avoid distortion. As the thinner tubes heat up and expand faster than the thicker plates, we need to ensure uniform expansion and contraction."

Unique solutions

There are numerous businesses offering thermal cleaning, but Thermo-Clean raises the bar with their tailor-made solutions for cleaning large and heavily tainted parts. "Our cleaning/pyrolysis ovens, exclusively designed for Thermo-Clean, are the result of a partnership with an in-house system provider," shares Robert. "They are unique in the market because we also develop our own software to operate these cleaning machines. This approach enables us to cleanse specialized heat exchangers and restore their performance to an unmatched level."



Comparison of cleaning frequency high-pressure water jetting vs. thermal.

If needed, Total Cleaning can also cover casing refinishing, eddy current testing, and tube repair or replacement.

Their collaboration with TC Machinery BV has led to the development of an apparatus offering an efficient and secure environment for the superior thermal cleaning of heat exchangers. What makes these ovens exceptional is the ability to regulate oxygen and temperature, allowing accurate monitoring of the gasification of organic fouling during the cleaning process. Additionally, the company's large-scale units can handle multiple exchangers at once, assuming they share the same specifications, size, weight, and fouling type.

More than just cleaning

With its presence in the Netherlands, Belgium, France, Germany, and Slovakia, Thermo-Clean is equipped to cater to businesses across Europe with its comprehensive "10-step total care heat exchanger cleaning service " aka Total Cleaning.

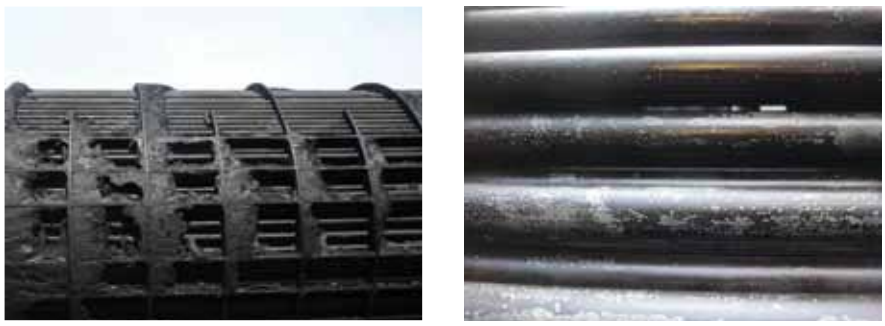
Total Cleaning is the foundation of Thermo-Clean's approach to heat exchanger maintenance, ensuring maximum efficiency, reliability, and longevity. Traditional cleaning methods, such as water jetting and chemical washing, fail to deliver a truly comprehensive clean. These methods remove only superficial dirt, leaving behind persistent fouling that compromises performance and energy efficiency. Thermo-Clean's advanced thermal cleaning technology, however, offers a complete solution that restores heat exchangers to their original state.

The process begins with the placement of the heat exchanger into a specialized oven where temperatures gradually rise to 420°C in a controlled environment. At this stage, organic contaminants are broken down and converted into gas. These gases are then recovered and used as fuel for the ovens, making the process both environmentally friendly and cost-efficient. What remains of the fouling is reduced to fine dust, which is then rinsed away, leaving behind a heat exchanger that is completely free from historical contamination. This method is effective even in hard-to-reach areas that traditional cleaning techniques cannot access.

The benefits of thermal cleaning extend beyond just cleanliness. A heat exchanger that is 100% clean operates with better throughput, consumes less energy, and enjoys an extended service life. Unlike on-site cleaning, which can be hazardous and environmentally damaging, Thermo-Clean's process significantly reduces waste and water consumption. Every kilogram of contamination is converted into just 50 grams of ash, and water usage is cut by 95% compared to conventional methods.

"But Total Cleaning is not just about the cleaning itself," begins Robert "it's a fully managed process designed to unburden the customer from start to finish. We take complete responsibility for transportation, maintenance, and reinstallation, ensuring a seamless experience. Additionally, with this method, we were able to achieve minimal downtime by cleaning not only the entire heat exchanger, but also its shell. " Their structured 10-step process guarantees efficiency and reliability at every stage:

1. The customer removes the complete heat exchanger and its shell for transport.
2. Thermo-Clean arranges secure transportation to the nearest specialized facility.
3. The unit is carefully disassembled, including removal of heads and floating heads.
4. If necessary, a preliminary cleaning is performed to safely extract the heat exchanger from its casing.
5. The thermal cleaning process is executed in in-house developed pyrolysis ovens, followed by high-pressure water jetting to remove remaining residues.



Before (left) and after (right) of a heat exchanger through thermal cleaning.

6. Additional maintenance is conducted, such as casing refinishing, eddy current testing, and tube repair or replacement if needed.
7. The heat exchanger is fully reassembled.
8. Multiple pressure tests are performed to ensure the unit is 100% operational and free from leaks.
9. The cleaned and tested heat exchanger is prepared for shipment.
10. The unit is returned to the customer, ready for immediate installation and use.

This comprehensive approach ensures that customers receive a heat exchanger that performs at peak efficiency, reducing operational costs and preventing unexpected downtime. Thermo-Clean's Total Cleaning service is not just a cleaning process; it is a commitment to delivering superior performance, sustainability, and peace of mind. Whether in industries like power generation, chemical processing, or food production, Thermo-Clean provides a turnkey solution that eliminates hassle and maximizes results. For those seeking a truly clean, fully optimized heat exchanger, Total Cleaning by Thermo-Clean is the ultimate choice.

Hand in hand with the future

Thermo-Clean is also marking its stand in sustainability, proving that innovation and eco-consciousness can go hand in hand. At the heart of their strategy is a strong commitment to mitigate climate change by aggressively curbing emissions generated from their operations.

The focus is on reducing pollution from their ovens, an initiative which involves a dedicated exploration of new technologies. This can ensure the preservation of their service quality while reducing their carbon footprint. The vision is clear: deliver supreme cleaning results with fewer emissions.

To further help customers understand the importance of adopting sustainable practices, Thermo-Clean has partnered with an expert company to construct a computation tool for customers. This tool serves to compare and contrast traditional cleaning methods with thermal technology, but through the lens of CO2 emissions. It's an enlightening look into the environmental implications of our everyday choices.

"We believe that superior cleaning results can spark a chain reaction leading to reduced energy consumption in customers' factories. It's a win-win situation - superior cleaning results bring about a cleaner environment, both at the level of the individual factories and the planet as a whole," explains Robert.

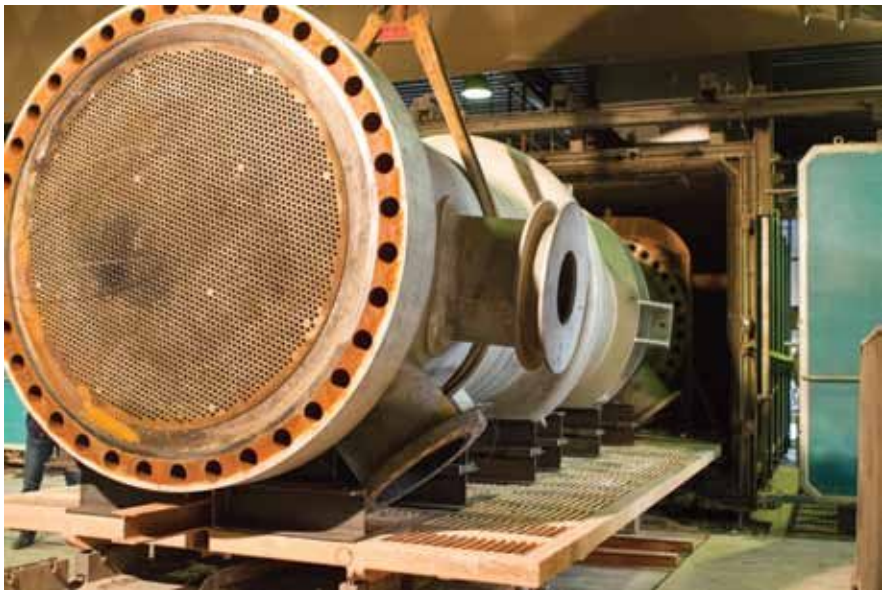
Sustainability isn't just a buzzword for Thermo-Clean, rather it is woven into every aspect of their work and service. They are committed to doing their part in the global fight against climate change and are helping their customers do the same through their services.

Looking ahead

With a vision set for the future, Thermo-Clean is not just enhancing its operational capacity, but also planning on widening its geographical reach. The company has

Thermo-Clean's CEO Robert Mol.

been actively preparing other Thermo-Clean sites with the same equipment, with a special emphasis on developing a dedicated cleaning team to cater to industries with specific cleaning needs, such as heat exchangers in the chemical and petrochemical industry. Recent attention has turned towards potential expansion into regions like Saudi Arabia and potentially North America. Demand for Thermo-Clean's unique services is growing in these locations, however, challenging market conditions have currently curtailed these plans. And yet, Robert Mol remains optimistic, stating that they aim to establish one or two factories in those regions within the next five years. Robert expresses confidence and optimism when discussing the company's future plans and focus, stating, "I really hope within five years that we can be active in one or two of the regions I've mentioned because I really think that there are big opportunities for us." It's clear that Thermo-Clean is on an exciting path of expansion and innovation, all while prioritizing their commitment to sustainability and customer needs. ■



Thermo-Clean is playing their role in the global fight against climate change and are helping their customers do the same through their services.

Industry News

Venture Global to begin commercial operations at Calcasieu Pass

Venture Global announced that it has notified its long-term customers that its Calcasieu Pass facility will commence commercial operations during the second week of April. The facility will achieve its commercial operation date, or COD, in under 68 months from its August 2019 final investment decision, despite substantial impacts including two hurricanes, the COVID-19 pandemic, and major unforeseen manufacturing issues, such as with the Heat Recovery Steam Generators (HRSGs) forming part of the facility's power island.
Venture Global wishes to express its gratitude to its construction and completion teams who tirelessly worked to safely complete the facilities, to the vendor teams who provided invaluable support for the necessary repairs, and to the government regulators, including the Federal Energy Regulatory Commission, for their oversight and cooperation. These efforts now allow us to supply long-term customers with the full 20-year contract term of the lowest-cost, clean LNG as promised under the contracts, and, with the COD, makes Calcasieu Pass among the fastest greenfield LNG projects completed.

Petrobras starts production from Buzios 7 FPSO

Petrobras commenced production from the FPSO Almirante Tamandaré (Búzios 7) in the Búzios field, located in the pre-salt layer of the Santos Basin. This is the first high-capacity unit to be installed in the field, with the potential to produce up to 225,000 barrels of oil per day (bpd) and process 12 million cubic meters of gas daily.
In total, 15 wells will be connected to the platform through a subsea infrastructure, including 7 oil producers, 6 water and gas injectors, 1 convertible well (producer and injector), and 1 gas injector.
The FPSO Almirante Tamandaré is part of the sixth production system of Búzios and will contribute to the field reaching a production level of 1 million bopd, expected by the second half of 2025. Shortly, it is anticipated that Búzios will become Petrobras' largest production field, with the goal of reaching 2 million bopd by 2030.
The unit was leased from SBM Offshore and, in addition to having above-average capacity compared to industry standards, it is equipped with decarbonization technologies, such as a closed flare system, which helps reduce greenhouse gas emissions into the atmosphere. The unit also features heat recovery technologies that reduce the demand for additional energy.
The Búzios consortium is composed of Petrobras (operator), the Chinese partner companies CNOOC and CNODC, as well as PPSA, the company responsible for managing production-sharing contracts.

Skyven Technologies & Kyotherm announce co-development agreement

Skyven Technologies, a leader in emissions-free industrial steam, and Kyotherm, a renowned financier of renewable thermal energy projects, have announced a USD 70M co-development and project finance agreement. The partnership provides project funding for accelerating the deployment of Skyven's groundbreaking steam-generating heat pump technology, Arcturus, aimed at decarbonizing hard-to-abate industries and facilities across the United States. This project finance is catalyzed by Skyven's recent USD 145M award from the Department of Energy's (DOE) Office of Clean Energy Demonstrations (OCED).
The co-development agreement combines project debt and project equity under a milestone-based structure, with Skyven Technologies maintaining majority ownership, control, and operational responsibility for the decarbonization projects. This seamlessly integrates all phases of funding required for Skyven's Energy-as-a-Service (EaaS) projects, combining development capital for initial design and planning and construction capital to support the on-site buildout of the Arcturus steam-generating heat pump.
The Skyven and Kyotherm partnership further enables Arcturus projects to improve air quality in local communities by reducing emissions, creating good-paying jobs across America, and developing workforce training programs to improve the competitiveness of industrial manufacturers.

McDermott completes an offshore project in East Malaysia

McDermott announces the safe and successful completion of transportation, installation, and commissioning activities for the Kikeh subsea gas lift project, awarded by PTTEP Sabah Oil Limited (PTTEP) in the first quarter of 2024.
The project, executed by the company's Kuala Lumpur (KL) based team, in water depths of approximately 1,400 meters, progressed on a fast-track schedule. It involved the replacement of an existing gas lift riser, and the installation of a new dynamic riser section, flowline, and two thermoplastic composite pipe jumpers. Rigorous safety protocols, readiness planning, robust engineering, and procurement efforts ensured seamless vessel mobilization, and completion of the offshore scope of work in under eight months.
Kikeh is a producing field, located approximately 75 miles (120 km) northwest of Labuan Island, offshore Sabah, East Malaysia. It came on stream in 2009 as one of the largest deepwater developments in Malaysia, at the time. The work completed by McDermott includes upgrades essential to maintaining gas delivery to the subsea production system tied back to the Kikeh floating production storage and offloading vessel.

HERING supplied 2 steam generator systems to Bangladesh

HERING delivered 2 steam generators to Bangladesh in October last year. The steam generators are using the waste heat from 2x 4.5MW natural gas engines to produce over 10,000 kg/h of saturated steam for the production plant of a large food company.
HERING was already involved in the first feasibility studies for this project a few years ago. In the end, HERING has been responsible for the thermodynamic design, the detailed construction, and the complete production - 100% in-house in Gunzenhausen / Germany, right up to the transport. The steam generators will be commissioned by the local partner on site.

Barossa FPSO named in Singapore

THE FLOATING production storage and offloading unit for Santos Ltd's Barossa Field in the Timor Sea was officially named BW Opal at topsides builder Seatrium's Singapore yard.
BW Offshore claims it is one of the largest and most technically advanced ever built: "A landmark project for BW Offshore and industry collaboration ..." a remarkable journey since its inception in 2020.
"With sustainability at its core, it incorporates energy-efficient technologies that reduce CO_2 emissions by 15%, saving up to 2.3 million tonnes over its lifespan. Its combined-cycle gas turbines with waste heat recovery cut energy consumption by up to 66%, maximising both efficiency and environmental performance," BWO said.
BW Opal FPSO stands as one of the largest and most technically advanced units ever built, with a hull length of 358 metres and a width of 64 metres. It will have a gas handling capacity of 850 million standard cubic feet per day and a design capacity of 11,000 barrels per day of stabilised condensate. The unit will be turret moored, with a hull built using BW Offshore's innovative RapidFramework® design engineered to support advanced topsides, which weigh in at 45,000 tons.
"With the naming of our new flagship BW Opal, we have reached a milestone we have been looking forward to for almost four years," Marco Beenen, CEO BW Offshore, said.

Advanced Cooling Technologies CCHPs achieve 100m hours

Advanced Cooling Technologies, Inc. (ACT) has announced that its Constant Conductance Heat Pipes (CCHPs) have successfully achieved 100 million cumulative space flight hours. This achievement underscores ACT's unwavering commitment to innovation, reliability, and performance in space thermal management technology.
Since their introduction, ACT's CCHPs have played a vital role in spacecraft thermal regulation, ensuring the longevity and functionality of critical satellite components. These advanced two-phase devices efficiently transfer heat, providing a lightweight and highly reliable solution for aerospace applications. Used in commercial, government, and defense space missions, ACT's heat pipes continue to enable the success of numerous satellites and deep-space exploration missions.
ACT's CCHPs are extensively qualified to withstand the extreme environments of space, from geostationary orbit to deep space exploration. Their proven track record of performance has made them a trusted solution for major space agencies, prime contractors, and commercial satellite manufacturers worldwide.
As ACT continues to innovate and expand its spaceflight heritage, the company remains committed to advancing thermal management technologies that support the evolving needs of the aerospace industry.

ContiOcean delivers its first ship waste heat recovery system

ContiOcean®Environment Tech Group Co., Ltd. (ContiOcean) recently delivered its first (set of) 7000PCTC ship waste heat recovery system, adding new impetus to the green transformation of the marine industry!
The system recovers waste heat generated during the operation of the ship's main engine and converts it into electrical energy. It can effectively reduce energy consumption during ship operations and contribute to energy-saving and emission-reduction efforts in the shipping sector.
During the project implementation, the ContiOcean team fully considered the compact space of the ship's engine room and customized the design based on the engine room layout. By optimizing the shape of the skid-mounted unit, they effectively resolved the issue of limited space in the engine room. In addition, the skid-mounted unit features a detachable design, enabling disassembly for entry into the engine room and assembly inside, which significantly reduces installation time and improves construction efficiency.
The ship waste heat recovery system is one of the latest energy-saving devices- launched by ContiOcean. The system employs advanced ORC (Organic Rankine Cycle) technology to utilize waste heat sources from ships, including flue gas, jacket water, and air coolers. It drives a turbine generator through the evaporation and expansion of an organic working fluid, thereby converting waste heat into electricity.

Fresno State celebrates completion of Central Utility Plant project

Fresno State and officials from the Bulldog Infrastructure Group, the project company owned by Meridiam, gathered recently for a public ribbon-cutting ceremony to mark the substantial completion of the project to replace and modernize the university's Central Utility Plant.

The project is a 33-year public-private partnership (P3) between Meridiam, a leading infrastructure investment firm and sole owner of Bulldog Infrastructure Group (the project company), and Fresno State to design, build, finance and maintain Fresno State's central utility infrastructure system, replacing the Central Utility Plant with 3,700 tons of chilled water capacity, 35,000 MBH (millions of British thermal units per hour) of hot water generation, 700 tons of heat recovery chillers and thermal energy storage. The project is funded through a 30-year green bond and equity provided by Meridiam.

This project was the first P3 for major utility infrastructure in the CSU system. This delivery method will ensure that after the 30-year service period, the major equipment is well maintained and will not be an ongoing deferred maintenance risk for the university.

The project consists of replacing and modernizing the campus' Central Utility Plant, hot- and cold-water distribution network, and other energy conservation measures. The project installed a cost-effective mix of building efficiency and infrastructure improvements, including heating, ventilation, and air conditioning controls, energy management systems with reliable HVAC delivery, and lighting and domestic hot water upgrades to reduce energy consumption and the university's carbon footprint.

MAN Energy and ETH Zurich announce partnership

MAN Energy Solutions Switzerland and ETH Zurich, the public research university, have launched a strategic partnership to advance research in sector coupling and energy-system modelling. The collaboration aims to address one of the biggest challenges of the energy transition, namely the seamless integration of electricity, heating, and cooling networks.

The core of the partnership comprises funding for six postdoctoral researchers at the ETH Foundation to develop AI-powered energy-system models that will enable deeper technical and economic analysis of European energy markets and infrastructure. The research will also focus on optimising existing models by reducing computational demands, ultimately leading to more efficient and sustainable solutions.

A key aspect of the work will involve combining hardware and software innovations to enhance energy-system performance. Research activities will be coordinated by ETH's AI Center and Energy Science Center. ETH Zurich plays a key role in shaping national and international energy strategies. Researchers at the Energy Science Center and ETH AI Center combine cutting-edge interdisciplinary research with practical applications.

MAN Energy Solutions is contributing its expertise as a technology solutions-provider in the energy sector to the partnership, particularly within the areas of industrial-scale heat pumps and electrothermal energy-storage systems. Looking ahead, the company plans to integrate AI-based energy-management solutions for industrial infrastructure into its portfolio, with a strong emphasis on leveraging digital services to maximise the potential of sector coupling.

NANO Nuclear to work with Thermal Engineering International

NANO Nuclear Energy Inc. (NANO Nuclear), an advanced nuclear energy and technology company focused on developing clean energy solutions, has contracted with Thermal Engineering International (TEi), a Babcock Power Inc.® company, to advance the design and fabrication of several heat exchangers for use in NANO Nuclear's proprietary, portable ODIN nuclear microreactor in development.

TEi is a supplier of heat transfer technology to the electric power generation industry, designing and fabricating surface condensers, feedwater heaters, power plant heat exchangers, and moisture separator reheaters for the world's power generation industry continuously for over 100 years.

Under the terms of the contract, TEi will develop detailed designs for key heat exchanger technology integral to the ODIN microreactor. This includes the eventual fabrication of both primary and secondary heat exchangers. TEi will lead a broad, cross-functional initiative, drawing on its expertise to design practical heat transfer systems in collaboration with NANO Nuclear's world-class technical team, from procurement to the eventual fabrication of the exchangers.

The heat transfer systems are essential components within NANO Nuclear's innovative portable ODIN microreactor and their integration marks a significant milestone in advancing NANO Nuclear's proprietary microreactor toward demonstration, regulatory licensing, and eventual market introduction. This agreement builds on the work done by NANO Nuclear's world-class technical team and follows last year's external technical audit of the ODIN reactor by the Idaho National Laboratory, during which crucial design solutions and the system components were examined, reassuring the design development strategy.

Maine's businesses benefit from custom heat recovery technology

Maine commercial and industrial facilities are receiving incentives for heat recovery systems and saving energy in high-value areas like air ventilation and water heating.
Efficiency Maine has supported projects ranging from common energy recovery ventilators for fresh air supply in schools and offices to complex waste heat recovery in industrial processes.
Heat recovery is a broad topic with equally broad applications that can help reduce energy use in buildings ranging from residences to commercial spaces and large industrial facilities. Its most common application is air-to-air heat exchangers, or energy recovery ventilators (ERVs), that recover energy from exhaust air to precondition incoming outdoor supply air. Air-to-air heat exchangers are usually about 70% to 80% efficient and ERV systems typically provide a high rate of return with short-term, simple paybacks. Instead of direct air-to-air ERVs, larger facilities might use a glycol loop that circulates a water glycol mixture with a piping loop from exhaust air streams to supply air ventilation as a means of energy recovery (air-to-water and water-to-air).
Another common application for heat recovery is to recover heat rejection off of a refrigeration system. Grocery stores and other facilities with large cooling loads use this application because they inherently reject large amounts of heat in order to maintain their operating conditions.
Efficiency Maine was able to help Hannaford install glycol loop-based heat exchanger systems in two of their stores in order to recover heat from the refrigeration system and offset building heating needs. These systems typically involve using a water-to-water heat exchanger to recover heat from the refrigeration system, which can be used either directly in water-to-air heat exchangers to preheat outdoor supply air or to preheat water using another water-to-water heat exchanger.

Thermal Energy receives its largest engineering contract

Thermal Energy International Inc. has received a contract from one of the largest multinational pharmaceutical companies to provide detailed engineering services for a potential heat recovery project at one of the pharmaceutical company's sites.
After receiving orders for three major heat recovery projects from a different pharmaceutical company, this is the second major pharmaceutical company to engage Thermal Energy for heat recovery projects. This contract, valued at USD 500,000, is the largest engineering services project Thermal Energy has received in its history. All figures are shown in CAD.
"We are excited to have received such a significant engineering order from another world-leading pharmaceutical company," said William Crossland, CEO of Thermal Energy International. "The engineering to be done under this contract is much more extensive than the level we would provide under one of our project development agreements or PDAs. In fact, we signed a PDA with this company approximately a year ago and based on the outcome of the PDA the client has retained us to complete the full detailed engineering for the project. Typically, customers prefer the detailed engineering to be part of a total turn-key fixed-priced project agreement but in this case, the customer's preference is to approve the project in stages. This is also a lower risk option for Thermal Energy because firm pricing will not be provided until the detailed engineering is completed."

SAMSUNG E&A wins contract for Methanol plant project

SAMSUNG E&A has announced through a public disclosure that it had received a Letter of Award for the EPC of the TA'ZIZ Methanol Project. The contract value is USD 1.7bn, with a contract duration of 44 months.
This project includes the construction of a methanol plant with a production capacity of 1.8 million tons per annum at the TA'ZIZ chemicals and transition fuels ecosystem being developed in the Ruwais Industrial Complex, UAE.
SAMSUNG E&A will bring its successful experience of a recently completed methanol plant in Malaysia and the active application of its unique execution system, characterized by modularization and automation, to the project.
Hong Namkoong, President and CEO of SAMSUNG E&A stated, "We plan to actively leverage local resources and our network of partners based on our extensive regional experience in the Ruwais Industrial Complex, UAE." He added, "SAMSUNG E&A will ensure the project's success by applying our differentiated execution system, which integrates our innovative technologies such as modularization and automation."

Canadian startup secures patent for solar module cooling tech

Enertopia said it has secured US patent 12224704 from the United States Patent Trademark Office (USPTO) for its solar panel heat recovery system.
The system is designed to capture and retain moisture that forms on the panel at dew point temperatures. A moisture collection layer between the panel and a liquid transfer system enables rapid heat transfer from the photovoltaic panel to the liquid transfer system.
"In some instances, during periods when, due to surrounding ambient conditions, moisture will not naturally form, the heat recovery system described herein may employ a controlled water emitting means to ensure saturation of the moisture collection layer," the company said.
The moisture collection layer could also be used to provide water for irrigation of plants in dry areas.
The company said that solar panels equipped with cooling systems are potentially exposed to thermal shock when they come into contact with a cool liquid transfer system.
"Our patented process addresses this issue by providing an open loop system that helps to prevent or limit thermal shock, and thus failure," said the company. "The open loop system separates the liquid transfer systems that may include a cool liquid from the photovoltaic panel, while still rapidly encouraging and/or extracting heat from the photovoltaic panel and directing the heat to the liquid transfer systems."

Improving heat exchanger functionality with quantum mechanics technology to achieve net zero

A heat exchanger is a device that is used to transfer heat between a process and a cooling fluid during an industrial application. The term "thermal management" best describes the heat exchanger function. Relatively simplistic in design, HE's operational condition can significantly impact the day-to-day energy consumption of an industrial process and its carbon footprint. Due to phenomena such as biological fouling (aka, biofilms), calcium carbonate deposits (aka, scaling) & corrosion, cause heat exchangers to increase GHG emissions and energy expenditures.

By Robert B. Bender BS, MBA, MPTD

Heat exchangers are basic devices found in large numbers in all industries including mining, chemical production, petroleum refining, metallurgical, power generation and large commercial facilities (educational, multi-unit dwellings, manufacturing, warehousing, etc.). Typically rugged, they are over designed to compensate for potential inefficiencies to minimize excessive downtime or diminished functionality. Exchanger parameters to be considered for optimum function are exchanger size, plate surface area and importantly, cooling water flow characteristics. Unfortunately, even though sufficient design margins are anticipated, certain conditions, such as cooling water fouling (as seen in Figure1), can result in increased energy draw and thus excessive GHG. The results of this degrading functionality are expressed through reduced heat transference and increased back pressure within the cooling water system.

For a heat exchanger to function efficiently, it requires clean heat transfer surfaces and unimpeded cooling water flow. Fouling occurs when contaminants within the cooling water adhere and solidify on heat transfer surfaces and in flow spaces. This condition begins immediately after a clean heat exchanger is brought online. Although not immediately apparent, as formations increase in density or dimension, there is an ever-decreasing function expressed by the exchanger. Each exchanger requires a specified cooling water volume, speed, and pressure to ensure heat extraction. This is not achieved if there is impeded flow space or misdirection away from heat transfer surfaces.

Obstructions reduce flow volume which causes increased back pressure across the exchanger. Furthermore, on heat transfer surfaces, the biofilms & scaling function as thermal insulators, reducing the transfer of heat from one fluid to another. Sensors will demand greater water flow from the cooling water pump as a response to a temperature and pressure rise. To compensate, the pump increases water output necessitating increased amperage draw. This increased energy is typically from a source that uses fossil fuel combustion for electrical energy production, ergo the need for more fossil fuels, and their negative impact on our environment. Even a small, incremental rise in pump demand due to foul formation can often translate to measurable increases in GHG generation (see Figure 1). There is an ever-increasing decline in function (and corresponding increase in energy draw) that continues until an acute condition, such as total malfunction, requires an emergency disassembly. Unfortunately, due to the importance of a heat exchanger within a process system, they are not readily taken offline to clean and are typically tolerated until and when an issue arises.

Figure 1 is from one of the many papers that have indicated the relationship between heat exchanger fouling and its environmental impact [3,4]. The paper concluded the following:

"…the presence of unwanted deposits on heat transfer surfaces in power station steam condensers can increase the discharge of greenhouse gases. The extent of the increase is of course dependent upon the thickness of

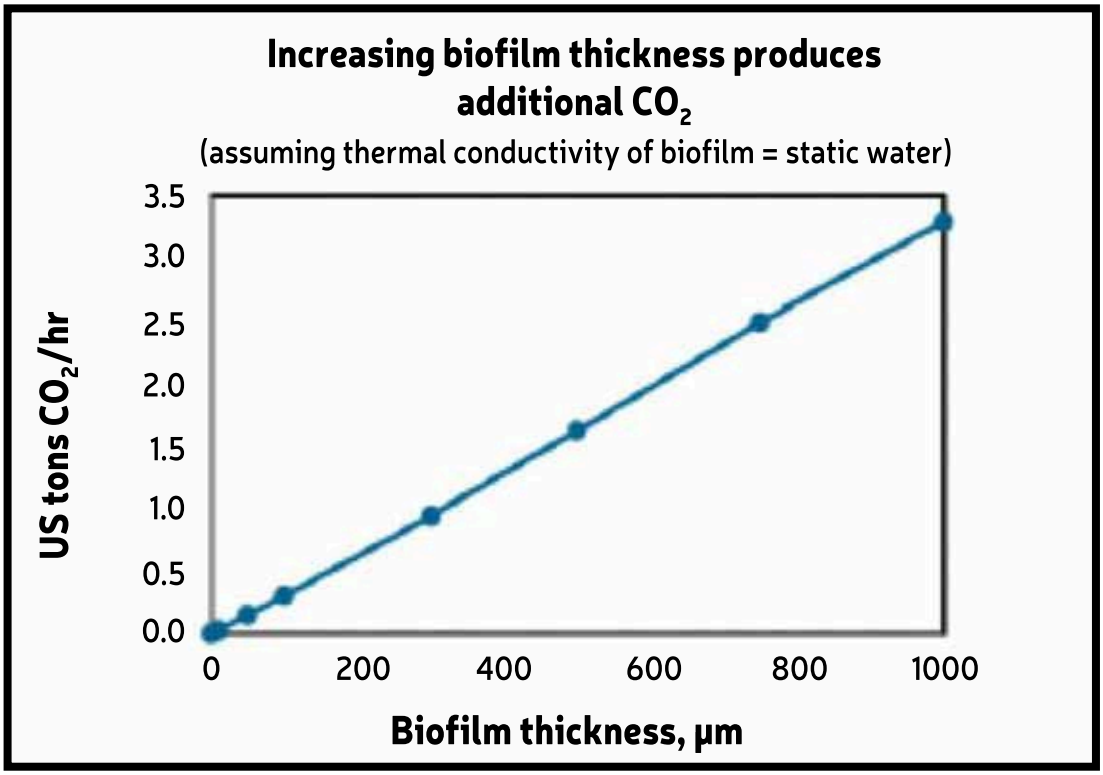


Figure 1. The relationship between heat exchanger fouling and its environmental impact.

the deposit. The loss of heat recovery and the additional energy for pumping represent a loss of thermal efficiency. When fuel combustion supplies energy, additional greenhouse gas emission will result."

Technical edification of quantum mechanics

An QMT Collar water treatment devices use quantum technology, an emerging, yet proven technology, to keep Heat Exchangers and other industrial equipment operating at peak efficiency. The QMT Collar uses specially modulated ultra-fine waves, stably stored on a silicon-aluminum material by utilizing laser injection technology. The QMT Collar continuously emits pre-recorded ultra-fine vibration waves, interfering with the material waves of various substances (Biofilms, Iron Oxide, Calcium Carbonate et.al) that results in a coordinated resonance reaction that causes physical changes that eliminate forming, bonding and sedimentation. The microscopic appearance of the substances will exist in the form of particles which will be flushed away by the circulating water. They will not accumulate on the Heat Exchanger Plates or Tubing. Any fouling or bonding that does exist will be broken down and flushed out as suspended solids or in solution.

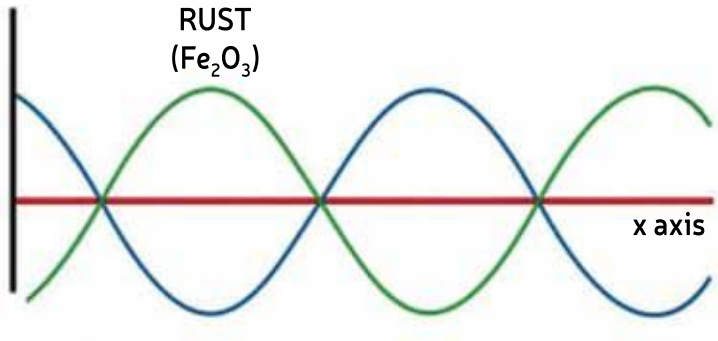
The QMT Collar water treatment products use quantum mechanics technology. This technology is the latest generation of environmentally friendly water treatment technology developed based on quantum mechanics. It uses specially modulated electromagnetic waves to interact with a dielectric material made of a special alloy composed of silicon and aluminum and stably stores ultra-fine vibration waves on this dielectric material by utilizing laser injection technology. The dielectric material will continuously emit pre-recorded ultra-fine vibration waves, changing the material waves of various substances in the medium through the medium (such as water, oil), resulting in a coordinated resonance reaction, causing physical changes, that is, changing existence. Form, no bonding, no sedimentation. The macroscopic appearance is calcium carbonate, and iron oxide will exist in the form of particles, which can flow away with the circulating water without accumulating on the pipe wall. Organic matter such as bacteria and algae will die in the shock wave environment, achieving the function of inhibiting bacteria and algae.

Mechanism of action scale inhibition & removal

There are a large number of soluble salts in the circulating water system, mainly $Ca(HCO_3)^2$. As water temperature and other conditions change, unstable calcium bicarbonate decomposes into the inorganic compound calcium carbonate ($CaCO_3$), which is extremely insoluble in water. A single calcium carbonate molecule which has a weak charge polarity on a microscopic level and is easily affected by water or other charged substances will aggregate and grow into flaky or even massive mixed crystal structures on the pipe wall or Heat Exchanger Plate.

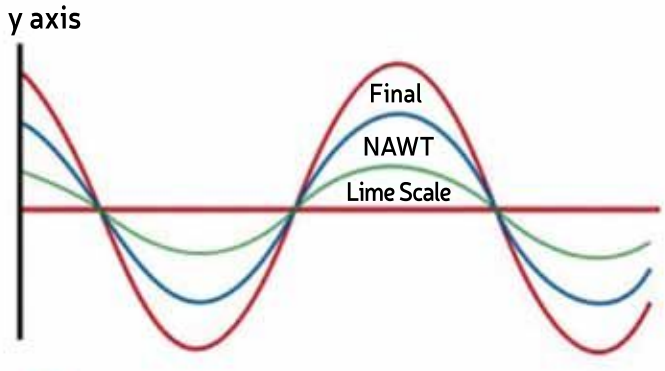
These mixed crystals are arranged in a staggered pattern to form an extremely strong scale layer that requires the use of chemical acids or high-energy physical impact to peel it off. Under the influence of an QMT water treatment product, single or small clusters of calcium carbonate molecular crystals in the aqueous solution are disrupted by the cooperative resonance effect of ultra-fine vibration waves. The microstructure of calcium carbonate crystals changes from a needle-like structure that is easily cross-bonded to a spherical or small granular structure with a smoother appearance. That is, scale appears as loose small particles that no longer adhere to the inner wall of equipment or pipes. It settles in the form of soft floc at the bottom of the container in still water and is eventually carried away by the water flow.

When the calcium ion concentration reaches 400 mg/L and the pH value exceeds 11, it still shows good anti-scaling effect.



- The green wave is the matter wave of rust molecules
- The blue wave is the oscillating wave of NAWT Collar
- The red line is the result of the final superposition of green and blue waves, changing the physical properties of rust

Figure 2. Interference effects on rust.



- The green wave is the matter wave of the lime scale
- The blue wave is the oscillating wave of NAWT Collar
- The red wave is the superposition of blue wave and green wave, indicating that the material wave of the lime scale has changed under the action of the oscillating wave. The result is changes in the physical properties of lime scale.

Figure 3. Superimposed effects on lime scale.

Corrosion prevention & inhibition

During the operation of the industrial circulation cooling process, there is a layer of metal oxide on the surface of the equipment and pipes .The ultra-fine vibration waves generated by products using quantum mechanics technology can react on iron atoms on the metal surface and oxygen atoms in the water, causing the iron atoms and oxygen atoms to be directionally combined to form a Fe_3O_4 film that acts on the inner wall of the pipeline, thereby isolating the erosion of corrosion factors. This oxide film is denser and has better corrosion inhibition performance when subjected to high-chlorine corrosive water.

Bacteria & algae

Quantum Technology products can continuously release ultra-fine vibration waves similar to biological signals into the water. After the water environment is affected, it destroys the biofilm, the nutritional source of bacteria and algae, making them unable to survive. At the same time, under the action of ultra-fine vibration waves, bacteria and other pathogen fragments are disintegrated, the biofilm loses viscosity and is dispersed in the water and finally discharged through the sewage system.

Benefits of quantum mechanics technology in heat exchangers

No maintenance required

Other types of mechanical systems used to mitigate bio-fouling & scaling in heat exchangers i.e., nanobubbles, magnets, UV, require additional equipment, equipment that requires maintenance ergo additional costs are accrued. Quantum Mechanic Technology requires no maintenance. The human element is removed. Install it & forget it!

No energy source required

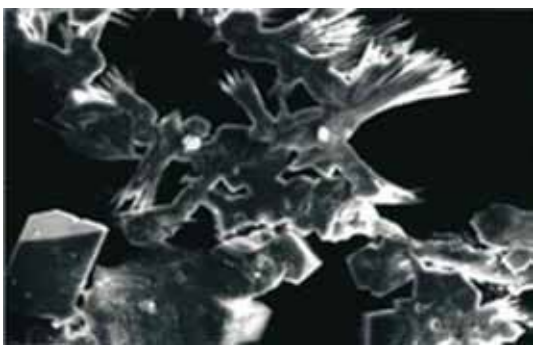
Nanobubbles, UV, Magnets require a power source. It increases electricity costs and increases installation costs.

No chemicals needed

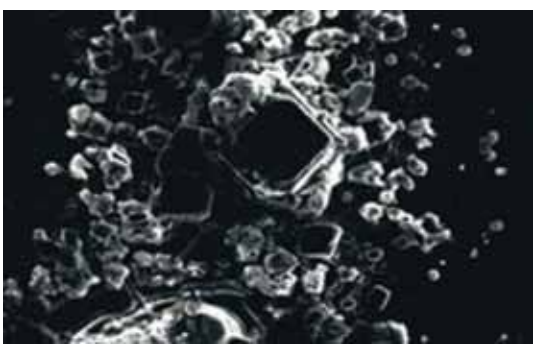
Eliminates the costs of procuring chemicals, handling chemicals, disposing of chemical containers and special handling equipment. Keeps the chemicals out of the environment. Biofilms can now be 100% removed, chemicals cannot remove 100%.

Easy, non-invasive installation

No cutting pipes, no installing flanges, no welding. Only two bolts that need tightening with only one tool, an Allen Wrench. No lost production and no downtime for equipment. The QMT Collar works on any material used for piping: steel,



Lime deposits in untreated water. Magnification: 250x.



Lime deposits in water treated with QMT Collar. Magnification 250x.

Heat exchanger closeup full of hard insoluble mineral deposits, salts scale and corrosion.

cast steel, stainless steel, cast iron, ductile iron, copper, PVC, CPVC, composite et.al. The pipe gets wrapped with RED electrical tape to prevent any galvanic reaction. Red tape needs to be used, because black is not conducive to the transmission of the waves. The red-light wave has a longer wavelength, so it is more conducive to spectrum transmission and can effectively penetrate the atmosphere and water, while black does not represent a specific wavelength, so the transmission ability is weaker. Depending on size, it should not take longer than 30 minutes. No Special Skills required to install. No footprint installs on the OD of an existing pipe.

Advanced solid-state technology

Activated upon installation. Useful life of over 10 years. Not affected by ambient conditions, heat, cold, water spray, high humidity, high temperature, VOC's, will not affect performance.

Extends life of service equipment

Inhibits & removes scale so cooling water flows unimpeded. No increase in pump motor speed or amperage draw. Keeps valves fully operational and cuts corrosion in piping systems.

Saves energy

No energy source required, no increased energy required to overcome flow impediments. Reduces system operating cost. For decades, industry has borne the financial expense and challenges presented by heat exchanger fouling because of the difficulty of remediation or prevention. It was understood that there was a fiscal impact of maintenance, repair, excessive energy, and loss of process which could reach .25% of an industrialized country's GNP due to fouling [5]. These challenges were tolerated since the results of these inefficiencies were only felt by the facility. It was the advent of climate change and an understanding that each malfunctioning heat exchanger offers a compounding impact on environmental global events. It is now universally accepted that there is a need to reduce GHG expression from industrial process systems by utilizing a sustained method to prevent fouling in heat exchangers. ■

About the Author

Robert B. Bender BS, MBA, MPTD has been introducing emerging technologies to corporate America for over half a century. His clients include Ford Motor Company, General Motors, Anheuser-Busch, National Grid, Brookhaven National Labs, Department of Environmental Protection - New York City, US Steel, Bethlehem Steel, Lever Brothers, AMTRAK, Long Island Railroad et.al. Mr. Bender's creative problem-solving skills at all corporate levels have resulted in much lower costs for the maintenance, operating and procurement corporate functions. Has made it his life's quest to remove toxic chemicals from the environment. Sits on the executive boards for DPCC, LIMBA, and AFE (Association for Facilities Engineering). President of the Long Island, NY Chapter of AFE since 2007.

Acknowledgments:

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Shell and tube HEX bundle offline spare criteria and storage procedure

This article details the guidelines to identify and establish spare criteria for critical assets (Shell and tube heat exchangers tube bundles categorized as "High Risk") in order to allow increasing the asset availability and minimize the equipment downtime due to lengthy and costly repairs.

By Miguel Gutierrez, Field Consultant Engineer at GME – Reliability Solutions Department in Saudi Aramco

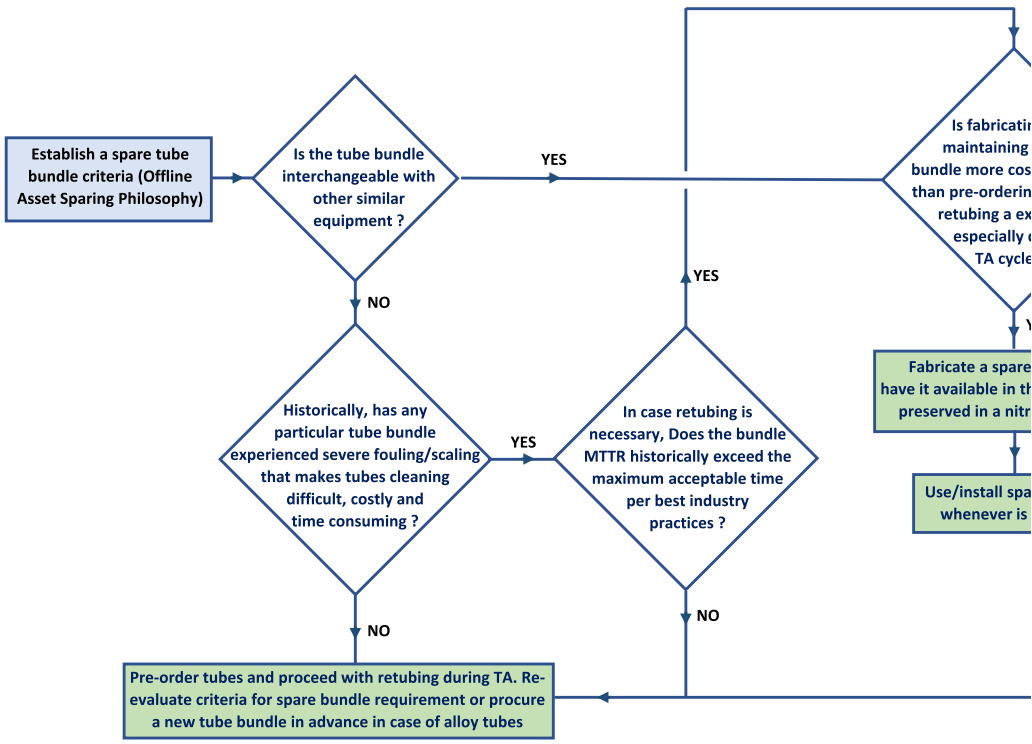
Objective

The main drivers to establish the required guidelines for maintaining a heat exchanger tube bundle spare (Offline asset sparing philosophy) are given by the asset criticality classification (Only applicable for "High Risk"), operational requirements, asset interchangeability, failure modes and frequency, lead time for tubes fabrication, logistics and space constraints, cost considerations (Cost of spare bundles and inventory holding costs) and repair vs replacement decision.

The benefits of implementing an offline bundle sparing philosophy focus on ensuring a reliable plant operation and efficiency which will translate on enhancing plant performance, reduce overall maintenance costs and extend bundle service life.

Expected benefits

- Minimal operational downtime: Ensure critical process has minimal disruption by having spare tube bundles readily available for immediate replacement when failures occur.
- Improved maintenance efficiency: Streamline maintenance activities by cataloging tube materials and having spare bundles available. This allows for unplanned or planned maintenance to be carried out quickly and efficiently without depending on tubes manufacturer delivery or bundle replacement.
- Enhanced equipment reliability: Increase reliability by identifying common failure modes, avoiding prolonged operations under sub-optimal conditions that could lead to a large failure.
- Avoiding costly delays: Production losses and penalties due to long repair lead times (Extended MTTR) can be avoided by maintaining a spare parts inventory.
- Reduced unplanned shutdowns: Prevent unplanned shutdowns that can be costly in terms of production losses and associated penalties by ensuring spare tube bundles are readily available in case of unexpected failures.
- Optimized spare parts inventory: Develop an efficient offline asset sparing strategy by holding critical spare bundles without over-



*Replacing the tube bundle (use spare bundle or procure a new bundle) instead of retubing is more cost effective, especially in those cases where the bundle repair/retu

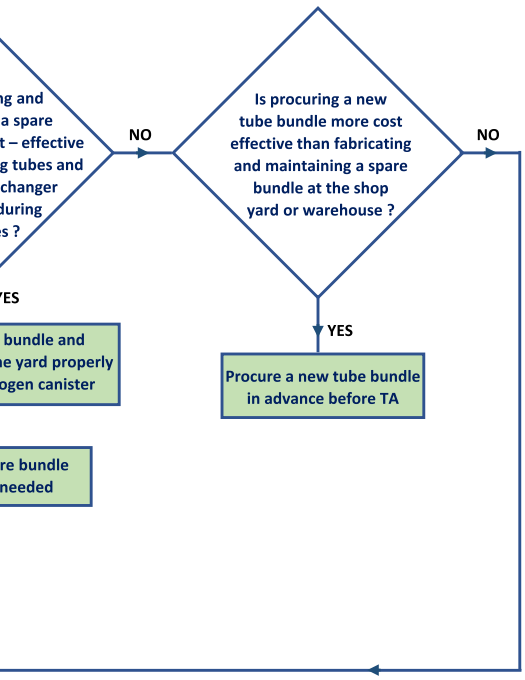
Shell and tube heat exchanger tube bundle spare criteria for high risk bundles (offline asset sparing philosophy) flowchart.

Photo courtesy of Saudi Aramco.

investing in components that are unlikely to fail. This balances operational risk and inventory costs.

- Supported predictive and preventive maintenance: Align the spare bundle philosophy with predictive maintenance programs. By monitoring the condition of the heat exchanger, spares can be ordered and replaced proactively avoiding failure before they happen.
- Compliance with safety and environmental standards: Ensure that critical equipment used in hazardous or environmentally sensitive processes is promptly repaired or replaced to meet safety and environmental regulations.
- Planned maintenance flexibility: Maintenance Team can schedule tube bundle replacements during planned shutdowns when spares are readily available, improving turnaround times and allowing for better planning of maintenance windows.
- Reduced emergency situations: A well-defined spares bundle philosophy reduces the likelihood of costly emergency repairs, where expedited shipping and labour costs can increase expenses.
- Timely replacements: Having spare bundles on hand allows for the timely replacement of severely corroded bundles and facilitate the utilization of interchangeable bundles for similar equipment, thus extending the bundle service life.

A structured approach that will facilitate an operating facility to establish an offline sparing philosophy for shell and tube heat exchanger bundles is shown in the flowchart.



be is the critical path of the turnaround.

Shell and tube bundle storage procedures

A) Using rust inhibitor

- Shop Supervisor to develop and inventory sheet of all tube bundles at the facility shop yard.

Photo courtesy of Saudi Aramco.

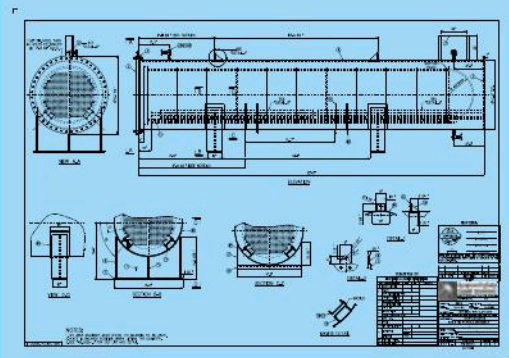
Pressurized N2 canister. Photo courtesy of Saudi Aramco.

- All tube bundles stored at the facility shop yard will be protected using a rust inhibitor that will be applied by spraying.
- Blow dries the surface to be sprayed using compressed air.
- Apply a liberal spray coating of the inhibitor to all surfaces that will rust.
- Apply a coating of grease to all gasket surfaces
- On carbon steel tube bundles that have been tube side tested, the ID of the tubes require to be blown dry and have rust inhibitor sprayed in each tube from both ends. (The actual application of the rust inhibitor shall be done outside the shop preferably in the hydrojetting area (Open yard)
- After the bundle is sprayed and approved for storage by the Shop Supervisor and Inspection QA/QC Team, an inventory and inspection tag will be added. It is advisable to store the tube bundle in close area warehouse and/or use heat shrink wrapping when stored in open yards.
- It will be the responsibility of proponent Engineer/Inspection QA/QC to inspect the stored bundles.
- Inspection QA/QC will check and verify each bundle against the inventory and mark the tag on the bundle that has been inspected including signing the inventory sheet.

Sample of an N2 canister fabrication drawing.

For the full resolution, please contact editor at

i.mukha@kci-world.com.



- Inspection QA/QC will indicate on the inventory sheet which bundles need to be re-sprayed with rust inhibitor.

B) Using pressurized nitrogen (N2) canister

- Shop Supervisor to develop and inventory sheet of all tube bundles at the facility shop yard.
- Determine the required canister dimensions that will fit the stored bundle.
- The canister shall be visually inspected for any defects (Corrosion, coating failure, lifting lugs damage, weld seams imperfection, sliding bar damaged, etc.)
- Flanged connections and all other machined surfaces area will be protected using an appropriate lubricant with rust preventive compound such as Cortec VpCI-369 or equivalent.
- Place the bundle inside the canister and close it using flanges and seal compound.
- Shop personnel should ensure a proper pressure gauge is installed on top of the canister including it has calibration sticker.
- Depressurize the canister and then re-pressurize with nitrogen (N2) until pressure gauge reaches 2 to 5 Psig.
- It will be the responsibility of Proponent Engineer/Inspector QA/QC to inspect the stored bundles
- Inspection QA/QC will frequently check and verify each canister pressure reading and log it and sign on the inventory sheet. ■

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1. SA MSSD Shop Department – Shop Heat Exchanger Bundle Storage Procedure
2. API 660 – Shell and Tube Heat Exchangers for General Refinery Services
3. ASME PCC-2 - Repair of Pressure Equipment and Piping
4. NB23 - National Board Inspection Code

About the author

Miguel Gutierrez is a Senior Mechanical Engineer with over 30 years of experience in the oil and gas industry, particularly in the Downstream Business showcasing his expertise in stationary equipment. His focus on piping/pipelines, pressure vessels, heat exchangers and storage tanks, along with hands-on troubleshooting during plant operations and turnarounds, reflects a comprehensive skill set. His international experience in Venezuela, the Caribbean Basin and the last 18 years in the Middle East adds a global dimension to his professional profile.

Engineering vital tools

Custom tools are necessary to support the diversity that spans heat exchangers and the industries that depend on them. Heat Exchanger World had the pleasure of speaking with Ben Lambers, Vice-President of Technology at Elliott Tool Technologies, to discuss his views and enthusiasm for an industry that influences behind-the-scenes but necessary applications that affect our everyday lives.

By Heat Exchanger World

Ben Lambers, Vice-President of Technology at Elliott Tool Technologies

Supporting, researching, developing

Ben Lambers' dedication to the industry and collaborative spirit are governed largely by his decision to work for Elliott Tool Technologies – a supplier of innovative heat exchanger tooling solutions such as tube expanders, plugs, cleaning systems, tube pullers, and more. He appreciates bearing witness to a process from beginning to end. "We take a design, start from a clean sheet of paper, and finish with a fabricated part." As the Vice-President of Technology at Elliott Tool Technologies he spends his day supporting his team, researching new product development, and reviewing legacy designs. He is a licensed professional engineer who has been with the company for six years. Lambers and his team solve applications-related customer problems and evaluate projects that will help solve these issues. "I have the privilege of leading the company's engineering and IT departments." His role entails ensuring his team has access to the resources they need to assist the company's customers.

"We provide tooling for the heat exchanger industry, which means anything that is needed to clean, test, and install key components in heat exchangers," said Lambers. This includes chillers, air coolers, and boilers. They provide all the tools needed to fabricate and service heat exchangers. Lambers is also involved in the metal finishing side of the business, which includes the process of burnishing. Burnishing is a cold working process that creates fine surface finishes and increased material hardness for fabricated parts. The process does not alter the metal's structural properties like shape, size, and thickness; in addition, burnishing provides the metal with protection from corrosion. "We do some cold working on the surface that improves the mechanical properties of the material as well as the surface, and that can be used in a variety of industries," said Lambers.

Wiedeke Dayton began in 1892 with Gustave Wiedeke, an inventor and manufacturer. Through constant innovation, he designed the first tube expander. Wiedeke Dayton became Elliott Tool Technologies, and Lambers is continuing the ritual of contribution through inventive process.

A flexible industry

Lambers marvels at the expansive heat exchanger industry that is crucial not only to the oil & gas industry but to industries most people do not even consider. "These industries touch so many different facets of our lives, including oil & gas and petrochemical refining. They are used to make products we all use every day. Think about it. Heat exchangers are used from nursing homes to nuclear power." Elliott Tool owns their designs, and

Elliott Tool's 24 series condenser expander.

Elliot Tool's diamond brushing tool boring bar style.

they collaborate with their customers to design tools that meet their customers' needs and solve their problems. "We manufacture all our products in-house. I have enjoyed learning about the heat exchanger and oil & gas industries. It has been really intriguing and kept me interested in staying in the industry."

Challenging the challenges

Navigating supply chain issues has become a common stance across most industries. "Our purchasing department has experienced trouble finding materials, and they are facing higher prices. We are fortunate that we manufacture 95% of our products in-house but if we have to deal with an outside vendor, it becomes more challenging."

"We are always trying to find new approaches to make processes more efficient," said Lambers. "But cost sometimes prevents innovation." When there is an established way of doing things that have always worked, there can be resistance to new processes, especially if cost is involved. "We try to find new ways to work with our customers to find new methods, tools, and processes. While that does take time, it is happening. We have worked with customers who will collaborate with us to test new products and even though they know the risk, they are excited about the opportunity and want to be part of innovation and development."

If a company is offline, they want to use what they know to get back online rather than use that moment to test something new. Lambers understands this view, but he is also intent on working with customers to improve innovation within the industry and accelerate the industry's pace.

Savoring success

Success to Lambers is being involved in the engineering of a product and watching that product come to fruition. Collaboration resulted in the development of a product customers can use that provides two different expansion methods on the same machine. "It leads to lower cost of capital and still gives them options on either a parallel pin method or a traditional tapering pin."

"The goal was to push the boundaries on essentially expanding more or greater length of tube within a single cycle to reduce the number of rolls or expansion cycles required to process or install tubes or tube sheets. It is about increasing productivity for our customers and reducing the time so that we can process these vessels and get them back into the field," continued Lambers.

Transfer of knowledge

Lambers has witnessed firsthand the departure of experienced experts, and he knows through discussions with customers that they are living the same situation. He has also seen the arrival of younger engineers with inventive concepts, but the challenge is retaining these newer engineers. "Incorporating cutting edge technology can be daunting for newcomers," said Lambers. "Initiatives like organized group lunches to share ideas, information, and knowledge help to combat this. Application specialists help train new operators on best practices and tricks as a proactive approach to mitigate the shift. These are places to ask questions."

Lambers references "lessons learned" documentation that the more tenured employees contribute to the Elliott Tool database for newcomers to learn about the company's tools, and why and how they are designed.

Lambers' advice for the engineering field is to leave the desk and the office and see where the products will be used and where investors are placing their service. He advises those new to the industry to learn as much as they can about the applications, and approach everything with genuine curiosity. "Do not be afraid to ask questions. Being reluctant to ask questions holds you back. Understanding how your role fits into the bigger picture influences other things around you. It drives a lot more excitement. Curiosity allows you to do a better job."

Recognizing commonalities that power the future

Lambers recognizes an industry in transition. There are now more options for energy, and their business is not immune to the changes. "I really think there will be a push for improved efficiency, waste elimination, and reduced costs. There will be a push in our direction to improve design, serviceability, and longevity for the vessels in the field of service," said Lambers.

Trying to succeed as an isolated entity does nothing to further the industry or those companies that operate within it. Leaving the silo and sharing ideas and philosophies regenerates an industry. "There is a commonality between us and other companies, such as driving change and innovation, companies that want to work with the whole supply chain to propel improvements, and cost reduction to advance the industry. The success of the industry depends on its ability to innovate and reduce costs. I want to support that," Lambers concluded. ■

Get more out of your heat exchangers with heat transfer enhancement: Part 2 – enhancement

In this series of articles we will look at the idea of heat transfer enhancement. The benefits of enhancement are that your heat exchangers will provide the same performance at a lower cost or provide better performance at the same or smaller overall size and footprint.

By Himanshu Joshi, Heat Exchanger Specialist, and Lou Curcio, Heat Transfer Advisor

In this part we will present more information on the enhancement types which were listed in Part 1, by elaborating on the following aspects: a more detailed description, which technique is applicable, and which side (shell or tube) is the best for enhancement. One important consideration in choosing the appropriate technique is the idea of "controlling resistance", i.e. which component of the overall heat transfer coefficient is most beneficial to enhance.

Controlling resistance

Repeating from Part 1, the heat duty is represented by equation (1):

$$Q = U * A * \Delta T \quad (1)$$

Which can also be written as:

$$A = Q / (U * \Delta T) \quad (2)$$

Q = heat duty [W]
U = overall heat transfer coefficient, OHTC [W/m^2–C]
A = heat transfer surface area [m^2]
ΔT = Temperature driving force for heat transfer [C]

Equation (1) shows that we can increase the heat duty by increasing the surface area and/or the OHTC, given the two flow rates and their incoming temperatures are fixed. Let's begin by looking at the OHTC, and how it is calculated. The OHTC for a heat exchanger with two fluids, one hot and one cold, is expressed by the following equation:

$$U = 1 / R_{total} \quad (3)$$

$$R_{total} = R_{hot} + R_{cold} + R_{fouling} + R_{wall} \quad (4)$$

R_{hot} and R_{cold} are determined based on the individual convective film heat transfer coefficients, which depend on the fluid properties, flow conditions, and the geometry of the heat exchanger. A thermal design is optimal when the R_{hot} and R_{cold} values are equal. This design may sometimes be infeasible due to constraints like pressure drop or mechanical limitations. In certain designs, one thermal resistance can be significantly greater than the others, and it is known as the Controlling Resistance. An example of this concept is the design of air-cooled heat exchangers. Often, the thermal resistance on the airside with bare tubes is the Controlling Resistance due to the low film heat transfer coefficient of air compared to that of the tube side fluid. When this situation arises, the thermal design will benefit from enhancing the airside with external, high fins. The fins significantly increase the outside surface area, which reduces the airside thermal resistance. In this example, the Overall Heat Transfer Coefficient (OHTC) decreases because it is based on the finned surface area instead of the bare tube area. The additional surface area from the fins overcomes this deficit, resulting in an increase in Q. There are two lessons from this example. First, the design is enhanced by reducing the Controlling Resistance using an appropriate enhancement technique, namely external high fins. Second, the combination of the OHTC multiplied by A must increase for the enhancement technique to boost Q.

Enhancement types

Four types were listed in Part 1, we will look at each in detail below.

Increased surface area

Surface area can be increased simply by making the heat exchanger larger - more tubes and a larger shell diameter. This approach has many drawbacks - higher purchase cost, decrease in OHTC, lower velocities and higher fouling if the fouling is velocity dependent, and the possibility of poor flow distribution. Additionally, this approach cannot be used in debottlenecking situations where the shell size is already fixed.

The most common technique to increase the surface area, without making the heat exchanger larger, is by forming or attaching fins on the outside of tubes. In shell-and-tube heat exchangers the fins are formed from the base tube material and such finned tubes are commonly referred to as *Low Fin Tubes*, here we will call them Integral Fin Tubes (IFT). A sample tube is shown in Figure 1 below.

IFT provide 2.5-3.0 times the surface area compared to smooth tubes and are therefore ideal for use when the controlling resistance is on the shell side. In chemical process industries IFT can offer benefits for shell side condensing or gas flows, and occasionally with liquid flows.

Figure 1. Integral fin tube. Photo courtesy of NEOTISS-HPT Fin Tube.

IFT are made by starting with a smooth tube and using the tube wall material to form the fins. The OD (outside diameter) of the finned tube, measured at the top of the fins is the same as the smooth tube. This results in a tube wall thickness, under the fins, which is smaller than the starting smooth tube. For corrosion or pressure retention, it is the new, smaller wall thickness that is relevant, not the starting thickness. Secondly, the ID (inside diameter) of the finned tube is smaller than the starting smooth tube which increases the tube side pressure drop, a consideration in the thermal design.
A myth about IFT is that, compared to smooth tubes, fins make the shell side more prone to fouling and IFT are more difficult to clean with traditional hydroblast techniques. This thinking has taken hold because of the mental picture of foulant material getting trapped in the gap between the fins. However, the experience of the authors in over a dozen fouling services and that of IFT manufacturers has never borne out this fear. IFT fouling is governed by the same mechanisms as those for smooth tubes and they foul at the same rate. With an area increase of 2.5-3.0X, the finned heat exchanger can provide that much extension in run length before the same fouling level is reached, we will elaborate on this in a future article.

Increase the heat transfer coefficient
The heat transfer coefficient is a strong function of velocity and turbulence in single phase flows. Enhancement techniques can be applied on the tube side when it is the controlling resistance. Two such techniques are available, inserts and internal fins (ribs). Tube inserts create improved mixing at the wall and thus improve the rate of heat transfer. Spring-like wire inserts (Figure 2) provide 1.3-1.5X improvement while wire matrix inserts (Figure 3) can provide as much as a 10X increase if the flow is laminar.
Internal ribs are shown in Figure 4 (tube ID). They create a swirl flow and increase the tube side heat transfer coefficient, additionally providing a small increase in the surface area.

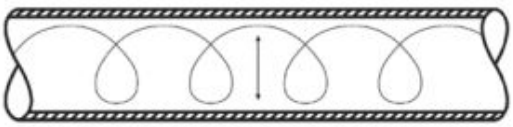


Figure 2. Coiled wire insert.

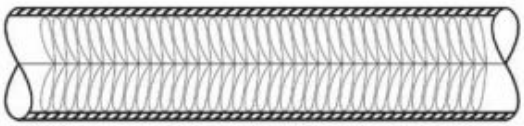


Figure 3. Wire matrix insert.

Figure 4. Nucleate Boiling structure on the shell side and Internal Ribs on the tube side. Photo courtesy of Wieland.

In boiling services the heat transfer coefficient can be increased by improving the nucleate boiling ability of the surface by providing a large number of nucleation sites (tube side or shell side). A specially designed surface coating or fin-like structures formed from the tube material (Figure 4, tube OD) are available and proven. Details of these techniques will be covered in future articles.

Decrease the Fouling Resistance
If fouling is the controlling resistance, several techniques are available to reduce fouling and thus increase the OHTC. These were described in the series Fouling Focus (Parts 4 & 5, Heat Exchanger World Dec 2023 and Feb 2024). The techniques include tube inserts, coatings, vibration, and a change of tube metallurgy.

Change to non-tubular heat exchangers (plate-type)
Heat exchangers such as Plate-and-Frame, Spiral, Plate-Fin, and Plate-in-Shell offer several advantages — compactness (smaller size, volume, and plot-space), higher OHTC, and lower fouling. Selecting one of these, either as an initial design or as a replacement requires consideration of several factors including cost, reliability, and pressure drop. We will address plate-types in a future article in this series.

Pressure drop

In general, an increase in the heat transfer coefficient for single phase services comes at the price of pressure drop. When we use inserts or increase velocity, there is an added pressure drop that must be accounted for in the overall cost of using the technique. Technology suppliers have data and experience to advise how much extra is needed.

Upcoming in this series

In upcoming articles, we will look at details of specific technologies available for heat transfer enhancement - how they work, advantages and disadvantages, applicability, precautions to be taken, costs, maintenance aspects, and field experience. ■

About the authors

Himanshu Joshi retired from Shell in 2021 after 34 combined years with ExxonMobil and Shell, during which he specialized in heat exchangers and fouling. He was part of a team that was granted a patent related to fouling deposit analysis at ExxonMobil, and led applied fouling R&D projects at both companies. He has made several presentations about the field aspects of fouling and fouling mitigation, and deployed many mitigation technologies in the field. He can be reached by email at alph.hmj@gmail.com.

Lou Curcio has over 30 years of experience in design, troubleshooting and repair of all types of heat exchangers. Leader of technology development projects and advisor for ExxonMobil's global manufacturing teams. Co-inventor of two U.S. patents and co-author of papers on enhanced heat transfer and fouling of heat exchange.

Optimizing shell-and-tube heat exchangers with GPU-accelerated CFD

Heat exchangers are a cornerstone of industrial thermal management, especially in the chemical and energy sectors. Among these, shell-and-tube heat exchangers (SHTX) are a preferred solution due to their mechanical robustness, ease of maintenance, and high heat transfer efficiency. Traditional design relies heavily on empirical correlations, but these approaches fall short when faced with unconventional geometries or operating conditions.

By Harlley Parno & Benjamin Turner, LATTICEPT

To address the aforementioned limitations, advanced computational tools like M-Star CFD are paving the new way engineers analyze and optimize heat exchanger performance. By leveraging the lattice Boltzmann method (LBM), M-Star CFD enables rapid and accurate simulations of complex fluid dynamics and heat transfer, all powered by modern GPUs.

Recently, Thomas et al. (2024) conducted extensive validation of a generalized approach for the calculation of convective heat transfer coefficients across multiple industrially applicable geometries: agitated tanks, pipe flow systems, cylinders in crossflow, and tube bundles. The authors validated the method implemented against expectations from experimentally derived empirical design correlations for SHTX.

Why use M-Star CFD for heat exchangers

M-Star CFD is purpose-built to take advantage of the GPU's parallel processing capabilities, offering dramatic reductions in computational time compared to traditional finite-volume methods (FVM). Unlike FVM, which relies on solving differential equations, the LBM simulates fluid behavior as interactions between particle-like elements. This method simplifies grid generation and allows for more natural modeling of turbulence, a critical factor in heat exchanger performance.

Recent studies have shown that M-Star CFD can deliver high-fidelity results for heat transfer and pressure drop in SHTX designs while significantly reducing computational overhead. A key innovation is its use of a generalized convective heat transfer coefficient approach, which eliminates the need for near-wall turbulence models. Instead, local energy dissipation rates in the bulk flow are used to compute heat transfer coefficients, streamlining the simulation process.

Shell-and-tube heat exchanger geometry.

Mesh	Lattice Size (m)	Fluid Cells (millions)	Computational Time (min)
Coarse	0.001590	3.42	42
Intermediate	0.001136	9.39	128
Finest	0.000935	15.59	257

Table 1 – Mesh parameters for sensitivity study

Simulating shell-and-tube heat exchangers

In this study, a shell-and-tube heat exchanger was simulated under various flow rates using M-Star CFD on an NVIDIA RTX 3090 GPU. Three different grid resolutions were tested to balance accuracy and computational cost. The intermediate resolution proved to be the optimal choice, achieving results within 10% of experimental data while maintaining reasonable runtimes.

To ensure accurate predictions, a "wall function" model was applied. This method smooths boundary layer interactions and reduces numerical artifacts associated with traditional grid-aligned boundary conditions. The results were benchmarked against experimental data and demonstrated excellent agreement for both pressure drop and heat transfer coefficient predictions.

A fixed flow rate of 0.00222 m^3/s was specified at shellside inlet and a 0 psig pressure boundary condition was prescribed at the shellside outlet. Water with a kinematic viscosity of $1e^{-6}$ m^2/s and a density of 1000 kg/m^3 was used for the fluid properties.

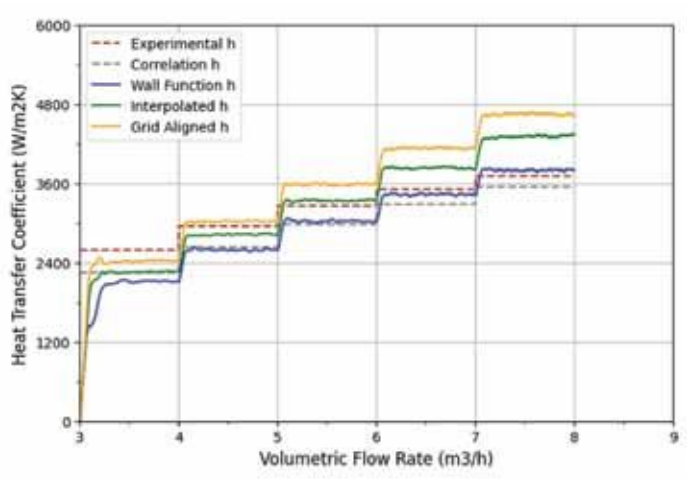
All simulations were performed on an NVIDIA RTX 3090 GPU, with each simulation running for a total of 10 seconds, discarding the first 5 seconds to eliminate initial transients during startup. A time-averaged analysis was then performed over the remaining 5 seconds.

In addition to these numerical studies, the intermediate lattice size was chosen to evaluate the entire range of volumetric flow conditions experimentally reported by Chen et al., 2019. Initially 3 m^3/h, increasing 1 m^3/h every 5 s until reaching 7 m^3/h.

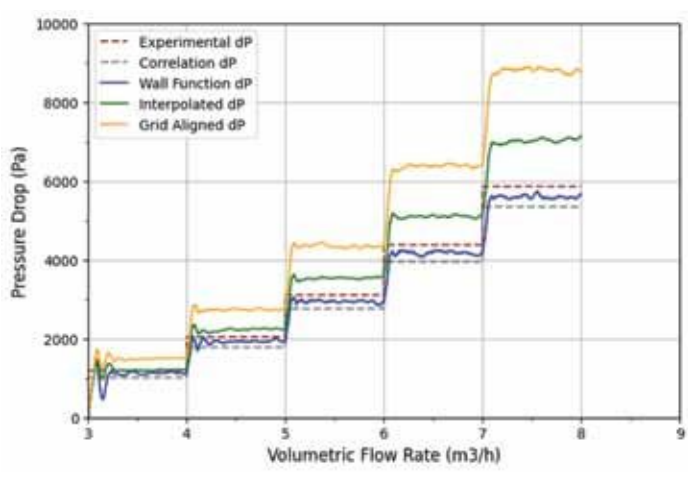
Key findings

The results of the pressure drop in the shell side of the heat exchanger are presented below.

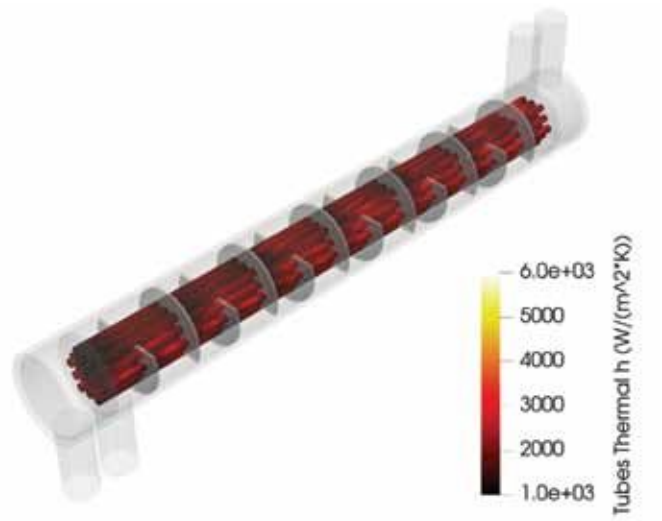
1. **Pressure drop:** Simulations using the wall function model closely matched experimental values across a range of flow rates, outperforming traditional grid-aligned and interpolated boundary conditions. This is critical for ensuring realistic energy requirements in industrial systems.
2. **Heat transfer:** The wall function model also excelled in predicting heat transfer coefficients, showing deviations of less than 10% from experimental values at higher flow rates. The approach effectively captures local heat transfer variations, offering deeper insights into exchanger performance.
3. **Local heat transfer coefficients:** One standout feature of M-Star CFD is its ability to resolve local heat transfer coefficients across the entire surface of the heat exchanger. This provides engineers with detailed insights into where heat transfer is most efficient and where potential bottlenecks exist. By visualizing these



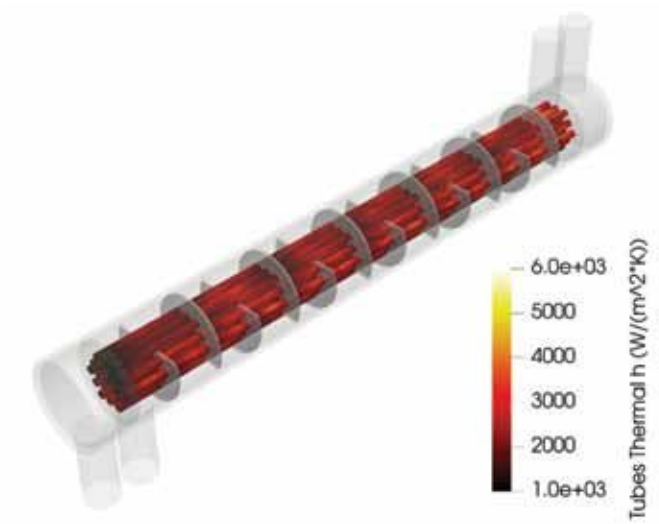
Numerical and experimental shellside pressure drop.



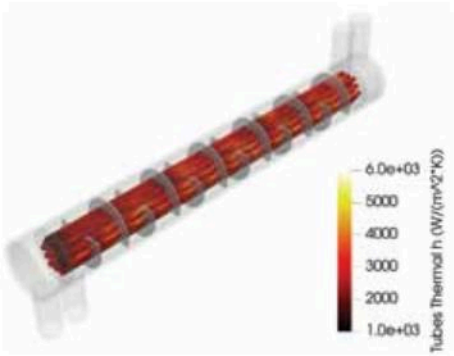
Numerical and experimental heat transfer coefficients.



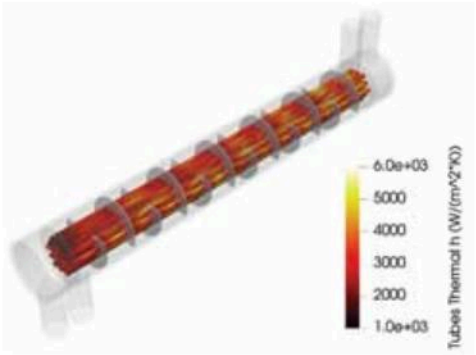
Local heat transfer coefficient (Flow = 3 m^3/hour).



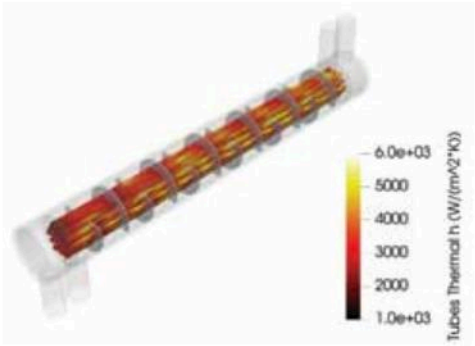
Local heat transfer coefficient (Flow = 4 m^3/hour).



Local heat transfer coefficient (Flow = 5 m^3/hour).



Local heat transfer coefficient (Flow = 6 m^3/hour).



Local heat transfer coefficient (Flow = 7 m^3/hour).

localized variations, designers can pinpoint areas for optimization, such as improving flow distribution or modifying tube and baffle arrangements. This level of granularity is invaluable for enhancing overall performance, ensuring uniform heat transfer, and addressing any potential inefficiencies in the system. Additionally, this capability supports predictive maintenance by identifying regions prone to fouling or performance degradation over time.

Practical implications

The ability to simulate transient flow phenomena opens up new possibilities for optimizing heat exchanger designs. Engineers can now assess the impact of varying operating conditions or geometric modifications with unprecedented speed and precision. Moreover, the local heat transfer coefficient distributions provided by M-Star CFD enable targeted improvements, such as optimizing baffle placement or tube arrangements M-Star CFD demonstrates its potential as a transformative tool for the heat exchanger industry. Its combination of GPU-accelerated performance, robust turbulence modeling, and innovative heat transfer coefficient calculations makes it an invaluable resource for engineers looking to push the boundaries of design and efficiency. As the industry continues to embrace digitalization, tools like M-Star CFD are set to become essential for staying ahead of the curve. For more information visit www.latticept.com and www.mstarcfd.com. ■

Enhancing efficiency and safety in pharmaceutical manufacturing

Active Pharmaceutical Ingredient (API) industries require multi-purpose plants capable of handling highly corrosive fluids. This need is even more critical for Contract Development and Manufacturing Organizations (CDMOs), which frequently change production processes, necessitating flawless equipment cleanliness and reliability.

Text & images by Italprotec Industries

The shift from graphite to silicon carbide heat exchangers

Historically, impregnated graphite heat exchangers were widely used due to a lack of viable alternatives. However, graphite presents several issues: it is porous, prone to degradation, and can release dust contaminants—posing a significant risk to the purity of pharmaceutical substances. Given that APIs are often delicate and expensive, contamination can lead to severe financial and regulatory consequences.
To address these challenges, heat exchangers with Silicon Carbide (SiC) tubes have been developed. Silicon Carbide, being a ceramic material with excellent thermal conductivity, eliminates contamination risks and reduces equipment size due to its high heat exchange coefficient. A prominent Italian API company has already implemented FLOWSiC® exchangers with SiC tubes, replacing traditional graphite exchangers for enhanced efficiency and safety.

Advanced features of FLOWSiC® heat exchangers

FLOWSiC® exchangers are designed with PFA-lined steel tube plates, ensuring robust construction and simple PED qualification. The process fluid is typically directed through the tubes, with PFA- or enamel-lined heads providing full resistance against corrosive substances. Additionally, sealing O-rings made of FFKM perfluoroelastomer further enhance durability. In cases where the process fluid is placed on the shell side, a PFA- or enamel-lined shell is also available for superior corrosion protection.

Heat exchanger with SiC tubes.

Two exchangers (condensers) with Silicon Carbide (SiC) tubes have replaced graphite exchangers at an Italian API company.

Standard design parameters include operational temperatures ranging from -25°C to +200°C and pressure tolerances from full vacuum to 6 bar. Custom configurations are available to meet specialized industrial requirements. With heat exchange surfaces exceeding 20 square meters, FLOWSiC® heat exchangers offer long-term reliability, safety, and absolute contamination-free performance.

Conclusion

The transition to Silicon Carbide heat exchangers marks a significant advancement in API manufacturing. By eliminating contamination risks, enhancing thermal efficiency, and providing a durable solution for corrosive applications, FLOWSiC® exchangers set a new standard for safety and performance in pharmaceutical production. ■

Table 1. Thermal conductivity of various materials.

MATERIAL	THERMAL CONDUCTIVITY W/(m K)
IMPREGNATED GRAPHITE	129
SILICON CARBIDE	120
TANTALUM	57,5
ZIRCONIUM	22,7
TITANIUM	21,9
STAINLESS STEEL	17
HASTELLOY	11
GLASS	2
PTFE	0,25

Enhanced welded tubes: From the strip to the heat exchanger performance

Examples of Neotiss' enhanced tubes for heat exchange efficiency

Regardless of the application, the main challenge in heat exchanger design is to achieve the optimal balance between layout/footprint, costs, weight and, of course, the thermal efficiency and longevity. The performance and lifetime of shell and tube heat exchangers depend heavily on the choice of material and tube design.

By Olivier Favrat, Innovation and Development Manager, NEOTISS

To enhance and optimize heat transfer efficiency in heat exchanger tubes, various innovative solutions have been developed. These include the application of external low fins, internal ribs (commonly referred to as microfins), or a combination of both. These enhancements are adaptable to a wide range of materials, such as titanium, stainless steel, duplex or nickel alloys, copper, and aluminium, ensuring versatility in addressing diverse industrial requirements.

Enhanced tubes benefits and expected performances

Enhanced tubes can be utilized for both new heat exchanger design and retrofitting existing heat exchanger. It enables to increase heat duty for a limited heat exchanger size, to decrease the layout of a heat exchanger by decreasing their size or by limiting the number of heat exchanger in case of multiple heat exchangers or, to lower the total heat exchanger cost (tube and assembly costs).
For sensible heat transfer (no phase change) heat duty transferred though the tube surface can be written as:

$$Q = U \cdot A \cdot \Delta T \quad [1],$$

Where Q is the exchanged heat duty (W),
U is the heat transfer coefficient ($W \cdot m^{-2} \cdot K^{-1}$),
A is the exchange area (m^2),
ΔT is the temperature difference between hot and cold fluids (K).

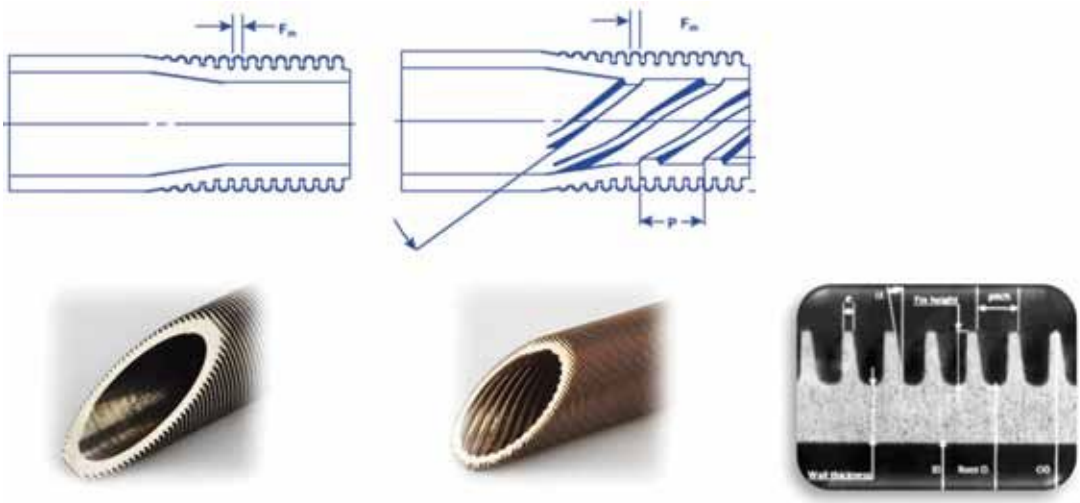


Figure 1 : Illustration of low fins and internal ribs enhancements

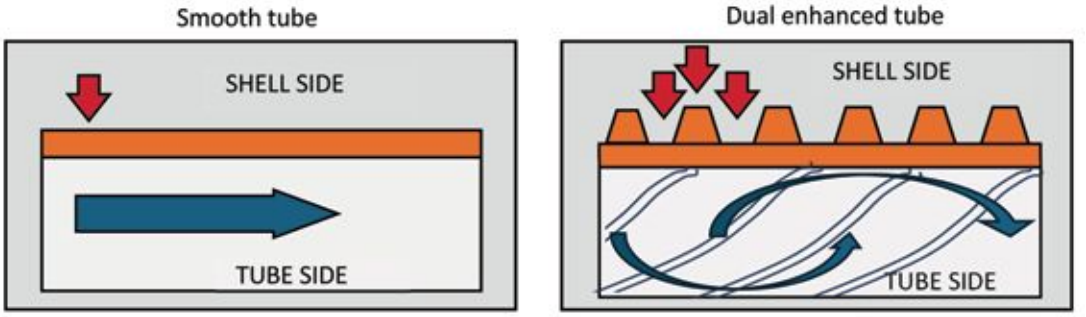


Figure 2 : Increase in area and turbulent flow induced by dual enhanced tubes

Surface modifications can be performed to increase the heat duty calculated from the equation [1].
Low fins are created by a cold deformation of the outside surface of the tube. One of the consequences is that it implies an increase of the outside tube area (A in equation [1]).
Internal ribs are created by a cold deformation of the inside surface of the tube. It generates local flow turbulences which increases heat transfer coefficient (U), in equation [1], with minimal impact on pressure drop.
Figure 1 shows the design of enhanced tubes whereas Figure 2 illustrates the performances modifications.
Low fins and internal ribs modify the surface area, pressure drop and heat transfer coefficient by a factor that depends on fin/rib density and shape, on tube diameter and thickness, on the fluid properties, and on the process conditions. Typical range of coefficients are summarized in Table 1.
Selection of tubes and the related impact on heat exchanger performances can be assessed using a thermal process design and simulation software such as HTRI that includes Neotiss tubes references and performances, under its brand HPT (High Performance Tubes).
Even in the case where the cost of enhanced tubes is higher than the cost of smooth tubes, the total price is always balanced by the fact that less material is necessary (decrease of required tube length and/or number of tubes), shell cost decreases because the size is reduced, and assembly costs also decrease when less tubes are necessary.
Significant gain can also be realized by debottlenecking cases where heat duty is limited in an existing shell size.

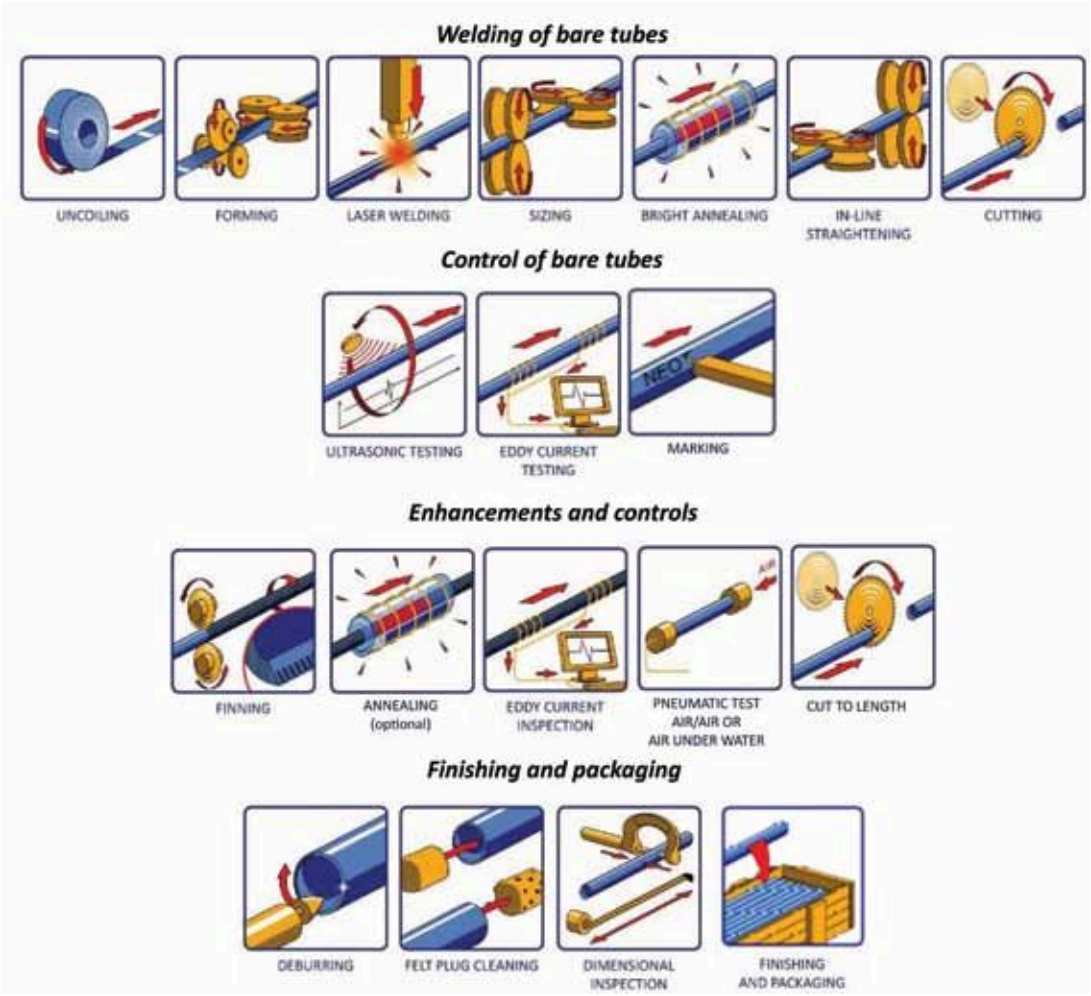


Figure 3 : Example of process from the strip to ready-to-ship tubes

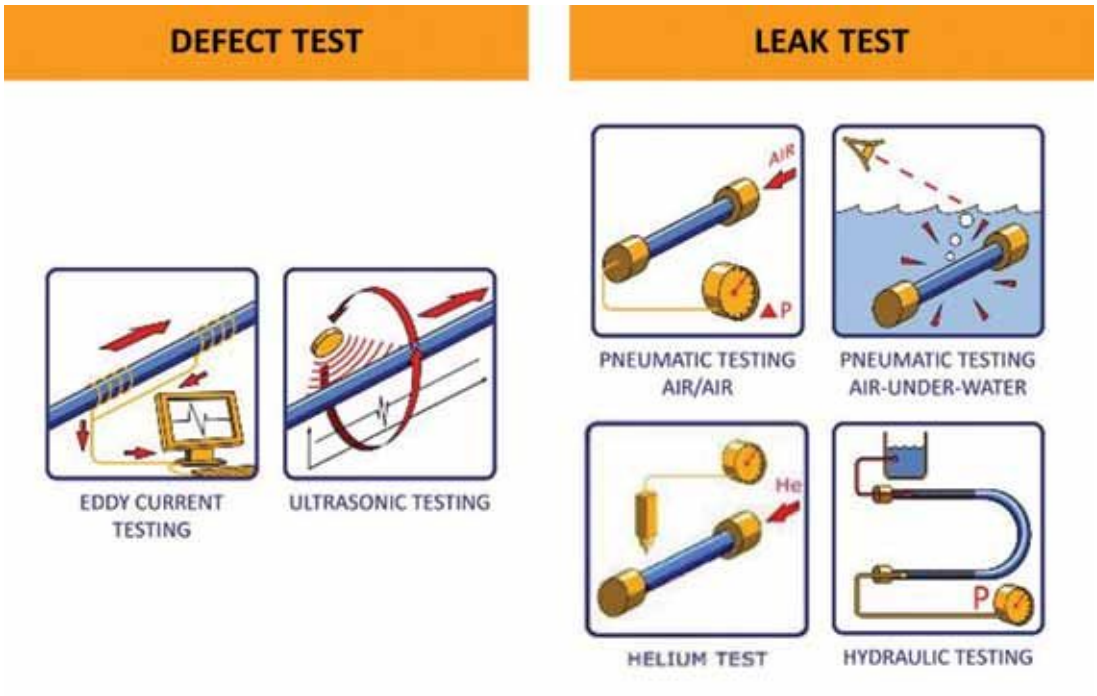


Figure 4 : Range of Non-Destructive Tests commonly used at Neotiss

	Smooth tube	External low fin	Internal ribs
Surface area	1	2 to 3	1,25
Pressure drop	1	1,1	1,4 to 1,8
Heat transfer improvement coefficient	1	1	1,7 to 2,5

Table 1 : Impact of enhancements on surface area, pressure drop and heat transfer coefficient

Also, Neotiss brings its heat transfer expertise to propose the most suited tubes for the customer defined application and specifications.

Production of welded enhanced tubes

Example of Neotiss full integrated process for producing such enhanced tubes is illustrated in Figure 3.

The main steps of the fully integrated manufacturing process are detailed on Figure 3. A series of forming rollers forms the tube which is welded by TIG or laser. Tubes are then annealed and cut. All tubes are 100% submitted to Non-Destructive Tests (NDT) and marked for traceability. Then, low fins and/or internal ribs enhancement are performed by cold forming, so without adding nor removing material. Low fins are created by stacks of discs that are pressed against the external tube surface. Internal ribs are created by a mandrel with spiral grooves that acts on the inner surface of the tube. Heat treatment following the cold forming could be performed to remove the stress induced, for specific applications. A new set of NDT is performed before cutting to final length. Tubes are then deburred, cleaned and inspected before a careful packaging.

This process can be subjected to slight variations (bending, additional tests as well as hydraulic test…) depending on customer requests.

Destructive tests, not displayed here, are also realized according to international standards and customers' specification.

Highlight on NDT

The Non-Destructive Tests belong to Neotiss' DNA, as they guarantee the tubes quality and integrity These tests are detailed on Figure 4.

Eddy current and Ultrasonic testing on bare tubes enable to detect defects such as pores, inclusions, holes, edges mismatches, cracks, lack of welding… whereas leak tests (air/air, air under water, helium test and hydraulic test) enable to detect weld stoppage, cracks, holes. High-pressure hydraulic testing also serves as a mechanical integrity test.

Eddy current testing on finned tubes allows to detect defects on fin shape or metal inlay.

By applying the right Non-Destructive Tests, Neotiss ensures that the quality of the tubes complies with the level required. ■

About the author

Olivier joined Neotiss SAS in 2019 as Innovation and Development Manager. His background in Material Science and his technical approach allow him to lead development of products and processes. He is also involved in heat transfer expertise to carefully take in account customer needs.

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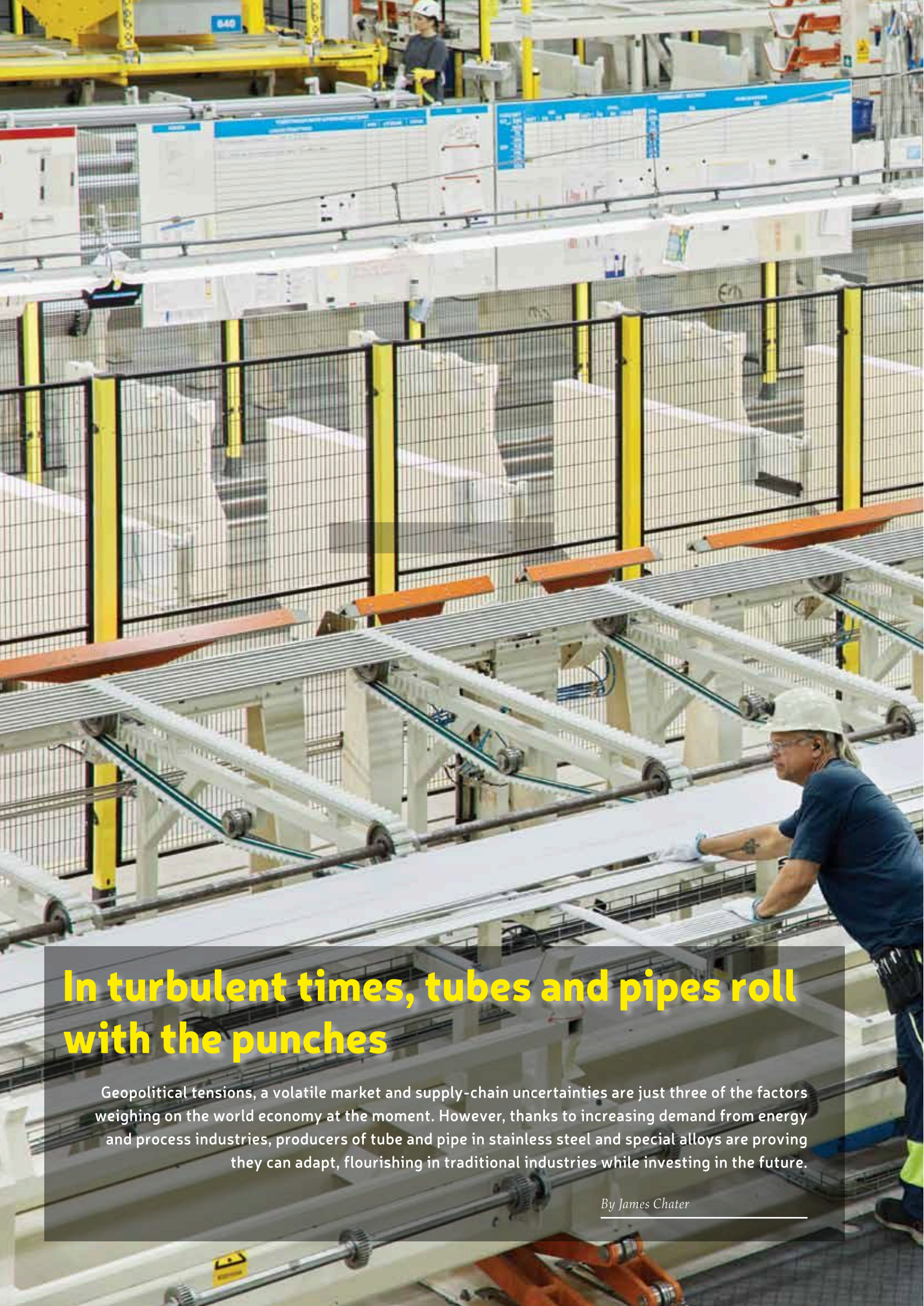


In turbulent times, tubes and pipes roll with the punches

Geopolitical tensions, a volatile market and supply-chain uncertainties are just three of the factors weighing on the world economy at the moment. However, thanks to increasing demand from energy and process industries, producers of tube and pipe in stainless steel and special alloys are proving they can adapt, flourishing in traditional industries while investing in the future.

By James Chater

Alleima tube mill.

Outlook

It can be quite depressing when the pundits start talking about overproduction, deindustrialization and Europe. The Old Continent's industries are faced with mounting fuel prices and increased competition from China and other Asian countries. But whereas European steel market is in crisis, the stainless-steel tube and pipe industry is buoyant, even in Europe: the sector is projected to show a CAGR of 4.8% between 2023 and 2034[1]. Oil & gas, food & drink, auto and infrastructure (including water pipes) are the sectors that account for most of the demand. In Europe, green energy and decarbonization will be an important growth area as the world moves towards net zero.

Investments

The buoyant mood of the stainless tube & pipe sector can be gauged by the number of capacity additions currently under way. To meet increasing demand for remelted high nickel and stainless steel and tubes, Alleima is installing a fourth VAR furnace at Sandviken, to expand production of nickel alloys and grades such as Sanicro® 625 and Sanicro® 925 for aerospace, medical and oil & and gas. Marcegaglia UK has announced it will offer electro-welded stainless-steel tubes (mainly in type 304) at its Oldbury site. In the USA, Global Seamless Tubes & Pipes will establish its first US production facility in north-west Louisiana, catering for the engineering, oil & gas and power generation sectors. Tube maker Corrosion Resistant Alloys has just completed a manufacturing facility in Brenham, Texas. A Turkish subsidiary of Taiwan's YC Inox has increased capacity for its stainless-steel pipe output. In 2024 India's Viraj Profiles inaugurated its advanced Piercer Mill at its new stainless-steel seamless pipe plant. In the UAE Raccortubi opened a warehouse to serve the oil & gas industry.

Processing plant at ENI's Argo Cassiopea offshore gas field in Sicily, Italy.

Stainless-steel exhaust system from a racing car.

Markets

Oil & gas in fact remains the no. 1 client of stainless-steel tubes and pipes. This would probably be true even if President Trump had not vowed to "drill, baby, drill". The US president has revoked his predecessor's bans of drilling and fracking on federal lands and in coastal waters. The deepwater sector is likely to increase sharply, requiring stainless steel tubes to bring the hydrocarbons from sea level to surface. Several contracts have been signed or renewed. Petrobras has signed a contract with Tubacex for supplying its offshore fields in Brazil. Tubacex has also been awarded API Spec Q1 certification for a manufacturing plant in

Aiming high

Walsin Lihwa, a Taiwanese producer of stainless-steel long products, has been on a buying spree, through its Italian subsidiary Cogne Acciai Speciali (CAS), a European leader in stainless steel bars and wire rods. Walsin acquired CAS in 2022, and a year later CAS acquired two rolling mills in Sweden from Outokumpu to penetrate North European markets. In the same year it bought UK-based Special Melted Products, a manufacturer of specialty steels and nickel-based superalloys used in critical applications. CAS continued to aim high with its acquisition of Inox, a stainless-steel and nickel-alloy recycling company. And in November of last year the Italian company acquired Mannesmann Stainless Tubes Group (MST) from the Salzgitter Group. (Its name has been changed to "DMV".) All in all, a resounding vote of confidence in the higher end of the stainless-steel and CRA sectors, in vertical integration and in global presence.

Abu Dhabi. Nippon Steel and Sumitomo renewed a long-term contract with Equinor to supply OCTGs and for carbon sequestration & storage projects. The National Oil Company of Abu Dhabi renewed its contract with Vallourec. Tenaris continues to supply Exxon Mobil, while Alleima won two major awards for tubes, OCTGs and umbilicals. The same company has launched its duplex grade SAF™ 3007 for enhanced performance of umbilicals in tough deepsea conditions.

CCUS (carbon capture, utilization and storage) is a growing industry important for stainless tubes and pipes. This umbrella term covers a multitude of activities designed to curb CO_2 emissions. The sector is being massively subsidized by governments as they strive to achieve zero carbon emissions by 2050. Several projects are under way: a feasibility study is being conducted by Petronas and several stainless-steel producers to develop technologies designed to curb emissions in the Tokyo Bay area through CO_2 capture, storage and liquefaction. Various forms of recycling CO_2 have recently been developed. Also, direct air carbon capture and storage, which consists of extracting CO_2 from the air and storing it underground, received a boost after the commissioning of the Mammoth project in Iceland. However, the consensus is that industry will need to quadruple in size if climate targets are to be met.

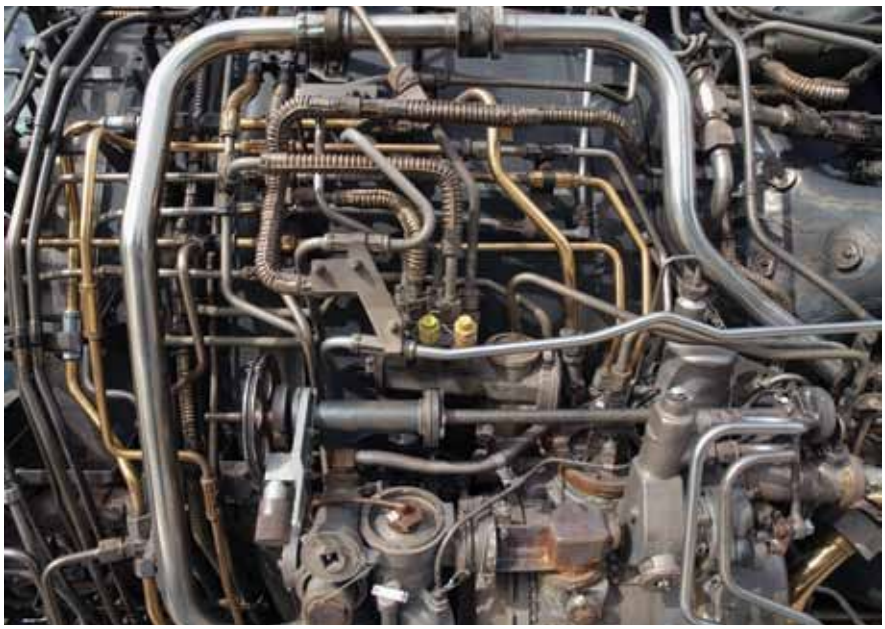
CO_2 handling can be quite corrosive because of the combination of water and chlorides. If salt is present in the water, it is necessary to use 316L or a higher grade. CRAs such as duplex stainless steel and nickel alloys are being applied in capture plants and CCUS projects. Stainless steel is applied to the compressors and tubing of injection wells. The need to curb emissions is driving innovation: for example, Tubacex has introduced Sentinal® Prime, a connection technology for OCTGs, which can be used in deepwater oil & gas, CO_2 storage and hydrogen. Choosing the right materials for CO_2 handling is a complex affair, which is why there is still no unified set of standards for CCUS infrastructure.

Hydrogen, along with its derivative, *ammonia*, is an essential tool for curbing emissions. It can be produced when energy supply exceeds demand and used as a fuel when demand exceeds supply. It is therefore an ideal storage device in combination with wind and solar, and one can expects its use to increase with the growth of green energy. According to a recent survey[2], this is a dynamic market, with a CAGR of 7.8% between 2025 and 2050. Storage and transportation normally require hydrogen to be liquified, which means lowering the temperature to -253°C. This requires the use of austenitic stainless steels that combine ductility and energy absorption, such as 316L and 316LN. The "greenest" hydrogen comes from electrolysis, with power sourced from renewal energy. Up to now, progress has been hampered by the cost of the materials used, including titanium and manganese. However, a new material, SS-H2, can achieve better corrosion resistance at a lower cost. Developed at the University of Hong Kong, it uses a "sequential dual-passivation" process incorporating both chromium- and manganese-based layers. It can be used in direct seawater electrolysis and can also be applied in ammonia synthesis, oil refining, steelmaking and methanol production.

Several stainless tube and pipe producers are working with the hydrogen industry to develop products for hydrogen storage and transport. Vallourec's "Delphy" storage facility was unveiled in France in 2023, and in 2024 the company entered into partnership with Nextchem. Tubacex is involved with a project called DESSERT ("Advanced thread connected production string for hydrogen storage in underground formations"), which is working on the development of a new stainless-steel pipe for injecting and withdrawing hydrogen from underground reservoirs. In December Centravis agreed to supply stainless steel pipes to South Korea for a hydrogen

Corrosion-resistant heat exchanger chiller tubes with flanges, for a refinery.

Heat exchanger in refinery plant.



Jet engine tubing and layers of mechanical parts.

production plant. The Ukrainian company previously supplied seamless pipes to a German company specialising in hydraulic connections with a high degree of leakage protection in projects using hydrogen and compressed natural gas. In the field of solid oxide fuel cells, JFE Steel is producing a new ferritic grade for interconnectors, which is expected to reduce the cost of generating energy via SOFCs.

The *Nuclear* industry is benefitting from the drive to net zero emissions. About 65 reactors are under construction, and 90 more are planned; China is in the lead, followed by India, Russia, Egypt and several other countries[3].

Although larger reactors will predominate, small modular reactors (SMRs) are being developed in China, Russia and the USA are expected to play a role. Among the tube makers who will benefit are Alleima, which supplies steam generator tubes for the SMR); Superior Tube, another supplier to SMRs; Mannesmann Stainless Tubes, a supplier of stainless-steel and nickel-alloy seamless tubes and pipes; UK manufacturer Fine Tubes; Tubacex, which has been a supplier to EDF as it maintains its reactors in France; and French supplier Framatome.

Welded stainless-steel tubes. Photos by BUTTING Gruppe GmbH & Co. KG.

Semiconductors are a growing and highly strategic industry, further buoyed up by the attention that AI has been receiving. With most of the production capacity being found in China and Taiwan, countries and regions across the world are providing incentives to boost domestic production. The market for semiconductor tubing is expected to grow at a CAGR of 7.05% between 2024 and 2032. The USA is expected to be the fastest-growing market[4]. The demand for Ultra High Purity (UHP) tubing is growing because of technological advances. UHP provides the means for safe transport of gases and chemicals such as nitrogen, hydrogen, helium and argon used in fabrication. The need to avoid contamination makes grade 316L the material of choice for UHPs. However, China Minmetals has developed a UHP made of graphite.

Aerospace is also an area experiencing growth, now that the Covid-19 seems safely in the rear window. The demand for civil aircraft and space vessels is increasing. Defence spending is also on the rise in several countries.

One beneficiary is likely to be Tubacex, whose subsidiary Schoeller-Bleckmann Edelstahlrohr (SBER) recently achieved AS/EN9100 certification from the Aerospace Quality Group. Another company that is heavily involved in space vessels is Butting in Germany. Its Cryotech division received an order for Isar Aerospace for 1,100 metres of vacuum-insulated transfer pipe systems. These were prefabricated into a total of 171 spools with a permanent high vacuum. Material 304/304L was selected for the process pipe and 316/316L for the vacuum envelope.

Conclusion

Although the extent and effect of current uncertain market conditions are yet to be experienced, the investment strategies of numerous tube and pipe manufacturers seems to bode well for the future. ■

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TEADIT TF 1570 receives USP class VI certification

TEADIT® has achieved a significant milestone with its TF 1570 gasket sheet receiving USP Class VI certification, validating its exceptional safety and performance for pharmaceutical and biotech applications. This approval reinforces TEADIT's commitment to high-quality sealing solutions for critical industries.

Text & images by Teadit

Tealon sheet handled by staff. Photo courtesy of Teadit.

TEADIT®, a global leader in innovative sealing solutions, is proud to announce that its TEADIT TF 1570, a structured PTFE gasket sheet, has completed rigorous testing and received USP Class VI (General Chapter §88 and §87) certification. This prestigious approval emphasizes the product's exceptional biocompatibility and suitability for use in critical applications, including the pharmaceutical and biotechnology industries, where adherence to the highest safety and quality standards is vital. This milestone achievement is recognized under the Classification of Plastics – Plastic Class VI – at a maximum temperature of 121 °C. The study was conducted at a test facility in Munich, fully adhering to Good Laboratory Practice (GLP) regulations, ensuring the integrity and quality of the testing process. During testing, TEADIT TF 1570 was exposed to four different types of media: polyethylene glycol, cottonseed oil, saline, and ethanol, to ensure its versatility and reliability across various environments.

Outstanding biocompatibility and durability

TEADIT® TF 1570 is engineered with a unique fibrillation process that enhances its resistance to creep relaxation and cold flow, ensuring reliable performance even under extreme conditions. Combining superior chemical compatibility with high compressibility, this gasket sheet offers an ideal sealing solution for applications requiring precision, safety, and durability. Its high performance, now confirmed by the USP Class VI certification, further solidifies TEADIT® TF 1570's reputation as a trusted product for industries demanding the highest levels of compliance and reliability.

This latest accomplishment adds to TEADIT's impressive portfolio of products that have received USP Class VI certification, including the 28 LS-LE, 30 SH, and 24 SH gasket sheets, demonstrating the company's continued leadership in providing top-quality sealing solutions to the pharmaceutical and biotech sectors. ■

Shell & tube heat exchangers: challenges, opportunities, trends and forecasts

The evolution of heat exchangers has been remarkable. Patented in the late 1800s, early designs led to modern shell and tube heat exchangers (STHEs) decades later. Known for efficiency and versatility, STHEs transfer heat between fluids and are widely used in key industries. In 2024, they held ~25% of the USD 16 billion global heat exchanger market, highlighting their importance in thermal management.

Text & images by Stratview Research

Top applications of shell and tube heat exchangers

The initial designs of the STHEs were developed to fill the needs in power plants for large heat exchanger surfaces such as condensers and for the oil industry in oil heaters/coolers, reboilers, condensers, etc. in crude oil plants.

Even today, STHEs are the preferred choice in the power generation sector where they are used for different applications including feed water pre-heating, cooling gearbox oil, seal water, and generator cores, as well as recovering heat from exhaust gases to enhance overall efficiency. In 2024, the demand from the power generation sector for STHEs was valued at >USD 900 million, representing over 23% of the global STHE market value, making it the largest segment (see Figure 1).

The petrochemical and chemical industry, although the second-largest end-user of STHEs, was very close to the power generation industry in market share. Both industries together accounted for >45% of the global STHEs market. The heat exchangers are primarily used in heating or cooling of reactors, recovering heat from waste streams, and regulating the temperature of various chemicals and solvents by heating or cooling them during processing.

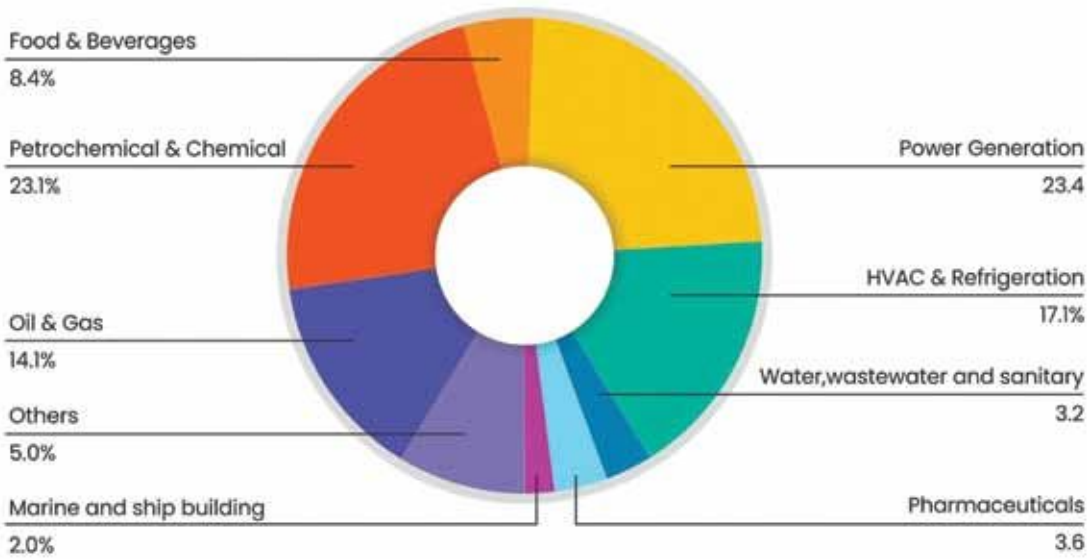
Following closely is the HVAC and refrigeration sector, which represented approximately 17% of the total market share in 2024. The increasing demand for heating, ventilation, and air conditioning (HVAC) systems worldwide, driven by urbanization and climate change concerns, ensures a continuous need for effective heat exchangers. Heat exchangers like STHEs allow smooth heat transfer between air and refrigerant for efficient cooling and heating in buildings.

The food and beverage industry comprises different operations, majorly being the pasteurization of dairy products, processing of fruits, vegetables, prepared foods, brewing, and other dietary supplements, etc., that creates a consistent demand for heating and cooling solutions. These solutions eliminate microbials to ensure product safety, preventing spoilage and making the product safe for consumption. In 2024, the demand for STHEs in this industry accounted for a smaller market share of approximately 8%. Other sectors like water treatment, pharmaceuticals, and marine applications demand STHEs as well but collectively contribute less than 10% to the global shell and tube heat exchangers market.

The dominance of Asia-Pacific

In 2024, the United States, China & Germany were the top 3 countries generating nearly half of the demand for STHEs. While the United States & China were close having a demand value of USD 790 million (~21% share) and USD 680 million respectively (18% share) in 2024, Germany was far behind them with a value of USD 280 million.

Among the regions, the demand from Asia-Pacific reached approximately USD 1,430 million in 2024, which is more than 35% of the global STHE market.



Applications of shell and tube heat exchangers market share in 2024.

APAC's dominance can be linked to certain factors including a significant demand coming from the power generation sector, which accounted for over 28% (in 2024) of the total the STHEs demand from the region. Home to >60% of the world's population, the APAC region is playing a critical role in shaping the global energy future. Growing economies, increasing energy demand from this region, and a push towards renewable energy sources, etc., are demanding reliable heat transfer technologies. Studies have predicted that by 2030, renewables are set to make up 30% to 50% of the power-generation mix in most Asia-Pacific markets. This transition is likely to increase the demand for STHEs, as they are essential in optimizing the efficiency of renewable energy systems, such as solar thermal and biomass plants.

The petrochemical and chemical industries closely follow the power generation sector in demand for STHEs in the APAC region with a share of ~26%, totalling > USD 370 million in sales value in 2024.

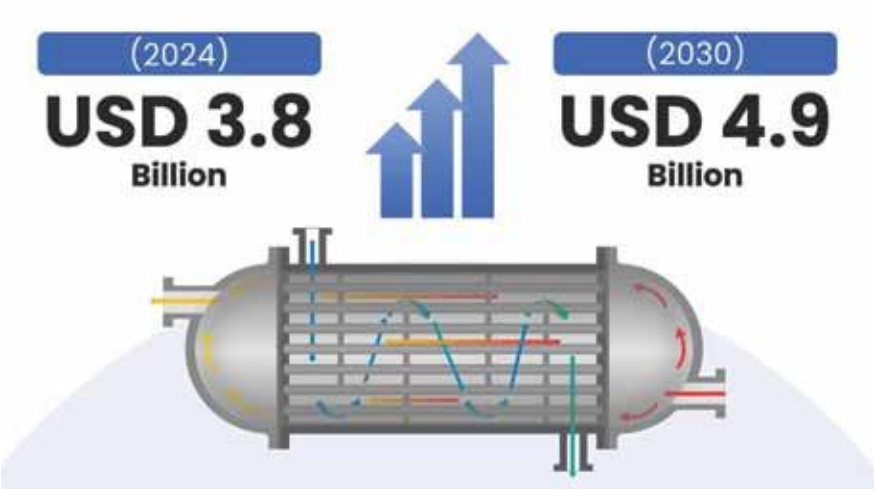
The APAC region also leads the global petrochemical market, with China as the foremost producer of industrial chemicals. In 2023, the Asia Pacific petrochemical market was valued at ~USD 325 billion, driven by rapid industrialization and strong demand from industries like automotive and packaging. China's self-sufficiency policy has significantly strengthened its position in the global petrochemical market.

Japan & India are the next two large demand generators in Asia-Pacific region together accounting for nearly 30% of the region's market.

Increasing focus on less carbon-intensive activities and demand for sustainable energy usage is driving demand for thermal management solutions like STHEs in the European region too. With countries like Germany and France making substantial contributions to the global STHEs market, Europe stands as the next largest market after Asia-Pacific.

The challenges

The STHE market is currently at crossroads witnessing growth alongside some significant challenges, and promising opportunities.



The global shell and tube heat exchangers market forecast (2024 – 2030).

The production of STHEs is significantly impacted by high raw material costs, which directly affect the initial installation expenses for heat exchanger setups. All types of heat exchangers are prone to corrosion, fouling, etc. due to heavy interaction with liquids, extreme temperatures and different chemicals, etc. To safeguard the equipment from certain challenges, it is vital to the choose proper materials for manufacturing. The best material for non-corrosive heat exchangers depends on the environment they'll be used in, but common choices include stainless steel, nickel alloys, etc.

Prices of stainless steel, and nickel – crucial for nickel alloys used in heat exchangers, are projected to be influenced by global supply, shifting economic conditions, and demand dynamics. It is clear that there is a struggle to meet demand due to limited raw material availability or logistic challenges. It also depicts fluctuating prices of crucial raw materials that may experience price pressures due to market conditions, further impacting the STHEs market too. High overall expense makes it challenging for new entrants to compete against established manufacturers and can deter smaller players from entering the market.

Top 10 countries in the global shell & tube heat exchangers market (USD million in 2024).

Moreover, the STHEs' market depends heavily on maintenance to ensure operational efficiency and reduce overall costs. The growing aftermarket for STHEs creates a lucrative opportunity for spare parts and maintenance service providers and suppliers. Several original equipment manufacturers (OEMs) like Alfa Laval AB, Funke Warmeaustauscher Apparatebau GmbH, Kelvion Holdings GmbH, etc. are into manufacturing original equipment and also offer spare parts and maintenance services to ensure optimal performance of their equipment.

Emerging trends and prospects

Tracing back from ancient systems like the hypocaust to today's connected, micro and nano heat exchangers, the progression reflects significant advancements driven by technological innovations and trends.

One such trend is the integration of renewable energy systems with heat exchangers, enabling efficient utilization of waste heat and the integration of thermal energy storage. Solar water heaters are the perfect example. Shell and tube heat exchangers move solar power from collectors to water for drinking.

The development of smart heat exchangers equipped with Internet of Things (IoT) technology, sensors and control systems has emerged as a game-changer. By integrating Internet of Things (IoT) technology, these devices provide real-time monitoring, predictive maintenance, and optimized performance. Additionally, studies have shown that companies have saved energy by up to 25% after integrating smart heat exchangers into their systems.

Emerging nanomaterials like Graphene and carbon nanotubes, and polymer composites have shown exceptional thermal conductivity, significantly higher than conventional materials. Replacing copper and aluminum with highly conductive polymer composites in heat exchangers can reduce materials costs and overall manufacturing costs, providing energy savings during manufacturing and end use. The U.S Dept of Energy considers, the manufacturing time for polymer composite heat exchangers can be reduced by up to 90% compared to metallic ones. Additionally, overall material and manufacturing costs could drop by as much as 50%.

As industries increasingly focus on reducing CO_2 emissions, the demand for efficient heat transfer solutions is set to surge, particularly due to the growth of renewable energy sectors like solar thermal power, geothermal, and wind energy. The International Energy Agency (IEA) projects that the world will add 5,500 gigawatts (GW) of new renewable capacity between 2024 and 2030.

These sectors require effective heat exchangers to optimize their systems. The global market for STHEs is projected to grow steadily from approximately USD 3.8 billion in 2024 to an estimated USD 4.9 billion by 2030. As innovations in heat exchanger technology continue, STHEs will play a critical role in addressing global energy challenges and reducing carbon emissions, ultimately contributing to a greener industrial landscape. ■

Supporting astrophysical breakthroughs: heat exchangers at the world's largest observatory

ELT – Extremely Large Telescope, Chile. Photo courtesy of European Southern Observatory.

Astrophysics is on the brink of a major breakthrough with the Extremely Large Telescope (ELT), the world's largest optical/infrared telescope, located in Chile's Atacama Desert. This groundbreaking project demands cutting-edge engineering, and Arsopi Thermal is proud to contribute by providing advanced Plate Heat Exchangers and technical support. Their expertise ensures the ELT operates efficiently, reinforcing their commitment to high-performance solutions for complex applications.

Text by Arsopi Thermal

Advanced cooling solutions for a critical component

Processor rooms are the nerve center of the ELT, where high-resolution photographs from space are stored and analysed. These rooms generate immense amounts of heat, requiring sophisticated cooling solutions to maintain the stable and precise conditions necessary for optimal performance.

Arsopi Thermal's plate heat exchangers (PHEs) achieve this by using a series of thin, corrugated plates arranged to create alternating channels for hot and cold fluids. As the hot fluid from the processor rooms flows through one set of channels, the cold fluid passes through adjacent channels. The corrugated design maximizes the surface area for heat transfer, allowing the heat to move efficiently from the hot fluid to the cold fluid without the two mixing. This precise thermal exchange effectively dissipates excess heat, maintaining a stable environment critical for the reliable operation of the sensitive equipment.

By employing this advanced technology, the PHE's ensure optimal cooling performance, energy efficiency, and reliability, enabling the ELT's processor rooms to function flawlessly under demanding conditions. These plate heat exchangers use a corrugated plate design to maximise surface area for efficient heat transfer, allowing precise temperature control with minimal energy use, while their durability and reliability ensure uninterrupted performance.

Model	Power Duty	Dimension (mm)	Qty.
FH-SX80M.5	1750 kW	1220 x 3577 x 3900	3
FH-SX30.5	960 kW	684 x 2693 x 3100	2
FH-RX00.5	30 kW	220 x 548 x 400	1

The six supplied plate heat exchangers:

Model FH-SX80M. Photo courtesy of Arsopi Thermal.

Model FH-SX30.5. Photo courtesy of Arsopi Thermal.

Challenges in the construction of the ELT project

The construction of the ELT project presents a unique set of challenges, including tight lead times, coordination across diverse teams, and the need to meet stringent certification standards. With a project of this scale and complexity, it is essential that every component is built and tested to the highest specifications. The collaboration between various engineering teams, each specializing in different aspects of the project, demands careful planning and seamless communication. Meeting these challenges head-on, Arsopi Thermal contribute their expertise in delivering reliable, high-performance HVAC solutions, ensuring that every part of the project meets the rigorous standards required for success.

A shared vision for excellence

As the ELT project progresses, the world is eager to see its impact on the scientific community and beyond. It underscores the important role of advanced engineering in achieving groundbreaking discoveries.

At the heart of this endeavor is a shared commitment to excellence—bringing together astronomers, engineers, and industry leaders to push the boundaries of human knowledge. Each component, from the telescope's intricate optics to the thermal management systems ensuring its stability, represents the collective expertise of global innovators. Arsopi Thermal's contribution to the ELT exemplifies this spirit of collaboration, where precision engineering meets scientific ambition.

A crucial step for smooth transportation: loading with precision and care. Photo courtesy of Arsopi Thermal.

By leveraging state-of-the-art heat exchange technology, Arsopi Thermal helps maintain the ideal operating conditions necessary for the ELT to function at peak efficiency. Their dedication to reliability and performance ensures that the observatory's systems will support decades of scientific breakthroughs. More than just a technological achievement, the ELT embodies the pursuit of deeper cosmic understanding—made possible by the seamless integration of world-class research and engineering.

This collaboration is a testament to what can be achieved when expertise and vision align. The discoveries made with the ELT will not only expand our knowledge of the universe but also inspire future generations of scientists and engineers to continue pushing the frontiers of exploration. ■

Six plate heat exchangers leaving our factory, in route to their destination.

Digitalization-enabled optimization of cooling water chemicals in an LNG plant

The implementation of digital technologies in industrial processes is reshaping efficiency and cost management. This paper explores the case of an LNG plant in Africa that utilized a digital dashboard and systematic trials to optimize the use of cooling water chemicals, leading to significant operational and financial benefits.

By Dr. Anal Chavan, Lead Utilities Technologist, Nigeria LNG

Digital dashboard for monitoring cooling water systems

One of the liquefied natural gas (LNG) plants in Africa includes water-cooled heat exchangers (HX's), where cooling towers play a crucial role in production performance. A collaborative effort between utilities technologists and information technologists resulted in the development of a digital dashboard. This dashboard not only showcases operational metrics like supply temperatures, basin levels, and the availability of the chemical dosing system but also highlights critical factors such as cycles of concentrations, water chemistry and microbiology (in terms of corrosion indicators, scaling indicators, deposition indicators and bio-fouling indicators), that directly impact the efficiency of the HX's. Ultimately, this tool enabled technologists to conduct daily interventions, ensuring that cooling water chemistry and microbiology are maintained within specifications for over 90% of the time.

Laboratory trials for chemical dosing optimization

Cooling water chemistry consists of corrosion inhibitors, scaling inhibitors, oxidizing biocides and non-oxidizing biocides (NOB's) to control corrosion, scaling and bio-fouling in cooling water circuits including HX's. It was observed that consumption of NOBs at this plant was nearly four times higher compared to similar plants globally. However, sudden reduction in NOB's poses a risk of bio-fouling in HX's with the potential of microbial induced corrosion. Thus, number of mitigations were put in-place. Firstly, a 100-day pilot trial was initiated in a laboratory setting, simulating field conditions (in terms of temperature, aerobic conditions, compensation for evaporation losses, slip stream filtration and blow-down). Secondly, an additional method in terms of ATP test kit was introduced to measure the bacterial count/cleanliness of the system, which measures the ATP in 10 seconds. As this ATP test was not a standard test, a limit for this parameter was defined in-house based on Manufacturer's recommendation. Thirdly, this digital dashboard was utilized for closed monitoring. In the laboratory, the trials consisted of two sets: one with normal NOB dosing (Control) and another with reduced NOB dosing (Experimental) (Fig. 1). After 80 days of trial, it was found that there was no significant differences between the control and experimental sets in terms of pH and conductivity (which impact HX integrity), Total Suspended Solids (TSS) (a deposition indicator), and Total

Experimental setup.

About the author

Dr. Anal Chavan is currently working as Lead Utilities Technologist at Nigeria LNG as a Shell Secondee. She is a Process engineer professional with expertise in Utilities and Specialist in Water and Wastewater systems including Cooling water. She has >15 years of experience at reputed organizations like Siemens and Shell. She is a holder of a number of research papers in reputed journals, international conferences and patents.

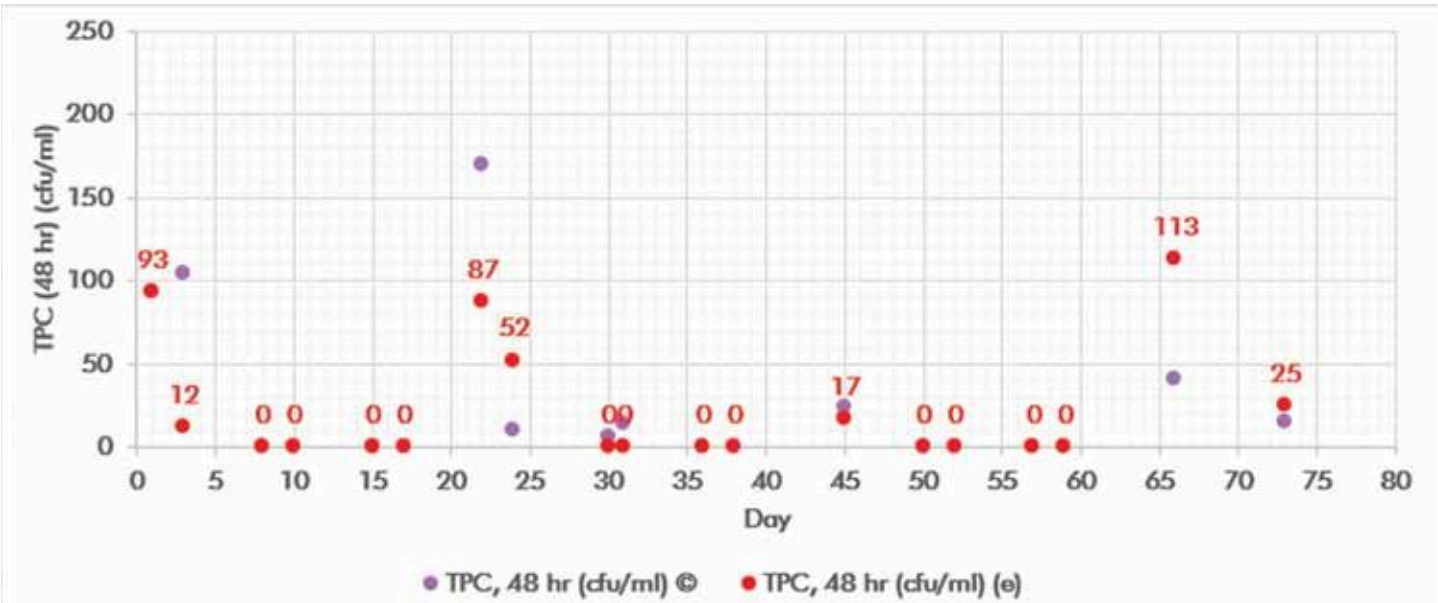
Planktonic Count (TPC) (a bio-fouling indicator). All parameters remained within specifications. Most important parameter in terms of TPC was found well within the specifications (<104 cfu/ml) (Fig.2).

Field trials and cost savings

Building upon the success of the laboratory pilot trials, field trials were subsequently conducted and proved to be successful. Later, when heat exchangers were opened during the plant shut-down, they were found in good condition/reduced bio-fouling. This suggests that continuous monitoring was crucial, and decreasing the use of chemicals did not negatively affect the fouling of a heat exchanger (HX). Overall, this approach (digitalization followed by optimization) led to a 33% reduction in chemical consumption and an annual operational cost reduction of $200,000.

Conclusion

The use of digital dashboards and laboratory trials at the LNG plant highlights the potential of combining digital tools with traditional industrial processes. This initiative not only optimized chemical usage but also ensured consistent operational performance and significant cost savings. Such advancements underline the importance of adopting innovative solutions for sustainability and efficiency in industrial operations. ■



TPC during laboratory trials.

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Critical importance of heat exchanger inspection

Engineer inspects spiral heat exchanger in petroleum industrial plant.

Heat exchangers play an essential role in industrial operations, facilitating the efficient transfer of thermal energy across various sectors. From oil refineries to chemical processing plants, power generation facilities to HVAC systems, these critical components enable sustainable and energy efficient processes. However, their continuous exposure to extreme conditions including high temperatures, corrosive substances, and high-pressure fluids makes them susceptible to various forms of degradation.

By Omari Hussein Sabuni, Mechanical Engineer, Kinyerezi Power Plant

The necessity for rigorous inspection protocols cannot be overstated. As heat exchangers operate in increasingly demanding environments, the risk of performance degradation, efficiency losses, and potential failures grows significantly. This article delves into the crucial aspects of heat exchanger inspection, offering insights into inspection frequencies, scheduling strategies, essential tools, and both in-service and shutdown inspection procedures. By understanding and implementing these practices, organizations can significantly enhance their maintenance strategies, optimize operational efficiency, and prevent costly failures.

Understanding inspection frequency requirements

Routine inspection protocols

The foundation of effective heat exchanger maintenance lies in daily and weekly monitoring procedures. Operating personnel must conduct regular temperature differential monitoring across the exchanger using calibrated instruments, as unexpected variations often serve as early indicators of developing problems such as fouling or reduced heat transfer efficiency. Alongside temperature monitoring, pressure differential analysis forms a critical component of routine inspections. By establishing baseline measurements and tracking deviations, operators can quickly identify potential blockages or flow restrictions that might impact system performance. The verification of consistent fluid flow rates is equally important, as maintaining designed flow parameters ensures optimal heat transfer efficiency throughout the system. External visual inspections constitute another vital aspect of routine monitoring. Qualified personnel should thoroughly examine the equipment's exterior for any signs of leakage, which might manifest as drips, stains, or dampness around joints and connections. They must also pay close attention to vibration patterns and noise levels, as changes in these parameters often indicate developing mechanical issues. Surface corrosion indicators require careful observation, particularly around joints, supports, and areas exposed to harsh environmental conditions. The integrity of insulation materials must also be verified to maintain system efficiency and prevent energy losses.

Periodic inspection requirements

Semi-annual to annual inspections demand a more comprehensive evaluation approach that begins with sophisticated non-destructive testing methods. Ultrasonic thickness measurements

provide crucial data about wall thinning patterns, helping maintenance teams predict potential failure points before they develop into critical issues. Eddy current testing proves invaluable for assessing tube integrity, capable of detecting both surface and subsurface defects that might compromise system performance. Magnetic particle inspection techniques enable detailed examination of surface conditions, particularly effective for identifying developing cracks in ferromagnetic materials. Penetrant testing complements these methods by providing detailed information about weld integrity and surface discontinuities.

The development and implementation of cleaning schedules form another critical component of periodic inspections. Maintenance teams must assess fouling levels through various methods, including pressure drop analysis and heat transfer efficiency calculations. Based on these assessments, they can implement appropriate chemical cleaning protocols, selecting specific cleaning agents based on the type of fouling present and the material composition of the heat exchanger. In cases where chemical cleaning proves insufficient, mechanical cleaning methods may be necessary, though these must be conducted with great care to prevent damage to heat exchanger surfaces.

Mechanical integrity verification represents the third major aspect of periodic inspections. This includes detailed assessment of gasket conditions, looking for signs of deterioration, compression set, or chemical attack that might compromise sealing integrity. Bolt torque requires careful checking and adjustment to maintain proper sealing force while preventing over-compression that could damage gaskets or flanges. Flange faces must be examined for signs of corrosion, erosion, or mechanical damage that could affect sealing capability. Support structures require thorough evaluation to ensure they continue to provide adequate support while allowing for thermal expansion and contraction.

Comprehensive inspection planning

The most thorough examinations, typically conducted every three to five years, begin with a complete system disassembly process. This involves the careful removal of tube bundles, requiring specialized equipment and trained personnel to prevent damage during extraction. Internal components must be made accessible through systematic disassembly, with each step carefully documented to ensure proper reassembly later. The documentation process should include photographs, measurements, and detailed notes about the condition of each component as it is removed.

Component assessment during these comprehensive inspections must be extremely detailed. Microscopic examination of tube surfaces reveals subtle signs of deterioration that might be missed during less thorough inspections. Shell-side inspection requires careful attention to erosion and corrosion patterns, particularly in areas of high flow velocity or where

The technician checking power lines of the heat exchanger with current clamps.

phase changes occur. Baffle condition evaluation focuses on signs of wear, displacement, or damage that could affect flow patterns and heat transfer efficiency. Header box examination must cover all internal surfaces, looking for signs of corrosion, erosion, or cracking that could lead to mixing of process fluids.

Advanced testing procedures form the final phase of comprehensive inspections. Hydrostatic testing, when applicable, provides crucial information about system integrity under pressure. Tube bundle pressure testing helps identify any leaks or weak points that could lead to cross-contamination between fluids. Shell-side integrity verification ensures the pressure boundary remains sound and capable of containing process fluids safely. Comprehensive non-destructive testing implementation brings together multiple inspection technologies to provide a complete picture of equipment condition.

Strategic inspection scheduling

Daily operational monitoring

The implementation of effective daily monitoring systems requires a sophisticated approach to performance tracking. Modern facilities employ automated monitoring systems that continuously collect data on critical parameters such as temperature, pressure, and flow rates. This data undergoes regular analysis to identify trends that might indicate developing problems. The system should be capable of generating early warning signals when parameters deviate from established norms, allowing operators to take corrective action before minor issues develop into major problems.

Visual inspection protocols require careful development and implementation. Facilities must establish standardized inspection routes that ensure all critical components receive appropriate attention. These routes should be documented in detailed inspection checklists that guide operators through the inspection process, ensuring consistency and completeness. The reporting procedures must provide clear guidelines for documenting observations and escalating concerns when necessary. Proper training ensures inspection personnel

Heat exchanger opened for inspection.

understand both what to look for and how to interpret their observations effectively.

Monthly and quarterly assessments

Thermal analysis during monthly and quarterly assessments provides crucial information about system performance and condition. Infrared scanning programs help identify hot spots or unusual temperature patterns that might indicate developing problems. Regular documentation of temperature patterns enables comparison over time, helping identify gradual changes that might otherwise go unnoticed. Hot spot identification requires careful analysis to determine whether elevated temperatures indicate normal operating conditions or developing problems. Thermal efficiency assessment helps track system performance over time, identifying gradual degradation that requires attention.

The mechanical evaluation process requires a systematic approach to equipment examination. Detailed external inspection procedures guide technicians through a thorough examination of all accessible components. Vibration analysis implementation helps identify developing mechanical problems before they become severe enough to cause failure. Noise level monitoring provides additional information about equipment condition, as changes in operating sounds often indicate developing problems. Support system evaluation ensures the equipment remains properly supported while accommodating thermal movement and maintaining alignment.

Essential inspection tools and technologies

Advanced non-destructive testing equipment

Modern ultrasonic testing systems provide sophisticated capabilities for assessing equipment condition. These systems combine accurate thickness measurement capabilities with advanced flaw detection functionality, enabling inspectors to identify both general wall thinning and localized defects. Data recording and analysis features allow trending of results over time, helping predict future deterioration rates. Proper calibration procedures ensure measurement accuracy and repeatability, crucial for making sound maintenance decisions.

Eddy current testing equipment has evolved to provide highly sensitive detection capabilities for various types of defects. Modern systems offer sophisticated signal analysis functions that help inspectors differentiate between different types of indications. Data recording systems enable documentation of findings for future reference and comparison. Probe selection criteria must consider factors such as tube material, expected defect types, and inspection speed requirements to ensure effective examinations.

Digital monitoring systems

Contemporary sensor systems provide continuous monitoring of critical parameters. Temperature monitoring equipment must offer both accuracy and reliability for extended operation. Pressure measurement systems need to combine accuracy with durability in demanding industrial environments. Flow rate tracking requires sophisticated instruments capable of handling various fluid types and operating conditions.

Vibration analysis equipment must provide detailed information about equipment condition while remaining reliable in harsh industrial environments. Data management tools have become increasingly sophisticated and crucial for effective inspection programs. Modern collection systems can handle large volumes of data from multiple sources simultaneously. Analysis software helps identify trends and patterns that might indicate developing problems. Trending capabilities enable prediction of future conditions based on historical data. Reporting functions generate clear, detailed documentation of findings and recommendations for maintenance planning.

Conclusion

The implementation of a comprehensive heat exchanger inspection program represents a critical investment in operational reliability and safety. Through careful attention to inspection frequency, strategic scheduling, and the utilization of appropriate tools and technologies, organizations can significantly enhance their maintenance effectiveness and equipment longevity.

Success in heat exchanger maintenance requires a commitment to continuous improvement and adaptation to emerging technologies and methodologies. Organizations must regularly review and update their inspection protocols to incorporate new techniques and address evolving operational challenges. This includes evaluating current inspection protocols against industry best practices, assessing tool and technology requirements for comprehensive inspections, developing structured implementation plans for enhanced procedures, investing in staff training to ensure proper execution, and establishing regular review periods to evaluate and improve inspection programs. ■

About the author

Omari Hussein Sabuni is an experienced mechanical engineer at Kinyerezi Gas Power Plant, specializing in heat exchanger design, optimization, troubleshooting and providing practical solutions for various heat exchanger problems. He is skilled in analyzing thermal systems and developing innovative solutions to enhance heat transfer efficiency and adept at conducting feasibility studies, performing risk assessments, and ensuring compliance with industry standards.

Product News

Vent-Axia's embodied carbon calculations for commercial heat recovery aid building design

To help with the design of low and zero-carbon buildings, leading ventilation manufacturer Vent-Axia has completed its embodied carbon calculations on its product portfolio.

This includes its CIBSE award-winning Sentinel Apex, the next generation of commercial heat recovery, which is set to help specifiers create low-carbon buildings as the company heads towards the UK's 2050 net-zero target. Sentinel Apex was developed from the outset with equal consideration to operational performance and whole-life-costing, and this is visible in the data available for the product.

Embodied carbon calculations have been carried out in accordance with the latest CIBSE (Chartered Institution of Building Engineers) 'TM65 Embodied Carbon in Building Services: A Calculation Methodology (2021)' digital tool requirements. This enables Vent-Axia to provide basic-level report figures for all its products and the company is now working towards the completion of more comprehensive and independently verified Environmental Product Declarations (EPDs) for its products.

TM65 is an internationally applicable methodology for the calculation of embodied carbon in building services engineering. With the methodology, embodied carbon is understood as the greenhouse gas emissions associated with the manufacture of a product, its installation, maintenance, repair, replacement, and end-of-life.

It covers the whole life cycle, excluding operational aspects and the potential recovery, reuse, or recycling of materials.

Brenmiller Energy to launch bGen ZTO

Brenmiller Energy Ltd., a global energy provider of thermal energy storage (TES) solutions to industrial and utility markets, has commenced the development of a ground-breaking TES system, the bGen ZERO Thermal Oil™ (bGen ZTO) designed to electrify thermal oil for industrial applications. Planned for commercial availability in 2026, bGen ZTO expands Brenmiller's total addressable market into the USD 8bn annual thermal oil heating equipment market growing at a compound annual growth rate (CAGR) of 6%.

Thermal oil is used for industrial heating processes of pharmaceuticals, chemicals, petrochemicals, and food processing industries. Today, 95% of thermal oil is powered by fossil fuels.

A breakthrough innovation, bGen ZTO is a modular TES system that will combine an internal electric conversion for storage with integrated heat exchange, achieving nearly 100% cycle efficiency through simplified maintenance and indirect oil heating with minimal degradation, smooth stability, and limited breakdown, if any, while heating thermal oil upto 340°C.

The launch of bGen ZTO comes as industries increasingly turn to renewable energy solutions in the face of fossil fuel volatility.

Alleima launches high-temperature alloy

Alleima is proud to announce, Alleima® TD, an innovative solution for the heat treatment industry where there is a need for reliable high temperature materials. The product ensures consistent performance for mineral insulated cable (MIC), measurements, and heating cables, even at extreme temperatures up to 1250°C.

Industries with a focus on the productions of automotives, aluminium, gas turbines, and aerospace engines, are known for its harsh environments that put high demand on surrounding materials in the production. Alleima® TD is a response to the increasing demand from these kinds of industries as they need new products with high precision, reliability, and safety requirements for temperature, control, and measurement engineering.

With over 160 years of Swedish steelmaking heritage, Alleima, a leading manufacturer of high value-added products in advanced stainless steels and special alloys, can now provide a high-temperature alloy with excellent corrosion resistance, and strength for advanced MIC protection. Alleima® TD ensures consistent performance in elevated temperatures minimizing corrosion and contamination of the cable insulation.

With over 900 advanced steels and alloys, Alleima helps reduce carbon footprint and energy consumption while increasing efficiency. The company's production processes use 80% recycled steel and 96% fossil-free energy worldwide.

Panasonic launches decentralized water-to-air heat pumps

Japan's Panasonic has released new decentralized water-to-air heat pumps designed for residential and commercial buildings.

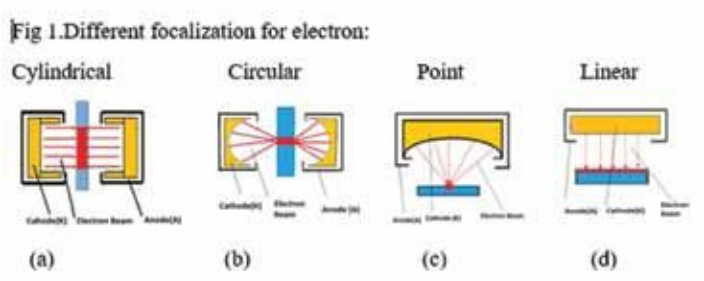
The Aquarea Loop system is available in three versions with cooling capacities ranging from 1.1 kW to 2.6 kW and heating capacities between 1.10 kW and 3.10 kW, with noise levels spanning from 48 dB(A) and 52 dB(A).

The smallest product has a size of 641 mm x 775 mm x 144 mm and a weight of 35 kg. For this device, the manufacturer boasts a coefficient of performance (COP) of 5.20 and a seasonal coefficient of performance (SCOP) of 6.44, with the seasonal energy efficiency rating (SEER) being 5.50.

As for the largest system, it measures 641 mm x 1,225 mm x 144 mm and weighs 45 kg. The COP is indicated at 5.90 and the SCOP at 6.74, with the seasonal energy efficiency rating (SEER) being 7.90.

Panasonic said the new heat pumps can be installed using existing piping or replacing conventional radiators in refurbishment projects.

InventionHome® Inventor creates electron beam system



Elena A. of Hanover, MD is the creator of High-Power Plasma Electron Beam Installations (HPPEBI), a groundbreaking technology that has the potential to revolutionize industrial processes across various sectors: melting-casting technologies of hard fusible alloys, ultra-fast surface heat treatments of steels and alloys (hardening, annealing, tempering, texturing, and polishing), "single shot" welding of different metals, alloys, insulators and thin layer deposition (ALD).

Since the mid-20th century, the Conventional Thermionic Electron Gun (TEG) has provided the basis for a variety of specialized applications in surface treatments (hardening, annealing, tempering, texturing, and polishing), welding, and coating deposition. Comparing this Invention HPPEB with the TEG, this Invention HPPEBI, offers the most practical, technical, and economic advantages for a wide range of technologies. It generates a very powerful electron beam with different configurations, and different thermal profiles (circular, punctual, cylindrical, and linear), in the target. This is possible because the electron beam configuration is determined by the cathode geometry only.

It is suitable for processing any kind of material (metal, alloys, dielectric, glass; ceramic, isolator) because it doesn't have a build-up charging effect. The conventional electron gun can't be used for dielectric, isolating materials because the first electrons that reach the target remain in the structure of the target and reject the other electrons that come. The distortion, warping, and failure in service are reduced significantly during any heat treatment because the electron beam and plasma will cover uniform the entire workpiece during the process.

Any heat treatment technology can be done in a single shot completely. No need to rotate the workpiece, or move the electron gun/laser during the treatment, or use a magnetic field to focalize the electron gun.

Daikin unveils new Pro-C CRAH at Data Centre World London 2025

Daikin announces its participation in the upcoming Data Centre World (DCW) 2025, the premier event for data centre professionals. The event will also be the occasion to launch the new Pro-C CRAH, extending the set of Daikin solutions for data centre projects.

Aiming to broaden the solutions' portfolio, the new Pro-C CRAH will be presented at DCW, with a complete unit at the stand. Ranging from 30 to 210 kW, this new product range allows for more precise temperature control in the white space. The key advantage of Pro-C CRAH relates to its flexible design, making it suitable for all kinds of data centres. Indeed, Pro-C CRAH is available under hard and raised floor configurations and features a comprehensive list of accessories for optimal performance and outstanding reliability.

One of the highlights of Daikin's offerings is its advanced heat recovery solutions. At DCW, Daikin will explain its latest heat recovery technologies, in a presentation scheduled for March 13th at 10:45 am in the Energy Efficiency Theatre. Attendees will have the opportunity to meet with a Daikin specialist and learn how these solutions can significantly reduce energy consumption.

Metalforms Heat Transfer & TransTech Group announce new channel partners

Metalforms Heat Transfer, a division of TransTech Group, proudly announces the expansion of its channel network with the addition of four premier channel partners. These partnerships mark a significant step in re-establishing Metalforms Heat Transfer's industry-leading direct customer support network, ensuring plant-level expertise and responsive service for Twisted Tube® Heat Exchanger and Brown Fintube® Hairpin Heat Exchanger products.

The newly appointed channel partners include: Heat Transfer Specialists of Louisiana – Serving Louisiana and Southern Mississippi; Apogee Equipment Solutions – Covering Texas; Andersen & Associates – Supporting the Western United States; and Thermal Transfer Solutions Ltd. – Serving British Columbia, Alberta, Saskatchewan, and Manitoba in Canada.

These partners bring decades of expertise in Twisted Tube® and Brown Fintube® Heat Exchanger Technologies and have extensive experience supporting complex heat transfer applications in the refining, petrochemical, and industrial markets. Their addition reinforces Metalforms Heat Transfer's commitment to delivering best-in-class technical support, faster response times, and localized engineering expertise.

To support this expansion, Metalforms has appointed Alvin Jones as Regional Sales Manager to oversee the channel partner network and ensure exceptional service delivery across the Americas.

Low-carbon technology upgrades planned for Fish Creek WWTP

The City of Calgary is set to begin construction on significant upgrades to the Fish Creek Wastewater Treatment Plant, including Alberta's first wastewater heat recovery system. The project was recently awarded to Graham.

The upgrades will improve plant efficiency, increase capacity, and reduce greenhouse gas emissions by 1,600 tonnes of CO_2 annually—equivalent to removing 330 cars from the road. Key improvements include odour control, sludge processing facilities, a UV disinfection upgrade, and new administrative buildings.

The USD 547M project ensures the plant can support Calgary's growing population while advancing the city's climate goals. The innovative heat recovery system will capture thermal energy from treated wastewater to heat the facility, making it the first of its kind in Alberta and the second in Canada.

By upgrading the existing plant rather than decommissioning it and building a new one, the city is saving between USD 120M and USD 200M. Officials emphasize that this investment strengthens Calgary's leadership in sustainable infrastructure.

Carrier launches R-290 high-temperature heat pump

Carrier has unveiled the AquaSnap® 61AQ, its first high-temperature air source reversible heat pump for commercial applications that uses R-290, a natural refrigerant with nearly-zero Global Warming Potential (GWP). Carrier is a part of Carrier Global Corporation (CARR).

The AquaSnap® 61AQ has been specifically designed and optimised for R-290, combining Carrier's innovative engineering with features that deliver high temperatures, increased energy efficiency, noise reduction, and enhanced operational performance. It can deliver high-temperature heating up to 75°C at outdoor temperatures as low as -7°C and operates efficiently in extreme conditions down to -25°C.

The unit's design makes it perfect for diverse applications such as healthcare and collective dwellings and can integrate seamlessly with building systems to meet a wide range of heating needs while minimising environmental impact.

Tailored to meet the challenges of stricter regulations, including F-Gas, the AquaSnap® 61AQ sets a new standard in performance and sustainability in the race to decarbonise heating. The monobloc version spans capacities from 40 to 140 kW, while the modular version allows connection of up to four units, extending the capacity range to 560 kW.

The use of R-290 refrigerant underscores Carrier's commitment to sustainable heating solutions. R-290 complies with evolving environmental standards while maintaining reliable performance, and according to the IPCC Sixth Assessment Report, has a GWP of 0.02.

Alfa Laval's hydrogen solution

In today's era of speedy implementations of sustainable solutions, Alfa Laval through Business Unit Welded Heat Exchangers, is at the forefront of innovation by developing heat exchangers serving the high-capacity hydrogen refueling stations for heavy-duty vehicles. As a part of the European consortium 'Refuelling Heavy Duty with very high flow Hydrogen', known as the RHeaDHy project, Alfa Laval is contributing to tackling climate change and promoting sustainable development with the EU's Horizon Europe research program.

Alfa Laval's participation in the RHeaDHy project underscores its commitment to advancing hydrogen technology and solidifying its leadership in sustainable solutions. With Europe's plan to deploy hydrogen refuelling stations in every major city by 2030, Alfa Laval's innovative contributions are crucial for the future of transportation.

The technology developed by RHeaDHy was nominated for the EU Innovation Radar Prize, which highlights the project's potential impact. RHeaDHy's high-performance hydrogen refuelling stations are essential to the EU's transport decarbonization ambitions. By developing new high-flow refueling protocols and associated equipment, this project aims to transform the transportation sector, paving the way for a cleaner, sustainable future.

Vertiv launches liquid cooling services portfolio

Vertiv (VRT), a provider of critical digital infrastructure and continuity solutions, has announced the launch of Vertiv™ Liquid Cooling Services. This offering provides customers with the tools to enhance system availability, improve efficiency, and navigate the evolving challenges of advanced liquid cooling systems with confidence. The offering is now globally available.

Vertiv Liquid Cooling Services offering is focused on providing seamless integration of liquid cooling systems with IT equipment and adjacent infrastructure. It includes expert installation and commissioning, ongoing maintenance with special attention to fluid management, cleanliness, and preventing air from entering the system — key for system reliability. Traditional maintenance practices aren't enough for the complexities of liquid cooling systems supporting critical AI applications. This offering leverages Vertiv's decades of industry experience and provides best-practices delivery of preventive and condition-based maintenance to provide reliable and efficient system performance and to maximize availability.

Vertiv™ Liquid Cooling Services include a full range of solutions designed to support AI-driven and high-performance computing environments, providing seamless integration, long-term reliability, and operational continuity. Vertiv's certified technicians and field engineers provide

expert support at every stage, confirming that heat rejection systems and cooling loop fluid systems function optimally:

MHI Thermal Systems to launch "Ene-Conductor" heat source control system

Mitsubishi Heavy Industries Thermal Systems, Ltd. (MHI Thermal Systems), a part of Mitsubishi Heavy Industries (MHI) Group, announces the launch of a new model of its "Ene-Conductor" Heat Source Control System for integrated control of centrifugal chillers and peripheral equipment such as chilled water pumps, cooling water pumps, and cooling towers. The new EC-8 model, to be added to the lineup this spring, allows for control of up to 8 centrifugal chiller units. With these features, the new model can be more widely used and installed in overseas large-scale facilities, as well as enhancing energy conservation for the whole facility.

Ene-Conductor incorporates the operational and control knowledge and experiences as a centrifugal chiller manufacturer, offering a packaged solution with higher energy-saving control functions, such as controlling the number of centrifugal chillers, controlling the variable flow rate of chilled water and cooling water. With these packaged features, the new model automatically determines the optimal operation of the entire air conditioning system, reducing power consumption by up to approximately 26%. In addition, because the repeated system design in each project and workload for installation can be reduced, the system can be installed easily. Furthermore, Ene-Conductor can be added to existing facilities, therefore, even without renewing and updating facilities, it is possible to install the Ene-Conductor and realize further energy savings.

Project News

Lummus announces first commercial award for SAP Technology

Lummus Technology has announced an award from SHCCIG Yulin Chemical Co., Ltd., a subsidiary of the SHCCIG Group, for its superabsorbent polymer (SAP) technology.
This marks the first commercial deployment of Lummus' SAP technology since it was added to the company's portfolio in 2023.
Lummus' scope for the award includes the technology license, process design package, technical services, and training for a 40 KTA unit at SHCCIG Yulin Chemical's complex in Shaanxi Province, China. Superabsorbent polymers are widely used in hygiene, health, and other consumer products that are in growing demand in many markets around the world. With SAP technology now part of its portfolio, Lummus offers an expanded range of polymer solutions, which can also be combined with its propylene technologies. This comprehensive offering positions Lummus for growth and strengthens its competitive position in the specialty polymer market.

Worley awarded a contract by Power2X

Power2X, a green molecules company, has contracted Worley, a global professional services company of energy, chemicals, and resources experts, to provide engineering and project management services for its eFuels Rotterdam project, a world-scale production facility for sustainable aviation fuel and ultra-low carbon fuels.
The Power2X production facility will use imported green methanol produced from green hydrogen and biogenic carbon as feedstock and have the capacity to produce over 250,000 tonnes/year of e-SAF, a non-fossil, synthetic fuel made from green hydrogen.
Worley will provide early engineering services, including a Class III estimate, supporting the preliminary design phase of the project. Worley will also work together with Power2X to define the best execution approach for the FEED and Execute phases of the project. This aims to create the baseline of the project, mitigate technical and commercial risks, increase CAPEX certainty, and develop a solid project schedule. Sustainable aviation fuel is a critical component in reducing CO2 emissions, cutting lifecycle carbon emissions by 90% compared to conventional jet fuel. Europe's ReFuelEU Aviation Regulation mandates the increased use of SAF, including e-SAF from 2030 onwards. The eFuels Rotterdam hub will contribute 40% of the required e-SAF volume in Europe when it starts up around the turn of the decade, making it a crucial player in Europe's energy transition.

Bloom Energy & Chart Industries announce carbon capture partnership

Bloom Energy (BE) and Chart Industries, Inc. (GTLS) (Chart) have announced a carbon capture partnership that will use natural gas and fuel cells to generate near zero-carbon, always-on power.
In announcing this partnership, the companies aim to offer a solution to customers, like data centers and manufacturers, who are seeking power solutions that can be deployed rapidly without compromising reliability or emission goals.
As part of the partnership, Chart will use its carbon capture know how to process Bloom's high-purity carbon dioxide (CO_2) exhaust stream into outputs that are ready for utilization or sequestration. The CO_2 utilization market serves as an important near-term term bridge to carbon sequestration in locations, where sequestration infrastructure is not available or permitted. According to Morgan Stanley, more than 500 million tonnes per annum (MTPA) of carbon storage capacity is expected to come online within the next five years. As sequestration capabilities grow in the U.S. and globally, CO_2 utilization provides an immediate pathway to repurpose captured carbon while supporting long-term decarbonization efforts.
Efficient carbon capture depends on the purity of CO_2 in the exhaust stream, which varies widely across power generation technologies. Conventional technologies that generate electricity from natural gas through combustion—such as gas turbines and reciprocating engines—produce exhaust streams with approximately 5% CO_2. Capturing such low-concentration emissions

remains technically complex and costly. In contrast, Bloom's proprietary high-temperature fuel cell technology converts natural gas without combustion, yielding a CO_2-rich stream that has 15 times lower mass flow and ten times the CO_2 concentration, making the capture process more efficient and less costly.

REHVA signs a MoU with ASHRAE

REHVA is happy to announce the renewal of a partnership with ASHRAE.
During the ASHRAE Winter Meeting in Orlando, USA, the REHVA President, Catalin Lungu met with ASHRAE President elect, Bill McQuade and signed a Memorandum of Understanding.
The company's President had the chance to discuss with the current ASHRAE President, Denis Knight, and meet with many important members of ASHRAE such as former presidents Ginger Scoggins and Tim Wenz. Many members of the REHVA Family were present, Ioan Silviu Dobosi, Bjarne W. Olesen, Bratislav Blagojević, Ilinca Nastase, Marco Ignatovici, the REHVA Journal editor-in-chief, Jaap Hogeling, and also Martin Dieryckx, Claudio Zilio, Luca Pitera, and Gratiela Tarlea. REHVA is happy to renew this collaboration and looks forward to working together.

Advanced Heat Treat Corp. expands at Michigan location

Advanced Heat Treat Corp. (AHT), a recognized leader in heat-treat services, announced a building expansion at its Monroe, Michigan facility. Groundbreaking for the project took place during the last week of November 2024, with construction anticipated to be complete by summer 2025.
The new production space will house two additional pieces of equipment, a gas nitrider and an ion nitrider, with room for more equipment and possibly new services in the future.
"The building expansion and new equipment demonstrate our sustained growth and forward-looking investments as we continue to adhere to our mission of 'exceeding expectations with UltraGlowing® results'," said Mike Woods, president of Advanced Heat Treat Corp. "The additional nitriding units will increase our nitriding capacity and enable faster turnaround."
AHT is collaborating with local contractors Davison Building & Development on the project, further supporting the local community and its businesses.
AHT has four locations: Monroe, Michigan; two in Waterloo, Iowa; and a fourth in Cullman, Alabama. Among the four locations, they offer more than 20 surface treatments including gas and ion nitriding/nitrocarburizing, UltraOx®, induction hardening, stress relieving, and more. AHT Michigan has the unique capability to nitride parts up to 31-feet in length.

JAFZA, A-HEAT to establish largest heat exchanger facility in GCC

Jebel Ali Free Zone (JAFZA) has signed an agreement with German technology group Allied Heat Exchange AG (A-HEAT) to develop the largest heat exchanger production facility in the GCC.
The state-of-the-art facility, set to be developed by JAFZA, will meet the rising demand for energy-efficient cooling solutions, particularly for data centres that require advanced thermal management to enhance operational efficiency and sustainability.
Spanning 1.2 million square feet with a built-up area of 400,000 square feet, the built-to-suit facility will be located within DP World's flagship free zone, JAFZA, and operated by Güntner, A-HEAT's flagship brand. With a legacy dating back to 1931 in Munich, Güntner is a global leader in heat transfer technology.
The new facility will serve as a key production and distribution hub, and by localising production, A-HEAT aims to strengthen its supply chain efficiencies, enabling faster, more flexible deliveries across the GCC, India, China, Africa, and Asia.
The exponential growth of data centres, driven by artificial intelligence and cloud computing, has significantly increased the need for energy-efficient cooling solutions. Cooling remains one of the largest power-consuming components in IT infrastructure, making high-performance heat exchangers essential for optimising efficiency and reducing energy consumption.
As part of this expansion, Güntner will manufacture its most advanced heat exchangers, using natural refrigerants such as CO_2 and ammonia for energy-efficient cooling.

Energy Partners, Aspen sign R300m deal

Energy solutions provider Energy Partners has entered into a partnership with pharmaceutical manufacturer Aspen Pharmacare, to invest R 300M to build, operate and manage a centralised ammonia cooling plant at Aspen's Gqeberha production site, in the Eastern Cape.
Energy Partners will assume full responsibility for the plant's temperature compliance, uptime, and efficiency over the 20-year span of the agreement.
Aspen's current production facilities are spread across several large factory buildings in Gqeberha and rely on several independent cooling and heating systems.
Energy Partners will replace this with a centralised 17 MWR (megawatts of refrigeration) ammonia cooling and heating system.
Construction on the project is already underway, with the centralised plant expected to be fully operational by the end of the year.

Additionally, the initial phase has been designed for expansion by 25% to meet planned future growth.
The agreement is an example of the cooling-as-a-service (CaaS) model pioneered by Energy Partners across multiple sectors in South Africa over the last decade.
Energy Partners says this project is the largest ammonia system of its kind in the country and represents a considerable stride in sustainability and the pharmaceutical industry's approach to energy management.

Sarens supports the expansion of Talimarjan Thermal Power Plant

Sarens is collaborating with client Callik Enerji on an important plant expansion project in the Kashkadarya region of Uzbekistan.
The Talimarjan Combined Cycle Power Plant is undergoing expansion and upgrade work to increase its power supply, with two more combined cycle plants being added to achieve a total capacity of at least 900 MW.
As part of this work, Sarens will be lifting several heat recovery steam generators (HRSGs) and other modules weighing up to 258 tonnes and measuring up to 125 metres.

NORMA Group receives an order for tank ventilation line systems

NORMA Group has won a major order for tank ventilation systems. From mid-2026 to 2035, the company will supply a well-known European car manufacturer with tank ventilation systems for gasoline-powered passenger cars and plug-in hybrids. The contract has a total volume of around EUR 140M. The tank ventilation systems ensure that fuel vapor does not escape into the environment; but is used in the combustion process instead.
The major order includes the development and production of tank ventilation systems for various models of the OEM. The systems consist of several plastic tubes and quick connectors. NORMA Group manufactures them in Subotica in Serbia and Qingdao in China. The customer installs the systems in the vehicles at its plants in Europe, Asia, and America.
Gasoline contains harmful volatile organic compounds that can be released into the air through evaporation. The tank vent line from NORMA Group is connected to the tank and prevents fuel vapors from escaping into the environment from there. Instead, the ventilation system directs the gasoline vapors from the tank into an activated carbon container. The vapors are stored there and later fed into the regular combustion process. Among others, the Euro 6 and China 6 emission standards contain strict limits for evaporative emissions from gasoline vehicles.

PCL, Stantec selected for USD 121M San Francisco biogas build

Edmonton, Alberta-based construction firm PCL Construction and engineering company Stantec have won a USD 121M fixed price design-build contract for the Southeast Treatment Plant Biogas Utilization Project in San Francisco, according to a Jan. 23 news release from PCL.

PCL, whose U.S. headquarters are in Denver, expects to complete construction of the project in early 2027, per the release. Stantec, also based in Edmonton, is acting as lead designer on the build and is underway with the full-scale design of the facility.

The project will treat the biogas, generated as a byproduct of wastewater treatment at the Southeast Treatment Plant, in the new digesters to transform it to renewable natural gas quality for injection into the nearby Pacific Gas and Electric gas pipeline, per the release.

PCL said the project would reduce emissions and support the city's renewable energy goals. The system consists of state-of-the-art gas conditioning and separation processes, which will prepare the renewable natural gas for injection into the existing gas pipeline.

The plant, which is the city's largest wastewater treatment facility, handles about 80% of San Francisco's combined stormwater and wastewater and treats an average of 57 million gallons of wastewater per day, according to PCL.

DL E&C wins won 236bn order for S-OIL heat & power plant

DL E&C has secured a contract for a won 236bn combined heat and power plant project from S-OIL. The project secured this time involves a combined heat and power plant with a capacity of 121 megawatts and a production rate of 160 tons of steam per hour. It is set to be completed by December next year at S-OIL's Ulsan plant and will generate and supply its own power. DL E&C will carry out the entire process using the Engineering, Procurement, and Construction (EPC) method.

Combined heat and power generation uses natural gas as fuel instead of coal. Natural gas is considered a 'bridge fuel' for energy transition as it produces fewer greenhouse gases and fine dust compared to coal. Additionally, the high-temperature exhaust gases generated during the power generation process will not be directly discharged into the atmosphere; instead, they will be utilized to produce steam through a waste heat recovery boiler for plant operations.

DL E&C has won several contracts from S-OIL. The company is currently working on the 'Shahin Project,' which is constructing South Korea's largest petrochemical facility. It successfully completed multiple large-scale projects, including the 'Residue Upgrading Complex (RUC)' in 2018.

EBRD invests over EUR 800M in Serbia in 2024

The European Bank for Reconstruction and Development (EBRD) invested EUR 807M in Serbia last year, continuing to scale up its activities in the country. The Bank also mobilised EUR 395M from other investors. The Bank supported a record total of 37 projects across all sectors of the economy. Nearly EUR 500M of last year's investment volume went towards accelerating Serbia's green economy transition, particularly on renewable energy projects, greening district heating networks, and upgrading environmental infrastructure.

Highlights included a EUR 105M loan for the construction of a large solar thermal plant in Novi Sad which will contribute green energy for the city's district heating, reducing air pollution and providing additional balancing capacity to the power system.

In the same sector, the Bank also financed with a EUR 30M loan the piloting of cutting-edge technologies in the district heating systems of ten additional municipalities across the country, including solar-thermal, heat pumps, urban and industrial waste heat recovery, and geothermal power.

In renewables, the Bank provided a EUR 45M project financing for the first project constructed under the EBRD-supported program of wind and solar auctions, the Pupin wind farm, as well as a EUR 67M loan to EPS for the rehabilitation and expansion of the Vlasinske hydro power plant.

BWCC awarded USD 35M contracts

Babcock & Wilcox (B&W) (BW) has announced that its Babcock & Wilcox Construction Co., LLC (BWCC) subsidiary was awarded USD 35M in contracts for maintenance and service work at power plants and industrial facilities in North America, contributing to a backlog of more than USD 160M in construction services heading into 2025.

"We continue to see a robust market for maintenance and service work in North America as our customers look to keep their power generation, industrial, and manufacturing facilities operating at peak performance," said BWCC Vice President and General Manager Mike Hidas. "Maintaining the thermal power fleet also is essential to energy security and grid reliability."

"We're proud to play a key role in helping utilities and manufacturers serve their customers and ensure the stability of power grids," Hidas added.

BWCC's broad capabilities include outage services, installation, refurbishment, mechanical repair and maintenance services, and equipment and plant installations.

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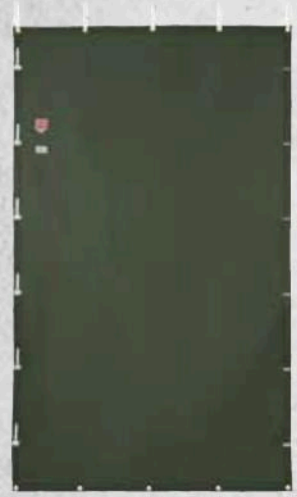

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