cover story:
Sun Mark Stainless: the evolving arm of Sunrise Group

In this issue...
- Tubes & pipes: thriving, but for how long?
- Challenges & opportunities in additive manufacturing
- Onboard with marine scrubbers: resilient solutions for lower emissions
- Role of stainless in offshore applications

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Volume 32, March 2020
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**A spring in our step**

“Good seasons start with good beginnings”
American Major League Baseball player, coach, manager

Spring has arrived early this year; in fact six weeks earlier than usual here in the Netherlands. At a time when we are usually enduring sleet, frost and the occasional snowfall, this weekend I spent a few hours in the garden clearing away the detritus of winter and marvelling at the daffodils and crocuses that are blooming so early. Despite enjoying the warmest February ever on record, I couldn’t help but worry that this is not the natural order of things and that our climate is changing faster than nature can keep pace.

Fortunately, I did get to experience some ‘real’ winter weather during a recent visit to Lapland – hence my new photo above – where the thick snow and frozen lakes were perfect for dog-sledging, skating and skiing. Imagine my delight when I came across this stainless steel sculpture outside the cultural centre in Luleå!

This month our special focus is on tubes and pipes; James Chater has provided us with an excellent overview of the market, which you can read from page 28. It’s a tale of flourishing markets and strong growth across many sectors. Oil & gas, power generation, auto and wastewater are all resulting in a buoyant market for tube and pipe manufacturers.

We welcome the Indian tube manufacturer Sun Mark Stainless to the cover for the first time this month. Sun Mark focuses primarily on manufacturing stainless steel welded pipes and tubes, coils and bright bars; recently, the company added butt weld fittings to their portfolio. If you’re interested in additive manufacturing, don’t miss our special report by John Butterfield. It’s an insightful look at how the sector is rapidly developing in some sectors, and some of the reasons it’s taking a while to become widely utilised in demanding applications such as the offshore industry.

For our end user interview this month, I had the pleasure of speaking with Dr. Willem Maarten van Haaften, Senior Researcher, Materials & Corrosion at Shell Global Solutions International. Based down the road in Amsterdam, Willem Maarten is also a member of the Duplex World steering committee and is looking forward to helping assess the abstracts sent in response to the Call for Papers. With the deadline extended to 20 March, you still have a few days to send me your abstract and join the conversation at Duplex World Seminar & Summit in Düsseldorf, Germany, on 13 & 14 October.

This month we also have a feature relating to the fire safety of stainless steels, kindly provided by the Australian Stainless Steel Developments Association. The article explains that stainless steels are an excellent choice where fire safety is a consideration and reinforces the versatility and value of this marvellous family of materials.

Joanne McIntyre
Editor-in-Chief of Stainless Steel World
j.mcintyre@kci-world.com
Time to fight corrosion – for the environment’s sake

The global cost of corrosion exceeds USD$2.5 trillion annually or three% of global GDP, and the environmental consequences are enormous. Innovative premium high-strength and high-performance stainless steel fasteners offer significant benefits.

Tubes and pipes: thriving, but for how long?

The tubes and pipes sector has continued to prosper on the back of higher oil and gas prices, and a moderately good global economy. The energy industries continue to provide important markets, but other industries, such as auto and wastewater treatment, are not far behind.

End User Interview

Looking forward to further growth

Dr. Willem Maarten van Haaften is Senior Researcher, Materials & Corrosion at Shell Global Solutions International. Based in Amsterdam, his work focuses on upstream issues and the development of new materials for the short and long term.

Cables

Stainless steel cable ties a growing market

In terms of revenue, the global stainless steel cable ties market is anticipated to expand at a CAGR of ~5% during the forecast period, owing to numerous factors, states a recent market report.

Environment

Swedish industry joins forces for electrical heating

The Swedish Energy Agency has granted a project to evaluate the potential of replacing gas-fired furnaces with electrically heated furnaces for material heating.

Human Resource Management

Shortage of engineers starting to impact industry

According to reports from various countries, there is a shortage of qualified engineers in general across many industries. If the public and the private sectors are not pro-active, this shortage could lead to significant economic losses and collateral damage.

Nickel Alloys

Onboard with marine scrubbers: Resilient solutions for lower emissions

Ever-tightening sulphur oxide emission regulations are increasing the use of marine scrubbers globally. Operating in a highly corrosive environment, scrubbers require nickel-containing alloys to prevent failure.
Editor’s Page
Editorial comment by the Editor in Chief of Stainless Steel World, Joanne McIntyre

Community Update
Helping you to stay in touch with the international stainless steel industry community

Industry Update
Upcoming and ongoing projects around the world, plus company and industry news from the global CRA community.

Special Topic Update
New relating to the special topic covered in this issue: duplex stainless steels.

Calendar
Upcoming events for corrosion experts around the world.

Advertisers’ Index
A list of the supporters of Stainless Steel World magazine

Buyers’ Guide
The Buyers’ Guide and Application Guide are your essential reference tools for sourcing corrosion resistant alloy suppliers, distributors and manufacturers.

SPECIAL FOCUS TOPICS IN UPCOMING ISSUES…
April: Architecture, Building & Construction
May: Titanium & Exotics
June: Chemical & Petrochemical
High Performance Alloys for innovative solutions to demanding requirements

High corrosion resistant materials for SOx scrubbers and marine structures

- super austenitic stainless steel: UNS S31254 (SUS312L)
  UNS S32053 (SUS836L)
  UNS N08031
  UNS N08354

- duplex & super duplex stainless steel: UNS S32205 / S31803 (SUS329J3L)
  UNS S32506 (SUS329J4L)
  UNS S32750 (SUS327L1)

- high corrosion resistant stainless steel: UNS N08020
- corrosion resistant nickel alloy: UNS N10276 (NW0276)

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**COMMUNITY UPDATE**

**Chi Zhang joins Sverdrup Steel**

Mr. Chi Zhang has joined Sverdrup Steel as its representative in the Chinese market. Mr. Zhang is highly experienced in sales of high-performance alloys and has extensive knowledge of the market. A further asset for both the customers and Sverdrup Steel is his technical expertise, acquired through his education as a metallurgist and his previous employment at Outokumpu. His main work experience is with selling high-performance alloys from the European manufacturer to Chinese clients. Mr. Zhang will help Sverdrup Steel further grow the market in China. Sverdrup Steel serves the South East Asian markets from a service center in Busan, Korea.

**New Director Projects & Business at SAIL**

Shri Anirban Dasgupta has been appointed Director Projects & Business Planning of the Steel Authority of India Limited (SAIL). Previously, he served as CEO of SAIL's Bhilai Steel Plant (BSP). He shall continue to look after the works of CEO – BSP till further orders. Shri Dasgupta started his career in Centre for Engineering & Technology (CET) of SAIL in 1986. In September 2017, Shri Dasgupta took over as the CEO, IISCO Steel Plant (ISP). Under his leadership, ISP progressed towards achieving rated capacities. Shri Anirban Dasgupta took charge as Chief Executive Officer, Bhilai Steel Plant in June 2019.

**Kerner replaces Grolms at thyssenkrupp**

Markus Grolms, Vice Chairman of the Supervisory Board of thyssenkrupp AG, is resigning from his position. Jürgen Kerner, Chief Treasurer and Executive Board member of IG Metall in Frankfurt, will succeed him. IG Metall has also informed thyssenkrupp AG that it will propose Markus Grolms for the soon to be filled position of Labor Director and Human Resources Director for thyssenkrupp’s steel business. Grolms is expected to assume his new role on April 1, 2020. The change is subject to the approval of the Supervisory Board of thyssenkrupp Steel Europe AG.

**Sandvik proposals for 2020 AGM**

The Nomination Committee of Sandvik AB proposes the re-election of the Board members Jennifer Allerton, Claes Boustedt, Marika Fredriksson, Johan Karlström, Johan Molin and Helena Sjöholm, and the election of Kai Wärn and Stefan Widing as new Board members. Johan Molin is proposed to be re-elected Chairman of the Board. Kai Wärn is currently President and CEO of Husqvarna AB and a member of the Board of Husqvarna AB and AB Electrolux. He is also Chairman of the Board of Electrolux Professional AB. Stefan Widing assumes the position of President and CEO of Sandvik after several leading positions within Assa Abloy.

The Nomination Committee’s other proposals will be made public in the notice convening the Annual General Meeting of Sandvik AB on 28 April 2020.

**Roeland Baan to resign from Outokumpu**

Outokumpu’s President & CEO Roeland Baan has informed the company's Board of Directors that he will resign from Outokumpu this spring to take a CEO position in a company outside Finland. Baan will continue as the company’s CEO until May 15, 2020. The search for Mr. Baan’s successor has been underway since last autumn, and the Board expects to make a decision well ahead of Mr. Baan’s departure.
AMETEK announces enhanced regional support in 2020

Francois Levac

Satoshi Suzuki

Paul Stuyt

Yamina Lansari

AMETEK Surface Vision has announced a reorganization that will bring the company’s sales, support, and application expertise closer to customers in 2020. Dedicated business regions in the Americas, Europe, and Asia will become the primary regional gateways for Surface Vision to support users of Surface Vision’s SmartView® and SmartAdvisor® surface inspection and monitoring solutions. By offering easy access to local sales and project teams, service requirements, technical support and application engineering, Surface Vision will respond quickly and decisively to all its customers.

And by drawing on its regional team’s expertise as well as an extended pool of technical and applications knowledge embedded in its global business network, Surface Vision can fully support customers through the entire lifecycle of their assets.

To drive the change, Francois Levac and Satoshi Suzuki have been promoted to the key roles of Americas Business Director and Asia Business Director, respectively. Paul Stuyt and Yamina Lansari have been appointed Global Manager of Projects and Service, and Global Manager of Technical Services, respectively.

Olympic Steel appoints VP’s

Olympic Steel Inc. has promoted Francis (Frank) Ruane to the role of Executive Vice President - Supply Chain, and employed Michelle Pearson Casey as Vice President - Corporate Communications & Marketing.

Mr. Ruane will lead Olympic Steel’s supply chain efforts and manage the company’s distribution and proprietary fleet. He is a member of the Market Research Committee for the Metals Service Center Institute (MSCI) and is a past Communications Chair (Steel Buyers Forum) for the National Association of Purchasing Management.

Ms Pearson-Casey leads the company’s internal and external communications efforts. She is a former Olympic Steel employee, re-joining the Company with nearly 16 years of prior service and close to 20 years of experience in communications, change management and human resources.

Area Sales Manager (M/F)

based in Switzerland (French speaking canton)

European Market with special focus for Germany and France (based at our HQ and plant in Aigle)

Duties:

• Follow and implement our existing customers portfolio mainly manufacturers of heat exchangers
• Prepare and issue offers with intensive follow-up with your clients and feedback to our management
• Develop your business volume by selling our technical products to reach ambitious objectives
• Listening to your customers’ needs and advise them selling our most customized solutions
• Maintain, support and develop your customer base by creating a relationship of trust and confidence with your contacts
• Manage the entire sales process, from prospecting to the conclusion of the deal (commercial follow-up, follow-up of contracts, etc.)
• Work closely with our sales, operation and quality teams you will report directly to the Commercial Director.

Your profile:

• Sales experience in stainless steel tubes or heat exchangers sector
• General technical understanding, stainless steel would be a plus
• Working for sales targets in autonomy and as part of a team
• Exceptional interpersonal and communication skills
• Fluent in German, English and French. Italian would be a plus.

Since Germany is our main market, your language level in German has to be excellent. Perseverance, achievement of results and discipline will complete your profile

Do you want to join an international, multicultural and dynamic team in order to learn more?

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**INDUSTRY UPDATE**

**Gpi launches Gpi Tanks XL**

In 2020, the Gpi Group launched Gpi Tanks XL, a new operating company specializing in the sale and production of stainless steel storage tanks which have a capacity of 500 cubic metres or more. Production takes place at its state-of-the-art production plant in Groot-Ammers (NL) or on location at the customer’s site. Gpi Tanks produces stainless steel tanks of every shape and size, but Gpi Tanks XL specializes in large-scale tanks up to 15,000 m³. The business is now able to take on large-scale projects with relatively short lead times using innovative construction methods which have been developed in-house. Storage tanks of up to 5,000 m³ can be assembled in Groot-Ammers and shipped directly via the river Lek to destinations such as the port of Rotterdam. The construction methods are explained on the new website: gpi-tanksXL.com. The markets include customers from diverse industries: from storage terminals and bio-energy plants to producers of edible oils or (fine) chemicals.

**Sandvik complete purchase Summerill Tube**

Sandvik has completed its acquisition of Summerill Tube Corporation, a manufacturer of high precision tubes. Since 1892 it has delivered seamless and welded tubing in stainless steels and nickel alloys to various high demanding industries including aerospace, transportation and petrochemical. Summerill Tube Corporation is headquartered in Pennsylvania, USA, and generated revenues of about SEK 100M with 45 employees in 2018.

**ABB to supply HYBRIT electrification**

ABB has been selected to supply a full electrification and automation package for the unique HYBRIT pilot plant in Luleå, northern Sweden, whose main energy source is fossil-free electricity. HYBRIT (Hydrogen Breakthrough Ironmaking Technology) is a ground-breaking effort to reduce CO₂ emissions in the steel industry by replacing coal with hydrogen in the steelmaking process. The initiative, by the steel, mining and energy companies SSAB, LKAB and Vattenfall, has the potential to reduce Sweden’s total carbon dioxide emissions by 10%. The pilot plant in Luleå is expected to be in place in 2020 and SSAB will be able to produce the first fossil-free steel from 2026. By 2035, the goal is to sell fossil-free steel on a broad front. The pilot plant will be integrated into the latest version of ABB Ability™ 800xA with Select I/O solutions for greater flexibility in design and increased scalability. ABB will also deliver the ABB Ability™ System 800xA Simulator, a software simulation solution that allows operators to learn and test processes in a disconnected, safe and offline environment to enable swift commissioning and reduce the risk of unplanned shutdowns.

**Fives supply eco-friendly furnaces for China**

Fives was selected for two strategical contracts to design and supply reheating furnaces to Chinese steelmakers, both with very strict requirements on energy consumption and NOx emissions. The first project covers an ultra-low NOx emission furnace to reheat long products, such as stainless steel bars, coils or wires for Yantai Walsin Stainless Steel. The advanced technology offered by Fives, Stein Reheating WBF, a walking beam furnace, has a capacity of 85 tons per hour and will be equipped with the latest generation of AdvanTek® burners, designed in France. The AdvanTek® burners will guarantee energy efficiency and ultra-low NOx emissions. The second contract, with HBIS SHISTEEL, is for two reheating furnaces, each with a production capacity of 130 tons per hour. The Stein Digit@l Furnace™ was chosen due to its green performance. HBIS SHISTEEL set up new standards for cleaner, more flexible and more efficient steelmaking in China.

**GE and TerraPower collaborate on VTR**

GE Hitachi Nuclear Energy (GEH) and TerraPower have announced a collaboration to pursue a Public Private Partnership to design and construct the Versatile Test Reactor (VTR) for the U.S. Department of Energy (DOE). The two companies recently submitted a joint response to an Expression of Interest issued by the Battelle Energy Alliance (BEA) on behalf of the DOE which seeks stakeholders interested in forming a partnership for a cost-sharing arrangement to design and construct the VTR utilizing sodium fast reactor technology. The U.S. Department of Energy Office of Nuclear Energy established the VTR program to introduce fast neutron spectrum technology that does not currently exist in the U.S. and to support accelerated development of nuclear fuels and materials for advanced reactors.
Perryman: 2 new Ti furnaces

Titanium producer Perryman Co. commissioned two new furnaces at its California, PA, plant, designed and built by Retech Systems LLC. This will more than double its titanium melting capacity with the addition of an electron-beam (EB) furnace and a vacuum arc remelt (VAR) furnace.

An electron-beam furnace uses a high-energy, electron beam under vacuum to deliver heat to the titanium or other material being melted. At Perryman, EB melting is used to produce electrodes weighing up to 12,500 lbs.

VAR is a secondary process that melts the electrodes and refines the metal alloys using an electric arc under vacuum to produce metal ingots, which become feedstock for forging or rolling.

Babcock produces gas-fired water heater

Babcock Wanson has produced a bespoke TPC SW 1MW gas-fired Supercritical Water Heater, which operates at 275 bar pressure and reaches a temperature of 490°C, for Promethean Particles as part of its nanoparticle production process.

Promethean Particles has built the continuous multi-material nanoparticle manufacturing plant, based in Nottingham, producing in excess of 1000 tons per year. For this bespoke heater, Babcock Wanson designed and manufactured a specially wound continuous coil assembly to form the main heating surface using ASI 321 9mm thick stainless steel. This material and thickness were chosen to meet the pressure and temperature demands of the process to be able to produce supercritical water at up to 250 bar and 450°C.

The resulting heater is now an integral part of the process, which includes return fluid heat recovery to limit the final temperature rise of the fluid to 90°C. This brings it up to 360°C water at 270 bar to take it to the temperature required for the supercritical condition.

CDP recognizes ArcelorMittal

ArcelorMittal has been recognized by CDP for its leadership on corporate transparency and action on climate change from among over 8,000 companies worldwide who were scored on their 2019 disclosures. ArcelorMittal scored an A- in the 2019 CDP Climate Change assessment, an improvement from C in 2017, which means the company has now reached a leadership level.

This puts ArcelorMittal amongst the top 11% of companies within the industry, and compares favourably against the Global average of C, Europe regional average of C, and the metal smelting, refining & forming sector average of C.

Designed to harness the competitive spirit of business to raise ambition and spur action on corporate climate action, CDP scores thousands of companies that disclose climate data through its platform each year at the request of their corporate customers and investors.

The positive score reflects CDP’s assessment of ArcelorMittal’s ambition to significantly reduce its carbon footprint by 2050, and work on a broad portfolio of low-emissions technologies designed to reduce carbon emissions.
GSOL expanding ferronickel business

According to Reuters article the private equity fund GSOL is now the world’s second biggest producer of stainless steel ingredient ferronickel, and is holding talks about further potential acquisitions. As denoted by Marcos Camhis, the Global Special Opportunities Ltd (GSOL) fund aims to boost its output of 80,000 tonnes a year of ferronickel both by expanding its current two operations and potential new takeovers.

Since 2015, GSOL has revived the Falcondo operation in the Dominican Republic, which it bought from Glencore, and reopened the ferronickel plant in North Macedonia. At Falcondo, GSOL-backed Americano Nickel restarted one production line in 2016 and a second in 2018 and has now ramped up to around 30,000 tonnes a year of nickel contained in ferronickel.

The other operation, named Euronickel Industries, is now producing around 20,000 tonnes after GSOL acquired it last year and invested EUR 100M (USD 111M).

ESAB completes brand transition

ESAB Welding & Cutting Products has finalized the transition to the Exaton™ brand name for all welding filler metals involved with its 2018 acquisition of Sandvik Welding Consumables.

For stainless consumables, the Sandvik name has been replaced with the Exaton followed by the AWS/ASME classification of the product. For example, Sandvik 317L is now Exaton 317L.

The nickel-based consumables, previously sold under the Sandvik & Sanicro names, have been renamed with the Exaton followed by the AWS/ASME classification of the product. For example, Sandvik NiCrMo-3 is now Exaton NiCrMo-3.

Users can find a complete list of Exaton product names online. Previously completed brand transition activities included the updated brand look, moving the Exaton mobile app and moving Material Safety Data Sheets to the ESAB website.

Tenova to supply EAF to Nippon Steel

Tenova, a Techint Group company specialized in innovative solutions for the metals and mining industries, was awarded a contract for the supply of a Consteel® EAF (Electric Arc Furnace) for Nippon Steel Corporation. This new Consteel® EAF is the first one for the Nippon Steel Group in Japan - and it will be installed at their Hirohata works. Production is targeted to start in H1 of 2022 financial year.

Tenova’s Consteel® EAF offers high-quality standards as well as an environmentally friendly approach to steel production compared to the other EAF technology. Tenova’s exclusive Consteel™ technology is, in fact, the only fully proven industrial process that continuously heats and feeds metallic charge into the EAF, while simultaneously keeping gaseous emissions under control.
Reorganization at BUTTING

To continue improving quality and reliability, the organizational structure at BUTTING in Knesebeck was adjusted at the end of last year and now consists of four business units and two central divisions. At the same time, Anna Negri and Dieter Kleen took on their new responsibilities as Business Unit Directors.

The traditional organization at BUTTING in Knesebeck has been replaced by a process-oriented organization. In the future, four business units will focus on the special market requirements: Stainless steel welded pipes; Clad pipes; Spools and plant construction; and Customised components. The business unit “Stainless steel welded pipes” will be managed by Anna Negri. The Italian-born manager has worked as sales and purchasing manager for pipe manufacturers in Italy and Switzerland. Anna Negri has been with BUTTING in Knesebeck since September 2018.

Dieter Kleen is taking responsibility for the business unit “Spools and plant construction”. For more than 10 years, the mechanical and welding engineer held various management positions in international companies in the shipbuilding industry.

Euro supply high-purity manganese at Chvaletice Plant

Euro Manganese Inc. has entered into a memorandum of understanding (MoU) with JFE Steel Corporation (JFE) of Tokyo, Japan, to supply high-purity manganese products from its proposed demonstration plant at the Chvaletice Manganese Project in the Czech Republic for testing and evaluation. Approximately 10% (1,000kg) of the demonstration plant’s planned production, in the form of high-purity electrolytic manganese metal (HPEMM), will be provided to JFE.

The company and JFE also intend to collaborate by sharing technical and other information, so that EMN’s proposed Chvaletice Manganese Project plant can be designed and built to meet JFE’s requirements for reliable, high-quality and environmentally superior HPEMM for use in high-end specialty steel applications. The parties will work toward establishing a non-exclusive, long-term supply arrangement of HPEMM produced at the Chvaletice Manganese Project.

SynCOR plant in Russia

Gaz Sintez is developing a methanol plant project at the port of Vysotsk in the Leningrad Region of Russia. Hyundai Engineering has started the development of the FEED-package, and NIIK has been awarded the Russian general designer contract. The plant is expected to be completed in 2023. SynCOR Methanol™ features single-stage oxygen reforming, a methanol synthesis loop, and rectification. It is the most cost-efficient large-scale methanol technology in industrial operation currently, with capacities can be up to 10,000 tons per day. It also offers considerable environmental advantages.

Stamicarbon urea plant for Talcher

Stamicarbon, the innovation and license company of Maire Tecnimont Group, will license the technology for a grassroots urea plant for Talcher Fertilizers Limited in India. The new ammonia and urea complex will mark the revival of urea production in the state of Odisha, Angul district, in eastern India. Stamicarbon will deliver the Process Design Package for a 3850 mtpd melt and prilling plant. The urea melt plant will feature Stamicarbon’s Pool Condenser design and the complete synthesis section will be carried out in Safurex® stainless steel.

The commissioning of the plant is expected in 2023.

DuPont supply alkylation unit

DuPont Clean Technologies (DuPont) has been awarded the contract to supply Next Wave Energy Partners with licensing, engineering and proprietary equipment for a STRATCO® alkylation unit near the Houston Ship Channel in Pasadena, Texas, known as Project Traveler. Next Wave commissioned DuPont for a STRATCO® alkylation unit with 28,000 bpsd of alkylate production capacity from an ethylene feedstock.

The STRATCO® alkylation unit will enable Next Wave to generate low-sulfur, high-octane, low-Rvp alkylate with zero olefins that exceed the current U.S. gasoline specifications with an octane greater than 96.0 (R+M)/2. The startup is targeted for mid-2022.
DUPLEX creates sustainable solutions.

High-strength = Weight reduction
Excellent Corrosion resistance = Durability
Alloy-saving = Resource conservation

Biratori dam open channel
(NSSTS™2120)

News
Sep. 2019
NSSTS™2351 Launched

stainless.nipponsteel.com
**ISSF releases a new website “worldstainless.org”**

The International Stainless Steel Forum has released a new website; worldstainless.org which aims to be a site for anyone interested in stainless steels. The navigation and look & feel of the website have been upgraded to a more contemporary level. A key feature of the new site is the responsive design, which means that its content will display well on all devices, be it a mobile phone, tablet or computer. The site has five core sections which inform about stainless steels, their sustainability, applications, statistics, and training. The latter section offers the opportunity to learn more about this family of corrosion-resistant fully recyclable alloys. For members, there is a protected part of the website in which they can find information on meetings and projects including key documents.

**Outokumpu reviews long products business**

Outokumpu has initiated a strategic review of business area Long Products as part of its process to determine optimal long-term business mix for the company. During the review, Outokumpu will investigate multiple options regarding the business area’s future including opportunities for consolidation within the stainless long products markets. The strategic review is expected to be finalized during 2020. In 2019, business area Long Products’ net sales amounted to EUR 642M and adjusted EBITDA was EUR 7M.

**Fluor partnership awarded EPC contract**

Fluor Corporation (FLR) announced that Heartland Canada Partners (HCP), Fluor’s 50/50 partnership with Kiewit Construction Services ULC, was awarded a contract to provide engineering, procurement, and construction services for a new propane dehydrogenation (PDH) unit for Canada Kuwait Petrochemical Corporation (CKPC), a 50/50 joint venture between Pembina Pipeline Corporation (Pembina) and Kuwait’s Petrochemical Industries Company K.S.C. (PIC). The new PDH unit is part of CKPC’s integrated PDH plant and polypropylene upgrading facility that will be located in Sturgeon County, Alberta, Canada. Fluor expects to book its portion of the contract value in the first quarter of 2020. When complete, CKPC’s integrated PDH plant and polypropylene upgrading facility will convert locally sourced, low-cost propane into 850,000 tons per year of polypropylene.

Engineering on the project has begun, and construction is anticipated to begin in late 2020.

**Rapidia 3D arrives in rural Canada**

KAST’s MIDAS Lab became the first rural fabrication lab in Canada to house a 3D metal printer. The Rapidia 3D Metal printer at MIDAS Lab in Trail, B.C. is one of five machines to first come off of the assembly line. Having this type of 3D metal printer will enable users to make complex metal parts in a sustainable way. The Rapidia 3D metal printer uses a water-based process, which is the fastest and simplest way to 3D print complex metal parts in just two steps. The water-based metal paste eliminates the debinding step, enabling the two-stage Rapidia process to produce most parts within 24 hours. The innovative support system cuts printing time further by avoiding the need to print a metal base plate or most metal supports, saving up to 90% of the metal normally wasted on these elements. The Rapidia can print a wide range of materials including stainless steel, inconel, tool steel, ceramics, and titanium.

**Worley secures FEED contract for TOTAL**

Worley has been awarded the Front-End Engineering Design contract for TOTAL E&P USA’s North Platte field development in the Gulf of Mexico. The project brings together Worley’s recently acquired capability for the floating production unit topside design with Intecsea experience for the design of the hull, mooring and subsea pipelines. The FEED component of the project is being led by Worley’s Houston office with support from its Hyderabad office in India. The North Platte Development forms part of TOTAL’s re-entry, as an operator, into Gulf of Mexico operations with oil production expected to average 75,000 barrels per day at plateau level. TOTAL expects to make its final investment decision in 2021.

**Niles opens new stainless facility**

Niles Steel Tank, a subsidiary of Bradford White Corporation, has announced a new 85,000-square-foot facility that expands the company’s capacity to produce custom stainless steel vessels. Alloy Works is a fully integrated facility for American-made stainless products for the hydronics, chemical and petrochemical, dairy and food processing, brewing and winery, pharmaceutical and air products industries. Niles Steel Tank is the premier manufacturer and supplier of custom pressure vessels, process tanks, glass-lined water storage tanks and OEM vessels for commercial and industrial use. Products from the Alloy Works facility are fabricated to the highest standards, including ASME Boiler and Pressure Vessel Codes and National Board “R” Stamp, and provide customers with unmatched strength, corrosion resistance and performance.
CRAFTED FOR YOU

Fittings from our internal production, available with pipes and flanges from multiple warehouses around the globe, make the perfect combination for your needs worldwide.
Join Women in Steel @ wire+Tube
The Women in Steel group is meeting on March 31st 2020 at the wire+Tube exhibitions in Dusseldorf, Germany. The initiative was started by Jan Ward, CEO of Corrotherm. With an active interest in promoting the steel industry in general, Women in Steels is Jan’s vision to provide a network for women of all ages working in the global steel industry with the aim of proving support and encouragement and, where possible, nurturing to the next generation of steel professionals. Members stay in touch via the LinkedIn group ‘Women in Steel’ and at industry events. If you are interested in joining the networking event on March 31st, please contact Jan at email: Jan.ward@corrotherm.co.uk

Titan to make custom US fittings
Titan Fittings is expanding its offering to include custom US manufactured fittings using a state-of-the-art machining process in the manufacturing facility in Denver, CO. The fittings will be made to meet the increasing demand of the stainless steel hydraulic and instrumentation market. The fittings are used in various industries and applications and include NPT and BSPT Threads. They are available in a variety of configurations including straights, elbows, tees, crosses, caps, plugs, connectors, adapters, and reducers, and include options like port connectors, tube stub, AN fittings, NPT thread, SAE thread, BSP threaded.

Midland acquires Stainless Adapters
Midland Industries, LLC, a portfolio company of Wynnchurch Capital, LLC announced the acquisition of Stainless Adapters Inc. Located in Houston, Texas, SAI supplies premium, stainless steel hydraulic adapters and pipe fittings to a diverse set of end markets, including oil & gas, agriculture, automotive, marine, and general industrial.

GenerationS and ChelPipe Group look for startups
GenerationS corporate acceleration platform by RVC is looking for innovative projects in the area of pipe and tube production for ChelPipe Group. The main objective of the accelerator is to find the most advanced solutions ready for the following implementation into Chelpipe’s facilities. Startups for participation in the Accelerator will be selected in the following areas: new products, materials, and production technologies relevant to pipe and tube industry; innovative product substitutes for traditional steel pipes or pipe coatings; machine vision and production monitoring systems; and solutions relevant to White Metallurgy philosophy. Experts from Chelpipe Group and GenerationS will select up to 30 teams that will present their solutions to the Chelpipe’s Group top management; 15 of them will be admitted to the acceleration program.
Tenova LOI roller hearth for JSC Pervouralsk

Tenova LOI Thermprocess is the specialist, within Tenova, for customer-specific heat treatment lines and continuous roller hearth furnace systems for bright annealing stainless steel pipes in a 100% H2 atmosphere. It was recently awarded an order from the Joint Stock Company Pervouralsk Pipe Plant, Russia, for the delivery and installation of a continuous roller hearth system for stainless steel pipe.

JSC Pervouralsk Pipe Plant is a subsidiary within the ChelPipe Group and specializes in the production of stainless steel tubes for a wide variety of industrial uses.

Tenova LOI Thermprocess roller hearth furnaces for the heat treatment of pipe material are ideal for the continuous production of larger throughputs. This flexible furnace type is characterized by uniform heating, a definable holding time and subsequent material-specific cooling. The high-temperature uniformity and the low energy consumption of these systems ensure reproducible processes, which can be precisely adapted to the desired heat treatment of the material.

Prysmian super duplex umbilical contract

Prysmian Group has been awarded a contract by Libra, a consortium of prime international oil & gas operators, for steel tube umbilicals to be installed in the Mero offshore oilfield. Mero 1, an ultra-deep-water project, consists of up to 17 wells and one FPSO, situated 180 km offshore Rio de Janeiro in the pre-salt area of the Santos basin at a water depth of approximately 2,000 m with oil production due to commence in 2021. The contract includes the supply of 60 km of umbilicals consisting of 9 and 12 functions 1/2” diameter 10kpsi super duplex steel tubes that will be manufactured in the Group’s production unit in Vila Velha.

These achievements mark the transition of the Group from the traditional Thermoplastic technology used so far and are the successful result of end-to-end production of deepwater subsea umbilicals.

Sandvik adds new tube line

To increase the availability of its high-quality seamless stainless steel tube, add flexibility for introducing new grades and strengthen regional service, Sandvik is adding a new cold finishing tube manufacturing line at its Mehsana Mill, in Gujarat western India. The new high-tech line, mainly aimed at the production of heat exchanger tubing and other demanding industrial applications, will double Mehsana’s cold-working capacity and thus allow for swifter delivery times across the Asia Pacific region.

Cold finished seamless stainless steel tube from Sandvik is popular among fabricators and OEMs using high-temperature heat exchangers with special requirements for resisting corrosion and high temperatures. The tube is used in a wide range of industries such as petrochemical, oil & gas, chemical, fertilizer, and others.

The Mehsana mill tube program covers ANSI pipes, redraw hollows, heat exchanger tube, and high-temperature tube. Tube grades comprise a wide range of corrosion-resistant alloys (CRAs) from austenitic and super austenitic to duplex, super duplex and nickel alloys.

www.stainless-steel-world.net
**Stainless Steel World Middle East Exhibition**

Stainless Steel World is expanding its presence in the Middle East with a new event in Muscat, Oman: Stainless Steel World Middle East Exhibition (SSWMEE) on 9–11 March 2020. The exhibition will form part of the large and well-established Oman Petroleum & Energy Show (OPES) event. OPES is the only event in Oman that serves the entire oil and gas industry and is organized under the patronage of the Ministry of Oil & Gas of Oman. SSWMEE will provide a unique opportunity for international manufacturers and suppliers of corrosion resistant alloys to access key purchasers and end users from both the local Oman market as well as the wider Middle East region.

**Location:** Muscat, Oman  
**Contact:** Mr. Mehmet Erel  
**Phone:** +31 575 585 286  
**Email:** m.ere@kci-world.com  

**AOG 2020**

Explore specialized industry zones showcasing the latest in Instrumentation Control and Automation, Asset Integrity, Subsea, Health, Safety & Environment and Drilling & Completion.

**Location:** Perth convention and exhibition centre, Western Australia  
**Contact:** Bill Hare  
**Phone:** +61 03 9261 4538  
**Email:** aog@diwcom.net.au  
**Url:** [https://aogexpo.com.au/](https://aogexpo.com.au/)

**SPE Latin American and Caribbean Petroleum Engineering Conference**

LACPEC continues to meet the existing, emerging, and future technical needs for the upstream petroleum sector. The event focuses on discovering the key drivers influencing and shaping the region while driving operational excellence in the upstream petroleum sector.

**Location:** Ágora Convention Center, Bogotá, Colombia  
**Contact:** Bienor Melo  
**Email:** Abme_91417e117f_60630@spe.org  

**EAOGS 2020**

The scope, scale and spread of current and future oil and gas infrastructure development projects in East Africa is positioning the region as a hotbed of oil and gas exploration, investment and development.  
**Location:** Nairobi, Kenya  
**Contact:** Dan Qrogon  
**Email:** dqrogon@gep-events.com  
**Url:** [https://eaogs.com/](https://eaogs.com/)

**20th Annual Arctic Oil & Gas Symposium**

This is an opportunity to hear directly from the key stakeholders about progress on infrastructure, transportation projects, and regulatory strategies to move forward with sustainable development. Learn about commercial projects in other Arctic-interested countries and how Canada can position itself for global opportunities.

**Location:** Hotel Arts, Calgary, Alberta  
**Phone:** 416-927-7936 / 1-877-927-7936  
**Fax:** 416-927-1563  
**Email:** customerservice@canadianinstitute.com  
**Url:** [https://www.canadianinstitute.com/20th-annual-arctic-oil-gas-symposium/](https://www.canadianinstitute.com/20th-annual-arctic-oil-gas-symposium/)

**Materials 2020**

The conference aims to bring together the collection of investigators who are at the forefront in the field. The scientific program will include oral presentations of sub-disciplines, keynote sessions led by eminent scientists and poster sessions presented interactively by junior scientists and graduate students.

**Location:** Valencia, Spain  
**Contact:** Sophia Loren  
**Phone:** 1 (702) 988-2320  
**Email:** materialsscience@magnusmeetings.com  
**Url:** [https://magnusconferences.com/materials-science/](https://magnusconferences.com/materials-science/)

**OTC ASIA 2020**

The conference where energy professionals meet to exchange ideas and opinions to advance scientific and technical knowledge for offshore resources and environmental matters. It provides opportunities for industry professionals and their employers to share their applied technologies and best practices with other producing areas in the world and to create opportunities to institute and strengthen inter-society collaboration and cooperation with member societies based in Asia.  
**Location:** KUALA LUMPUR CONVENTION CENTRE, KUALA LUMPUR, MALAYSIA  
**Email:** otcasia@otcnet.org  
**Url:** [http://2020.otcasia.org/welcome](http://2020.otcasia.org/welcome)

**16th annual Argus Asia Fertilizer conference**

The event will bring together key organisations doing business in Asia including global players, major Chinese suppliers, and distributors from across Southeast Asia. 450+ attendees will enjoy more opportunities to network with local market participants, in-depth market analysis and the opportunity to hold numerous meetings across 3 days.

**Location:** Four Seasons Hotel, Shanghai, China  
**Contact:** Marilene Leow  
**Phone:** 65 6971 6338  
**Email:** AsiaFertsConference@argusmedia.com  

**Cippe 2020**

This exhibition is an annual gathering of the petroleum and petrochemical industry. With an exhibition space of around 90,000 sqm, 18 international pavilions, 1,800 exhibitors and over 120,000 professional visitors from 65 countries and regions, cippe has become one of the largest petroleum exhibitions in the world.

**Location:** New China International Exhibition Center, Beijing, China  
**Contact:** Mona Wang  
**Phone:** +86 10 56176968  
**Fax:** +86 10 56176998  
**Email:** cippe@zhengweiexpo.com  
Stainless Steel World Japan Conference & Expo 2020

8th - 9th June Miraikan, Tokyo, Japan

For more information please contact:

Ms. Ichikawa : k.ichikawa@kci-world.com Tel: +31 (0)575 789 260
Ms. Sato : a.sato@kci-world.com Tel: +31 (0)575 585 272

www.stainless-steel-world.net See: Events
What does trust, reliability, and commitment look like in the global stainless steel market? For Mr. Pratik Shah of Sun Mark Stainless, the answer is best given in the form of an anecdote: “In 2014, a client placed a large order with us. Then the market price suddenly increased by more than $500 per ton before the order had been processed. But there was never a word spoken about trying to renegotiate the prices agreed upon, because if we take care of the client, if we take care of each other in difficult market situations; we are fulfilling our commitment as a company.” Unsurprisingly, with an attitude like this, Mr. Pratik and his brothers- Mr. Ruchit & Mr. Jignesh have led Sun Mark to tremendous success over the past 6 years, building on a legacy that began with their father’s company, Sunrise Group, in the late 1970s.

By Daniel Sweet

Mr. Mahendra Shah founded the Sunrise Group in Gujarat over 42 years ago, choosing to name his company after a universal symbol of birth, growth, and awakening. The company has lived up to its inspired name, becoming a conglomerate made up of four individual businesses, each successful in their own right, with approximately 1,500 total employees in India. The Sunrise Group supplies high quality stainless steel products to companies within India and abroad, catering to markets in the oil and gas, petrochemical, construction, engineering, agricultural, nuclear and thermal, paper and pulp and shipbuilding industries. 80% of their business is in exports—spread across 23 countries—while domestic sales comprise the remaining 20%.
Several years ago, Sunrise Group became a family business when Mr. Mahendra Shah was joined at the helm by his two sons—Mr. Pratik Shah and Mr. Ruchit Shah—as well as his nephew, Mr. Jignesh Shah. Emulating their father’s leadership, the brothers made the customer a central focus of the company, but they also introduced innovative changes to the Sunrise Group business model that has fostered rapid growth. The Group’s total turnover leapt from $100 million in 2015 to $170 million in 2019. Plans to accelerate this already impressive rate of growth are being continuously implemented. A major aspect of the Shah brother’s strategy entails a continued focus on Sunrise Group’s subsidiaries like Sun Mark Stainless.

**Forward Integration and Sun Mark Stainless**

Seeking to widen the Sunrise Group product portfolio through forward integration, the Shah’s created Sun Mark Stainless in 2014. Sun Mark became operational in 2015 and primarily focuses on manufacturing stainless steel welded Pipes & Tubes for the ever evolving and expanding needs of the Indian and international markets. In addition to welded Pipes & Tubes, output from Sun Mark includes stainless steel coils. Most recently, the company has added butt weld fittings to their line. As Mr. Pratik explained, “we wanted to add another product downstream, and by using our own pipes and tubes to create the stainless steel Butt Weld fittings, we are able to guarantee their quality.” These fittings come in a variety of shapes, including elbows, reducing tees, equal tees, end caps, and concentric and eccentric reducers. In just a few years, Sun Mark has morphed from a boardroom strategy into the largest manufacturer of stainless steel welded pipes & Tubes in India. This growth was made possible by the construction of a new, state-of-the-art production facility in Gujarat, currently operating at around 60,000 tons per year. The facility includes 21 Tube Mills for welded pipes and tubes, with

Visit Sun Mark at Tube 2020

Sun Mark Stainless will be exhibiting at the Tube 2020 event in Düsseldorf, Germany. Meet them in Hall 3, stand E42.

**For Sun Mark Stainless, teamwork at all levels of the business is vital to success.**

“We took 40 years to build the reputation and goodwill that Sunrise Group has today. I am very proud that the next generation is taking it forward with the same passion, energy, and zeal!”

Mr. Mahendra Shah, founder of Sunrise Group
plant machinery sourced from leading Taiwanese Machine manufacturers. The pipes welded in the facility range from 1/2” NB (21.34mm) to 16” NB (406.40mm) to SCH 5, 10, and 40, mainly in grade 300 series. They come in the ASME, ASTM A312, A778, A269, and A270 specifications, equivalent to EN and DIN standards.

In terms of butt weld fittings, the facility produces the same size and grade range as their welded pipes, though these are offered in the full suite of ASTM and EN standards.

Mr. Shah noted when discussing Sun Mark’s facilities that in addition to the quality products produced, the company is dedicated to providing a healthy and happy working environment for their employees. “We place employee safety above all else, because we believe that a positive working environment leads to positive results. We have been rewarded for our culture by our dedicated staff, who are truly invested in our company’s success and growth. Ensuring the happiness and safety of our staff and in turn, the happiness and financial stability of our associates’ families, is one of the most rewarding aspects of our work.”

Expansion in Sun Mark Stainless
Mr. Shah pointed out that in April 2019, the Sunrise Group erected an additional seven pipe mills—including a larger diameter mill that can produce up to 16” NB SCH 40—to bolster Sun Mark’s production capacity. The additional mills are outfitted with in-line annealing equipment and are capable of both hydrostatic and eddy-current testing. Due to this expansion, there has been a significant reduction in lead times, allowing Sun Mark to bring several major projects to completion with leading end users.

Quality Assurance and On-time Delivery
In discussing Sunrise Group’s holdings, Mr. Pratik Shah continuously returned to the theme of trust, reliability and commitment, emphasizing the rigorous quality check system in place at every Sunrise Group facility. “Making a welded pipe or tube is not rocket science,” he said, “but getting the highest quality product to the customer on time and in full is no easy task.” Sun Mark has implemented new systems for quality assurance. The process begins on the production floor, where workers carry handheld X-ray fluorescent analysers that quantify the purity of every product. This allows them to spot-check goods before they are ready for packaging. Every item that leaves production is then bundled with color-coded tape to differentiate 304/L and 316/L shipments. This gives Sunrise Group employees and customers alike a visual reference when surveying the large orders that pass through the facilities every day, ensuring efficient processing and thus on-time, error-free and in full delivery. Pratik views this as a key competitive advantage and remarked, “Always under commit, over perform.”

The Shah brothers continue to embrace the use of digital technology throughout the Sunrise Group. Sun Mark facilities are now using QR codes for product traceability and live tracking of the material in process.
and labelling. Each product coming out of process comes with a QR code containing a number of data points: from the bundle’s specification, grade, size, heat number and product code to the customer’s purchase order number and shipping date. Each employee has unique QR code for himself as his ID along with each machine defined with its own unique QR code. Portable QR scanners that employees have allow them to access this information from the production floor, and the easily readable codes on the packaging allow end users to quickly access details about their purchase. Equally important to Sun Mark’s on-time delivery and customer satisfaction is their custom-built online platform, which allows purchasers to check the status of ordered material in real-time. Also stored in the online system are documents pertaining to the order, which remain accessible to customers for 5 years after the order is successfully delivered. This gives users the ability to track their products back to the source and provides peace of mind, with a backup of all important document records only a few clicks away.

Certifications
Sunrise Group’s renewed focus on quality assurance has earned them positive reviews and successful audits from customers, but it has also earned them coveted certifications from major industry regulators. TÜV Nord has granted the Sunrise Group and its subsidiaries certifications like the ISO 9001-2008 and ISO 14001-2004, the BS OHSAS 18001-2007, the PED 2017. Of particular note is the Group’s AD 2000 Merkblatt W0 UL certification (NSF 61 /NSF 372 - Drinking Water System Components), as theirs is the only mill in India to achieve it.

Joint Venture - Chromeni Steels
The Sunrise Group signed a joint venture with Tsingshan Group and Formed Chromeni Steels in 2017. (the subject of last month’s Stainless Steel World cover story). Sunrise Group also manages several other companies, including Sunrise Stainless, Shah Foils, and Steelora.

Global presence and future goals
In a reflection of the new generation’s global mindset, the Shahs have attended numerous international conferences and trade shows over the past few years, and their positive reception at these venues is a major source of pride for the group. Shows attended include the 2014, 2016 & 2018 TUBE Exhibitions in Dusseldorf, Germany, the 2018 Stainless Steel World Conference and Expo in Maastricht, the Netherlands, and South Korea’s Metal Week in 2016 and ADIPEC – 2019 - ABUDHABI. By personally representing Sunrise Group the Shah brothers have been able to showcase the best of their companies have to offer; it has also provided them with crucial introductions to several global clients.

As a result of their international interfacing, the Sunrise group and its subsidiaries now have dealings with companies all around the world. Their presence in the United States is notable. They also have contracts with companies across Europe, Turkey, Brazil, Australia, Canada, South America & Mexico. When asked what kind of feedback Sunrise Group has received from their domestic and international clients, Mr. Pratik Shah said that their best reviews come in the form of returning customers: “When a customer keeps buying from us, their action speaks for itself: we know they are satisfied with our quality and our products because they keep coming back to us.”

“As my father has instilled in all of us, our customers are not just buyers,” declared Mr.Pratik, “and we are not building buyer-seller contacts. What makes us unique and keeps it so personally rewarding is that we are building genuine partnerships.”
In terms of revenue, the global stainless steel cable ties market is anticipated to expand at a CAGR of ~5% during the forecast period, owing to numerous factors, states a recent market report.

By Transparency Market Research

The report on the stainless steel cable ties market highlights different types of stainless steel cable ties that provide the ability to hold heavy loads securely while dealing with extreme temperatures and conditions. Stainless steel cable ties are designed for fast and secure installation. They are mostly used in the bundling of cables and wires in various applications such as automotive, construction, petroleum and chemicals, electrical and electronics, ship building, telecommunications, transportation, mining, energy, and utilities. Manufacturers of stainless steel cable ties offer cable ties in packs of 250, 100, 50, 25, and 10.

Three main types
The report by Transparency Market Research estimates the market of stainless steel cable ties in terms of roller balls, ladders, and releasable cable ties. Roller ball stainless steel cable ties are designed with a ball locking mechanism and is the most preferred choice of end-use industries. Their demand is likely to continue to expand rapidly during the forecast period. An internal locking ball is located within the head of the tie, which provides the locking mechanism for cinching. Roller ball stainless steel cable ties are equipped with a self-locking feature and are easy to install.

Stainless steel cable ties are usually manufactured from stainless grades 304 and 316. Furthermore, coated stainless steel cable ties are non-abrasive, non-toxic, halogen-free polyester coated, and are resistant to abrasion, corrosion, and radiation, besides working in extremes temperature. Uncoated stainless steel cable ties dominate the market as compared to coated stainless steel cable ties. Cable ties are available in different colours, sizes, lengths, and tensile strength.

Major application areas
Usage of stainless steel cable ties is seen in various application areas and end-use industries across the globe. Electronics, ship-building, automotive, petroleum & chemicals, and transportation are considered some of the major industries expected to generate huge demand for stainless steel cable ties in the forecasted timeline. In European countries, the automotive industry drives the stainless steel cable ties market. In the Middle East & Africa, the petroleum and chemicals industries are expected to dominate the installation of stainless steel cable ties in the near future. Increasing demand for stainless cable ties is also expected from the energy sector, especially for wind and solar energy.

Prominent regions
The Asia Pacific region is projected to experience prominent growth in the global stainless steel cable ties market in the near future, due to rapid industrialisation, an increase in construction activities, and a rise in the utilisation of stainless steel cable ties in telecommunication and general industries in countries such as China, India, Japan, and Australia. China and India are considered prominent markets for manufacturers and distributors of stainless steel cable ties. In China and India, the market of stainless steel cables ties is highly fragmented. A large number of local manufacturers and distributors are present in the market. The markets in North America and Europe are anticipated to expand at a moderate growth rate during the forecasted
Stainless steel cable ties market 2019 – 2027

- Market by Region, 2019
- Key Market Findings
- CAGR (2019-2027)

- Major brands are likely to focus on the expansion of production capacity and new product development to strengthen their footprints in the global stainless steel cable ties market.
- Companies are engaged in expanding their product portfolios and business through online modes of distribution. They are also working toward upgrading their existing products to increase profitability for the sustainable growth of their businesses.

Key players in the market
Prominent companies operating in the global stainless steel cable ties market include Norma Group, HellermannTyton, Panduit, ABB Installation Products Inc. (Thomas & Betts Corporation), Essentra plc, Tridon Australia, Advanced Cable Ties, Inc., BAND-IT, NSi Industries, LLC, and Heyco (Penn Engineering).

For further information on the report, please visit www.transparencymarketresearch.com
Tubes and pipes: thriving, but for how long?

The tubes and pipes sector has continued to prosper on the back of higher oil and gas prices, and a moderately good global economy. The energy industries continue to provide important markets, but other industries, such as auto and wastewater treatment, are not far behind.

By James Chater
Van Leeuwen’s warehouse at Zwijndrecht, the Netherlands.
Background

A report out this year predicts annual growth of roughly 3.9% in the stainless tubes and pipes market between 2019 and 2024. High profitability will, it says, encourage investment and lead to an expansion in production (1).

Much of the recent prosperity is due to the rise in the prices of oil and gas, still the most important sector for stainless tubes and pipes, which has led to increased activity in the upstream sector.

The economic background has also been benign – but how long will this last? No one quite knows how Brexit will play out; as I write, the Coronavirus is denting confidence, especially in China; and the USA and China have still to reach a definitive trade deal.

Economically, many governments and corporations are over-saddled with debt. A specific area of uncertainty within the industry is the current transformation taking place in energy markets, with renewable energy, electric vehicle batteries and energy storage advancing at an astonishing rate. This will have repercussions for the oil & gas, auto and power generation industries, all of which are important consumers of stainless-steel tubes and pipes.

Performance

Although in a minority of cases profits are down and debt weighs heavily on a few companies, on the whole, the stainless steel tube and pipe sector has performed well. Tubacex especially can claim to be the poster-boy of growth, breaking its own records for several years in succession. This has been achieved by deftly positioning itself in key sectors and regions with impeccable timing.

An example was the development of new technology for coal-fired thermal power stations at very high temperature, currently under development in India. For years also Tubacex has been pressing ahead with geographical and product diversification. Especially important are three strategic alliances: with the Egyptian government to develop nuclear energy; with India’s Midhani, to handle energy growth in India; and with Senaat of Abu Dhabi, to work on oil & gas projects in the Middle East and to offer repair and maintenance services through its acquisition of three plants from NOBU. In addition, it has built a second plant in Oklahoma, USA, to cater for the aerospace sector. Other good performers include Vallourec, which wants to triple its production capacity and become a leading supplier of umbilical tubes; Sandvik, which acquired a 30% stake in BEAM to strengthen its position in additive manufacturing technology, and also Summerill Tube, a Pennsylvania-based manufacturer of high-precision tubes; and Van Leeuwen, which, after acquiring Ferrostaal Piping in 2018, bought Benteler Distribution this year to improve its access to European markets.

The measure of confidence in the sector can be seen in other investments and acquisitions.

Expansion

Many companies have been expanding. Butting is doubling the output of its BuBi® mechanically clad pipes, entailing the construction of a new hall; adding a further hydroforming press; and expanding its pipe and steel plate storage facilities. Centravis has opened an additional warehouse in the UAE. DICSA, a Spain-based maker of tube, pipe and fittings, has been expanding in Spain, investing in robotics and also strengthening its presence in the USA. Marcegaglia opened a new rolling mill in Ravenna and is increasing its investments, especially in IT, to form a fully digitalized supply chain. Sandvik opened a coiled tubing line in China for small-scale seamless stainless-steel products. Schoeller Werk invested in a new sawing centre and is expanding its inline induction annealing capacities for laser welding. Stalatube ramped up a new plant in Lodz, Poland and launched a new production line in Lahti, Finland. Finally, Tenaris has been investing in the oil & gas upstream sector: in Canada, where it has expanded production capacity and upgraded its seamless and welded pipe production, with an emphasis on sour service; and in Saudi Arabia, with the acquisition of a substantial stake in Saudi Steel Pipe (SSP), a local welded pipe producer. Acquisitions are another way in which companies are expanding. Apart from those already mentioned, the Schoeller Group acquired AK Feinrohr, a specialist in cold redrawn precision tubes. We are likely to see more such acquisitions because of the low level of concentration among stainless tube and pipe makers, with the largest of them possessing a surprisingly low percentage of the total (2).

Industrial sectors

Upstream oil & gas

The recent spate of investments and acquisitions shows this is still perceived as the no. 1 market for high-end stainless-steel suppliers. Umbilicals and other high-end tubular products are still in high demand, as can be seen in recent orders placed with Sandvik, Vallourec, Tubacex and other companies for upstream projects around the world, but especially in the Middle East. In Abu Dhabi (UEA) the well environments are extremely corrosive, making CRA materials all the more necessary. Sandvik won a contract from Tenaris for OCTG pipes made in Sanicro® 28 (UNS N08028), a highly corrosion-resistant austenitic, for the Abu Dhabi National Oil Company (ADNOC). For these and other tubes and pipes made of CRAs Sandvik has used a coating called Dopeless® technology, permitting the first-ever run of CRA tubulars in stands of three pipes, providing greater robustness and
Steel alloys
Apart from stainless steel and CRAs, the oil and gas industry makes use of alloy steels. In Russia, pipes are constantly exposed to corrosion by a mixture of salt and oil, exacerbated by cold weather. To overcome this problem, Severstal has developed a new steel grade, Severcorr, with added chromium, copper and nickel to improve corrosion resistance. Researchers hope that this will at least double the lifetime of the pipes.

Tenaris has developed a seamless carbon-manganese line pipe for use in high-temperature, high-pressure environments. It is being applied in the Buckskin project in the Gulf of Mexico. Butting’s mechanically clad Bubi® pipes are made with a stainless-steel inner pipe for corrosion resistance surrounded by a carbon-manganese outer one for resistance to high pressures. Butting is to add a hydro-forming press to double production.

Another important market for alloyed steels is the LNG industry. For a long time, 9% nickel was commonly applied in cryogenic conditions, but now Posco is offering a cheaper alternative, high-manganese steel (HMS) specifically developed for the storage and transport of LNG. Following approval by the International Maritime Organization, HMS may now be applied to LNG carriers and LNG-fuelled vessels, and its use can be expected to increase.

Vehicles
Although the auto market has slowed down in the past year, more and more stainless-steel tube makers have been investing in it. Tube makers that have invested heavily in auto parts include Schoeller Werk, Mannesmann Stainless Tubes and Marcegaglia. Marcegaglia has developed specific know-how in the sector of stainless-steel flat products and welded pipes for exhaust systems and for hydroforming applications, as well as for bus frames and other structural applications in commercial vehicles.

Behind this drive towards stainless steel is the need to reduce pollution and CO₂ emissions. Greater fuel efficiency requires hotter engines, therefore heat-resistant ferritics are increasingly being

Severstal has developed a new steel grade, Severcorr, for oil and gas pipelines in Russia.


Exhaust system of a Burns Stainless Harley-Davidson Milwaukee-8 touring-frame motorcycle.
applied in exhaust systems. Stainless steel is becoming ever more necessary in applications such as exhaust systems (including exhaust gas recirculation, a technique for reducing NOx emissions) and catalytic converters, not only in cars but also motorcycles. Vehicles fuelled by compressed natural gas or LNG also require stainless steel tubes to resist high pressure and cryogenic conditions respectively. Using stainless, especially duplex grades, can result in lighter frames and chasses.

**Renewables – the joker in the pack**

“Green” energy, storage and electric vehicles (EVs) are disrupting the energy and transport markets. The transition from fossil to renewable is happening far faster than anyone predicted, mainly thanks to lower prices but also government intervention. No one knows how quickly the transition will occur, but it is only a matter of time. Industry, therefore, to faces a crucial question: is it not possible that the energy and transport infrastructure and products currently being rolled out – oil and gas resources, fossil and nuclear power stations, and the internal combustion engine (ICE) – will soon become surplus to requirements? Already the problems being experienced by US coal power companies and German utilities suggest that rapid advances in renewabes could outflank more traditional energy sources sooner than we think.

This question has obvious repercussions for the stainless tube and pipe industry. Demand may soon shift away from umbilical tubes and other products for offshore and towards tubing used in concentrated solar power (CSP) facilities and tubes and pipes in geothermal power stations. (In this connection, Marcegaglia has just supplied 6000 tons of stainless tubes for the collectors of the Noor Energy 1 CSP park in Dubai.) Similarly, the days of ICE vehicles are numbered, though here again the rate of change can only be guessed at.

**Duplex**

Since 1979 BUTTING has been processing more than 200 000 tons of duplex materials for projects in the petrochemical and oil and gas industries, as well as for waste water treatment and seawater desalination plants.

Our product range in duplex materials includes:

- Stainless steel welded pipes
- Spools and plant constructions
- Customised components

Take advantage of our know-how and contact us.

**BUTTING Group**

Phone: +49 5834 50-0
info@butting.de
www.butting.com
The newest ICE vehicles depend heavily on stainless steel tubing, especially as regards the exhaust system, but battery-driven electric vehicles (EVs) have far fewer moving parts, are lower-maintenance and do not have an exhaust system. Correctly predicting the timing of these transitions is a thorny question for strategic planners within the tube and pipe industry.

**Water: a safe bet**

Whatever form our energy and transport needs will take in the future, our need for clean drinking water and wastewater management will not go away. The world’s growing population is colliding with melting glaciers and unpredictable weather patterns due to global warming to create a scenario in which, it is predicted, demand for water will exceed supply by 40% in the year 2025 (3). A recent market survey claims that the market for wastewater treatment services will grow by 6.1% annually between 2019 and 2024 (4). It is now recognised that stainless-steel pipes are indispensable for water purification, transport, collection, and wastewater treatment. They are less likely to leak because of corrosion and, unlike copper, iron or steel, can withstand velocities of up to 40 metres per second. Typical water systems will include type 304, or type 316 in higher chloride concentrations. Duplex 2205 provides greater tensile strength and can save weight and facilitate installation.

In hot and dry climates where drinking water is scarce, demand for desalination is growing, especially reverse osmosis (RO). Desalination systems use the whole gamut of stainless-steel grades, from austenitic to duplex and super-duplex, superaustenitic and titanium.

Aquafin wastewater treatment plant of Antwerpen-Zuid, located in the southern area of the conurbation of Antwerp.

Sandvik supplied type 316L stainless steel pipes for these fountains at the Marcel Dassault roundabout on the Avenue des Champs-Élysées in Paris. Designed by Ronan & Erwan Bouroullec and constructed by Atelier Blam Lemunier & Meyer and Swarovski Crystal, they were inaugurated in March 2019. Atelier Blam has asked Sandvik to supply an additional set of pipes, for a fountain project in Rennes, Brittany, France.

In an uncertain, shifting global scene, the demand for water is a true constant.

**References**

2. Ibid.
Although coming from a carbon steels background, Dr. Willem Maarten van Haaften was quick to adapt to his current focus on corrosion resistant alloys as Senior Researcher, Materials & Corrosion at Shell Global Solutions International. Based in Amsterdam, one of the company’s three technology hubs, the main areas of his work center on upstream issues and the development of new materials for the short and long term. As Willem Maarten continues to learn from his research and expand his knowledge of stainless steel, he also hopes to apply his specialized knowledge of well technologies to help grow the industry itself.

By Joanne McIntyre

Before his employment with Shell, Dr. Willem Maarten van Haaften spend a decade at Tata Steel, where his work focused on carbon steels. It was only two years ago that he became involved with stainless steel, and as he said in a recent interview, “the field certainly presents a learning curve.” But Willem Maarten quickly adapted to his new line of work, and at his current role in Shell’s Materials & Corrosion department in Amsterdam, Willem Maarten is focused on the longterm. “There are a lot of materials and corrosion specialists who are in working in plants around the world,” he explains. “These specialists are essential to help safely run Shell assets every day, tackling the daily issues and problems that may arise. My department in Amsterdam, however, is tasked with looking at issues over the long term. For example, we collaborate closely with suppliers to steer them towards providing the products we will need in four or five years. This ensures suppliers have the opportunity to develop the stainless steel products we need, on time, for the future. Another good example is our work to find new ways to develop fit-for-purpose materials testing.”

Looking forward to further growth
Qualifying 13Cr
At the Stainless Steel World Conference 2019, Willem Maarten shared an example of the kind of fit-for-purpose research project he is involved with, in this case involving 13 chrome martensitic stainless steel. “We will use the new test method to qualify 13 chrome materials for conditions that are normally not suitable for this material,” he explains. “Our materials and corrosion team found that certain onshore wells in the Middle East constructed with 13Cr martensitic stainless steel have become increasingly sour over their lifetime, which means higher levels of H2S. If we were to requalify the material using test methods currently in the international standards at the conditions now present in the well, it would fail. And yet, we did not experience any failures in those fields. Faced with the choice of removing or reworking all the tubulars and replacing them with higher-grade materials, we needed to investigate this discrepancy.”
Carrying out fit-for-purpose testing and mimicking the conditions in the well confirmed that failures would not occur and demonstrated that the test specifications are overly conservative.
“In collaboration with Vallourec, Total and the National Physics Laboratory (UK), our team set out to find a better way to qualify materials; going forward, this could lead to significant cost savings. Of course, this type of research only works if you thoroughly understand the material and the environmental conditions in the field. If you can achieve that and mimic the conditions in tests, it’s a valid method for qualifying materials.”
This same research is highly relevant for older wells, where the reinjection of water to maintain pressure in the subsurface reservoir creates an environment that produces increasingly higher concentrations of H2S. “While this example was an onshore gas field in the Middle East, it could potentially be a good solution for offshore wells. However, we would need to qualify the material for the set of conditions in each well.”
Shell has shared this research widely among other oil and gas majors and is keen to make this a generally applied method. According to Willem Maarten, “it will take several years to implement our findings as an ISO, or other, standard. Currently, we are working to expedite the acceptance of the fit for purpose testing method, which promises significant well completion costs. This work was partially presented at Eurocorr in 2019 with a lot of interest, and we are happy to share our research. It’s a very conservative industry, so we know it will take time to spread the word and increase acceptance.”

New materials challenges
A common challenge with which the materials and corrosion experts must contend is achieving a combination of higher strength and corrosion resistance, especially for the wells requiring high strength tubulars and castings to minimise weight. “For example, when we look at carbon steels, we’d ideally like to have a 140 KSI (965 MPa) material with sufficient sour resistance. The stronger the material gets, the more likely it is to have hydrogen embrittlement which presents a challenge for us. The main hurdle to switching to stainless steels in wells is the cost, so we try to do as much as we can in carbon steels. For most well applications there is probably a stainless steel grade which would function perfectly, but they remain too expensive, even considering the life cycle. It’s perhaps difficult to accept as we build our wells to last up to fifty years, yet in the end, stainless is still often considered too expensive.”

Future plans
Looking to the future, Willem Maarten is excited to continue expanding his knowledge of corrosion resistant alloys. “I’ve just started down this path, and there is much more to learn. That’s why it’s essential I attend events such as Stainless Steel World and Duplex World, which are great learning opportunities. On top of that, for my first four years working for Shell, I worked on wells technology, which is a great benefit for my current role. If I can help the company to gain knowledge and apply stainless steels and duplexes for wells, it will be a great opportunity. The materials and corrosion experts are a small group within the company; those focusing on upstream is a subset of that, and finally, those focusing on CRAs are a smaller group still! So I’m working in a niche field, which I thoroughly enjoy.”

Join the conversation @Duplex World 2020!
Dr. Willem Maarten van Haaften is a member of the 2020 Duplex World Seminar & Summit Steering Committee, and is helping to put together the conference program for this niche event. If you would like to share your expertise at Duplex World, please contact the seminar organizer Mrs. Joanne McIntyre, at j.mcintyre@kci-world.com
The global cost of corrosion exceeds USD$2.5 trillion annually, or three percent of global GDP. Moreover, the environmental consequences are enormous. Innovative premium high-strength and high-performance stainless steel fasteners offer significant benefits – from product and asset infrastructure maintenance to total lifecycle costs – in many global industry sectors.

By Nimeka de Silva and Patrik Lundström Törnquist

Metallic corrosion is the result of electro-chemical interaction between a metal and substances present within its operating environment. Corrosion results in degradation of that material, to the point where it is no longer mechanically or structurally fit for purpose. Corrosion presents a formidable global challenge. It affects many everyday products and almost all infrastructure – through increased maintenance, shorter product lifecycles, end-of-life management and generally the overall utilization of more resources over a product’s lifetime.

The economic and environmental impact is significant, and it is high time to place the fight against corrosion in a proper sustainability context.

The International Measures of Prevention, Application and Economics of Corrosion Technology (IMPACT) study by NACE estimates the global cost of corrosion to be US$ 2.5 trillion annually – equivalent to around three percent of global GDP in 2018. However, it also estimates that existing corrosion control practices could save 15-35 percent of the cost of corrosion, equating to between US$ 375 and US$ 875 billion globally each year (NACE International, 2016).

Corrosion impacts heavily on the environment

The consequences of corrosion-related impacts on the environment are not included in this study but are increasingly important. In response to greater interest in issues related to environmental impact and sustainability, engineers are ever more encouraged to design products and infrastructure that can minimize negative environmental and societal impact. Sustainability in design, optimizing a product’s lifecycle, minimizing maintenance requirements and end-of-life upcycling/recycling for example are all becoming an important part of product performance, quality and overall cost.
In future, it is very likely that we will see even more burden placed on product manufacturers and asset infrastructure owners towards end-of-life management, so making early considerations in the design and planning stage will become a more crucial aspect of engineering. Life Cycle Assessments (LCAs) are becoming ever more important for any product or project from both a customer and regulator perspective.

More robust and cost-effective fastener solutions
Stainless steel fasteners have long been used in corrosive environments, such as within the oil & gas industry, chemical processing, marine and coastal applications. In recent years, stainless steel materials, predominantly austenitic grades A2 (304) and A4 (316), have become more readily available, largely due to low-cost high-volume Asian manufacturers. However, interest in premium stainless steel and high-grade alloy fasteners has really taken off. Within the correct application, they offer improved product performance, reduced maintenance and can help to maximize the product lifecycle. Considering total lifecycle costs can help to deliver significant cost efficiencies over the lifespan of a product, rather than an approach focusing purely on the initial upfront cost.

Particularly in more technical industries where performance, safety and reliability are all critical factors, engineers are now starting to give more consideration to an ever-increasing range of fastener products and material options available to them, in an attempt to design more robust and long-term cost-effective products and infrastructure.

Traditional fastener challenges for engineers
One of the traditional limitations accepted by engineers when considering the use of stainless steel materials, is reduced mechanical strength compared with high tensile carbon steel. If a combination of high strength and corrosion resistance was required, then engineers may often resort to the use of high tensile carbon steel with an additional protective coating.

However, high tensile carbon steel brings with it the burden of finding a coating suitable for the application and the associated performance, quality and lifespan considerations for the coating. High tensile carbon steels are also prone to the risk of hydrogen embrittlement as a result of their manufacturing process. Engineers often express concerns regarding this risk and careful consideration should always be given during their production.

The solution – corrosion resistance and high strength
Enter premium high corrosion-resistance stainless steel fasteners. These are products that combine the corrosion resistance capabilities of different stainless steel material grades, with the strength of high tensile carbon steel (such as the BUMAX DX 129 range). In addition, ductility and fatigue properties are also considerably better, outperforming high tensile carbon steel. By eliminating the limitations of strength in stainless steel materials, these premium fasteners open up new possibilities for design engineers that require a combination of high mechanical performance and corrosion resistance.

Applications for these premium stainless steel fasteners include aerospace, offshore equipment, steel construction, high-end electric bikes, high pressure applications, fueling systems and semiconductor manufacturing equipment – all with excellent results. Many more applications may follow, to the benefit of not only the owners and users of products and infrastructure – with higher quality, reduced maintenance and longer lifespans – but also the entire planet with the potential for the more sustainable use of material resources.

About the authors
Nimeka de Silva is Development Manager, UK & Ireland, for BUMAX, a leading Swedish specialist manufacturer of premium stainless steel fasteners. A chartered mechanical engineer with an MBA from Aston Business School, Nimeka has experience in engineering, project management and commercial roles across the construction, energy and manufacturing industries. See www.bumax-fasteners.com

Patrik Lundström Törnquist is Managing Director of BUMAX. He has more than 20 years of experience from C-level positions in the global mining, steel, manufacturing and engineering industries. He has an M. Sc. from the Chalmers University of Technology and an M.B.A. from the Hult International Business School.
Take part in the Duplex World Seminar

Join the worlds’ premier duplex stainless steel event! Network with the leading minds driving ahead innovation and excellence in the field of materials science and explore the many possibilities for networking while sharing knowledge and expertise. Duplex World is a dynamic and interactive event with a strong focus on personal interaction, coupled with a high-quality technical seminar program. Unique in the industry, the Duplex World Seminar unites duplex researchers, manufacturers, end-users and suppliers in an open, explorative and focused forum. Join the conversation in 2020!

A WORD FROM OUR CHAIRMAN...

Duplex World Seminar & Summit 2020 promises to be an exciting event, with world-leading experts from across many industries presenting on the latest topics in the field of duplex stainless steels. I would encourage all working in this field to take the opportunity to present and exchange information in this unique environment. Whether it is a new development such as additive manufacturing, a new application for an existing grade, or failure cases, the work and information will be welcomed. The seminar gives all a chance to learn together and to continue promoting the use of these wonderful engineering materials. I look forward to seeing you all in Dusseldorf.

Bruce Cowe,
Materials & Corrosion Specialist,
Total S.A.

SUBMIT YOUR ABSTRACT TODAY!

The Duplex World Steering Committee invites duplex experts from all industries to take part in dynamic and interactive technical sessions. Come and join the discussions, showcase your expertise, and explore the endless possibilities for business networking!

Duplex experts are invited to give a technical presentation during the Seminar. Speakers are allocated 15 minutes plus 5 minutes questions time.

If you would like to give a technical presentation you must submit your 300 word abstract outlining the topic and content of your material for consideration by the Steering Committee by 20 March 2020.

On acceptance, speakers are only required to prepare a PowerPoint for their presentation: full papers are not necessary.

Send your abstract by 20 March 2020 to: Joanne McIntyre, Conference Coordinator
Email: j.mcintyre@kci-world.com
Tel: +31-575-585-298

CENTRAL LOCATION

In 2020 Duplex World will take place in the Van der Valk Airport Hotel Düsseldorf, Germany. Located just five minutes from the airport, the Van der Valk is a luxury hotel offering modern conference facilities, free parking and wifi, fitness & wellness facilities and outstanding catering.
Possible Presentation Topics

Duplex World covers a wide variety of applications for the specification, manufacture and use of duplex stainless steels. Possible topics for presentations include, but are not limited to, the following:

- Additive manufacturing
- Casting & forging
- Cladding and overlay
- Construction & architecture
- Duplex in the process industries
- End-user requirements
- Ferrite measurements
- Heat exchanger fabrication
- Heat treatments
- High & low-temperature applications
- Improving quality and avoiding failures
- Innovations & new grades
- Lean, super & hyper duplexes
- Lifecycle costs
- Market information & forecasts
- Oil & gas applications (offshore & onshore)
- Research projects
- Surface properties
- Welding, etc

The Duplex World 2020 Steering Committee will select presentations based on:
- Content quality
- Innovation and topicality
- Focus on application experience and practicalities, where possible presenting case studies
- The presentation of practical challenges (and/or solutions)
- Technicality: commercial presentations will not be accepted

NEW! DUPLEX SUCCESS STORIES

An interactive workshop highlighting case studies on the many applications for duplex stainless steels will be hosted by Barinder Ghai from Sandvik Materials Technology. Do you have a case study to share outlining an example of duplex being used in a new or innovative way? If so, send a brief outline to j.mcintyre@kci-world.com for consideration.

WHY JOIN THE DUPLEX WORLD SEMINAR?

Knowledge exchange
Duplex World has an outstanding reputation for promoting and aiding knowledge exchange. Presentations have an application orientated approach – problems & solutions, research results, new developments & applications, case studies, market trends.

Showcase your expertise
This is a premier networking event where every attendee is involved with duplex. Presenters are recognized as leading experts on the specification, production and use of duplex stainless steel.

Business networking
This is a highly targeted event. The network you will build during the event will be of benefit for the rest of your career.

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YOUR 300-500 WORD ABSTRACT/OUTLINE OF YOUR PRESENTATION OR PAPER MUST BE SUBMITTED BY 20 MARCH 2020 FOR EVALUATION BY THE STEERING COMMITTEE TO MRS JOANNE MCINTYRE, SEMINAR COORDINATOR EMAIL: J.MCINTYRE@KCI-WORLD.COM TEL: +31-575-585-298

DATES TO REMEMBER

Abstract submission deadline 20 March 2020
Notification of acceptance 1 April 2020
Deadline for PowerPoints 1 August 2020
The rolling process for the production of seamless tubes was invented by the Mannesmann brothers in 1885 in Remscheid, Germany. Today the Mannesmann Stainless Tubes team is proud of its long heritage and is committed to the continuous development products to support the most demanding of customer needs and applications.

By Brian Mercer, Jean Christophe Chassaigne & Mauro Leali, Mannesmann Stainless Tubes

**Power generation**
In the context of the power generation sector, the accelerating migration towards renewable energy forms such as solar power is driving ahead innovation. However, recognising the balance and contribution of gas-fired power stations is essential. As such, there is an increasing emphasis on improving the efficiency of gas power generation. In particularly, enhancement can be achieved by combining a gas turbine with a heat recovery steam generator (HRSG). These generators utilise exhaust heat from the gas turbine to produce steam that drives the steam turbine, creating a significant amount of additional power. When combined with the primary energy produced by the gas turbine, it enables the efficiencies of the plant to exceed 60%. In a typical modern combined cycle gas turbine (CCGT), about 40% of the power is typically generated by the steam cycle. Similarly to coal-fired power plants, a gas turbine becomes more efficient as the combustion temperature increases. The latest generation of gas turbines operates with waste gas temperatures around 1500°C (2700°F), enabling superheated steam to be produced within the heat recovery steam generator (HRSG). A significant consequence of these high exhaust and steam temperatures relies on both the development of material selection and tube length. Conventional steels, when exposed to HRSG environments, suffer oxidation on the inside (steam side) of the tube. This, in turn, leads to the migration towards austenitic stainless steels for the hottest zones and now, as HRSG improves still further, the use of special alloys such as DMV 304HCu. Tube length also becomes an increasingly important factor as temperatures rise. As HRSG’s increase in size to reflect improved cost and energy efficiencies, so the shell-and-tube heat exchangers are becoming more and more compact. As the drive towards improved operational efficiencies continues, many end-users can no longer accept the consequences of welded joints in any of the straight tube sections and instead require exceptionally long tubes.

**Hot extrusion**
While the cold processing part of seamless tube manufacturing is a key process for manufacturing ‘long’ lengths, the hot extrusion process is equally
Hot extrusion is a critical process for determining the structure, quality, mechanical properties and ultimately length of a seamless stainless steel or nickel alloy tube or pipe.

The production of long tubes and pipes creates other types of constraints and challenges.

Cold manufacturing process

Cold processing within MST enables the production of tubes up to 43m (141ft) long. The two technologies employed are cold pilgering, up to 60.3mm OD at Costa Volpino, Italy and Houston, US; and cold drawing, from 0.3mm OD at Issoudun, France.

The production of long tubes at Costa Volpino is focused on heat exchanger tubing (straight or U-bent), instrumentation, HRSG and umbilical tubing; and HRSG boiler tubes up to 30m (98ft) long.

Several process improvements have been implemented in recognition of the need for longer tube lengths and the benefit of increased extrusion capabilities. These include upgraded pilger mills to handle increased input billet length necessitates that the time needed for processing be controlled to obtain the metallurgical properties of the material, allowing optimised corrosion behaviour with regard to the selected chemistry. The final properties and the dimensional characteristics such as straightness, roundness and eccentricity limits must be maintained along the complete length. All these facts need to be considered and validated. With the MST upgraded extrusion press, the combination of both larger and longer billet helps to deliver up to +30% longer tubes and pipes.

From the starting point of hot extrusion, the product can either go through the finishing process as a hot finished product or be used as a mother tube or “hollow” – which forms the starting point for the cold manufacturing process.

Production of long tubes at the Issoudun, France facility is focused on cold drawing technology with tube diameters as small as 0.3mm and lengths up to 43m (141ft). The cold drawing process takes long hollows from the extrusion of cold pilgering process and reduces these to the required dimensional size in a number of draw passes. Processes were developed for handling long tubes, and for the manufacturing steps of drawing, degreasing, annealing, testing and final inspection.

A significant part of the production from the Issoudun facility is focused on the high specification applications serving the aerospace, nuclear, oil & gas and medical markets with applications including instrumentation, hydraulic systems, actuation to high-pressure controls. With a product range from 0.3mm OD to 280mm OD combined with tubes ranging from cut pieces to tubes 43m (141ft) long, the team at MST is well placed to meet the challenge of today and innovations of tomorrow.
Swedish industry joins forces for electrical heating

The Swedish Energy Agency has granted a project that will evaluate the potential of replacing gas-fired furnaces with electrically heated furnaces for material heating. The goal is to reduce CO₂ emissions through better energy efficiency and reduced loss of material.

Text & image by Kanthal

The steel industry is working hard to reduce their use of fossil fuels. There are several ongoing projects in this direction of which the most well-known, the HYBRIT project, aims at eliminating the need to use fossil fuel for iron ore reduction.

Electrifying heating

The Swedish Energy Agency has granted a project that will explore the possibilities of electrifying heating processes. This can lead to more efficient production with less energy consumption and lower carbon dioxide emissions. This has the potential to create a competitive advantage for Swedish steel companies on the global market. Kanthal is part of the project. “The Kanthal offering is designed for sustainable industrial heating, and we have solutions to electrify most processes. There are still gaps, but we are in this project to fill them”, says Dilip Chandrasekaran, R&D Manager, Kanthal. By replacing fossil fuels with electricity, the need for added energy is reduced by approximately 30%. If the electricity is fossil-free, the carbon dioxide emissions are eliminated. The project is critical, as the target for the Swedish government is net zero emissions of carbon dioxide by 2045. It is also seen as an important input for future investment decisions for the steel industry.

“Jernkontoret is the Swedish steel producers’ association and hosts the project. The project manager comes from the consultancy agency COWI. “We will evaluate future potential heating systems, such as induction, plasma and reduction heating in extremely high temperatures. I am convinced that the results will lead to technical solutions that can boost the Swedish industry”, stated Björn Ahlqvist, Project Manager at COWI, in a press announcement.

Other members in the project are SSAB, Outokumpu, Kanthal AB, Uddeholms AB, Ovako and Linde. The project runs from January 2020 to mid-2021 with a total budget of 3.4 MSEK (EUR 321,000).

Kanthal delivers products and services in the fields of sustainable industrial heating technology and resistance materials. The company is part of the Sandvik Group and has a strong tradition in innovation and extensive investments in R&D.
Shortage of engineers starting to impact industry

According to reports from various countries, there is a shortage of qualified engineers in general across many industries. If the public and the private sectors are not pro-active, this shortage could lead to significant economic losses and collateral damage. The good news is that there many ‘fixes’ but, given the complexity of the issue, a comprehensive approach is required.

By Lucien Joppen

There have been numerous reports in the last couple of years on this topic, illustrating that a present and future shortage of engineers is very much on the agenda of national governments, sectoral organisations and private companies. This is not surprising as countries and companies are highly dependent on technical personnel, for example, in civil engineering (to maintain and improve infrastructure) or the various engineering domains in the manufacturing industry.

According to the recruiting agency Gobrightwing, this shortage could lead to a potential loss of USD 454 billion in the United States alone. There are also other challenges such as keeping civil infrastructure up and running and addressing critical societal challenges. Examples include facilitating an energy transition or developing viable processes for recycling.

Trust in engineers high
It would go too far to address this issue on a global level as various parameters - economies/industries, demographics, educational systems and geographies - all have an impact on the supply and demand of engineers/technical personnel.

Therefore, this article focuses on three large economies – the US, United Kingdom and Germany. This choice is also motivated by the relative abundance of data generated on this issue.

To begin with, let’s look at the general picture. In 2017, a comprehensive report titled 2017: Create the Future was published which focused on the UK but also targeted nine other major economies to address supply-demand and other issues. One of the significant findings was that five countries – UK, USA, China, Germany and South Africa – experienced a mismatch in supply-demand in skilled engineers. The good ‘news’ is that the public perception of engineers is positive. In an era where trust in some professions is diminishing, the role of engineers is valued highly, partly also because of the aforementioned societal challenges. “Engineers are seen as having as much influence as politicians in solving major world challenges,” according to the report.

Various bottlenecks
Time to zoom in on particular countries/geographies. The United Kingdom struggles with getting the right engineers for the right jobs. A survey from 2019 from the temp agency Randstad states that the sector “faces a skills crisis like never before, and measures need to be taken to help the leaders of the engineering
industry fill the jobs that are integral to the field”. According to another study by the UK government, 186,000 skilled recruits per year would be needed until 2024 to fill the gaps. Within the EU, there are various bottlenecks in different engineering fields. Depending on the country and engineering domain, there are more or less urgent issues. Shortages in software/IT are among the highest; in mechanical, electrical and civil engineering it is still challenging to fill the gaps but this doesn’t mean it is less pressing.

**Nationwide shortage in Germany**
In Germany, one of the manufacturing powerhouses in the world, the engineering skill shortage is already noticeable. According to a recent study by the German federal government, this shortage will increase in the coming decades. By 2030, a shortage of 3 million ‘skilled workers’ is expected in Germany (Source: Prognos). Skills shortage is now the most significant concern of German businesses according to a recent economic survey by the German Chamber of Industry and Commerce. In particular, highly qualified engineers, technicians, researchers, medical and other similar professionals are needed. The recent skill-shortage analyses, dating back to 2017 drawn up by the Bundesagentur für Arbeit, states a nationwide shortage of engineers in the areas of software development, programming, metal construction, aerospace and automobile, mechatronics and construction. This gap is going to be hard to fill for small and medium-sized enterprises in particular. Those companies are already having difficulties in recruiting skilled workers as they are limited to the local labour market.

**Regional differences**
The US is not immune to supply-demand issues in engineers. There are considerable shortages expected in so-called STEM-professions (science, technology, engineering, math). According to the Smithsonian Education Center, by the end of 2018, 2.4 million positions will be unfilled. Again, as with other economies, these shortages are varying depending on geography. In some areas, like California, tech hubs used to have no problems attracting software engineers. With the cost of living rising in these areas, companies have moved to or opened offices in more desirable areas that offer a better salary/cost of living-ratio. In the UK, the need for engineers is the highest in the Midlands, the South West and Scotland, whereas there is an ‘oversupply’ in the London metropolitan areas. Young engineers are less inclined to move from the big city to the ‘countryside’ (source: HESA Destination of Leavers of Higher Education survey, 2018).

**Public& private sector involved**
There are various reasons other for the shortage in engineers/technical professions. Of course, it is essential to look at the root causes, but it is even more important to look at the solutions. There are various strategies/methods to address the shortage. Because of the complexity of the issue, it is fair to say that only a comprehensive, concerted approach will be effective. Education (STEM) requires the involvement of

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**Reasons for shortages**
There are various reasons for a shortage in engineers. As stated before, it is better to use the term mismatch as the situation is more complex than a matter of just numbers. Companies also experience mismatches in terms of skill sets. The phenomena listed below are mentioned often in research reports on this subject.

1. **An ageing workforce**
   In the US, almost 27% of workers in the manufacturing sector will retire within the next decade. Babyboomers - and even some older members of Generation X - are out the door, taking their knowledge and skills with them.

2. **Declining interest in STEM**
   In major, more advanced economies (e.g. US, Western Europe) there seems to be a lack of interest in STEM (education). As a result, the influx of homegrown talent is stagnating. This gap can be filled by attracting skilled foreign workers from emerging economies (India, China etc.). There are challenges in terms of visa regulations and cross-cultural hurdles.

3. **Lack of women**
   Only 11% of teenage girls in the US are interested in STEM careers. The number of female engineering graduates is higher - at 24% - but that’s still drastically uneven, despite the fact that women outnumber men in overall graduate school enrollment. Studies show that the US manufacturing workforce consists of just 29% of women workers.

4. **Engineers move into non-engineering professions**
   UK statistics over 2017 show that of roughly 16,000 people with engineering first degrees, a third didn’t go to work as an engineer but moved into other sectors – e.g. finance – or started a job that didn’t require an engineering degree.
the public sector, preferably together with the private sector. For example, in Germany, the VDMA, representing the mechanical engineering industry, proposes the introduction of teaching technology in all secondary schools - with its own curricula, its own didactics and corresponding training for teachers at universities.

Young students also need to be informed about the opportunities and the relevance of engineering for our society and economy. This requires a unified voice from the engineering/manufacturing sector. Typically, associations (sectoral associations) are suited for this task.

**Inspiration**

Given the shortage of qualified STEM-teachers in secondary education, for example, in the Netherlands, it is also necessary to attract and retain teachers that can inspire a young generation to become an engineer. Education, in general, should not be used to balance the budget; it is a critical condition for economies to develop and to face future challenges.

The above solutions can only be realised in the long(er) term. In the short term, individual companies can act and are already acting by hiring engineers from outside. Most of these companies are already active in various continents. Either these multinationals can relocate (some of) their offices to areas where talent is abundant or attract foreign talent to their ‘home base’. In the latter case, there is also a public-private overlap as immigration policies of individual governments come into play.

**Addressing shortfalls**

Individual companies can also address specific existing or projected shortages in engineers/tech-workers. For example, Emerson is very active in STEM-activities in the US. “Emerson has been dedicated to elevating the criticality of STEM education for many years,” said Kathy Button Bell in 2018, senior vice president and chief marketing officer for Emerson. “We have supported everything from collegiate engineering programs to hosting ‘We Love STEM’ days for our own employees’ children. This is a focal point of Emerson’s global values initiatives.” Another company-specific method is to make the carrot bigger. Larger salary packages can make a difference in the short term but it remains to be seen whether money is a structural driver.

**Automation**

In various articles on the topic of the shortage of engineers/skilled workers, automation is mentioned as a way of managing shortages. Interestingly, automation is not mentioned as a structural solution but more as a way to take away repetitive, non-value added tasks from engineers to free them up for the tasks they are trained for.

The World Economic Forum suggests that by 2022, 42% of total task hours will be managed by machines and algorithms. One in three manufacturers is already using these tools and technologies to supplement low-skilled jobs to focus their recruiting efforts on higher-skilled roles. As a result, 64% of executives, interviewed for the WEF-report, have found that automation helps them overcome the challenges of the talent shortage.

It’s expected that the need for some engineering expertise – automation, data science – will rise, whereas the need for other expertises might stabilise or even decline.

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Gary Downie I +44 7717 783092
garyd@emeticsnc.com

www.stainless-steel-world.net Stainless Steel World March 2020 43
Ever-tightening sulphur oxide (SOx) emission regulations are increasing the use of marine scrubbers globally. Scrubbers operate in a highly corrosive environment and require the resilience of nickel-containing alloys to prevent failure.

By Geir Moe, P.Eng, Nickel Institute

On board with marine scrubbers: Resilient solutions for lower emissions

Because of known environmental and human health impacts associated with sulphur and diesel particulates, Sulphur Emission Control Areas (SECAs) already exist in several parts of the world. The fuel sulphur cap limit in SECAs is 0.10% since January 1, 2015. Mandated by the International Maritime Organization (IMO), new limits for SOx emissions outside of SECAs are effective from January 1, 2020. The sulphur cap limit in bunker (dense, high sulphur) fuels is reducing from 3.50% to 0.50%. In lieu of using the 0.50% low sulphur fuel, ships can install an exhaust gas cleaning system (scrubber) to limit SOx emissions.

Open and closed
In response to these regulatory requirements, two types of wet scrubber technology have been developed: open loop and closed loop. In many cases, they are combined into a hybrid system that can employ the most appropriate technology, depending on the alkalinity in the marine environment or designated zero discharge areas in which the vessel will operate.

The inside of a scrubber is an extraordinarily harsh environment. The hot acidic chloride solutions require the use of highly corrosion-resistant nickel alloys, such as Alloy 31 (N08031), Alloy C-276 (N10276) and Alloy 59 (N06059). In wet marine scrubbers, the exhaust gas passes through a water stream, sulphur oxides are removed by reacting with the wash water to form sulphuric acid and the scrubbed gas leaves through the funnel. The sulphuric acid that is produced by the reaction with the wash water is neutralised by the alkalinity of the wash water. The wash...
An explanation of open and closed loop scrubbers

Open loop scrubber

An open loop system uses seawater as the scrubbing solution. The sulphuric acid formed is neutralised by reacting with carbonates and other salts in the seawater to form sulphates. This scrubbed solution is treated to remove solids and raise the pH before being discharged back to sea, and the removed solids are stored onboard for shoreside disposal. Open loop scrubbers work satisfactorily with the natural alkalinity of seawater, while fresh and brackish water is not effective for this system because of their lack of natural alkalinity. For this reason, an open loop scrubber is not considered suitable for areas such as the Baltic Sea, estuaries, and areas close to land, where salinity levels are lower. MARPOL regulations require the wash water to be monitored before discharge to ensure that the pH value is not less than 6.5.

OPEN LOOP SCRUBBER

The inside of a scrubber is an extraordinarily harsh environment requiring the use of highly corrosion-resistant nickel alloys. Photo courtesy of Yara Marine

Water can usually be discharged into the open sea after being treated in a separator to remove any sludge. Open loop utilises the natural alkalinity of seawater for neutralisation, while closed loop adds an alkali solution (typically sodium hydroxide) to perform neutralisation.

Closed loop scrubber systems are necessary for marine areas with low natural alkalinity. Once cleaned, effluent can be safely discharged into the water. When operating in a zero discharge region, the effluent must be collected in a holding tank for land-based disposal. Marine scrubbers of one type or another are part of engine management and critical to the safe operation of the vessel. If they don’t work, the shipowner can cause harm to the environment and human health, as well as risking significant legal consequences and damage to their reputation.

The new regulations will significantly improve air quality in many populated coastal and port areas, preventing pollution-related early deaths and asthma, as well as acid rain in these regions. With the help of nickel-containing alloys, the marine industry will be ‘scrubbing up.’
**Closed loop scrubber**

A closed loop system uses an alkali solution (typically sodium hydroxide) as its scrubbing solution, which is required for water with low alkalinity (fresh or brackish water) and areas where no discharge is allowed. This process is less corrosive due to lower chloride levels. However, chlorides will increase with time in the scrubbing liquor until it is changed out. Every system, requires varying amounts of nickel-containing materials depending on the operating environment.

*For more information please visit: www.nickelinstitute.org*

**Why high sulphur?**

Some crude oil is naturally low in sulphur ‘sweet’ but much is high in sulphur ‘sour’ and needs to be treated differently. High sulphur fuel oil ‘bunker’ is plentiful and relatively cheap. Marine engines tolerate it well and use approximately four million barrels (550,000 tonnes) per day. Its availability and low cost are factored into the current cost structure of marine freight tariffs. The new IMO regulations are challenging that status quo.

Available options to meet the IMO2020 regulations include switching to significantly more expensive low sulphur fuel or retrofitting with an exhaust gas scrubber system. For the largest vessels in particular, the lower cost and quicker payback of installing a marine scrubber have container ships lined up to get the job done and avoid penalties and fines imposed by IMO nation states. Currently, the high demand for vessels requiring retrofit is stretching the capacity of material suppliers, equipment suppliers and facilities capable of doing the work.
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From a recent workshop held at the Stainless Steel World Conference & Expo, which took place November 26th– 28th, 2019, the session leader, Mr. Harsharn Tathgar, Senior Principal Specialist at DNV GL in Norway, pointed out some of the advantages and disadvantages of working with additive manufacturing, as well as what DNV GL is doing to get ahead with this exciting technique. Some of these advantages are further illustrated by Ms. Valeria Tirelli, CEO of Aidro Hydraulics & 3D Printing from Italy.

Starting off his presentation Harsharn Tathgar, Senior Principal Specialist at DNV GL in Norway pointed out that although the use of additive manufacturing is advancing rapidly in a wide variety of industries its scope of use varies considerably per industry. For example, its use in the medical and aerospace industries far outstrips that in the construction and oil & gas industries – see Fig. 1. However, even though additive manufacturing has seen a growth of over twenty-five per cent in the last thirty years, this is still only about 0.1% of all global manufacturing. The ‘lack of maturity’ in the use of additive manufacturing in the offshore industry can be attributed to a number of factors, such as: lack of understanding of how the technology should best be put to use; the uncertainty of whether it is the right time to invest in this relatively new technology given that the value chain itself is not fully understood, as well as the general lack of trust in the technology on the part of many parties. In many business cases, moreover, end-user and EPC companies do not use additive manufacturing simply because they do not own the intellectual property of their designs or are unsure with whom these rights will lie after redesigning to achieve better properties by use of additive manufacturing. As such roles

How mature is AM?

Fig. 1. How mature is additive manufacturing – expected growth vs. maturity? (Courtesy DNV GL)
and responsibilities are not clear throughout the supply chain when it comes to additive manufacturing. Finally, it is additionally often difficult to get funding for additive manufacturing projects due to the fact that methods to qualify the produced parts have not, as yet, been fully developed. An advantage of using additive manufacturing in the offshore industry would be that lighter weight parts could be supplied, but again this is something not generally considered to be important to the industry at this point in time. Nevertheless, the technique does enable in many cases not only lighter, but also stronger, and more complex parts to be printed.

**Benefits of using additive manufacturing**

The benefits of using additive manufacturing for the oil & gas industry can be listed as: less material loss; lead-time reductions, part count reductions, the high level of geometric complexity of the parts that can be printed; the considerable weight reduction that can be achieved when compared to traditional production forms, and the fact that printing parts generally leads to a lower carbon footprint.

**Challenges of printing using additive manufacturing**

The use of additive manufacturing to produce parts is not all plain sailing, however. Just as important as the advantages are the many challenges that the technique brings. Certainly, the anisotropy of the printed object can prove a contest whereby an object’s properties exhibit variations in physical properties along the build direction and perpendicular to it. This can lead to different physical and mechanical properties along the different axes. Other challenges posed by 3d-printed objects can encompass such factors as: defects (inclusions and porosity, etc.), microstructure variations, and residual stresses. Moreover, the printing can prove a problem in itself because of the lack of industrial experience a company might have in producing objects. There is also at present a lack of standards to which goods should be produced, making it very difficult to ensure that a series of products are all produced identically. Additionally, very often existing test procedures may not be relevant to 3D printing but are based on traditional methods of manufacture, which makes them totally irrelevant.

Fig. 2 shows a summary of the key challenges but also the benefits from the advancement of additive manufacturing over the next ten years.

**(DNV GL’s) progress with additive manufacturing**

The DNV GL organization has been moving into the field of additive manufacturing since 2014. Its activities have covered feasibility studies, right through to working on joint industry projects (JIPs) for the production of additive manufactured alloys for the US Navy, using integrated computational materials engineering to produce a nickel super-alloy heat exchanger, and other manufacturing projects in Norway, and China, for example. A pair of two-year-long Joint Innovation Projects (JIPs) aimed at the qualification of additive manufacturing in the oil & gas and maritime industries have recently come to a close. The projects, which brought together twenty partners from across the industries, concluded with a celebration in Norway organized by DNV GL and Berenschot at DNV GL headquarters.

The goals of the aligned JIPs was to develop guidelines for the qualification of parts produced using laser powder bed fusion (LPBF) and wire arc additive manufacturing.

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**About Harsharn Tathgar**

Harsharn Tathgar (DNV GL) has a Ph.D. in Materials Technology from Norwegian University of Science and Technology and over twenty-five years of broad international experience from large multinational companies as well as start-ups. He has substantial experience in leading projects with suppliers, customers, and within companies. The main areas of his specialization are technology- and product- development and qualification. He is further experienced in managing complex development projects with a specific interest in additive manufacturing.
manufacturing (WAAM) as well as to establish an economic model for the oil & gas and maritime sectors. To achieve these goals, partners from across the value chain were brought on, including operators, contractors and fabricators.

In the former category, the JIPs included BP, Equinor, Shell and Total. While SLM Solutions, Siemens, TechnipFMC, IMI Critical Engineering and Kongsberg were the contractors. In the fabricators category, the JIPs saw support from Ivaldi, Airo Hydraulics, voestalpine, Additive Industries, Sandvik, Immensa Technology Labs, Quintus Technologies, Vallourec, HPTec, Arcelor Mittal and the University of Strathclyde Glasgow.

By working together and pooling their respective areas expertise, the JIP participants made significant progress in the development of qualification guidelines and an economic model. These guidelines for the qualification of additively manufactured parts in the oil & gas and maritime industry for both laser powder bed fusion (LPBF) and wire arc additive manufacturing (WAAM) have been released.

Further developments since the workshop

In the last week of January 2020, DNV GL has launched two new Joint Industry Projects (JIPs). The first of the two is phase II of ProGRAM JIP and second is on digital warehouse enabled by additive manufacturing.

ProGRAM JIP phase II

ProGRAM JIP was initiated by DNV GL in 2018 to develop requirements for the qualification and production of parts by additive manufacturing for the oil & gas and maritime industry. Phase I of the JIP focussed on LPBF and WAAM technologies. In Phase II, a guideline for the qualification of parts made by LPB-EB (electron beam), WAAM on substrate, the laser metal deposition of blown powder, and binder jetting will be developed. In addition, experience from the use of the guideline from Phase I will be used to update the guideline issued in this second phase. The qualification of non-destructive testing methods for additive manufacturing and the effect of heat treatment on corrosion properties will also be a part of Phase II of ProGRAM JIP.

Digital warehouse JIP

Oil & gas and related companies purchase and store spare parts to minimize production downtime in the event of breakdowns. This is particularly important where operations are in remote locations with stretched and costly supply chains. This physical inventory constitutes significant value, which is locked up and only realized when a part is put into use. In many cases the parts are never used. In addition, there are inventory management costs that are incurred to maintain the readiness of the stored spare parts.

Additive manufacturing makes it possible to produce parts on demand, close to operations, with significantly reduced lead times compared to conventional manufacturing. This makes it possible to reduce inventory and save cost. Players in the offshore oil & gas industry are actively pursuing the creation of digital spare part warehouses; digital libraries of parts that can be manufactured on demand close to the end user.

However, in this new digital spare part value chain important questions arise:

- can the digital drawing be available when needed? In which format should it be provided? Can the parts be made ‘first time’ right when needed? Can the parts be made with the same quality at another location next time? Which party is responsible for the different stages?
- What requirements should be in place for the companies who wish to manufacture on demand?

In this JIP, parties will address some of the above questions and exemplify on-demand manufacturing solutions.

Additive manufacturing workshop – complete presentations

If you would like to view the PowerPoint presentations of this entire workshop including presentations from: Andy Imrie, Principal Technical Consultant at Lloyd’s Register, UK; Rebekka Jurtz responsible for Sales Operations at Gefertec, Germany; and Gerrit Kool, Senior R&D Engineer at the Netherlands Aerospace Center as well as from the two presented authors please contact: j.butterfield@kci-world.com
when applied to offshore oil and gas spare parts. Both JIPs will be kicked-off on 15-16th April at DNV GL in Norway provided there are enough partners who sign-up for the JIPs.

Additive manufacturing at Aidro Hydraulics & 3D printing
Aidro Hydraulics & 3D printing introduced additive manufacturing to its hydraulics portfolio approximately five years ago to create a new generation of solutions for the production of its products and to overcome the limits of traditional manufactured components. Today the company uses laser powder bed fusion to print many customized solutions with complex geometries for its clients. “The technique has brought us a number of advantages over more traditional forms of production,” says Valeria Tirelli, CEO at the company. “For a start, the technology results in faster lead times and a better performance of numerous products. Lead times have been reduced because even exotic materials, like AISI316L or Inconel 718, are almost always available as powders or as wire from stock at present, whilst this is certainly not the case with the same materials delivered from traditional steel works where smelt-order and delivery- times are much longer. Moreover, multiple parts produced by traditional methods of production can be produced connected together as a whole, for example, in compact hydraulic shapes. This, moreover, often ensures that the printed parts are able to exhibit a reduction in pressure drop over traditional parts and that they can often be produced with a considerable weight reduction – in some case up to 70% less. There is also far less wastage with parts produced by additive manufacturing since only the amount of material needed to print the part is used. Valves, for example, can be printed so that not only the eventual flow is better than with a similar valve produced by traditional methodologies but also with a body improvement efficiency of almost 40%. A particular advantage of the use of additive manufacturing in combination with heat exchangers is that the technique can be used to produce very complicated shapes.”

AIDRO was a member of the ProGRAM JIP on the guidelines for additive manufacturing.

Fig. 4. The advantages of using additive manufacturing to produce heat exchangers are that it can produce innovative and complex shapes, produce a compact size, and the weight of the heat exchanger will be less than that produced through traditional techniques. (Courtesy AIDRO.)

Fig. 5. The advantage of producing a crank disc by additive manufacturing is that it is possible to produce spare parts within a week instead of the normally eight weeks needed to produce a part traditionally. No minimum batch is required. The material is Inconel 718 and it was 3D printed by AIDRO for Kongsberg Marine. (Courtesy AIDRO.)

About Valeria Tirelli
Valeria Tirelli is CEO of Aidro Hydraulics & 3D Printing, an Italian company that has excelled in the introduction of additive manufacturing in hydraulics. She manages the enterprise, which was founded by her father almost forty years ago with great enthusiasm. The company specializes in the design and production of components, such as valves, hydraulic manifolds, heat exchangers, and fluid power systems. A few years ago, she foresaw the potential of metal additive manufacturing and decided to invest in this technology, creating a dedicated department within her company, alongside traditional manufacturing.

Valeria promotes the adoption of additive manufacturing in industry, participating in international groups for the definition of guidelines and standard in oil & gas applications. See also www.aidro.it
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Conference Participation
Mr. John Butterfield
Conference Coordinator
Tel: +31 (0)575 585 294
E: j.butterfield@kci-world.com

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The role of stainless steel in offshore applications

Stainless steels, including duplexes and super duplexes are of enormous benefit to the offshore oil and gas industry. They offer reduced weight, increased strength and corrosion resistance, and favourable lifecycle costs, compared to other materials.

By Mr Abhyuday Jindal, Managing Director, Jindal Stainless

Offshore projects are crucial for the production and processing of hydrocarbons around the world. Set up in some of the most extreme environments, offshore activities constitute almost 30% of the world’s crude oil production. However, the saline marine environment mandates high safety and longevity standards for offshore platforms. Infrastructure for marine and offshore applications is often susceptible to considerable amounts of air- and water-borne salts. Conventional carbon steel structures suffer frequent corrosion, requiring regular maintenance and upkeep. Stainless steel, on the other hand, guarantees to be a robust material choice for heavy-duty offshore applications. The metal is inherently resistant to corrosion, even in marine and coastal environments, and offers a high strength-to-weight ratio for infrastructural applications. Stainless steel also ensures a long design life along with impressive resistance to extreme pressure and high temperatures. It is noteworthy that by using stainless steel, the life expectancy of offshore structures can be increased by nearly five times as compared to its competitors.

Lifecycle cost
In addition to an enhanced life, stainless steel is further qualified for use in offshore applications by the burgeoning emphasis on minimal lifecycle cost (LCC) in architecture and construction. This concept underlines the strong demand for the development
of new infrastructure that is highly durable and does not require extensive maintenance or repair. Weight reduction is also a major driver while installing offshore structures. Reduced weight implies that the structure costs less to build while allowing for more drill pipes and production equipment to be carried for oil and gas production and exploration.

**Grades for offshore applications**

SS 316L has been a major austenitic stainless steel grade used for offshore applications. It augments strength at high temperatures and also defends the structures against severe acidic environments. Austenitic grades, containing 6% molybdenum, have conventionally been in use for permanent immersion in seawater. However, with the globally volatile nickel prices over the past years, duplex stainless steel grades have extensively taken over the austenitic grades. Given their excellent combination of mechanical properties and resistance to stress corrosion cracking, duplex grades make a good choice for offshore applications. UNS S32205 is the most common duplex stainless steel grade used in offshore installations.

While duplex stainless steel grades have proven their mettle for heavy-duty offshore applications, the new generation of super duplex stainless steels has properties similar to those of seawater corrosion-resistant austenitic stainless steels. Further, these grades have improved mechanical properties than duplex grades. These super duplex grades are distinguished by the presence of higher levels of nitrogen, chromium, molybdenum, and nickel that contribute to the improved resistance to pitting and crevice corrosion in them. Some examples are UNS S32750 and UNS S32760 which are used for more aggressive offshore applications, for example, submerged components. While we observe that stainless steel is a better alternative to carbon steel, it is crucial to understand that choosing the best stainless steel grades for specific requirements is necessary for a cost-efficient and long-life offshore setup. As India’s largest stainless steel producer, and with a dedicated R&D, Jindal Stainless specializes in manufacturing these high-end grades. The company holds a majority share in the domestic consumption of all such grades.

**Stainless usage in offshore applications**

- **Submerged components**: pipelines and grills for oil, sewage and water, risers for oil platforms, heat exchangers for ships and coastal power plants, equipment attached to hulls of boats and ships.
- **Platform structure components**: pumps, winches, storage vessels, process vessels, blast gates, umbilical tubes, rebars, cable trays, stairs, tread plates, walkways, oil and gas coolers, gravity separators, etc.
- **Deck components** for boats and ships like deck eyes, brackets for anchor ropes, shackles, etc.
- **Coastal (land-based) handrails, ladders, lamp posts, etc.**

A study by the Department of Metallurgy and Materials Science, University of Manchester/UMSIT, titled ‘Developments in the Use of Stainless Steel for Offshore Pipework Systems’, shows how using a super duplex stainless steel deluge system in offshore projects helps reduce the weight and size of the setup as compared to 90/10 cupro-nickel (Cu-Ni) alloy. The deluge system requires minimum nozzle pressure and water flow. The super duplex stainless steel system uses fewer pipes to control water flow velocity, as compared to 90/10 Cu-Ni systems. Thus, the dry weight of a super duplex stainless steel deluge system is reduced by ~15%. Moreover, it was found that due to the higher strength of super duplex stainless steel, the pipe requirements for the setup were reduced by ~38%. This also implies that applications such as sprinklers and firewater deluge systems, if developed using super duplex stainless steel, will further reduce weight by ~30%. The reduced weight and pipe requirements in a standard super duplex stainless steel deluge system thus essentially translate into a cost-efficient alternative when compared with 90/10 Cu-Ni alloy. As per the study, the effective cost of super duplex stainless steel piping material used for developing a standard deluge system will be nearly half of that for using 90/10 Cu-Ni alloy.

**Way forward**

Corrosion has posed a significant roadblock for the offshore oil and gas industry. Today a large number of corrosion-resistant stainless steel alloys have been developed, with duplex stainless steels having proven their worth for offshore applications. With lower nickel content, these high-end duplex grades are perfect for the developing Indian offshore landscape. Considering the rising fuel requirement in India, the country needs to establish dynamic coastal and marine infrastructure for offshore
It is essential to choose the best stainless steel grades for specific requirements for a cost-efficient and long-life offshore setup. Projects. This will include setting up offshore platforms with related logistics including supporting coastal infrastructure. Moreover, as a metal, stainless steel is quintessential for achieving sustainable and clean energy production. It is motivating to see the Indian industry is self-sufficient for developing such grades for a plethora of applications.

The Indian market
India is the third-largest consumer of oil and energy in the world. Oil and gas continue to be major import commodities for India. Fuelling growth across sectors, oil and gas play an important role in building robust infrastructural applications in the nation. With a committed effort from the government and the domestic stainless steel industry, harnessing stainless steel production to address energy access, energy efficiency, energy sustainability, and energy security in the nation is now possible. India stands tall as the world’s second-largest producer and consumer of stainless steel. With an accelerated growth rate, stainless steel is at par with the global economies as the fastest growing metal in the country. Jindal Stainless continues to empower the domestic industry by producing the best quality stainless steel grades, imparting professional training to local producers, and mediating with policymakers to ensure a level-paying field for the domestic industry. With strong economic growth, the energy demand in India is also expected to grow exponentially. This will require the up-scaling of existing offshore infrastructure in the country. As Indian stainless steel manufacturers become increasingly specialised in developing higher grades, it is possible to accomplish an efficient infrastructure and a self-sustaining ecosystem for offshore drilling and processing through indigenous resources.

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The rising popularity of its special beers meant that Belgium’s third-largest beer brewery needed to expand. New specialist stainless steel brewing tanks were required.

Text & images by Gpi

Haacht Brewery, based in Belgium, is a family-owned brewery founded in 1898. The company turns out around 900,000 hl of drink annually, 700,000 hl of which is beer (1 hectolitre = 100 litres). This makes Haacht the third biggest beer producer on the Belgian market. On the back of rising popularity for its special beers, the business needed new storage tanks. Gpi was entrusted to carry out the project in collaboration with the brewery.

The assignment
Gpi received the order to supply 4 vertical beer tanks – so-called cylindrical conical tanks (CCTs) – each with a capacity for 520 hl. Nikki Vreven, Project Engineer at Haacht Brewery was involved throughout the entire process. “We approached Gpi on the recommendation of a colleague,” Nikki explains. “Gpi addressed all our requirements and even came up with additional recommendations. For example, they suggested a more suitable cooling jacket.”

Unusual project design
When a beer tank is being designed it invariably has to take into account the brewing process: for example, a tank needs additional space for CO2, the gas produced from the fermentation process. In order to keep the temperature of the fermentation process in check, for each section of the tank 4 cooling sections were added: 3 on the main body of the tank and 1 on the cone section. The pipes
were concealed behind the stainless steel panels and emerge from the insulation at a single connecting point. A lot of thought went into the physical arrangement of the tanks. Two tanks, for instance, are positioned next to each other, with an interconnecting platform above. For the production of the CCTs, 304 and 304L stainless steel was used to achieve the right appearance and, not unimportantly, the material is easy to clean and highly corrosion-resistant.

**Transport and installation**
The 6500 kg tanks were transported from the production plant in Lopik (Netherlands) and then installed and anchored in place on-site at Boortmeerbeek in Belgium. Needless to say, Haacht Brewery also carried out its own thorough preparations to make sure that installation went smoothly. “Everything went without a hitch,” explains Nikki. “The tanks were hoisted into place by crane. It was precision work, but fortunately, it all went to plan.”

“The whole collaboration on the project was a success,” adds Nikki. “The supply of these 4 new beer tanks will go a long way to helping Haacht Brewery meet the growing demand for special beers. The tanks, each with a capacity of 520 hl, will be able to produce 320 hl or 480 hl of beer, depending on the number of brewing batches. To you and me, that means around 12,000 glasses of beer per tank.”

Niki Vreven, the Project Engineer at Haacht Brewery, oversaw the project.
Stainless steel and fire resistance

What is the fire rating of stainless steel? This is a common enquiry in the construction industry, especially with the current concerns about flammable cladding. The three major branches to this question are addressed in this article.

Text & images by the Australian Stainless Steel Development Association (ASSDA)

Will stainless steel burn, and if it does, will it give off fumes or facilitate the spread of fire?

This question is readily answered because it is recognised that steels do not burn and only start to melt at about 1400°C. This means that stainless steels do not have a “fire rating” as such, so the tests of AS/NZS 1530.3 (or the equivalent tests in BS 476) are not required.

Heating in a fire will obviously have a cosmetic effect because, unlike the transparent nanometer-thick passive layer formed in moist air, stainless steels heated above about 300°C in air discoulour as they grow a less dense oxide layer. This develops from the rainbow colours seen beside welds to a dark and non-protective oxide layer whose thickness depends on the time of exposure and temperature reached. The street rubbish bin shown in Image 1 suffered from a fire but remained functional for almost a year (until the repair cycle reached it) with a decorative rainbow oxide. By way of comparison, powder-coated bins would suffer from unsightly burn marks and corrosion.

For austenitic alloys such as 304 and 316, the temperature limits for lifetime section loss due to oxidation is about 870°C (with temperature cycling) so they are routinely used in high-temperature furnaces and ductwork. The current trend to apply decorative coatings to stainless steels would require an assessment to determine the combustibility, potential fumes and flame spread of the coating. Tests to AS/NZS 1530.3 would be appropriate. Microstructural effects of a short-term heat cycle (less than a couple of hours of exposure, such as a fire) could include carbide precipitation (sensitisation) in an austenitic alloy which was not an L grade (i.e. carbon >0.03%). Duplex and weldable ferritic grades should not have sufficient carbon for sensitisation. Sensitisation would degrade the corrosion resistance but not affect mechanical properties. Both duplex and ferritic grades can suffer 475°C embrittlement; however data produced by the International Molybdenum Association (IMOA) shows that this requires more than two hours in the 400°C to 500°C range for a 50% reduction in toughness. This duration is unlikely in most fires.

Will stainless steel provide a barrier to flames and if it does, how rapidly will the heat penetrate the barrier sufficiently to cause damage (usually a specific temperature rise) on the far side?

A satisfactory demonstration is supplied by reference BS 647 Part 22 tests carried out for a British Stainless Steel Association (BSSA) member, Stewart Fraser. The company manufactures 316 framed doors which include a cavity filled with non-combustible boards. The results are given at www.bssa.org.uk/topics.php?article=106. It showed slight discoloration and distortion on the flame impingement side with the sheltered side of the door reaching only 98°C after 60 minutes. The test was continued for another 80 minutes without the failure of flame containment or subsequent opening of the door in its frame.

For austenitic alloys such as 304 and 316, the temperature limits for lifetime section loss due to oxidation is about 870°C (with temperature cycling) so they are routinely used in high-temperature furnaces and ductwork. The current trend to apply decorative coatings to stainless steels would require an assessment to determine the combustibility, potential fumes and flame spread of the coating. Tests to AS/NZS 1530.3 would be appropriate. Microstructural effects of a short-term heat cycle (less than a couple of hours of exposure, such as a fire) could include carbide precipitation (sensitisation) in an austenitic alloy which was not an L grade (i.e. carbon >0.03%). Duplex and weldable ferritic grades should not have sufficient carbon for sensitisation. Sensitisation would degrade the corrosion resistance but not affect mechanical properties. Both duplex and ferritic grades can suffer 475°C embrittlement; however data produced by the International Molybdenum Association (IMOA) shows that this requires more than two hours in the 400°C to 500°C range for a 50% reduction in toughness. This duration is unlikely in most fires.

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Table 1. Deflection & failure modes of 3m cable trays

<table>
<thead>
<tr>
<th>Material</th>
<th>Result</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>316L stainless steel</td>
<td>Maintained integrity for five minutes. Burners continued until gas exhausted after 45 minutes. Centre sag 80.5mm – see picture.</td>
<td>Maximum average ladder temperature 707°C with max. Individual 757°C.</td>
</tr>
<tr>
<td>Galvanised carbon steel</td>
<td>Maintained integrity for five minutes. Centre sag 166.5mm.</td>
<td>Molten zinc dripped. Maximum average ladder temperature 642°C.</td>
</tr>
<tr>
<td>Aluminium</td>
<td>Collapsed after 26 seconds.</td>
<td>Fell outside monitoring zone so no temperatures measured.</td>
</tr>
<tr>
<td>Fibreglass</td>
<td>Collapsed before all burners ignited.</td>
<td>Subsequently ignited with fume emission.</td>
</tr>
</tbody>
</table>
the “safe” side reached 30°C after 40 minutes and 110°C after 60 minutes. The test was terminated after 120 minutes with containment still satisfying IMO resolution A518 (XIII).

**What are the effects (both during and after an event) to the mechanical properties of stainless steel? How do these compare with structural carbon steels?**

There are tests as well as a theoretical basis which demonstrate that both austenitic and duplex stainless steels have superior high-temperature properties compared to carbon steel.

Table 1 shows the deflection and failure modes of three-metre long commercial electrical cable trays loaded to simulate actual loadings (Image 2). They were heated with 18 LPG burners to obtain an average temperature of 1000°C to 1050°C for at least five minutes (Nickel Institute publication No. 10042). The publication also considers the life cycle costs (LCC) of the use of aluminium, galvanised steel or stainless steel for stairways, handrails, gratings and firewalls, as well as cladding for corridors and accommodation modules on North Sea platforms. Fire risk controls are obviously a major concern, although corrosion resistance is also critical. On an LCC basis, stainless steel was most economical especially when its reduced requirement for maintenance periods were included.

In addition to the above testing in cable tray applications, substantial research and application work has since been carried out and codified. Installations include 2205 duplex hangers suspending the slab which forms the floor of the emergency ventilation duct in the CLEM7 tunnel in Brisbane [ISSF], see Image 3.

In short term fires such as on balconies or stairways, the temperature rise exposed to an ISO 834 fire temperature profile depends on thickness and emissivity. Polished stainless steels typically have low emissivity of <0.1 and hence a slower temperature rise. Conservatively, after 30 minutes a 12mm sheet of stainless steel with 0.2 emissivity would reach 620°C whereas steel (with no rust) and 0.4 emissivity would reach 750°C.

When considering strength and deflection, the metal temperatures in a conventional fire do not reach levels to anneal the material so any cold work strengthening will raise the temperature for a 50% strength reduction. In addition, as shown in the graph, the reduction in Young’s Modulus, i.e. deflection from a specific load, is less than that of carbon steel for temperatures above ~200°C. By 600°C the modulus retention for stainless steel is 0.75 compared to 0.3 for carbon steel, i.e. less than half the deflection for a given load.

In summary, stainless steel has substantial advantages in structural use when fire risk is considered, and these advantages continue into higher strength and lower deflections at elevated temperatures.
A recent project in Venice, Italy, was undertaken to produce a uniform range of municipal water taxi pontoons.

The new range of floating taxi stands/pontoons were required to have a uniform recognisable appearance which would enable people to identify them easily throughout the city. It was also essential that the design for the taxi stands fitted in with the historic architecture in the centre of Venice. In this regard, suitable landscape compatibility was essential. Another important consideration was that the structures were designed to provide shelter from the elements for customers, as they waited for a taxi to arrive and during embarking/dismbarkation.

**Marine environment**
The city of Venice is famous for its location at sea, where canals provide the only means of access and transport. Given the marine environment of the city centre, the choice of material for all elements of the new taxi pontoons was stainless steel EN 1.4404 (AISI 316L). This material would guarantee corrosion resistance even in the aggressive atmosphere.

While there are slight variations among the various taxi station pontoons, depending on their location in the city, in general, the final design resulted in a very similar, easily recognizable appearance. The completed taxi pontoons were standardized with respect to the core elements. The pontoons were constructed using an appropriate framework essentially consisting of:

- Uprights (four square welded hollow sections),
- Beams and crosspieces (two longitudinal square hollow sections equal to that of the uprights),
- An upper frame (six round hollow sections and five longitudinal tubes),
- Two side gutters made from sheet metal,
- Two sheet metal fronts bearing the inscription “TAXI,”
- Handles for wooden railings obtained from a tube.

All the metal elements were made entirely from stainless steel EN 1.4404 (AISI 316L). Reproduced with kind permission from Centro Inox; text & images from Inossidabile 212.
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Stainless Steel Hollow Sections. Custom Made Quality i.e. cut length service, angular or laser cutting, perforating, special profiles. higher strength materials and special materials.

TUBACEX GROUP
Tres Cruces 8,
PO Box 22
E-01400 Llodio, Alava
Spain
tel: +34-94-671-9300
fax: +34-94-685-0894
sales@tubacex.es
http://www.tubacex.com

(continued)
Ratnamani Metals & Tubes Ltd
17, Rajmugat Society
Naranpura Cross Road
Ahmedabad - 380 013
(continued above)

SciAps, Inc.
7 Constitution Way
Woburn, MA 01801
USA
tel: +1-339-210-8164
sales@sciaps.com
www.sciaps.com
SciAps is a Boston-based instrumentation company specializing in portable analytical instruments.

Zhejiang Shenni Titanium Industry Co., Ltd
Xiaoshu Industrial Zone,
Meixi Town, Anji County,
Huzhou 313307 Zhejiang,
China
tel: +86 21 5872 8836
fax: +86 21 5872 8837
sales@shenni.com
www.shenni.com
Leading manufacturer of sheets/plates in titanium and titanium alloy. nickel and zirconium. AS 9100D Qualified.

Raccortubi Group
Viale De Gasperi 194
I-20010 Marcallo con Casone (MI)
Italy
tel: +39-02-976300-1
fax: +39-02-90376337
info@raccortubi.com
www.raccortubigroup.com

Marphil International
36, Rue de Richeleu
F-75001 Paris
France
tel: +33-1-42-97-44-74
fax: +33-1-42-96-27-18
marphil.int@wanadoo.fr

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Leading manufacturer of sheets/plates in titanium and titanium alloy. nickel and zirconium. AS 9100D Qualified.
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<th>Company</th>
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<tr>
<td><strong>S &amp; N Stainless Pipeline Products Ltd</strong></td>
<td>Unit 84 Fallons Road, Wardley Industrial Estate Worsley, Manchester. M28 2NY United Kingdom tel: +44-161-728-1148 fax: +44-161-351-6689 <a href="mailto:sales@sstainless.com">sales@sstainless.com</a> <a href="http://www.sstainless.com">www.sstainless.com</a> We are the leading supplier of pipe, pipe fittings &amp; flanges IN UNS S31254, DUPLEX and SUPER DUPLEX stainless steel. We carry extensive stocks in above grades in both UNS 32750 and UNS32760 in sizes from ⅝&quot; NB through to 24&quot; NB</td>
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<td><strong>Racottubi Group</strong></td>
<td>Viale De Gasperi 194 I-20010 Marcallo con Casone (Mi) Italy tel: +39-02-976300-1 fax: +39-02-90376337 <a href="mailto:info@racottubi.com">info@racottubi.com</a> <a href="http://www.racottubigroup.com">www.racottubigroup.com</a> UNS 32760 - UNS 32750 fittings, pipes and flanges to Nordic specs</td>
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<td><strong>Ratnamani Metals &amp; Tubes Ltd</strong></td>
<td>17, Rajmugat Society Narapura Cross Road Ahmedabad - 380 013 Gujarat, India tel: +91-79-2741-5501 fax: +91-79-2748-0999 <a href="mailto:info@ratnamani.com">info@ratnamani.com</a> <a href="http://www.ratnamani.com">www.ratnamani.com</a></td>
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<tr>
<td><strong>Sankyo &amp; Co Ltd</strong></td>
<td>1-13-12, Umezato, Suginami-Ku Tokyo 166-0011 Japan tel: +81-3-5929-1981 (continued above*)</td>
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<tr>
<td><strong>ACNIS INTERNATIONAL</strong></td>
<td>17 Rue Des Freres Lumiere, 69680, Chassieu France tel: +33 6 17 13 89 81 fax: +33 4 72 14 55 09 <a href="mailto:fpicard@acnis-titanium.com">fpicard@acnis-titanium.com</a> <a href="http://www.acnis-titanium.com">www.acnis-titanium.com</a> ACNIS INTERNATIONAL stocks and distributes Titanium, Special Alloys, Stainless Steel ISO9001–ISO13485-EN9120</td>
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### Stainless Steel World Application Guide

March 2020

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All these companies are listed in the Buyers’ Guide and in the Phone Directory.

For more Buyers’ Guide+Online information, please contact Vera Solís, e-mail: bg.ssw@kci-world.com or visit us at www.stainless-steel-world.net
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Strada Statale 45 Bi:
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sales@ilta.arvedi.it