NICKEL MAGAZINE

THE MAGAZINE DEVOTED TO NICKEL AND ITS APPLICATIONS

NICKEL, VOL. 34, NO. 3, 2019

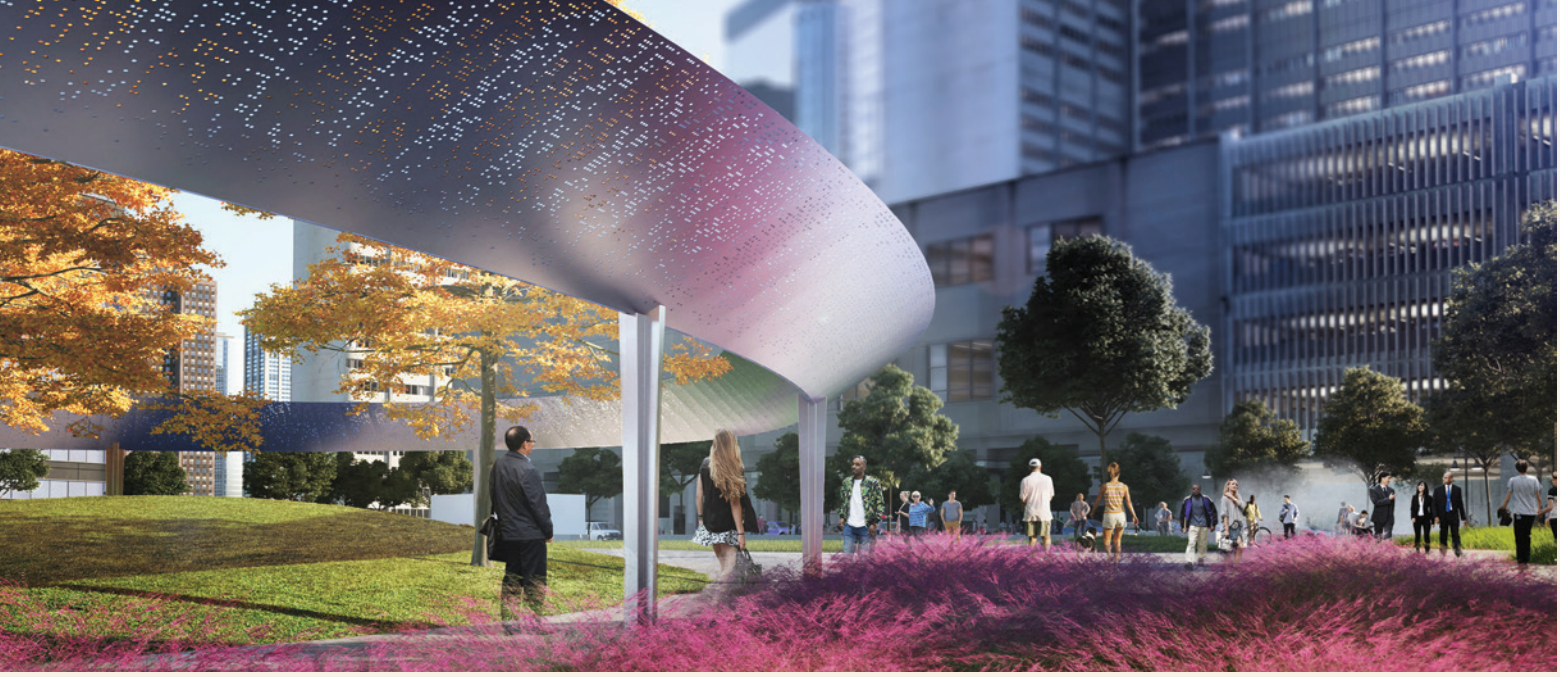
Resilience

Longevity and sustainability with nickel

Wind power
nickel making a hard case

Reducing
single-use packaging

Marine scrubbers
meeting lower emissions limits



CASE STUDY 17
PACIFIC PLAZA PARK PAVILION

HKS ARCHITECTS

The Morse Code design on the panels reflects the rich history of Dallas' Pacific Avenue, the Texas and Pacific Railway and the era when conductors and engineers communicated by telegraph.

The task *Turn a city-centre parking lot in Dallas, Texas into an inviting green space with a world-class brise-soleil, an architectural feature that filters sunlight and reduces glare.*

The challenge Situated in a dense urban area, the elliptical structure needed to entice pedestrians from every angle and complement the surrounding tall buildings.

The designers Dallas-based HKS Architects and their Laboratory for Intensive Exploration (LINE) were commissioned for the design of the pavilion. Zahner, an architectural metal and glass company, was hired by the park's lead design firm SWA, for Design Assist services.

The design The elliptical brise-soleil sits approximately 5 m above the ground and is supported by 11 columns, angled to appear as thin as possible. The panels, constructed from bead-blasted stainless steel, are an abstracted version of American Morse Code. Approximately 15.6 tonnes of Type 304 (UNS S30400) stainless steel was used.

HKS conducted numerous studies to ensure every detail of the Morse Code pattern was right, exploring spacing, hole size and expression of the pattern. The outcome was a gradient pattern with solid stainless steel at the lowest point, slowly becoming more perforated toward the top.

The result According to Parks for Downtown Dallas "This large, shade-providing structure reaches out toward the corner, wraps around the event and lawn space and ultimately creates an iconic sense of place that showcases generations of architectural heritage." Ni

EDITORIAL: RESILIENCE

'Resilience': not a word that everyone associates with nickel or nickel-containing materials. It's more associated with organic/dynamic systems: ecologies, cultures, ourselves: capable of 'bouncing back', or flexible and enduring in the face of changes and stresses.

This issue of *Nickel* challenges that narrow organic view of resilience and offers examples where the presence of nickel in various forms allows structures, products, and processes to exhibit properties of 'resilience', all to the benefit of society and sustainability.

The use of nickel-containing stainless steel in structures, such as this bridge deck, ensures that it can cope with decades of exposure to everything that humankind and nature throws at it (including salt). Nickel-containing materials which can withstand the severe North Sea climate also contribute to the resilience of offshore wind turbines. Also, nickel-containing stainless steels in all manner of pots, pans and food preparation surfaces endure knocks, scrapes and scratches…with surfaces that start to regain their corrosion resistance instantly. A scratch may remain visible, but it will not rust, giving additional years or decades of service. More on this in our new Q&A section on page 14.

And this is without mentioning the many and increasing uses and importance of nickel-containing batteries, let alone the large and growing amount of nickel in its many forms that is being recycled.

The idea of 'resilience' when applied to nickel is broader than the usual view. But, upon reflection, it's true and signals the depth of nickel's contributions.

Clare Richardson
Editor, *Nickel* Magazine

FRANK SMITH

"Resilience is the ability to withstand, adapt to changing conditions, and recover positively from shocks and stresses.

Resilient infrastructure will therefore be able to continue to provide essential services, due to its ability to withstand, adapt and recover positively from whatever shocks and stresses it may face now and in the future."

—The Resilience Shift resilienceshift.org

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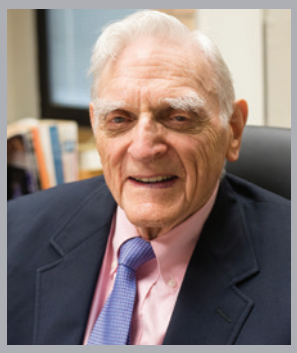
NICKEL NOTABLES

ROYAL CANADIAN MINT

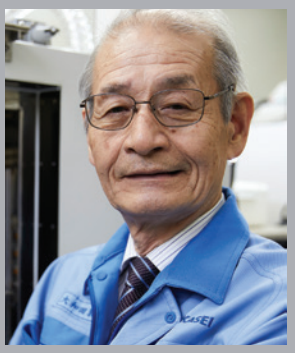
Award-winning tri-metal coin

The Royal Canadian Mint's tri-metal coin technology is turning heads around the world. These innovative tokens consist of a brass-plated steel ring and an inner core of nickel-plated steel on one side and copper-plated steel on the other. According to the Mint, by arranging multiple materials, the token combines "the most advanced overt and covert security features, including differentiated electromagnetic signatures in vending equipment." The coin was awarded *Best New Coin Product, Feature or Distribution* in the International Association of Currency Affairs' 2019 Excellence in Currency Awards for Coins.



JOHN B. GOODENOUGH

M. STANLEY WHITTINGHAM



AKIRA YOSHINO

Prized work on batteries

John B. Goodenough, 97, a German-born American engineering professor, M. Stanley Whittingham, 77, a British-American chemistry professor and Japan's Akira Yoshino, 71, of Asahi Kasei Corporation and Meiji University, have won the Nobel Prize in Chemistry for their work developing lithium-ion batteries. Their collective work in the 1970s and 1980s, led to the launch of commercial portable and rechargeable batteries in 1991, reducing the global reliance on fossil fuels and innovating energy storage for electric cars and mobile phones. From those early foundations, further developments with a high nickel content in the cathode has increased the battery's energy and power density.

At 97, Goodenough is the oldest person to ever win a Nobel Prize.

Faster fuel from seawater

Stanford scientists, Hongjie Dai, J.G. Jackson and C.J. Wood, have published a breakthrough sustainable way of separating hydrogen and oxygen gas from seawater using electricity. While electrolysis is not a new idea, it requires highly purified water, the cost of which made it unfeasible for large-scale use because of limited supply. The problem with plentiful seawater, however, was the rapid corrosion of submerged anodes. By introducing an anode of layered nickel-iron hydroxide on top of nickel sulfide, covering a nickel foam core, to repel corrosive chloride, the scientists were able to conduct up to ten times more electricity, generating hydrogen from seawater at a faster rate. "I think we set a record on the current to split seawater," Dai said. "Now that the basic recipe is figured out for electrolysis with seawater, the new method will open doors for increasing the availability of hydrogen fuel, powered by solar or wind energy."

SEABINPROJECT.COM

Ocean trash collector

It's the brainchild of two Australian surfers who were tired of seeing so much rubbish when they were out catching waves. Called Seabins, they are floating garbage collectors that intercept debris including macro and micro plastics, without interfering with marine life. Designed to be installed in the water of marinas, yacht clubs, ports and any water body with a calm environment, they use an electric pump to pull in the trash, which is captured in a catch bag that is monitored and emptied daily. Submersed, the grey and yellow lip of the bin can be seen, supported by a bracket of nickel-containing marine grade Type 316 (UNS S31600) stainless steel. A smart and timely solution to a growing global problem.

IN THE LOOP
DELIVERING THE PACKAGED GOODS

LOOP

Over 100 stylish, resilient recyclable packages have now launched including baking, beverages, pasta, snacks, frozen, personal hygiene and cleaning.

Reducing single-use packaging and increasing recycling of some of the biggest global brands is taking a big leap forward with TerraCycle's Loop, a new zero-waste platform. Stainless steel has a key role with its durability, and its easy to clean and sterilise properties. Announced at the 2019 World Economic Forum, TerraCycle has been working with major companies like Procter & Gamble, Nestlé, PepsiCo, Unilever, and more than a dozen others for over a year to develop the new platform.

According to Loop, "This initiative aims to establish a new model of consumption that ends society's dependence on disposability and eliminates the idea of waste. By doing so, it supports responsible consumption with clear benefits to consumers, businesses, governments and the environment."

Launched in early 2019, Loop is now available in Paris and parts of the US including New Jersey, Pennsylvania, Delaware, Vermont, Connecticut and Rhode Island. Residents in serviced areas are able to buy items like ice cream and shampoo in sleek, stainless steel containers. UPS is partnering on the initial pilot to both deliver orders and pick up.

Currently, products are available solely through Loop's e-commerce site. The order is delivered in a reusable tote, designed by engineers at UPS to withstand repeated journeys. When products are used up, the empty containers are put back in the reuasable tote. The tote will be picked up or can be dropped off when full, and delivered to a cleaning and sterilisation facility.

With the largest brands now acknowledging that current packaging practices need this kind of revolution, there will be great interest in seeing whether this model, similar to milk deliveries in glass bottles in the early 20th century, can be proven to work in today's world.

Innovative, resilient design

Loop is an initiative of TerraCycle, a New Jersey based recycling company that first came to public attention by marketing an organic fertiliser composed of worm feces.

Tom Szaky, its CEO, originally pitched the Loop concept at Davos in 2017. After getting the world's biggest packaged goods marketers onboard, a key challenge has been the engineering and evaluation of a wide range of everyday products to develop just the right consumer-friendly design to

Double-walled stainless steel ice cream containers stay cold for 24 to 36 hours, but are insulated and comfortable to touch.

Empty packages go into a tote that is picked up and delivered to a facility to be cleaned, then sent to manufacturers for refilling.

make adopting the system desirable.

Stylish stainless steel packaging is being developed to play a key role in convincing consumers to make this significant change in their consumption and recycling habits. From refillable deodorant, to ice cream that remains frozen, to diaper and hygiene product bins that filter out unpleasant odours, each package is designed for 100 or more uses.

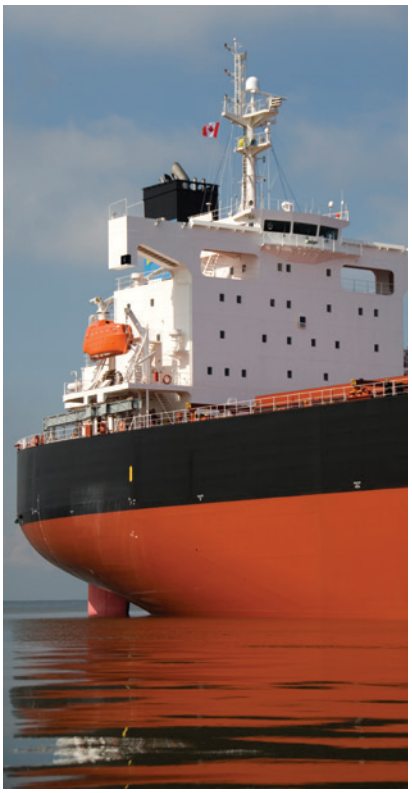
Through its pilot programs, Loop will test how the system works, including the durability of containers, the impacts on manufacturing operations, delivery and, crucially, whether consumers reorder products this way.

Loop currently ships around 100 products with plans to increase the number to 300-400 in the near future. At present only available as an online service, Loop products will eventually be in brick-and-mortar stores, positioned next to similar products with single-use, one-way packaging.

Next up? Loop is in the process of expanding across the United States, Canada, Germany, Japan and the United Kingdom. The objective is to have the entire world 'in the Loop' and nickel-containing stainless steel will make those journeys possible. Ni

LOOP

ON BOARD WITH MARINE SCRUBBERS
RESILIENT SOLUTIONS FOR LOWER EMISSIONS



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.

Because of known environmental and human health impacts associated with sulphur and diesel particulates, Sulphur Emission Control Areas (SECAs) already exist in the Baltic Sea, North Sea, a North American area (covering designated coastal areas off the United States and Canada) and the United States Caribbean Sea area (around Puerto Rico and the United States Virgin Islands). 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 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.

YARAMARINE.COM

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'. Ni

Why high sulphur?

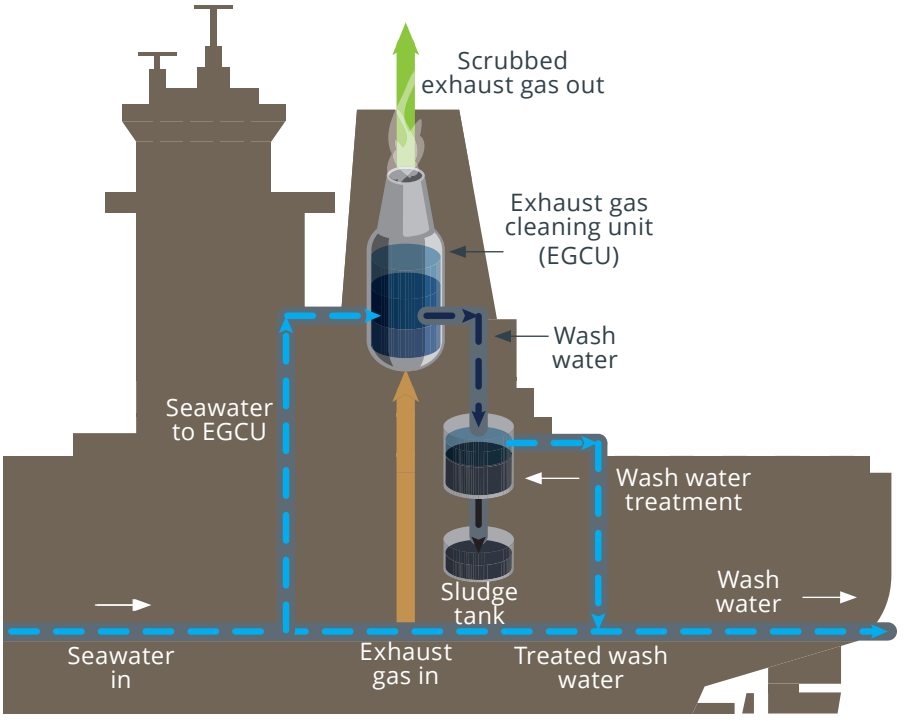
Some crude oil is naturally low in sulphur 'sweet' but much is high in sulphur 'sour' and needs to be treated differently. High sulphur fuel oil 'bunker' is plentiful and relatively cheap. Marine engines tolerate it well and use approximately four million barrels (550,000 tonnes) per day. Its availability 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.

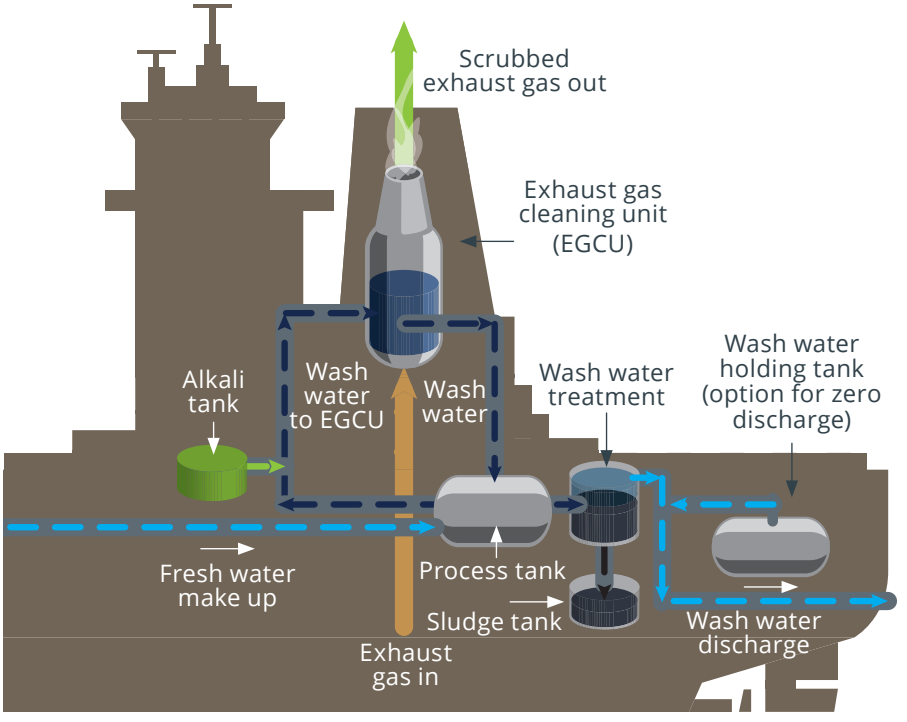
An open loop system *uses seawater as the scrubbing solution. The sulphuric acid formed is neutralised by reacting with carbonates and other salts in the seawater to form sulphates. This scrubbed solution is treated to remove solids and raise the pH before being discharged back to sea, and the removed 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



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.*

CLOSED LOOP SCRUBBER



SAFETY IN PLAY STRUCTURES
BALANCING FUN, CHALLENGE AND SAFETY

Parents expect play structures to be thoughtfully designed and safe. Especially safe. That's why nickel-containing stainless steel fasteners, brackets, chains, and assorted cast fixtures are so prominently used.

Children learn hard lessons. They fall off things. They misjudge distances or their strength and the consequences can be embarrassing or painful or both. Parents understand this and even expect it when they take children to playgrounds and allow them to use the play structures. Parents are used to screams and tears and occasional grazed knees. What is not acceptable, however, is any hurt caused by equipment failure.

Designers and manufacturers of playgrounds and their structures are acutely aware of their responsibility – and potential liability. A great deal of thought goes into the responsible design and material selection of their equipment. The results of their work are colourful and varied, calibrated to different age groups and different levels of skill.

They also make extensive use of nickel-containing stainless steel. Its attributes of strength, durability and corrosion resistance, make for structures that are as resilient as the youngsters that test them every day.

Children can always get hurt at playgrounds. But this is because they are children being children, not because of any material failure. Using nickel-containing stainless steel, a well-built, enduring play structure is a reassuring sight for anxious parents. Ni

BRUCE MCKEAN

These are strong and tamper-resistant fasteners of nickel-containing stainless steel, keeping play structures stable without compromising their function or aesthetic. Parents can be reassured that at least equipment failure will not be a problem.

NICKEL MAKES A HARD CASE FOR **WIND POWER**

Wind power is a fast-growing energy sector, with almost 600 gigawatts in operation at the end of 2018, providing about 5% of global electricity demand. Wind power, along with solar, biomass and hydro power, is one of the renewable energy sources replacing dependence on fossil fuels.

Utility-scale wind turbines are now exceeding outputs of five megawatts (MW). Measured in tonnes of material per MW, wind power is the most iron and steel-intensive of all power generation methods. Existing designs use about 300 tonnes of iron and steel per installed MW. *Table 1* lists some major components in a wind power system, the typical materials of construction and their purpose.

Nickel-containing materials can be present in various components as shown below.

Toughness and higher strength

High strength Austempered Ductile Iron (ADI) is a cast iron material in which carbon is present as graphite nodules in a matrix of ausferrite, a mixture of ferrite and austenite that provides the high strength and ductility of ADI. The addition of nickel, molybdenum and copper as shown in *Table 2*, delays pearlite formation to enable ausferrite formation and promotes hardenability. ADI possesses twice the tensile and yield strength of standard ductile irons, and 50% higher fatigue strength. Thus, ADI

Table 1

Component	Function / Remarks	Materials
Gearbox	Gears increase the rotational speed of the rotor shaft to the high speed needed to drive the generator	Heat-treatable carburising steel 18CrNiMo7-6; Austempered ductile iron (ADI)
Generator	Converts mechanical energy into electrical energy	Heat treatable CrNiMo steels
Main frame	Supports the entire turbine drive train	High strength low alloy plate; Spheroidal cast iron or ADI
Main shaft	Transfers the rotational force of the rotor to the gearbox	Heat-treatable CrMo steel; Spheroidal cast iron or ADI
Rotor hub	Holds the blades in position as they turn	Spheroidal cast iron or ADI
Screws, studs	Holds the components in place; designed for extreme loads	Heat treatable CrMo and CrNiMo steels

offers considerable weight savings compared with standard ductile cast irons for the fabrication of the larger castings such as hub, hollow shaft and gearbox housing.

High-performance gear steels

Wind turbine gear applications require long fatigue life and high toughness. A hard case and a tough core produce a wear-resistant gear, capable of handling high impact loads. High-performance NiCrMo carburising steels as shown in *Table 2* provide deep hardening ability and strong resistance to fatigue. Currently, the grade 18CrNiMo7-6 is the standard gear steel for windmill gearboxes.

The wind energy business has also a large impact on other equipment, such as large mobile cranes, which are required to erect the turbines.

Because of the hoisting heights and weights involved, crane booms made from ultra high-strength steel are required. Applicable steel grades are in the range of S690 to S960, *Table 2*. Crane booms are usually made from quench and tempered steel plate and may possess up to 2% nickel additions.

Stronger and more consistent winds are present further from shore. Typically, these sites are in water more than 60 m (200 ft) deep, which makes fixed-based turbines impractical. The wind power industry is testing floating wind turbines, such as the Hywind Scotland farm comprised of five floating turbines with a total capacity of 30 MW. The wind power industry is even considering larger turbines exceeding 10 MW output. Ni

Table 2		Alloy content (wt%, min./max.)						Minimum yield strength MPa <2" thickness
Steel grade	**Material number**	**C**	**Si**	**Cr**	**Mo**	**Ni**	**Cu**	
18CrNiMo7-6	1.6587	0.15 /0.21	≤0.40	1.50 /1.80	0.25 /0.35	1.40 /1.70	-	
ADI		3.5 /3.7	1.9 /2.3		0.15 /0.30	0.6 /2.5	0.6 /1.0	
S690QL	1.8928	0.02 max	0.80 max	1.50 max	0.70 max	2.0 max	0.50 max	690
S890QL	1.8983							890
S960QL	1.8933							960

The potential of offshore wind

The global offshore wind market is set to expand significantly over the next two decades according to a recent report from the International Energy Agency. The IEA projects capacity to increase fifteen-fold to 2040, driven by supportive government policies as well as technological progress in larger turbines and floating foundations. Offshore wind has the potential to generate more than 420,000 TWh per year worldwide. This is more than 18 times global electricity demand today. And nickel will be essential for performance in such highly corrosive maritime environments. www.iea.org/offshorewind2019/

ASK AN EXPERT
FAQ FROM THE NICKEL INSTITUTE TECHNICAL ADVICE LINE

Geir Moe P.Eng. is the Technical Inquiry Service Coordinator at the Nickel Institute. Along with other material specialists situated around the world, Geir helps end-users and specifiers of nickel-containing materials seeking technical support. The team is on hand to provide technical advice free of charge on a wide range of applications such as stainless steel, nickel alloys and nickel plating to enable nickel to be used with confidence.

Q: What does pickling and passivation of stainless steel mean?

A: A stainless steel surface in contact with oxygen (whether in air or in an aqueous solution) will spontaneously form a corrosion-resistant passive (protective) layer. Optimum corrosion resistance is achieved with a clean surface free of surface contaminants such as 'free iron' or rust (from contact with unalloyed steel), surface deposits, and heat tint from welding with the underlying chromium-depleted layer. If it is not clean, it will not form a proper passive layer.

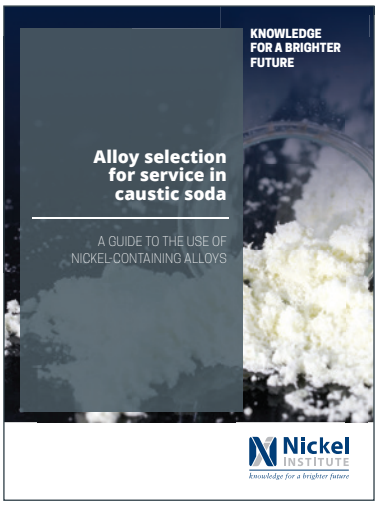
Pickling is an aggressive chemical cleaning with an acidic solution, typically a suitable nitric-hydrofluoric solution which is corrosive to stainless steel. This acid will remove the surface contaminants noted above as well as a very thin layer of stainless steel, including the chromium-depleted layer. After pickling the surface is rinsed with water and the clean surface spontaneously passivates.

Passivation is a chemical cleaning performed with a solution that is not corrosive to stainless steel but will remove surface free iron which hinders the formation of the passive oxide layer. Acids such as nitric, citric and phosphoric will do that as well as highly oxidising solutions such as hydrogen peroxide. Oxidising chemicals will also thicken the existing passive oxide layer, which increases the corrosion resistance slightly, although the main improvement comes from removing the surface free iron. Passivation chemicals are not strong enough to remove heat tint or the chromium-depleted layer. After the passivation treatment, the surface is rinsed with water and is then ready to be put into service.

Visit: inquiries.nickelinstitute.org Ni

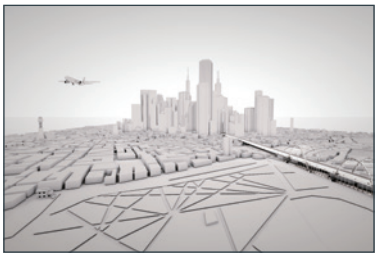
NEW PUBLICATION

Alloy selection for service in caustic soda (10019) reviews the corrosive effect of caustic soda (i.e. sodium hydroxide) at all concentrations. It discusses the corrosion behaviour of various alloys in caustic soda, alloys used in caustic production and for specific equipment as well as alloys used in various processes using caustic soda. Caustic soda is used in such industries as pulp and paper, alumina refining and as a cleaning agent. This fully revised technical publication from the Nickel Institute provides a useful guide for materials engineers. *Available to download free from www.nickelinstitute.org*



NICKEL – THE VIDEO

The Nickel Institute has produced a short video to introduce nickel to the uninitiated. "We know that many visitors to our website want to know basic information about nickel," says the video's producer Isaline de Baré, Communications Specialist at the Nickel Institute. "So, in around two minutes, we have explained what nickel is, where it comes from, its properties as well as some of the wonderful things it can do." And for those who are curious to learn more, the Nickel Institute's website contains a wealth of in-depth information. *The video is available on the Nickel Institute's YouTube channel and the Nickel Institute website.*



UNS DETAILS

Chemical compositions (% by weight) of the alloys and stainless steels mentioned in this issue of *Nickel*.

UNS	Al	C	Co	Cr	Cu	Fe	Mn	Mo	N	Ni	P	S	Si	W	V
N06059 p. 8	0.1-0.4	0.01 max.	0.30 max.	22.0-24.0	0.05 max.	1.5 max.	0.5 max.	15.0-16.5	-	bal.	0.015 max.	0.010 max.	0.10 max.	-	-
N08031 p. 8	-	0.015 max.	-	26.0-28.0	1.0-1.4	bal.	2.0 max.	6.0-7.0	0.15-0.25	30.0-32.0	0.020 max.	0.010 max.	0.3 max.	-	-
N10276 p. 8	-	0.02 max.	2.5 max.	14.5-16.5	-	4.0-7.0	1.0 max.	15.0-17.0	-	bal.	0.04 max.	0.030 max.	0.08 max.	3.0-4.5	0.35 max.
S30400 p. 2	-	0.08 max.	-	18.0-20.0	-	bal.	2.00 max.	-	-	8.0-10.5	0.045 max.	0.030 max.	1.00 max.	-	-
S31600 p. 5, 16	-	0.08 max.	-	16.0-18.0	-	bal.	2.00 max.	2.00-3.00	-	10.0-14.0	0.045 max.	0.030 max.	1.00 max.	-	-

VIRGINIA KING

Dimensions:
3.4m tall x 1.2m wide

Materials:
2.5mm marine grade Type 316 (UNS S31600)stainless steel. Hands and face were cast using recycled 316 stainless steel drop-outs.

WOMAN OF WORDS

Katherine Mansfield is one of Wellington and New Zealand's most internationally recognised literary figures. Her life and work have been commemorated by New Zealand sculptor, Virginia King. Mansfield's ambition was to be seen "first as a writer and then as a woman". Virginia's sculpture captures the essence of Katherine while celebrating her literary work.

The three metre tall stainless steel figure is laser cut with words and phrases from Mansfield's writing, such as "*This is not a letter but my arms around you for a brief moment*" etched on her outstretched right arm and "*Regret is an appalling waste of energy*". Mansfield's hair is a series of laser cut shopping lists found in her 1922 journal.

One of the challenges was to create the look of movement and soft folds of fabric using sheets of stainless steel. The etched rolling panels echo the landscape which Katherine wrote so passionately about. During the day she reflects the colour and beauty of her surroundings while at night she becomes an illuminated lantern lit from within.

The statue has been erected in Midland Park on Lambton Quay in Wellington. The project is a partnership between the Wellington Sculpture Trust, the Katherine Mansfield Society, and the Wellington City Council. Ni