NICKEL

THE MAGAZINE DEVOTED TO NICKEL AND ITS APPLICATIONS

China's Poly Plaza
Holding up the Curtain

Safety in Bridges
Shape Memory Alloys

The Thames Barrier
and Superduplex

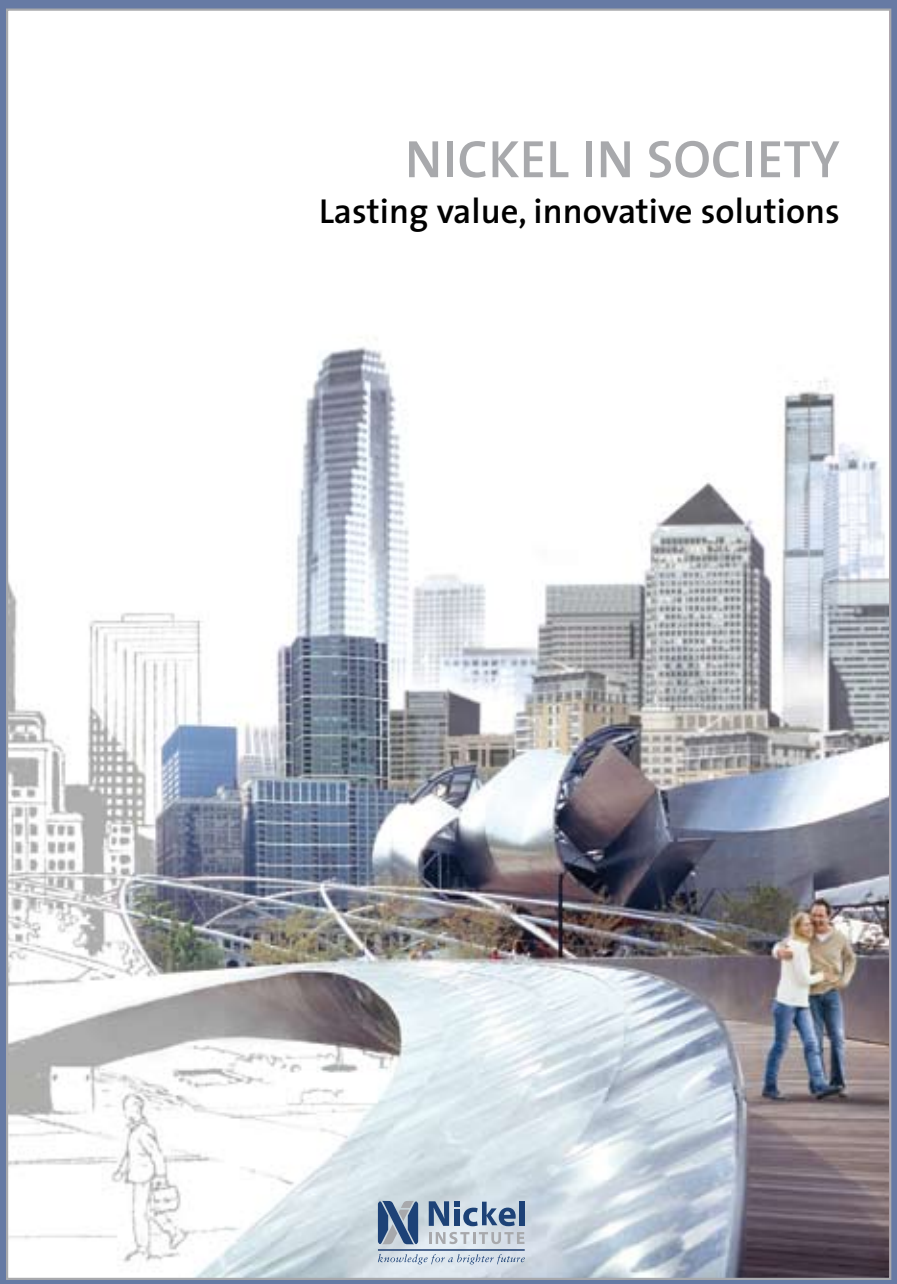
December 2009 Vol. 24, N°. 3

a tale of two nickel economies

NICKEL IN SOCIETY

A NEW PUBLICATION FROM THE NICKEL INSTITUTE

"As an organisation representing industry, it is our responsibility to offer the best information so that society can ultimately make the best decisions"



Today we care more about sustainability and yet we seem to know less about the materials that contribute to a sustainable future.

Making sustainable choices should be easy. The Nickel Institute's new publication, ***Nickel in Society***, highlights the most important applications of nickel, and explores how these applications contribute to innovation and sustainability in our daily lives.

Living Comfortably

Eating And Drinking

Staying Healthy

Communicating

Moving Around

Driving Industry

Enabling Clean Energy

Promoting Sustainable Development

Nickel in Society provides politicians, regulators, journalists and the general public with the necessary information to make informed choices – whether it is a green procurement decision, a specification for a construction project, or shopping for your family.

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NICKEL

The Magazine Devoted to Nickel and its Applications

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THE RIPPLE EFFECT

NICKEL MAGAZINE'S MANDATE IS TECHNICAL AND, BY EXTENSION, ECONOMIC. IT EXAMINES HOW THE ATTRIBUTES OF NICKEL-CONTAINING MATERIALS OFFER TOUGHNESS, DURABILITY, CORROSION RESISTANCE, CATALYTIC ACTIVITY, AND A HOST OF OTHER ATTRIBUTES TO PROCESSES AND PRODUCTS.

In addition, anyone who has read Nickel during the past ten years is aware that those attributes, largely prized for their engineering and economic performance, are also supportive of the environment. The choice of a nickel-containing material almost inevitably means that less material will be used. In addition, thanks to nickel's enduring value, the product or structure will last longer, less energy will be required while in use, and the recovery of material at end-of-life will be high.

However, the judgment of society depends on more than just economic and environmental contributions, vital as those are. Quality of life is also a measure of sustainability. Employment, occupational and community health, infrastructure – these and other social aspects need to be given due consideration.

The central story in this issue of *Nickel* reminds us of that social leg of the sustainability stool. What it reveals is just how wide the effect of nickel use is. Whether a country is also a producer or only a user of nickel, the ripples of economic and social benefits are strong. The research findings highlighted in the story provide a benchmark for understanding the consequences of regulatory decisions that will affect the future pattern of nickel use and applications.

Another highlight is our report on the use of nickel stainless steel in China's spectacular Poly Plaza. While prompted by traditional engineering considerations, the project is also a classic example of how environmental and social aspects are so often enhanced by the use of nickel-containing materials. Other articles provide information about nickel's many benefits (although, even for us, phosphorescence in nickel coatings was something new).

Stephanie Dunn
Editor, Nickel Magazine

The Stainless Alternative in Public Pools

Vichy Water Sports Centre makes a big splash

Indoor pools are topped with a dome of blue-tinted transparent panels that allows sunlight to reflect onto the submerged metal surfaces below

Easily maintained Olympic-size exterior pool

Municipal governments in France are turning to stainless steel as the material of choice for public swimming pools when both building new aquatic centres and refurbishing existing ones.

The country's first recreation complex to feature only stainless steel pools, the €22.5-million Vichy Water Sports Centre in Bellerive-sur-Allier, opened in January 2008. Its Olympic-size outdoor pool and indoor wading and amusement pools provide a combined 2,150 square metres of water surface and are crafted from some 65 tonnes of corrosion-resistant 316 (S31600) stainless steel.

The metal has been used for pools for more than four decades since the first were built in Austria, and today's stainless steel pools have a life expectancy of more than 75 years. Thousands are in service worldwide, providing a cost-effective and long-lasting alternative to traditional tile-lined concrete pools. ArcelorMittal of France supplied the steel used in the Vichy Centre, which was built by the French subsidiary of the Austrian firm HSB (Hinke Schwimmbad) Österreich GmbH.

Pool walls and bottom surfaces are constructed of prefabricated panels between 1.5 and 5 millimetres thick, depending on the strength required, and welded together on-site to make them watertight. The metal is strong enough to be self-supporting for pools up to 2.2 metres deep. For deeper pools, concrete footings clad in stainless panels provide additional stability. For the refurbishing of older pools, panels can be installed over the existing lining or used to replace an existing tile surface.

Steel-formed pools are lighter than concrete and flexible enough to withstand slight settling of the ground below, making them a good choice for areas of seismic activity or where the surrounding soil or rock strata is weak.

Stainless steel also offers advantages when it comes to safety, hygiene and maintenance. The smooth surface is easy to clean and does not contain crevices for bacteria to establish and grow. Welds are ground smooth and corners can be rounded to remove rough patches and sharp edges that might injure a swimmer. Embossing of stair treads and other surfaces where users walk reduces the risk of slipping. Pools operated in France must be emptied and thoroughly cleaned twice a year, but the ease of cleaning stainless pools means this operation can be performed faster with less downtime.

> "Stainless steel offers flexibility in the design and appearance of pools and their enclosures. The metal can be readily formed into elegant curves to create pools with distinctive shapes."

French law restricts the chloride content of pool water to 250 milligrams per litre. The 316 grade, with its 2.0-per-cent minimum molybdenum content, has the corrosion resistance needed to meet that standard and can handle higher-than-normal concentrations that occur as chemicals are mixed or water temperature increases.

Stainless steel offers flexibility in the design and appearance of pools and their enclosures. The metal can be readily formed into elegant curves to create pools with distinctive shapes. Jacques Rougerie, the Paris-based firm specializing in marine architecture that designed the Vichy Centre, topped the indoor pools with a dome of blue-tinted transparent panels that allows sunlight to reflect on to the submerged metal surfaces below.

Spokesperson Ariel Fuchs says Rougerie is using stainless steel pools in three other projects in France, including a 5,800-square-metre aquatic centre under construction in the Paris suburb of Montmorency and the Caudry Aquatic Centre, a 3,500-square-metre facility scheduled to open in northern France in 2012. Ni

PHOTOS: JACQUES ROUGERIE ARCHITECTE

Tall Tree and the Eye

PHOTO: GLOBAL STAINLESS, STUART LUMSDEN

Mirror polishing in progress

Anish Kapoor's stainless steel sculpture *Tall Tree and the Eye*, now on display in London's Royal Academy of Arts, is fast becoming one of the most photographed and talked-about installations in the U.K., following on from two other of his stainless steel sculptures, *Cloud Gate* in Chicago and *Sky Mirror* in the Rockefeller Centre in New York.

PHOTO: CHERRY PARK

Tall Tree is part of a larger exhibit of Kapoor's work, though it takes pride of place, towering over the classical Palladian buildings surrounding the Annenberg Courtyard at the front and reflecting them in the convex surfaces of each of the structure's gleaming stainless steel spheres. The sculpture engages everyone who sees it. Indeed, no visitor enters the exhibition without first stopping, looking up and marvelling at the myriad, endless, shifting and disorientating reflected images of the splendid buildings (and of themselves with their cameras).

Tall Tree and the Eye, which has been likened both to the weightless bubbles in a bottle of champagne and the structure of DNA, stands more than 14 metres high and consists of 73 spheres, each of which weighs 45 kg and measures 1000 millimetres in diameter. The spheres are made of type 316 (S31600) nickel-containing stainless steel, manufactured and mirror-polished by Global Stainless Ltd. of Hawera, New Zealand. The company, which specialises in double-curve forming stainless, won the commission over competing sphere manufacturers worldwide.

"The choice of nickel austenitic

cont'd on page 15

Cebu Temple

A bracket system designed for longevity

A recently built temple in the Philippine city of Cebu should last a minimum of 100 years, thanks to a novel structural bracket system consisting of nickel-containing stainless steel.

Most anchor bracket systems are made from galvanized steel and last only about 50 years in the hot, humid Philippine coastal environment. However, the Church of Jesus Christ of Latter-day Saints wanted the Cebu Philippines Temple to stand at least 100 years, without concern that the external white granite slabs would fall down because of corrosion to the support brackets. For this reason, brackets fabricated from Type 304 (S30400) and Type 316 (S31600) stainless steel were used.

Nickel-containing stainless steels are as strong as galvanized steel, and their mechanical properties are structurally suited to the anchoring system used at the temple. There is an economic advantage as well: the stainless steel anchors will cost less over the temple's lifespan than if galvanized steel were used.

The temple designers are confident the steel anchor brackets will not corrode and cause cladding panels to fall. Corroding steel anchors could also create unsightly staining on the white stone cladding whereas the stainless steel anchors will not.

The Type 304 structural brackets and fixings are hidden behind the granite cladding in a cavity where corrosion could develop on steel brackets. Type 316 stainless steel, which resists corrosion even better

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PHOTOS: NZ STRONG CONSTRUCTION

Detail photos of the Cebu Temple bracket system

PHOTOS: ISTOCKPHOTO © RAY ROPER, © RUDI TAPPER

A tale of two nickel economies:

Australia and Germany

understanding the different roles of nickel

There's more to nickel than meets the eye of the engineer, architect, chemist or regulator. All who either directly or indirectly earn their living through nickel need to know more about the metal that contributes in so many ways to the productivity and sustainability of society.

Because nickel is so rarely visible to the general public, few are aware of the economic and social dimensions of nickel. For this reason, the Nickel Institute commissioned socio-economic research to better understand where nickel goes and what happens – in terms of quality of life, employment and wealth generation. A new Nickel Institute publication, ***Nickel in Society: lasting value, innovative solutions*** (see page 2 for additional information) focuses on the contributions to the quality of life. This article considers the economic perspective and looks at just two of the countries examined: Australia and Germany were selected because of the contrasting roles played by nickel in their economies.

Australia and Germany

Germany mines no nickel and is poor in natural resources. Its economy is based instead on heavy industry and value-added technical exports. The Australian economy also functions at a high technical level yet relies heavily on the production and exportation of natural resources such as nickel. Australia's nickel reserves may be overshadowed by iron ore and coal, yet the country remains the world's third- or fourth (depending on the year) largest producer of nickel. It also has enormous reserves.

The two economies complement each other. Australia produces 12% of the world's nickel while Germany accounts for 9% of nickel use.

Global Rankings	Australia	Germany
Primary nickel production	3rd (12%)	nil
Nickel use	24th (0.12%)	4th (9%)
Reserves %	19%	nil

Employment

Not surprisingly, there are differences in how nickel contributes to the socio-economic well-being of the two countries. More surprising is the extent to which nickel in its various forms is important to the economy of Germany, a country that has no nickel resource and therefore no nickel mining.

	Employment Total direct + *(indirect)**	
Industry Segment	**Australia**	**Germany**
Mining/smelting/ refining/Recycling	29,929	2000 + *(1000)*
Further processing/ manufacturing	15,460	118,000 + *(46,000)*
Total Direct	45,389	120,000
Total Direct and Indirect	45,389	167,000

**The support and supply employment generated by the existence of the nickel-dependent direct employment.*

Australia is known as a mining country and that the nickel industry employs 30,000 comes as no surprise. But even in Germany, where nickel has a comparatively low profile, the metal has a profound effect on people's lives. If nickel were to become unavailable for reasons of supply or regulatory prohibition, it would not, at first, be seen as a serious development. That attitude would change when the employment directly dependent on nickel – jobs related to products and processes that could not continue without nickel – became evident.

Revenue

Many of the processes and products featured in Nickel magazine are engineered and manufactured in Germany. Turbo-chargers; aero, industrial and marine turbines; process plant equipment for food production; oil and gas production; and chemical refining – all require nickel either to perform well or perform at all.

Germany is also known for its production of nickel-containing materials (alloy steels, stainless steels, castings, nickel alloys) that go into these highly engineered, high value-added products. The revenue associated with their production and use exceeds €11 billion

Revenue Generated	**Australia 2006**	**Germany 2007**
Mining/smelting/ refining/Recycling	A$9.3 billion Salaries: A$1.85 billion	€1.5 billion (mainly recycling)
Further processing/ manufacturing	A$3.9 billion Salaries: A$660 million	€9.7 billion
Total	**A$13.1 billion Salaries: A$2.5 billion**	**€11.2 billion**

(January 2007: 1 Euro = approximately A$1.60)

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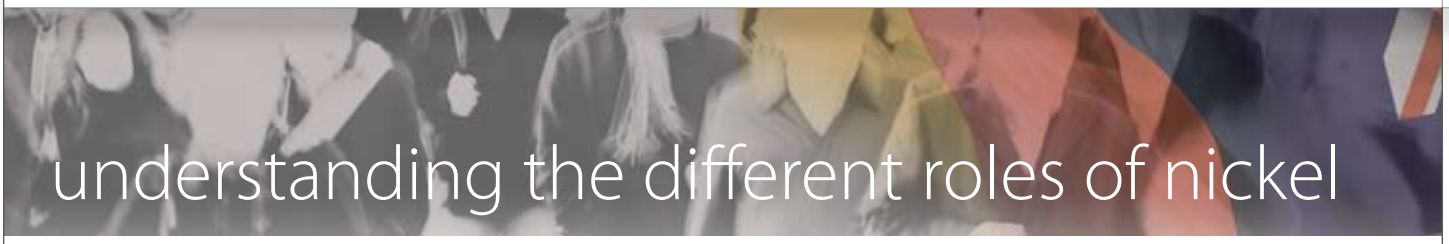
PHOTO ILLUSTRATION: CONSTRUCTIVE COMMUNICATIONS PHOTOS: ISTOCKPHOTO © RENE MANSI, NAPHTALINA, GONZALOMEDIN



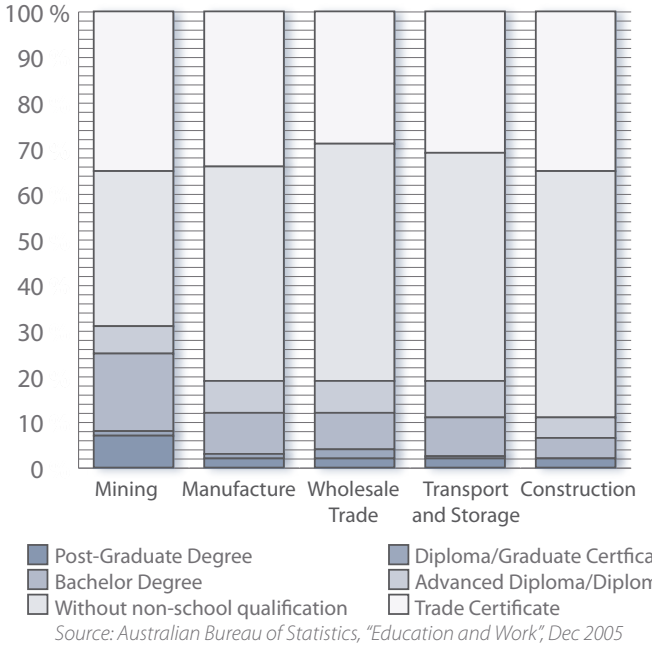
understanding the different roles of nickel

cont'd from page 7

Quality of life

But numbers tell only part of the story. The public's perception of metal production, from mining to refining, is not always entirely favourable, yet the research suggests that work in the sector is well-compensated and that workers are better-educated than they are in other major industries.

The trend was noted in all the studies, including Germany, but the data is best from Australia. In 2006, the average salary in Australia's nickel mining sector was A$80,000, compared with the national average of A$42,000. Approximately 30% of the country's workforce in mining and metal processing had graduate or post-graduate degrees. That compares favourably with manufacturing (20%), wholesale trade (20%), transport and storage (21%), and construction (11%).



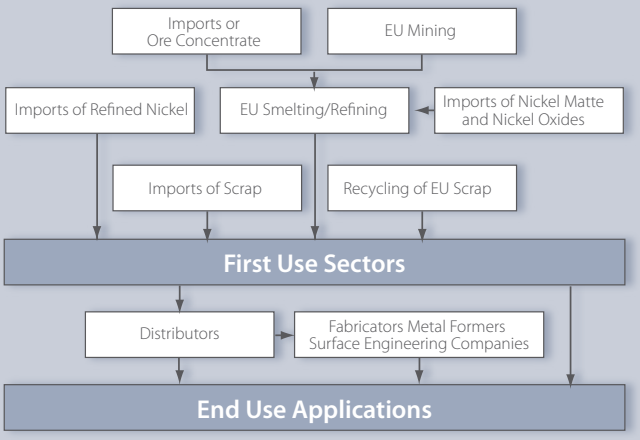
Source: Australian Bureau of Statistics, "Education and Work", Dec 2005

Complexity

The economies of Australia and Germany differ greatly in terms of nickel production and use. Other countries not reported on here show variations between their extremes. The constant, however, is that nickel is necessary and associated with high-value skilled employment and products and processes. Just as often, those processes are integral to the aspirations of society for a more sustainable future.

There are consequences to this ubiquity. It means there are exposures to nickel, especially in occupational settings, that have to be considered and science is providing data that allow the hazards to be clearly defined.

It is in the development of standards protective of workers and environments that all these metrics come together – scientific, social and economic – and we now have a much clearer picture of the contributions made by nickel and nickel-containing materials. Ni



The Nickel Value Chain

Nickel magazine focuses on the end of the value chain, which is just the end of a long series of industrial processes that liberate nickel from ore and bring it into forms (metals, powders, chemicals) that allow its qualities to be mobilized for thousands of different ways. A balanced evaluation of the value of nickel to society will take into account employment, the tax base, investment and development, as well as the impacts associated with its lifecycle.

PHOTOS: ISTOCK PHOTO © MIKE BENTLEY

Shape memory alloys for bridges

Bridges in earthquake-prone regions may one day benefit from the super-elastic qualities of shape memory alloys (SMAs) made of nickel and titanium.

Severe damage in conventional steel and concrete column end

Minor damage in SMA/fibre concrete end

PHOTOS SUPPLIED BY: M. SAID SAIID, UNIVERSITY OF NEVADA

New research from the University of Nevada in Reno suggests that by integrating SMAs into bridge columns, civil engineers can reduce the damage to bridges caused by earthquakes while increasing the capital cost of the bridge by only about 4%.

"During earthquakes, bridges swing back and forth and, in many cases, end up having a permanent side-sway with the whole bridge tilted to one side," says Saiid Saiidi, professor of civil and environmental engineering at the university. "When that happens, we have to close the bridge to traffic and often tear it down."

In trying to devise ways to prevent such damage, which is costly and potentially life-threatening when emergency vehicles are forced to find alternative routes after a quake, Saiidi considered the super-elasticity of SMAs. The nickel (55%) and titanium (45%) alloy, also known as Nitinol™ (UNS N01555), has long been valued in aerospace, medicine and dentistry for their ability to behave like rubber bands, snapping back into shape after being distorted by pulling or twisting.

In their fully equipped laboratory specifically designed to test bridges during earthquakes, Saiidi and his team built a 33-metre-long model bridge that used SMAs in place of steel in the longitudinal bars within the bridge columns. Since the alloys are expensive, Saiidi restricted their use to the sections of the column that were most likely to fail, while regular steel was used elsewhere.

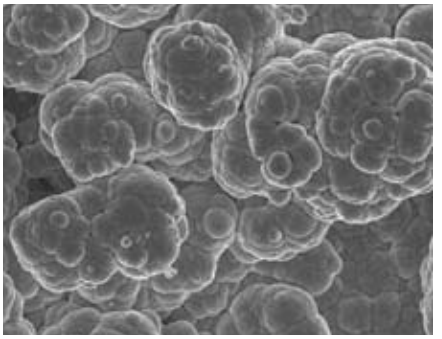
By experimenting with different quantities and placements of SMAs and replicating earthquakes using a shake table, Saiidi determined the optimal use of SMAs in the model bridge *cont'd on page 15*

Close up of SMA bars connected to steel bars

Illuminating wear with composite electroless nickel coatings

A new type of electroless nickel coating, that can be made to glow in the dark, is finding a market among manufacturers who need to know when a coating is wearing off, either to prevent damage to the underlying part or to ensure consistency of the resulting product.

Surface Technology Inc., a New Jersey based company that makes electroless nickel products began creating phosphorescent coatings in response to demand from a customer in the textile industry who wanted to protect an expensive component.



Nodular Structure of Electroless Nickel/ Phosphorus Coating on Magnesium Alloy AZ31

"Our customer had an intricate part that was being coated with our composite diamond coating," says President Michael Feldstein. "They wanted to be able to determine when the coating had worn off so that they could replace it and prevent damage to the base metal piece underneath."

Developed in the 1940s, electroless nickel coatings now come in a variety of composite forms to suit specific conditions, from high temperature environments to applications that require lower friction or corrosion resistance. The most common material incorporated into composites is diamond because of its unsurpassed ability to resist wear.

Surface Technology's composite phosphorescent coatings have all the inherent features of electroless nickel and are indistinguishable under normal lighting, but they emit a constant glow when exposed to UV light. The phosphorescence can either be integrated directly into the functional coating or serve as a stand-alone "indicator layer" underneath the functional layer.

The latter application is particularly useful in moulding applications where the shape and volume of the mould *cont'd on page 15*

IMAGE COURTESY OF KHALID M. SHARTAL, PROCESS ENGINEERING AND APPLIED SCIENCE, DALHOUSIE UNIVERSITY, WITH THE COLLABORATION OF MS. PATRICIA SCALLION.

HOLDING UP THE CURTAIN

China Poly building's stainless steel cable-net wall

Few outside China are aware of China Poly, a state-owned organization with diverse responsibilities in the defence trade, real estate, cultural industries and, most recently, mineral exploration. The innovative architecture of its new Beijing headquarters, however, is attracting international attention and awards, thanks in part to a combination of the high strength and corrosion resistance of nickel-containing stainless steels.

In addition to the company's headquarters, the 100,000-square-metre building houses office space, retail shops, restaurants, and the Poly Museum. Designed by Skidmore Owings & Merrill (SOM) with a mandate to establish a civic presence that would be reminiscent of Rockefeller Center in New York City, it's a simple, monolithic triangle with two distinct cable-net walls facing south (50 metres tall) and northeast (90 metres tall). The north-eastern cable-net wall is one of the largest in the world.

△ *Clamp Detail . Clamp in use.* ▷

Engineered safety

A conventional design using large trusses would have obstructed the view of the city. Instead, the wall is supported by an innovative V-cable counter-weighted by a suspended museum space using a specially designed pulley mechanism.

The relationship established between the wall and the floating museum is calculated to compensate for movement during a seismic event, while the glass and stainless steel wall can withstand 100-year winds and deflect up to ± 0.9 metres under maximum wind load.

Cables and castings

The relationship established between the wall and the floating museum is calculated to compensate for movement during a seismic event

The cable-net walls are supported by 26-millimetre diameter vertical and 34-millimetre diameter horizontal cables made of type 316 (S31600) stainless steel, while the cable net intersection points are connected with high-strength clamp fittings made of duplex 2205 (S32205) stainless. The rods between the main cable and the cable net are type 316 stainless steel. The support armature is cast from the high-strength duplex alloy CD3MN (J92205 - the cast version of duplex 2205 stainless steel) with a glass-bead blast finish. The exterior plate of this armature is slotted onto the interior plate and bolted through the glass-to-glass joint.

Stainless steel was selected because of its high strength and corrosion resistance. Beijing has a corrosive environment with high levels of industrial pollution and there has been a significant rise in the use of de-icing salt in the winter. Specification of corrosion-resistant stainless steels made it possible to avoid high-maintenance coatings and the bare stainless steel is a sculptural, structural design element.

Early design calculations indicated that large deflections would occur during high-wind loads due to the movement of the cables and glass. SOM addressed this problem with a hinged stainless steel glass support channel that allows free rotation of up to seven degrees without applying stress to the glass. The hinged channel is connected back to the cable net and held off the diagonal bridge cables by high-strength duplex 2205 stainless steel rods, which are allowed to rotate in their assembly.

▽ *Hub Detail . Hub in use.* ▷

Enduring contributions

The new Poly Plaza is only one of many developments that are changing the face of Beijing. Nickel-containing materials are found in all of them, making buildings safer, more efficient, and durable. Few of them will be more visually impressive than Poly Plaza. Ni

PHOTOS: CARSTEN VOECKER

DETAIL PHOTOS: NICOLE KINSMAN, INTERNATIONAL MOLYBDENUM ASSOCIATION EXTERIOR PHOTO: CATHERINE HOUSKA, TMR CONSULTING

PHOTO: ISTOCKPHOTO © RUI SARAIVA

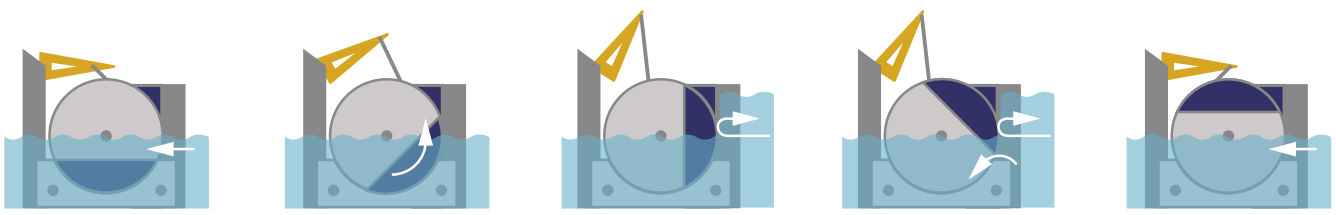
Thames Barrier maintained with **Superduplex**

In 1953, 307 people died in flooding along the North Sea coast of the United Kingdom, a coast that includes the Thames River and London. The Thames Barrier was part of the response to the flood threat from high tides and storm surges. It is an important piece of civil infrastructure and when an emerging corrosion issue needed to be addressed, a nickel-containing (7%) superduplex stainless steel (UNS S32760) was the material of choice.

The Barrier

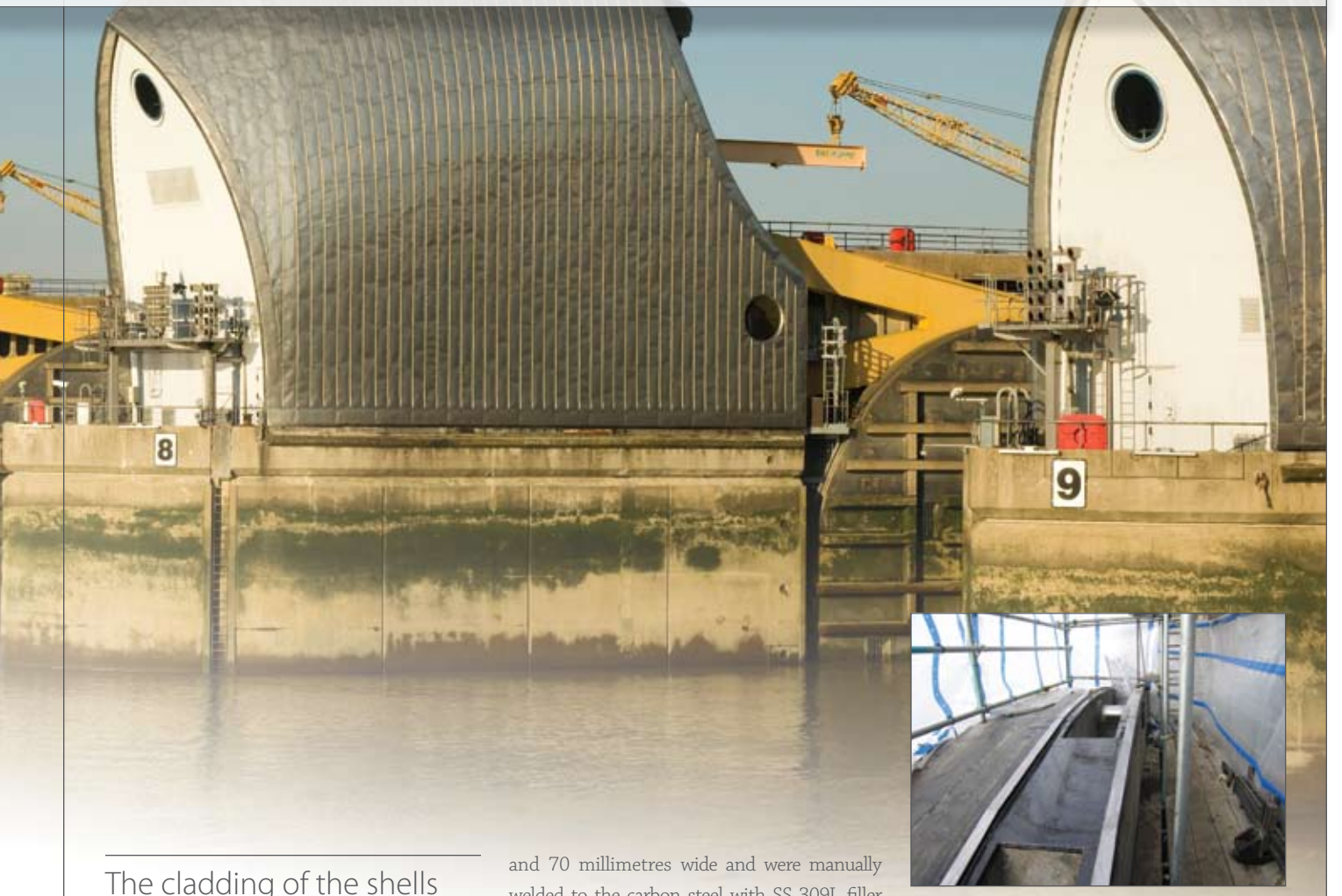
The Thames Barrier was first operational in 1982 and officially opened by Queen Elizabeth II in 1984. Built across a 523 metre wide stretch of the river, the barrier divides the river into four 60 metre and two 33 metre navigable spans, and four smaller non-navigable channels between nine concrete piers and two abutments. The flood gates across the openings are circular segments in cross section, and they operate by rotating, rather than by an up-and-down motion. When rotated to allow "underspill", operators control upstream levels. They are rotated 180 degrees to allow access for maintenance. The gates fill with water when submerged and empty as they emerge from the river. The four large central gates are 67 metres long, 10 metres high (above local ground level) and weigh 3,500 tonnes; the outer two gates are 30 metres.

The barrier is raised by hydraulics which involve trunnions (pins or pivots) running along a pair of tracks fastened around the sides of the barrier. The purpose of the tracks is to keep the barriers aligned and to enable them to roll freely. When the barrier is down, the tracks are underwater. The barrier has been used to resist high tides and flood surges more than 100 times since it began operation. In addition, each gate is tested monthly. The tracks were originally carbon steel with a coating, but over 25 years,



gate in normal lowered position | gate rising | gate in flood defence position | gate in underspill position | gate in maintenance position

DIAGRAM REFERENCE: ENVIRONMENTAL AGENCY OF THE UNITED KINGDOM



Finished rails after painting of carbon steel

Rusted steel tracks with frame to hold milling machine

The gate up showing the arm on its tracks

PHOTOS: R.A MATERIALS

The cladding of the shells that house the mechanisms is standard nickel-containing stainless steel type 316 with a 2B mill fiinsh

the estuarine water combined with the rolling of the wheels had removed the coating and opened the tracks to rolling contact corrosion.

The Solution

A plan was formulated to replace the carbon steel tracks with Zeron® 100 superduplex stainless steel, (UNS S32760) supplied by Manchester, U.K.-based RA Materials. The selection was based on its high corrosion resistance in seawater and its resistance to wear.

The old tracks were machined away using a milling machine fastened to a special jib between the tracks. The new tracks, cut from superduplex plate, are 30 millimetres thick and 70 millimetres wide and were manually welded to the carbon steel with SS 309L filler wire ER309L (W30983). This is a commonly used filler metal for joining corrosion-resistant alloys to carbon steel.

After welding, the carbon steel around the tracks was cleaned and re-painted with a marine-grade epoxy paint to help it resist corrosion when immersed. The tracks included a raised section, which is an actuator cam. A replacement piece was machined for each of these and welded into place after milling away the old one.

In 2004 one Barrier gate had its track replaced with Zeron® 100. The repair went well and the experience gained in this pilot repair led to a 3-year program to refurbish the other gates. The barrier is expected to prevent London from flooding at least until 2080 after which a combination of geological (Southern Britain is sinking by about 30 centimetres per century) and climatic developments (rising sea levels) will require additional defensive measures. Ni

In Memory *Bill Molloy*

Bill Molloy: A passionate advocate, a staunch colleague, a loyal friend 1940–2009

Bill Molloy, retired Vice President of the Nickel Institute, died on September 11, 2009 at his home in Bedfordshire of a rare and radical cancer.

Bill's association with the Nickel Institute began in early 1988 when he joined what was then the Nickel Development Institute (NiDI) and took on responsibility for its European program base, later adding India, South Africa and the Middle East to his responsibilities. Bill promptly proved himself a sound administrator, planner and organizer who quickly earned the respect of his partners at NiDI.

Bill never hesitated to express his opinion on a business matter even though he might be in the minority. At the same time, he always provided very sound input, particularly on a difficult or contentious issue, while demonstrating the utmost respect for both fellow employees and external contacts. Colleagues will remember Bill's contribution to the international success of the Institute. We will also remember his wit, humour, and song – not only entertaining and good fun, but often the leaven of a tough day. Those who were able to remain in touch with him during his struggle with cancer will remember his positive and optimistic spirit, his sensitivity to the needs of others, and his steady courage as he approached the last days of his life.

His friends and associates will miss him. Ni

Nickel Stainless Steel in the focus of Science & Technology

The Deutsches Museum (German Museum) in Munich, Germany, is the world's largest museum of technology and science, with approximately 1.5 million visitors per year and about 28,000 exhibited objects from 50 fields of science and technology. In November of 2008 a permanent exhibit on stainless steel was opened.

This highly interactive exhibit is part of the museum's metals section and covers a space of 100 square metres. A visit to the exhibit can be likened to a life cycle tour of stainless steel. It begins with a definition of stainless steel, describes its history, manufacture, alloying constituents, finishes and applications, and concludes with a visual reminder as to its recyclability at the end of a components life.

The exhibit on stainless steel at the museum is an initiative of and has been supported by the German Stainless Steel Information Centre (Informationsstelle Edelshtahl Rostfrei). Ni

UNS details

Chemical compositions (in percent by weight) of the nickel-containing alloys and stainless steels mentioned in this issue of Nickel.

Alloy	Al	B	C	Cb	Co	Cr	Cu	Fe	H	Mn	Mo	N	Ni	O	P	Pb	S	Si	Sn	Ti	V	W	Other
S30400 p. 5	-	-	0.08 max	-	-	18.00-20.00	-	-	-	2.00 max	-	-	8.00-10.50		0.045 max	-	0.030 max	1.00 max	-	-	-	-	-
S31600 p.4, 5, 10	-	-	0.08 max	-	-	16.00-18.00	-	-	-	2.00 max	2.00-3.00	-	10.00-14.00		0.045 max	-	0.030 max	1.00 max	-	-	-	-	-
S32205 p.10	-	-	0.030 max	-	-	22.0-23.0	-	-	-	2.00 max	3.00-3.50	0.14-0.20	4.50-6.50		0.030 max	-	0.020 max	1.00 max	-	-	-	-	-
S32760 p. 12, 13	-	-	0.03 max	-	-	24.0-26.0	0.5-1.0	-	-	1.0 max	3.0-4.0	0.2-0.3	6.00-8.00		0.03 max	-	0.01 max	1.00 max	-	-	-	0.5-1.0	
NO1555 p. 9	-	-	0.07 max	0.025 max	0.05 max	0.01 max	0.01 max	0.05 max	0.005 max	-	-	-	54.0-57.0	0.05 max	-	-	-	-	-	rem	-	-	-
J92205 p. 10	-	-	0.03 max	-	-	21.0-23.5	1.00 max	-	-	1.50 max	2.5-3.5	0.10-0.30	4.5-6.5	-	0.04 max	-	0.020 max	1.00 max	-	-	-	-	-

Tall Tree and the Eye

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stainless steels was based on their excellent stretch-forming properties," says Lincoln Raikes, managing director of Global Stainless. "Type 316 was chosen for the spheres in part because of its molybdenum content which gives increased corrosion resistance. The work hardening that occurs in these grades not only aids in their forming, but increases the strength of the formed components. The strength of the 2 millimetre thick sheet in the sphere is considerably higher than what it was initially. However, it does make it very tricky to do any minor changes to them afterwards", he states.

The process used to form the spheres in *Tall Tree and the Eye* is unique in that there is no weld shrinkage in the joining seams, so the spheres can be polished to a high standard. "Mirror polishing will highlight any underlying faults in the fabrication, but our special fabrication process allows us to polish to achieve a virtually perfect shining ball," notes Raikes, adding that the process remains a closely guarded secret. Ni

Cebu Temple

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than 304, was used in the tall window flashings since they are especially vulnerable to the severe marine environment.

Calibre Engineering of Auckland, New Zealand, designed and fabricated the stainless steel bracket system to a high standard, says Michael Green, the firm's design manager. Calibre cut the brackets and fixings to shape with a laser cutter; then, after delivery to Cebu, they were fixed to the granite slabs and attached to the concrete building.

The 100-year minimum lifespan is based on a design assessment using computer technology by Auckland-based Predefine Ltd., Virtual Design Consultants. This assessment indicates that the cladding will be safe even in severe weather.

Anzor Fasteners Ltd., also of Auckland, supplied fasteners made of nickel-containing stainless steel to attach the anchor brackets to the granite panels and to the building structure. In all, 120 tonnes of stainless steel were used in the construction of the anchor brackets, wind load support posts, and window flashings combined. The Type 316 window flashings, some of which are as high as 12 metres, can withstand strong winds.

Safely supported by the uniquely designed and corrosion-resistant nickel-stainless steel bracket anchoring system, the white granite façade on the Cebu Temple will continue to look beautiful well into the next century. Ni

Illuminating wear with composite electroless nickel coatings

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should remain consistent while, slowly and imperceptibly, being worn down with use. When a phosphorescent "indicator layer" underlies the functional coating, an inspector can use a hand-held ultra-violet light to check for wear on a regular basis and save the mould from damage.

"If spots of light come through, that means at least part of the functional coating is worn through and it's time to pull it off and have it stripped and recoated," says Feldstein. "It's all about preserving the base part."

Another potential market for phosphorescent coatings rests with manufacturers who want to ensure authenticity before installing parts in their equipment.

"Some machine shops are able to make a convincing counterfeit part for a proprietary piece of equipment, but they won't have the technology to put on a composite electroless nickel coating with phosphorescent particles," says Feldstein. "If the genuine part is tagged this way, all the operator needs to do is shine an ultra-violet light on the piece to make sure it's authentic and okay to use." Ni

Shape memory alloys for bridges.

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supports to prevent damage. He also modified the surrounding concrete by adding fibre to prevent cracking in the columns.

"The role of SMAs is to bring the column back and the role of the fibre concrete is to minimize damage," he explains.

Saiidi is now in discussions with bridge engineers in California and the state of Washington (two earthquake prone areas) to build a demonstration bridge that would incorporate shape memory alloys. He says that as a result of federal grants to support new technology, what started out as a lab experiment may one day save lives. Ni

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But it's striking, will last a remarkably long time and is wrapped in a durable material that can be molded into nearly any shape imaginable. It's also totally recyclable.

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You can't actually see nickel in high-quality stainless steel, like the kind being used in this Frank Gehry-designed office building. But you'll know the difference when it's there. How? Nickel-containing stainless steel is corrosion resistant, is easily formed and offers a wide range of surface finishes and colours. Also, the integrity of welds is critical—and nothing maintains that integrity better than nickel-containing stainless steel.

What's more, nickel-containing stainless steel is durable, delivering longer life while costing less to maintain. And even though you can't see the nickel, you can certainly see its effects: nickel-containing stainless steel can deliver an eye-catching, brilliant glint and tight, crisp edges that other stainless steels simply can't match. The quality of the materials you choose makes a difference—a striking difference.

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