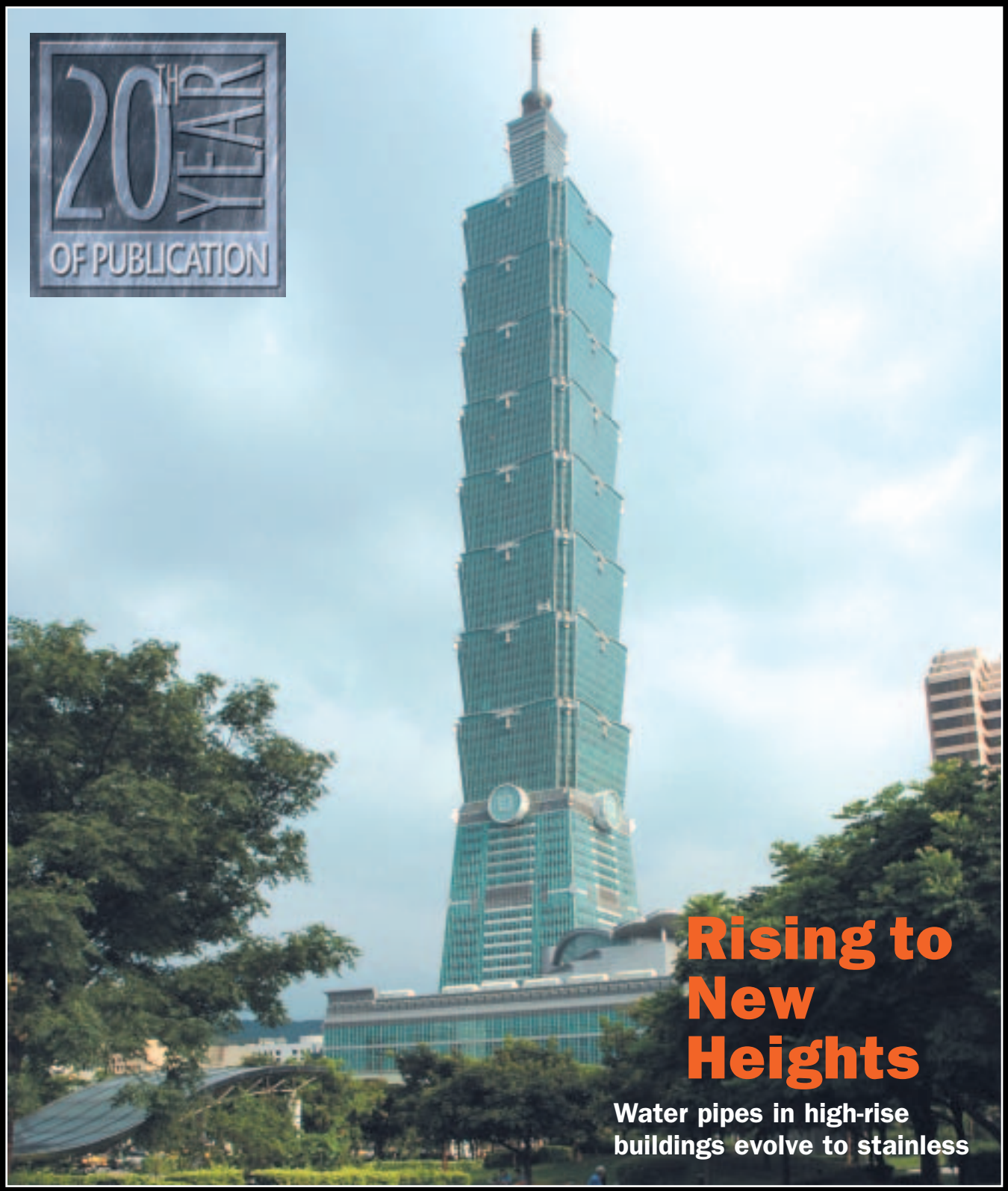
NICKEL

Super austenitic soy sauce tanks

A new catalyst for making hydrogen

MARCH 2005 VOLUME 20, NUMBER 2 THE MAGAZINE DEVOTED TO NICKEL AND ITS APPLICATIONS



Rising to New Heights

Water pipes in high-rise buildings evolve to stainless

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Good Practices:
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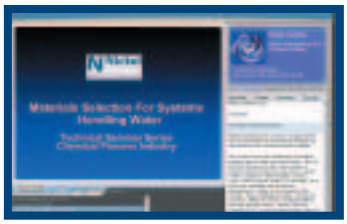
Tips on the storage, cutting, forming, welding and cleaning of austenitic stainless steels.



Corrosion by Water:
www.nickelinstitute.org/waters

An introduction to the challenges of handling various types of water in process plants.

Forms of Stainless Steel Corrosion:
www.nickelinstitute.org/forms

An introduction to selecting, installing and maintaining stainless steels in architectural applications.

Basics of Corrosion:
www.nickelinstitute.org/basics

A broad overview of the challenges facing designers in the chemical process industry.

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knowledge for a brighter future

Creating and Communicating Knowledge to Support the Production, Use and Reuse of Nickel

NICKEL

Volume 20, Number 2, March 2005

The Magazine Devoted to Nickel and its Applications

Nickel is published three times per year by
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ISSN 0829-8351

Printed on recycled paper in Canada.

Cover photo©John Yanhao Chen

The next issue of Nickel Magazine will be published in July 2005.

AUSTRALIAN STAINLESS STEEL DEVELOPMENT ASSOCIATION

A Materials Evolution

ONE OF MY FAVOURITE SCIENCE WRITERS IS STEPHEN JAY GOULD (1941-2002), WHO, besides being a world-renowned paleontologist, was a great communicator.

As a paleontologist, he naturally wrote about the evolution of living species, and in his various books, read by the general public and specialists alike, he stressed that scientific discoveries have profound implications for society and culture.

In this issue of *Nickel Magazine*, we address another significant evolution, albeit one that's taking place in the non-living realm of materials. We refer to the ongoing changes in global design. These changes are evident in two areas that are of particular interest to the Nickel Institute: pipes for distributing potable water, and reinforcing bar used in concrete structures.

THE THEORY OF EVOLUTION suggests that only the most adaptable survive. The same is true in the design world. Using corrosion-resistant, high-strength stainless steel, means potable water distribution systems and reinforced concrete structures will survive for many years.

Increasingly, the materials chosen by engineers for these applications are nickel-containing stainless steels. As you will discover in this issue, engineers in Ireland have decided to use S31600 stainless steel reinforcing bar in several concrete highway bridges over salt-water estuaries, and architectural engineers in Asia have chosen S30400 and S31600 stainless steels for high-pressure water pipes in tall buildings.

Not only are the engineers of new projects choosing corrosion-resistant, high-strength stainless steel, so are the experts responsible for retrofitting existing systems. At the University of Missouri, for example, energy management engineers are using stainless steel to replace carbon steel in that institution's extensive water distribution network. The advantages, in this case, are ease of installation, long operating life, and low maintenance.

The ascendancy of nickel-containing stainless steels has everything to do with durability, recycleability, and life-cycle costing. Note the story on our back cover, which tells of a copper-nickel material that has yet to be embraced by the designers of ocean-going vessels. This material offers the same benefits to marine designers that stainless steel offers building and construction designers. The incredible foresight of Dr. Kenneth W. Coons, who built the *Asperida* in 1967, has provided us with valuable data on the durability and suitability of this material for marine vessels. Not only does it exhibit little metal loss after thirty years in salt water; it provides a smooth surface free of "bio-fouling" (barnacles and such which reduce the energy efficiency of ocean vessels). In other words, the materials evolution we are seeing on land has potential to spread to the world's oceans as well.

Stephen Gould helped us understand that evolution proceeds in relatively short episodes of rapid change followed by long periods of stability, and that only the most adaptable survive. The materials evolution we are witnessing today could well be similar to Gould's biological one. One thing is certain: they both hold profound implications for society and culture.

Patrick Whiteway
Editor

inuse

THE LATEST NICKEL APPLICATIONS WORLDWIDE

Protecting Marine Environments

Ireland uses stainless steel reinforced bridges to span sensitive marine estuary

Think of the time and money to be saved if a bridge spanning a saltwater estuary were to require no maintenance for, say, 120 years. No need to break into the concrete piers to replace rusted rebar, no traffic tie-ups while road crews undertake repairs.

Dublin-based Arup Consulting Engineers not only envisioned such a trouble-free bridge; they designed and built it using stainless steel rebar. The twin spans of the Broadmeadow Bridge in eastern Ireland, part of a motorway that links Dublin and Belfast, opened to traffic in June 2003.

"We had an aggressive environment – salt water, wetting and drying – where future access for maintenance is very, very difficult," says Troy Burton, Arup's associate director and the principal design engineer for the bridge. "We wanted to guarantee a 120-year design life...and we needed to convince our client that we had a durable solution that would cost little money in the future to maintain."

The solution was to use stainless S31600 rebar to reinforce all 16 piers that carry the 313-metre bridges across the estuary.

Using stainless rebar was a first for Arup. "It pretty well ticked all the boxes in terms of a permanent, durable solution," Burton says.

In all, 169 tonnes of stainless were used. Most of it went into the piers, which have circular skeletons fashioned from rebar in diameters of 25, 32 and 40 millimetres (mm) for the upright strands, and 12 and 16 mm for the hoops, or shears. All but the 32-mm rods are stock items, but Arup built in plenty of lead-time, ensuring the larger gauge was available when needed and the bridge was completed ahead of schedule.

THE SIXTEEN PIERS of the Broadmeadow Bridge are reinforced with 169 tonnes of S31600 stainless steel.

Burton says using stainless rebar added less than three per cent to the approximate 12-million-Euros cost of building the bridge – a negligible expense, given the savings in maintenance and repairs over its lifetime. It is difficult to reach the Broadmeadow Bridge's piers without damaging the ecologically sensitive mudflats, making it essential that the structure not require maintenance.

Besides, Burton added, "bridges get forgotten about, and maintenance budgets are a fair way down the list of priorities. You can't guarantee that maintenance is going to happen."

STAINLESS STEEL REBAR was essential to protect areas of the bridge which are vulnerable to corrosion from road salt.

Carbon steel was used in the pilings driven into the riverbed and in other parts of the structure where corrosion was not seen as a problem. An exception is the 16-mm, S31600-grade rebar protruding from the precast parapet sections and the bridge deck. Once connected, a strip of concrete was poured to encase the bars and fuse the components.

Here, stainless is again essential. The edge of the parapet is vulnerable to corrosion from road salt and, once weakened, may fail if a car or truck strikes the side of the bridge.

MORE INFO: www.nickelmagazine.org/rebar

ARUP CONSULTING ENGINEERS

More photos and text are available at the URLs given at the end of each article.

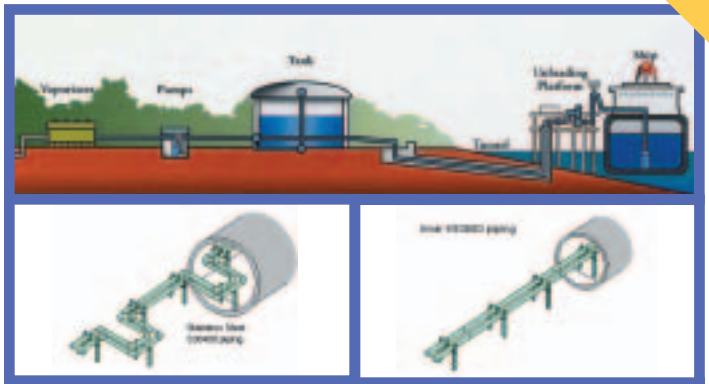
Lowering the cost of LNG Piping

Using a more expensive alloy allows for a lower cost design

A piping system engineered by Osaka Gas, of Japan, for handling liquified natural gas (LNG) has resulted in significant cost savings. The pipe is made of K93600 (an alloy of 36% nickel, the balance being mostly iron), rather than less expensive austenitic stainless steel. However, the system requires fewer metres of pipe and a smaller-diameter underwater tunnel, so the total cost of the system is lower than that of conventional designs.

The K93600 pipe used has an outside diameter of 31.8 centimetres (cm) with a wall thickness of 6 millimetres (mm).The piping is contained in an concrete tunnel 2.4 metres in diameter.

Natural gas, when cooled to minus 199° C, becomes a liquid, which causes the volume to be reduced about 600 times. One benefit of this is that LNG is economical to transport from far-flung sources such as Liberia to markets in Japan or North America, where it is re-gasified for use as regular natural gas. LNG is transported in ocean-going ships, contained in nickel alloy stainless steel S30400 or K93600 tanks. Once delivered to a port, the LNG must be off-loaded into stationary shore storage tanks. This is normally done through underwater or underground pipe-lines from the tanker.



FABRICATING LNG supply lines of stainless steel would require bends (left) to allow them to flex during expansion or contraction. However, using K93600 pipe, no bends are required (right). Therefore the tunnel containing the pipe is significantly smaller.

Owing to the extremely low temperatures involved, the thermal expansion and contraction of the pipeline are major factors in the design and construction of the piping system. Normal LNG piping construction uses S30400 stainless steel with loops or bends to allow it to flex with the expansion or contraction of the pipe when gas flows through it.

The Osaka design permits straight runs of piping because the coefficient of expansion/contraction of K93600 is low over a wide range of temperatures. K93600 contracts at a rate of 0.3 mm per metre of length between 20° C and LNG temperatures compared to 2.8 mm per metre for S30400 stainless. The total length of piping required is less, as the bends or loops needed with stainless steel are not required with K93600.

MORE INFO: www.nickelmagazine.org/lng

OSAKA GAS

Nickel-coated Components Solve Electrical Problem

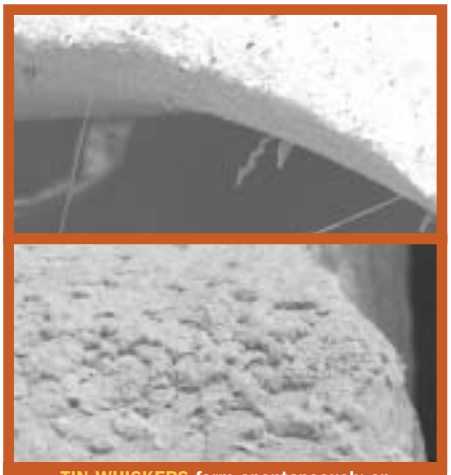
Nickel offers a solution to trimming 'tin whiskers'

Nickel is being used to combat a problem the electronics industry thought it had solved long ago: hair-like strands of metal that can form on soldered surfaces, causing electrical components to fail or short out.

These "tin whiskers," as they are known, have plagued everything from pacemakers to missile guidance systems and caused millions of dollars in damage. They have even disabled the central processors of communications satellites, knocking out television, radio and pager services back on Earth and turning the spacecraft into expensive space junk.

The whiskers can form spontaneously on surfaces coated with tin (as well as cadmium and zinc) under various environmental conditions. They can appear within days or take up to a decade to form.

The traditional solution has been to add lead to the solder, so that typically it is 40% lead and 60% tin. But with the European Union banning lead from electronic components in 2006 and China and other jurisdictions poised to follow suit, the industry is searching for alternatives.



TIN WHISKERS form spontaneously on surfaces coated with tin. One solution is to coat components with nickel.

Agere Systems of Allentown, Pennsylvania, U.S.A., a supplier of integrated circuits for manufacturers of wireless communications devices and computer hard drives, is devising a process to coat the copper leads of electronic components with a thin layer of pure nickel before the solder is applied.

While metallurgists and scientists are still debating what causes tin whiskers, John Osenbach, a consulting member of the company's technical staff, says they appear to be the product of internal stresses that are created as tin bonds with copper.

Agere's solution is to apply a layer of pure nickel, seven-tenths of a micron thick, before copper connections are soldered onto circuit boards. "The nickel is essentially a barrier between the copper and tin," Osenbach says. "It substantially improves the whisker resistance."

An off-the-shelf nickel sulphamate solution is used to coat the copper connections. A thicker layer would provide a better barrier between the tin and copper – "denser is always better," Osenbach says – but the connections often have to be bent after manufacture.

MORE INFO: www.nickelmagazine.org/whiskers

AGERE SYSTEMS

Water Pipes Evolve to Stainless Steel

The use of stainless steel piping for water distribution continues to expand in North America as lower maintenance costs become a top priority

The majority of cost in an underground utility project is associated with excavation," says Mathew Rice, senior staff engineer for the University of Missouri-Columbia's (MU's) Energy Management Department, which has been using S30400 stainless steel in some of its domestic water applications for the past five years. "Not to have to go back and fix pipe joints is a significant life cycle advantage."

The department, which provides an average of 7.6 million litres of water per day to the MU campus as part of an award-winning district energy system, has been gradually replacing some of its ductile iron and polyvinyl-chloride (PVC) pipes with stainless steel since 1999.

"We began by replacing our concrete-lined ductile piping with PVC," says Rice, "but we found that PVC offered limited strength when dealing with water lines in our expanding steam tunnel system."

The water distribution system serves 178 buildings on the campus, including hospitals, athletic complexes and research facilities, through five wells and 34 kilometres of underground piping ranging in size from 3 to 30 centimetres in diameter. Last year MU renovated the piping of one wellhouse built in 1938 using S30400 stainless steel and is planning to renovate another wellhouse in a similar fashion this year.

Rice says the thin-walled (schedule 10 or 20) S30400 stainless steel pipe is easy to use and modify, saves on construction costs, and gives a "food grade" appearance to the wellhouses that instills confidence in water quality among the campus community.

Eliminating the cost of cutting ductile iron pipe to size and installing additional joint restraints cancels out the higher capital cost of stainless steel.

"Due to the recurring challenges with leaks at PVC pipe restraints, it's easy to see how welding a stainless pipe would save future maintenance costs," says Rice.

THE PIPING IN THIS WELLHOUSE on the University of Missouri's campus in Columbia was replaced with S30400 stainless steel in 2004. Ease of installation reduced costs.

The S30400 stainless steel can withstand the regular disinfection treatments required under American Water Works Association (AWWA) regulations, provided the chlorine disinfectant is properly mixed in liquid rather than tablet form.

The energy management team also uses stainless steel piping in the power plant's water pretreatment facilities to prevent pipe corrosion. Stainless is also used in cooling towers that support the campus chilled water system, eliminating maintenance and performance problems associated with chip scale from mild steel piping.

They are also looking at using S30400 stainless steel mesh to capture coal dust and other small particles from storm water before it enters storm water drains. Rice says the team found that the steel mesh provides better screening and flow rates than conventional fabric filtration systems.

In 2004, the MU Energy Management Department won the "System of the Year Award" from the International District Energy Association for its high level of perfor- mance, including reliability, efficiency and energy conservation. Previous recipients of the award include Toronto's Enwave District Energy Ltd., profiled in this magazine in July 2004.

MORE INFO: www.nickelmagazine.org/missouri

UNIVERSITY OF MISSOURI–COLUMBIA

A New Nickel Catalyst for Fuel Cells

Small-scale stationary fuel cells need an inexpensive method of reforming natural gas to produce hydrogen

Although there are at least five different types of fuel cells, they all consume hydrogen and oxygen to generate electricity and water. Most of the hydrogen comes from the steam-reforming of natural gas, or methane, which splits hydrogen from carbon in the methane molecule. This is done industrially in huge installations that produce tonnes of hydrogen per day.

The challenge in supplying hydrogen to stationary fuel cells is how to produce hydrogen from natural gas on a small scale for domestic rather than commercial applications. Such small-scale reforming technologies have been under development for several years but are not yet widely available commercially.

The German chemical company BASF has been focusing on economic ways to produce hydrogen of sufficient purity for fuel cells. One of the problems is limiting the concentration of residual carbon monoxide in the hydrogen, which poisons the fuel cell catalysts and decreases their efficiency and effectiveness.

Existing small-scale reforming technologies require costly precious metal catalysts to generate hydrogen of sufficient purity, but BASF has developed base-metal catalysts for most of the reforming. These new catalysts based on nickel, copper and other metals perform similarly to precious-metal-based catalysts but offer significant cost savings.

A nickel catalyst has been developed and adopted for the dedicated challenges of small fuel processors used in the steam-reforming of natural gas. The catalyst provides high activity (even after thousands of start-ups and shut-downs), a low de-activation rate, and resistance to changes in the atmosphere.

This development shows that catalysts can be used with nickel as the active component not only for hydrogen generation on an industrial scale but for small-scale fuel processors. The excellent performance of the new catalysts, in combination with the low price, is a big step forward in the commercialization of fuel cell systems for the combined generation of heat and electricity in households.

MORE INFO: www.nickelmagazine.org/catalyst

BASF

RESEARCHERS IN GERMANY have developed a low-cost nickel catalyst suitable for the steam reforming of natural gas by small-scale fuel processors.

Italian Radiator Design Hot in the U.K.

Stainless steel appliances have transformed kitchen designs, and S30400 stainless steel, containing 8-10.5% nickel, has turned utilitarian radiators into attractive appliances that contribute to a home's decor.

For the past two years, Italy's Emmesteel S.R.L. has been manufacturing electricity- and water-heated radiators fabricated from 25-millimetre-diameter S30400 tube with a wall thickness of 1.5 mm. Soon, a new design, using 16-mm tubing, will be launched.

The radiators are available in a polished finish, preferred by Italian customers, and a satin finish, prepared primarily for the export market. Eighty per-cent of Emmesteel's radiators are sold in the United Kingdom.

The units are fabricated in several sizes, ranging from 440 by 780 and 1,940 by 1,040 millimetres and weighing 8.7 to 41.4 kilograms. Each contains six to 48 metres of tubing.

EMMESTEEL S.R.L.

INNOVATIVE DESIGN and quality materials are creating a growth market for residential stainless steel radiators.

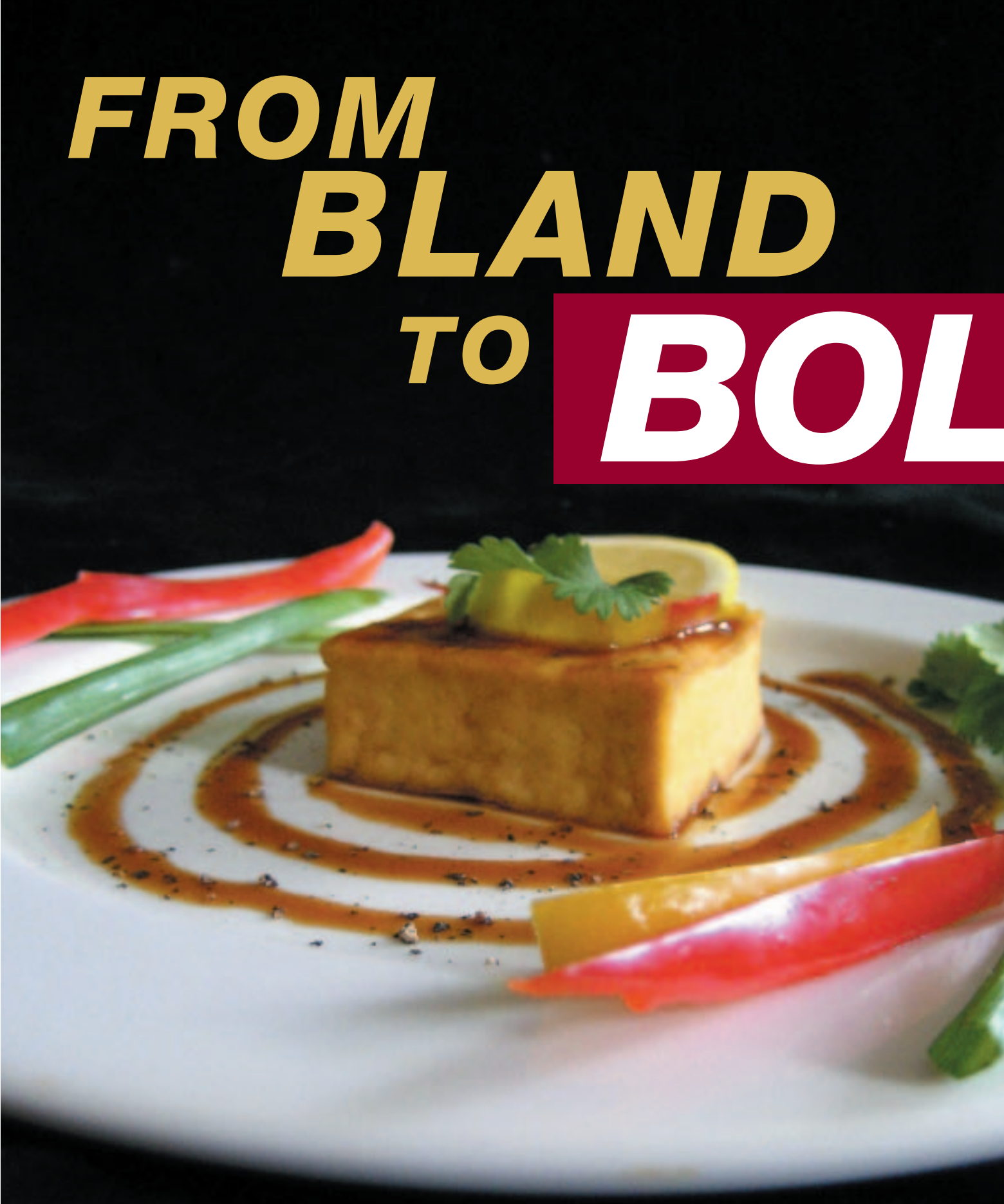
The design flexibility afforded by the tubular construction allows for tall, narrow units with as few as four tubes, and for small square units mounted on a wall beside a bathroom sink. The largest units contain as many as 18 tubes.

In another design, but offered in the same range of dimensions, flat S30400 sheet is hung on the warming pipes to create a nearly solid panel.

The tubing is TIG-welded, and the surfaces receive no chemical treatment, chromium plating or varnish. Thus they're assured of a long life and lower environmental impact during the manufacturing process and eventual recycling.

MORE INFO: www.nickelmagazine.org/radiator

FROM BLAND TO BOL



Adventurous cooks in North America are discovering soy sauce.

Connoisseurs of soy sauce are as passionate as beer lovers when it comes to the colour and flavour of their favourite brew. Indeed, the Japanese take their soy sauce so seriously that newlyweds have been known to fight over whose brand will dominate in the matrimonial home.

But the same qualities that lend soy sauce its cachet create such severe conditions during fermentation that the stainless steel tanks common to other food-processing industries are not up to the job of brewing the popular sauce. Instead, Japan has tended to use fibreglass and resin-lined steel, both of which resist corrosion.

Problem is, the mix of organic acids and sodium chloride in the sauce is so corrosive and the fermentation process so long (about six months) that the cost of maintaining the tanks can be prohibitively expensive.

The solution to this age-old problem may be at hand. A recent study shows that molybdenum-bearing super austenitic stainless steel S32053 resists the corrosion that affects other stainless steels immersed in conventional brewing tanks.

"The super austenitic stainless steel is less susceptable to corrosion, whereas S31603 suffers crevice corrosion and stress corrosion cracking, and duplex stainless steel S32506 is susceptible to crevice corrosion," writes Yutaka Kobayashi of Nippon Yakin Kogyo, one of the largest stainless steel producers in Japan, in a paper published in *Stainless Steel World*.

Based on the experimental results, Yamasa Corporation, which has been making soy sauce since 1645, built 100 fermentation tanks in S32053 with capacities of up to 390,000 litres for its Japanese operations. The tanks have been in commercial use since October 2002 without any corrosion.

The brewing process is based on techniques handed down through generations. First, steamed soybeans and roasted wheat are mixed with a proprietary mold to induce fermentation. This mash, called koji, is then mixed with salt and water. During the 6-month fermentation process the ingredients gradually decompose into organic acids, amino acids and alcohols, the combination of which gives the sauce its distinct character.

But these acids also lower the pH to about 4.7 in an already corrosive stew containing about 17% sodium chloride. The fermentation tanks must be able to withstand severe conditions.

If the S32053 tanks withstand the test of time in Yamasa's plant, their marketability will be significant. Every year, about 8 billion litres of soy sauce are consumed throughout the world, according to industry groups. Per-capita consumption in Japan is about nine litres a year, while the corresponding U.S. figure is just under one litre, and growing.

About 1 billion litres of soy sauce are produced in Japan per year, though this figure has been decreasing slightly, year by year, because of diversification in Japanese eating habits. Roughly, 1,600 companies produce soy sauce, the largest of which are Kikkoman, Yamasa and Higeta.

MORE INFO: www.nickelmagazine.org/soy

TOM SKUDRA FOR NICKEL MAGAZINE YAMASA CORPORATIO/NIPPON KAKIN KOGYO CO. LTD.

◀ Wooden tanks (left) have been used in Japan's soy sauce industry for centuries. However, soy sauce consumption in countries outside of Japan is increasing, most notably in the United States. To meet that increase in demand, manufacturers need to build new capacity in the next few years.

One solution to the age-old problem of ▶ the corrosion of soy fermentation vessels is to make these new plants out of super austenitic stainless steel (right).

◀ ***Delicious and healthy baked tofu:*** *Mix minced garlic, ginger, soy sauce and a few drops of sesame oil. Spread on sliced firm tofu and bake for 20 minutes at 350° C.*

CCIF TAIWAN

Buildings, such as the 101-storey, 509-metre-high, Taipei Financial Centre use stainless steel pipe for fire protection and hot and cold water supply.

The 70-storey, Aurora residential building in Brisbane, Australia uses stainless steel S31600 pipe for its water supply. Pressures are up to 2,500 kPa.

AUSTRALIAN STAINLESS STEEL DEVELOPMENT ASSOCIATION

Victaulic's Pressfit joining system provides economy, reliability and fast installation.

HIGH

PRESSURE

Urban water distribution systems are evolving toward stainless steel

The piping systems that deliver potable water and fire-fighting capabilities in tall buildings have unique requirements. They must be able to withstand not only high pressures but the motion of the building caused by seismic and wind forces. Speed and ease of assembly are also important during the construction phase as builders grapple with tighter deadlines and a more fluid, less skilled workforce.

As buildings grow ever taller, engineers are turning to stainless steel piping systems to meet these needs. Three of the newest and tallest buildings in the world, the Taipei Financial Centre in Taiwan, the Aurora tower in Brisbane, Australia, and the Petronas Twin Towers in Kuala Lumpur, are prime examples of this shift to high-pressure stainless steel piping systems in certain circumstances.

The Taipei Financial Centre, a 101-storey, 509-metre-high building completed in 2004 uses the Victaulic grooved stainless steel system for fire protection and plumbing, and Victaulic valves and stainless steel pipes up to 318 millimetres (mm) in diameter for hot and cold water supply.

The Victaulic grooved system provides the flexibility to withstand any seismic activity, up to the strongest earthquake in a 2,500-year cycle. The system, designed especially for standard or light-wall stainless steel, is also less costly than traditional methods of welding, flanging or threading; that's because it can be installed quickly using less skilled labour, and is easy to clean and maintain.

In the Taipei Financial Centre, the pipes for domestic water supply are made of Japanese standard JIS 3459 schedule 10 stainless steel for corrosion resistance. They have a wall thickness of 9.52 mm to accommodate pipes up to 318 mm and pressures of 2,065 kilopascals (kPa). Both hot and cold water can run through the system because the couplings are flexible enough to handle thermal expansion and contractions and the gaskets are rated from -34˚C to 100˚C.

S30400 stainless steel pipes and Victaulic couplings are also used in the Petronas towers, the tallest buildings in the world, to accommodate high pressures and vibration.

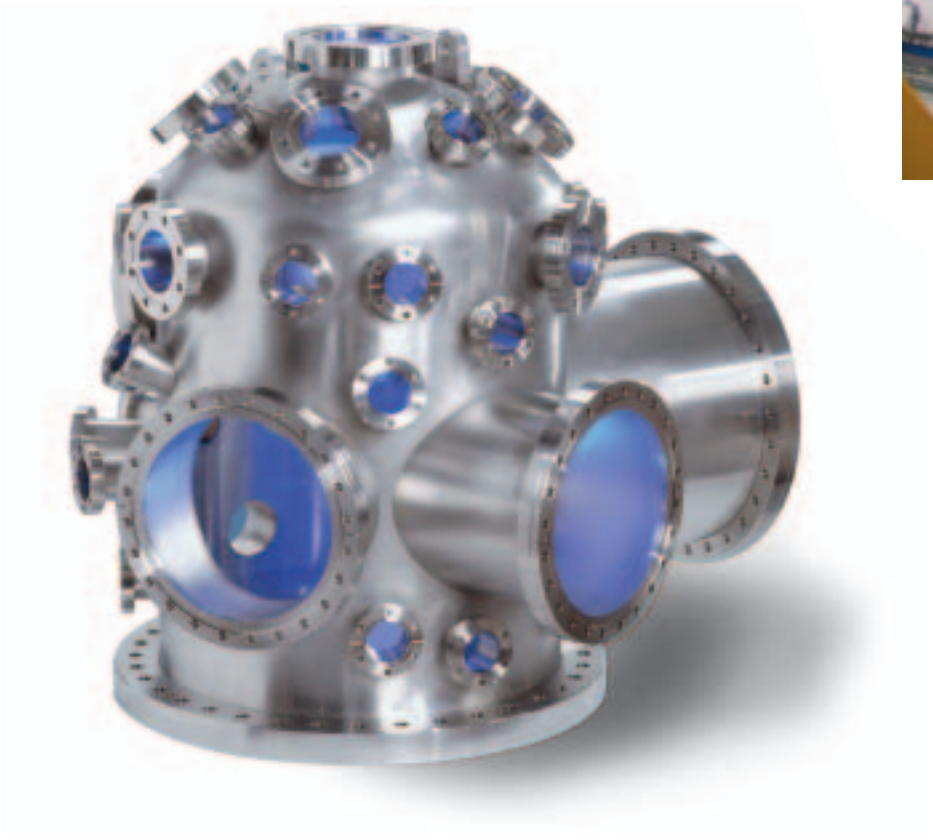
For smaller diameter piping systems that do not require ready access, Victaulic's Pressfit system (also marketed as the Mapress system) provides economy, reliability and fast installation. The system uses S31600 or S30400 stainless steel pipe with fittings that can be permanently attached using a handheld electric tool, eliminating the risk of fire from welding and brazing and the need for welded or threaded joints.

This type of system is being installed in Brisbane's tallest residential tower, the Aurora, scheduled for completion in January 2006.

MORE INFO: www.nickelmagazine.org/pipe

Harnessi

Stainless Steel Contributes to the Realization of the Perfect Vacuum



Vacuum chambers such as this, which were fabricated of S30400 stainless steel, are essential components in Saskatchewan's synchrotron.

JOHNSEN ULTRAVAC

Microscopes need light, and one of the most powerful sources of light in the world recently became operational.

Housed at the University of Saskatchewan in Canada, the synchrotron, as it is called, produces electrons that give off light millions of times brighter than the Earth's sun. Researchers use the light for various design and manufacturing projects.

Stainless steel, of which S30400, S30403 and S31603 are the most common types, is used extensively in the vacuum chambers, as well as in such specialised applications as the K93600 supports that provide dimensional stability in some of

ng

THE LIGHT OF A MILLION SUNS

Living cells such as this algae cell can be viewed as never before with the aid of a synchrotron.

Electrons are accelerated to nearly the speed of light before they enter the synchrotron's stainless steel storage ring (below).

the optic systems.

The need to achieve and maintain a vacuum of 10^{-11} Torr (a million, million times less than atmospheric pressure at sea level) determines the choice of materials, and the target is challenging: the CLS began operating in October 2004, but it will be a full year before an ultra-high vacuum target can be achieved.

Achieving a vacuum requires the removal of as many molecules as possible. Impurities not only slow the electron beam; they diffract the electrons, much like fog scatters the beam from a car's headlights. Some synchrotrons have been made of copper or aluminum, but stainless steel is more routine from a fabrication point of view, says Mark de Jong, CLS's director of operations.

The vacuum chamber components must be cooked in huge bake ovens for as long as 40 hours at temperatures as high as 250ºC. Aluminum begins to lose its strength at 150 ºC, but stainless steel does not – a critical attribute considering that the components are baked under vacuum. "Stainless doesn't lose strength at the typical pressures of our bake-out," confirms Mark de Jong.

Baking expels gases absorbed during manufacturing, such as water vapour, argon, oxygen, helium, nitrogen, hydrogen and carbon monoxide. Also, the metal components are washed as part of the degreasing process. Says Mark de Jong: "We want to avoid having any hydrocarbons inside. An absolute no-no is sulfur-based cutting oil, which can remain for an eternity."

Ontario, Canada-based Johnsen Ultravac uses S30400 in some of the vacuum chambers it manufacturers. The cost of S30400 is low, compared with other metals. It is also easy to machine and weld, and sufficiently hard that it can cut into the copper gaskets. The synchrotron's many fittings, flanges, ion pumps and valves are always stainless steel, so mating them to like-metals simplifies the engineering.

To learn how the synchrotron works, please see: **www.nickelmagazine.org/synchrotron**

CANADIAN LIGHT SOURCE INC., UNIVERSITY OF SASKATCHEWAN

Reducing Mercury Pollution

Letter to the Editor

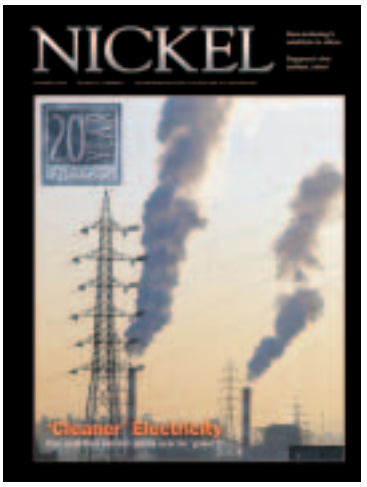
Is there a role for nickel in the equipment which will be required to remove mercury from the effluent of coal-burning power plants?

William L. Larsen, PE

Iowa, U.S.A.

The answer is yes, depending on conditions, but some background information is necessary for a full understanding of the problems encountered with mercury removal.

When coal is burned, it produces particulate mercury, elemental mercury and oxidized mercury. Particulate mercury is trapped with the flyash and removed in a collector such as an electrostatic precipitator. Elemental mercury can only be removed by some type of sorbent unless it is first oxidized. Oxidized mercury can be removed by wet scrubbing.



There is still much to be learned about mercury removal, but wet scrubbers which are used to remove most of the sulphur dioxide from the flue gas also will remove most of the oxidized mercury from the flue gases. Selective catalytic reduction units which are used to reduce nitrogen oxide emissions will also oxidize much of the elemental mercury to which they are exposed thus increasing the mercury capture in the scrubers to the required level. Most of the wet scrubbers that are installed or are being installed are constructed of nickel-containing alloys to resist the corrosive attack from the medium-to-high sulphur coals being burned.

About one-third of the coal being burned today in the U.S. is low-sulphur compliance quality coal which for the most part does not require wet scrubbers. Also, these coals emit mostly elemental mercury which means that a significant amount of mercury cannot be removed by existing equipment.

Legislation to reduce mercury emissions is still being worked out but it appears that reductions of up to 90% will be required by 2007 to 2009. Meanwhile, plans reportedly are underway for the installation of over 100 new wet scrubber installations within 10 years. It will be necessary for mercury control as well as other pollution control devices to be included in these plans.

W. L. Mathay

Consultant to the Nickel Institute

6.5 billion Euros for Italian Economy

Nickel and its value-chain adds an estimated 6.5 billion Euros per year to the economy of Italy, according to a socio-economic study by The Weinberg Group, an international science and regulatory consulting firm. The study was commissioned by the Nickel Institute to examine the socio-economic aspects relating to nickel in Europe.

Italy is a major user of nickel. Total Italian use in 2002 was 117,000 tonnes, which represented about 16% of European Union demand. Demand for the metal is satisfied by a combination of imports of refined nickel and the recycling of existing nickel products. Whilst the nickel industry in Italy is relatively small, it has a significant impact on the Italian economy through its value chain. Italy is not only a major nickel stainless steel producer. It is also a major fabricator and producer of goods and equipment in these alloys.

Total employment in Italy in the direct nickel industry, so-called first use industries and intermediaries and end-use industries that are critically dependent on nickel is estimated to be about 70,000. Some 35,000 additional jobs have been created in the economy through income and supplier multiplier effects and capital expenditure effects.

MORE INFO: www.nickelforum-eura.org/italy

UNS details

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

Alloy	C	Cr	Cu	Fe	Mn	Mo	N	Ni	P	Pb	S	Si	W	Zn
C71500 P.16	-	-	rem	0.40-1.0	1.0-max	-		29.0-33.0	-	0.05 max	-	-	-	1.0
K93600 P.5, 12	-	-	-	64	-	-	-	36	-	-	-	-	-	-
S30400 P.6,7,11,12,14	0.08 max	18.00-20.00	-	-	2.00 max	-	-	8.00-10.50	0.045 max	-	0.030 max	1.00 max	-	-
S30403 P.12	0.03 max	18.00-20.00	-	-	2.00 max	-	-	8.00-12.00	0.045 max	-	0.030 max	1.00 max	-	-
S31600 P.4,11	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	-	-
S31603 P.9,12	0.030 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	-	-
S32053 P.9	0.030 max	22.00-24.00	-	rem	1.00 max	5.0-6.0	0.17-0.22	24.00-26.00	0.030 max	-	0.010 max	1.00 max	-	-
S32506 P.10	0.030 max	24.00-26.00	-	rem	1.00 max	3.0-3.5	0.08-0.20	5.5-7.2	0.040 max	-	0.015 max	0.90 max	0.05-0.30	-

NICKEL INSTITUTE

A Stronger Voice

The Nickel Institute, which generates and communicates knowledge required to support the production, use and reuse of nickel now represents more than 90% of primary global nickel production.

The change is the result of the recent addition of two new members, JMC MMC Norilsk Nickel and Minara Resources.

Other members of the Nickel Institute include: Anglo American Brasil Ltda., Anglo Platinum, BHP Billiton, OM Group Inc., P.T. International Nickel Indonesia, Sherritt International Corporation, Sumitomo Metal Mining Co., Empress Nickel Refinery Limited, Eramet, Falconbridge Limited, Inco Limited, Inco TNC Limited, Nippon Yakin Kogyo Co., Ltd., Umicore, and WMC Resources Ltd.

MORE INFO: www.nickelinstitute.org/index.cfm/ci_id/139.htm

Fast Food Growth in China

The appetite for nickel in China is growing by leaps and bounds. One sector of the economy where growth is readily apparent to the general public is the fast food industry.

McDonald's, for example, is expanding into China in a big way. It is estimated that 100 new restaurants were built by the burger chain in this burgeoning new market last year. In addition, the company will build at least that number of new restaurants again this year, according to an article in *The Economist*.

TOM SKUDRA FOR NICKEL INSTITUTE

THE STANDARD McDONALD'S restaurant uses about two tonnes of S30400 stainless steel.

Since a standard McDonald's restaurant uses about two tonnes of S30400 stainless steel, according to McDonald's Canada, a significant amount of the nickel-containing product will be needed for the company's ambitious expansion plans.

S30400 stainless steel is typically used for food preparation surfaces because it is durable, can be kept scrupulously clean and does not transfer any unwanted tastes to the food product.

@www.nickelinstitute.org

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  www.nickelonline.org/subscribe
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  www.nickelinstitute.org/good_practices
- **FOLLOW** the regulatory process in the European Union as it relates to the classification of nickel compounds.
  www.nickelforum-eura.org
- **LEARN** about the advantages of using stainless steel in the potable water distribution industry.
  www.s-p-l-a-s-h.com

COMING EVENTS

Chinese Stainless Steel

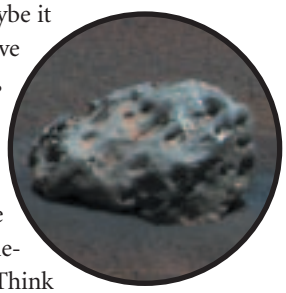
The 4th China/Asia Stainless Steel Markets conference will be held at the J. C. Mandarin Hotel in Shanghai, China, April 20-21, 2005. Organized by the Centre for Management Technology (CMT), this conference brings together a leading panel of experts to share insights into the challenges facing China. Investment in new stainless steel production capacity in Asia is raising concerns about China's dependence on imported raw materials. The effect of nickel supply and price on this expanding market are also a concern. This conference provides a platform for industry players to discuss these and other concerns, develop new strategies and evaluate new opportunities. Contact: Ms Nancy Phua, Event Executive, 80 Marine Parade Road, # 13-02 Parkway Parade, Singapore, 449269. E-mail nancy@cmtsp.com.sg Website: www.cmtevents.com

STRUCTURAL STAINLESS STEEL A one-day meeting (in Itallian) entitled "Structural Uses of Stainless Steel" will be held in Udine, Italy on May 19, 2005. Organized by Centro Inox and Centro Convegni Palazzo delle Professioni, the meeting will provide an overview of the growing interest among engineers to use stainless steel as a structural material for its corrosion resistance, fire resistance and ability to withstand seismic loads. Some examples will be shown. Contact: Centro Inox, Piazza Velasca 10, 20122 Milano, Italy. Tel: +39 02 86450559. Fax: +39 02 860986. E-mail: eventi@centroinox.it Website: www.centroinox.it

Nickel-Iron Meteorite Found on Mars

NASA's Mars exploration rover called "Opportunity" has found a nickel-iron meteorite, the first ever identified on another planet.

The pitted, football-size object is mostly composed of iron and nickel, according to data from the vehicle's on-board spectrometers. Only a small fraction of the meteorites that fall to Earth have a similar composition.



NASA

"This is a huge surprise, though maybe it shouldn't have been," says Dr. Steve Squyres of Cornell University in Ithaca, New York, U.S.A. the principal investigator for the science instruments on "Opportunity."

"I never thought we would get to use our instruments on a rock from someplace other than Mars," Squyres says. "Think about where an iron meteorite comes from: a destroyed planet or planetesimal that was big enough to differentiate into a metallic core and a rocky mantle."

"Mars should be hit by a lot more rocky meteorites than iron meteorites," Squyres says. "We've been seeing lots of cobbles out on the plains, and this raises the possiblility that some of them may in fact be meteorites."

NASA's chief scientist Dr. Jim Garvin says "exploring meteorites is a vital part of NASA's scientific agenda, and discovering whether there are storehouses of them on Mars opens new research possibilities, including further incentives for robotic and then human-based return missions. Mars continues to provide unexpected science 'gold', and our rovers have proven the value of mobile exploration with this latest finding."

MORE INFO: http://marsrovers.jpl.nasa.gov/newsroom/pressreleases/20050119a.html

Smooth Sailing

Perhaps the oldest copper-nickel boat in existence, the Asperida is still in fine shape.

COPPER DEVELOPMENT ASSOCIATION/INCO LTD./DRIVER ASSOCIATES INC.

Designers of boats need to consider many things when choosing materials for the hull of their ocean-going vessels – for example: ensuring the surface is smooth so that the vessel can move through the water with little resistance, keeping the weight to a minimum, and ease of maintenance. Attending to these design considerations improves the availability of the boat and lowers operating and maintenance costs, as Dr. Kenneth W. Coons has learned.

Coons, who was professor of chemical engineering at the University of Alabama in the late 1990s, is an avid yachtsman, who owned vessels made of wood, steel, aluminum and fibreglass. But he was dissatisfied with them all and so spent decades evaluating alternative materials. One technique he used was to tow sample coupons behind his yacht and then examined their resistance to corrosion. Based on these evaluations, he decided in 1966 to build a yacht made of copper-nickel alloy C71500, which contains 29-33% nickel.

Today's boat designers should be thankful that he made that decision because it allows today's designers to use this material with confidence.

Coons' yacht was designed by S. M. van der Meere and built in northern Holland in 1967 by Trewes International. The method of construction was almost identical to that used for carbon steel. However, welders had to be trained, and some welds (in W60715, containing 29% nickel) had to be redone. The hull was painted above the waterline for aesthetics. The hull plates were just 4 millimetres (mm) thick.

Although the initial cost of the hull was ten times that of a boat made of carbon steel, annual maintenance costs were so low that the savings paid for the higher initial cost in just five years.

After being sold five times, the Asperida landed in the hands of its present owners Waldemar Cieniewicz and Anna Muriglan. The duo sailed the ship to New Jersey in 2004, where it was refurbished and refitted. The average thickness of the hull was 3.86 and 3.96 mm (close to the original thickness), based on measurements by the Copper Development Association.

"Clearly, C71500 should be considered seriously as a hull material, not only for pleasure boats but also for commercial and military vessels," says Harold Michels, vice-president, technical and information services for Copper Development Association.

MORE INFO: "The Asperida, a Copper-Nickel Sailboat after More than Thirty Years in Seawater," by Harold T. Michels and Kenneth P. Geremia, paper no. 05238, NACE Corrosion/2005, NACE International, Houston, Texas, U.S.A., 2005.