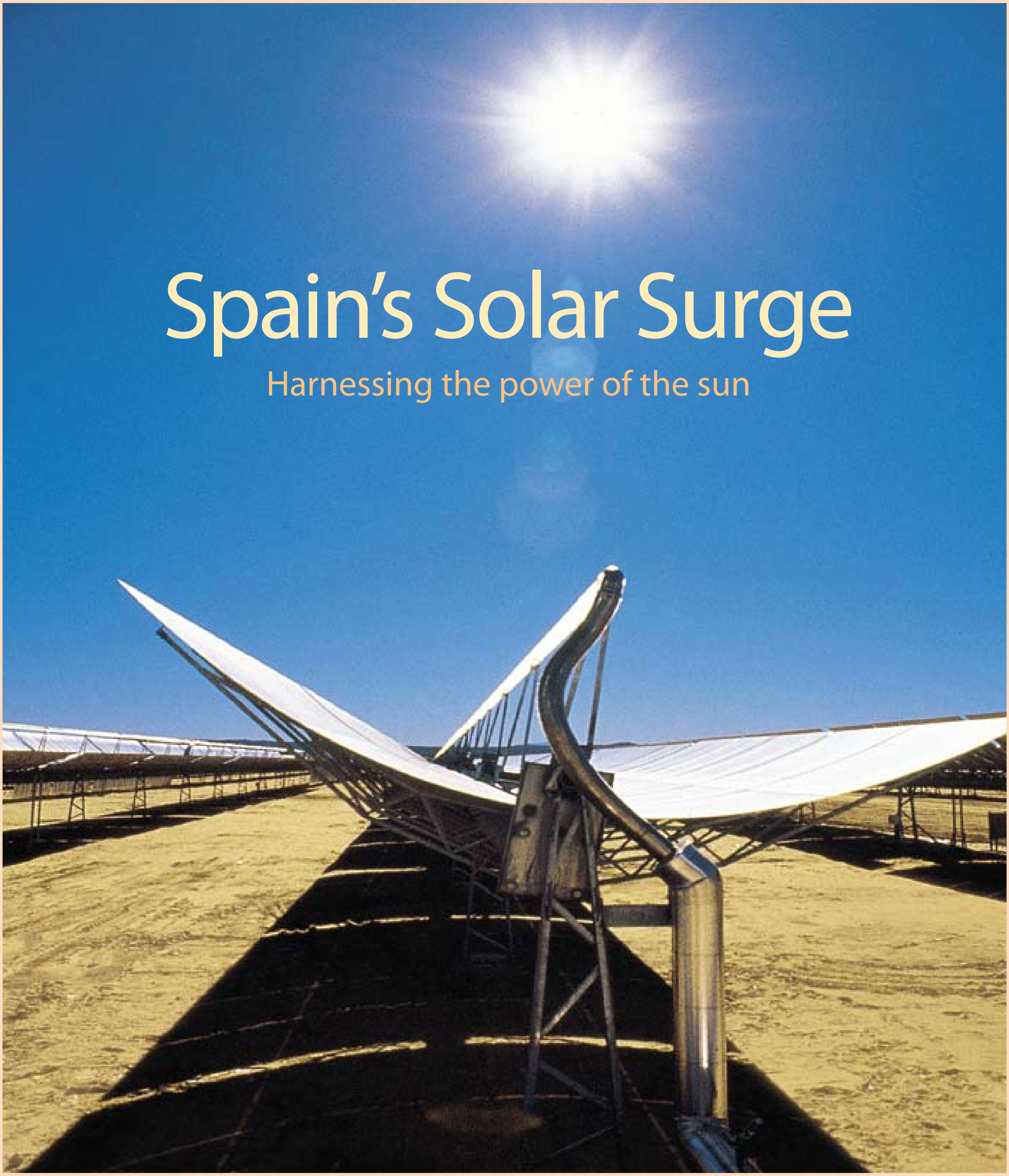
NICKEL

Stainless vehicles: the next generation

Europe's experimental fusion reactor

DECEMBER 2008 VOLUME 24, NUMBER 1 THE MAGAZINE DEVOTED TO NICKEL AND ITS APPLICATIONS



Spain's Solar Surge

Harnessing the power of the sun

NICKEL

Volume 24, Number 1, December 2008

The Magazine Devoted to Nickel
and its Applications

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The Nickel Institute
55 University Avenue, Suite 1801
Toronto, Canada M5J 2H7
Tel. +1 416 591 7999
Website: www.nickelinstitute.org
E-mail: ni_toronto@nickelinstitute.org

Stephen Barnett, President
Patrick Whiteway, Editor
Mark Crozier, Design

Circulation, 33,000 in 95 countries

Other Nickel Institute offices:

Europe
Sixth Floor
Avenue des Arts 13
Brussels 1210, Belgium
Tel. 32 2 290 3200
E-mail: euronickel@euronickel.org

European Technical Information Centre
The Holloway, Alvechurch
Birmingham, England B48 7QB
Tel. 44 1527 584777
E-mail: ni_birmingham_uk@nickelinstitute.org

Japan
11-3, 5-chome, Shimbashi,
Minato-ku, Tokyo, Japan
Tel. 81 3 3436 7953
E-mail: ni_japan@nickelinstitute.org

Central & South America
Nucleo Inox
Av. Brig. faria Lima, 1234 Conj. 141
01451-913 São Paulo – SP, Brazil
Tel. 55 11 38130969
E-mail: nucleoinox@nucleoinox.org.br

India
K-36, 1st Floor
Hauz Khas Enclave,
New Delhi 110 016, India
Tel. 91 11 2686 5631, 2686 3389
E-mail: ni_india@nickelinstitute.org

Australasia
c/o ASSDA, Level 15, 215 Adelaide Street
Brisbane, Queensland 4000, Australia
Tel. 61 7 3220 0722
E-mail: ni_australasia@nickelinstitute.org

South Korea
Olympia Building - Room 811
196-7 Jamsilbon-Dong, Songpa-Ku,
Seoul 138 229, South Korea
Tel. 82 2 419 6465
E-mail: ni_korea@nickelinstitute.org
Website: www.nidikorea.org

China
Room 677, Poly Plaza Office Building
14 Dongzhimen Nandajie
Beijing, China 100027
Tel. 86 10 6500 1188 (ext. 3677)
E-mail: ni_china@nickelinstitute.org

United States
NiPERA
2605 Meridian Parkway, Suite 200
Durham, North Carolina, U.S.A.
(Health and environment inquires only)
Tel. +1 919 544 7722
E-mail: cmandel@nipera.org

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Solar trough plant, Spain (Solar Millennium)

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NICKEL & SOCIETY

IN RECENT MONTHS IT HAS BECOME APPARENT THAT GOVERNMENTS HOLD THE KEY TO REVERSING THE PARALYSIS THAT HAS GRIPPED THE WORLD'S FINANCIAL SYSTEMS.

Massive spending on public infrastructure promises to stimulate economies worldwide and could, if implemented properly, have long-lasting benefits. Such spending could also be good for the nickel industry.

All the feature stories in this special issue of Nickel Magazine are reminders of the important role nickel plays worldwide. For much of the past decade, the use of nickel has increased by about 3-4% annually, driven mainly by China's increasing need for stainless steel. The world has benefited from this increased use of nickel in two significant ways.

First, society benefits from the many attributes nickel brings to the industries that produce durable products, generate electricity sustainably, and create energy-efficient automobiles and buildings. In this issue, we focus on three applications of nickel that have broad implications for society: solar energy, fusion energy, and innovative, lightweight ground transportation.

The governments of most nations recognize the need to develop sustainable economies. Doing so demands a reduction of the emission of greenhouse gases into the atmosphere, as well as greater energy efficiency. Nowhere is this trend more evident than in the European Union. As our feature story shows, nickel makes it possible for various industries active in Europe (fuel cells, automotive and aerospace, to name only three) to be innovative in these areas.

The second way the increased demand for nickel improves the world is spinoffs. The nickel-producing regions of the world benefit from the economic spinoffs their activities generate. Usually Nickel Magazine focuses on nickel applications, but in this issue we bring together special reports on the social and economic benefits that nickel – its production, use and re-use – brings to the European Union, Canada and Australia. These benefits include capital employed (total financial resources dedicated to the nickel industry), economic output (value of production attributable to nickel), value added (contribution to GDP), employment (including salaries and wages), capital expenditures, research and development, and taxes.

Policy-makers are often blind to the social benefits nickel brings to their nations and regions. The three reports in this issue crunch the numbers to show how nickel exploration, production, use and re-use contribute to society. If one of the justifications for mining nickel is to provide the materials necessary to harness the promise of sustainable energy production and energy efficiency, then another is the socio-economic benefits of the extraction and processing industry itself.

BHP BILLITON

Australia holds the largest reserve base of nickel in the world and is the third largest producer behind Russia and Canada.

Government-financed infrastructure programs could have a significant impact on the nickel industry in the next year and beyond. For example, the construction of wastewater treatment plants, water treatment and distribution systems, and durable concrete highway bridges and buildings (reinforced with stainless steel rebar) could boost demand for corrosion-resistant, nickel-containing stainless steels. That would go a long way toward stimulating downstream industries as well as the nickel industry and producing long-lasting benefits for society.

Patrick Whiteway

Patrick Whiteway
Editor

Solar Solution

How nickel stainless steels are improving the prospects for solar energy

Human activities generate 23 billion tonnes of carbon dioxide a year, according to the European Renewable Energy Council. According to the Intergovernmental Panel on Climate Change calculates that these emissions will increase the world's temperature by up to 5.8° C within a hundred years.

Many technologies are being developed to slow global warming and avoid its consequences. Some have already proved effective: in 2004 renewable energy sources met 13% of the world's primary energy demand, according to World Energy Outlook, an annual publication of the International Energy Agency.

The general objective is to tap into renewable energy sources so as to eliminate fossil fuels and the carbon dioxide emissions they produce. One of these sources is solar power. The so-called sunbelts of the world offer the best locations for solar power plants. These include the southern United States and Mexico, southwestern South America, a broad swath stretching from Spain and North Africa to China, Southern Africa, and Australia. According to Abengoa Solar, a solar developer in Spain, just 2% of the solar radiation that falls on the world's deserts would supply all the planet's power demands.

The most-used way to tap the sun's energy is photovoltaic technology, which uses solar panels that produce free electrons when exposed to light, to produce electric current. However, utility-size power plants are also turning to a low-cost subset of solar technologies called concentrating solar power (CSP). Construction of CSP technologies depends on stainless steels such as S31600, nickel-based low-thermal-emission coatings, conventional alloy-based steam power, and as-yet unspecified superalloys.

CSP technologies concentrate the sun's energy with mirrors to heat fluids that in turn heat water to make steam. The steam activates turbines that generate electricity. The two main CSP technologies are "solar troughs" and "solar towers."

Some plant designs include backup power at night generated from a fuel; others do not. Other, hybrid designs supplement conventional power plants, such as a 150-megawatt combined cycle and solar field which will be constructed in Hassi R'Mel, Algeria.

Solar trough plants, consisting of row upon row of concave mirrors, concentrate the sun's energy onto stainless steel receiver tubes positioned at the mirrors' focal lines. A heat transfer fluid, such as oil, transfers the heat to water via heat exchangers and sometimes also to molten salt in heat storage tanks. The heat is recovered at night.

Solar tower technology uses an array of ground-based mirrors to concentrate the sun's energy onto stainless steel tubes in a central receiver at the top of a tower. A heat transfer fluid (typically molten salt) circulates through the receiver, heating water in heat exchangers. (In most designs, excess heat is stored in huge tanks of molten salt.)

Spain is a hotbed of CSP development thanks not only to its geographic location but to government support in the form of "feed-in tariffs," legislated incentives that encourage the adoption of renewable energy. The Spanish government guarantees a tariff of 0.269375 euro per kilowatt hour for CSP plants of up to 50 megawatts (MW). The

Solar trough plants depend on nickel stainless steels such as S31600.

tariffs have stimulated investment worth hundreds of millions of euros. According to one projection, solar electrical production in Spain will reach 3,000 MW by 2010 and 10,000 MW by 2020.

The world's largest solar trough plants are in the Spanish city of Granada. The plants, spearheaded by German developer Solar Millennium AG and known as Andasol 1, 2 and 3, are in various stages of completion. Each facility has more than 1,008 troughs and about 550,000 square metres of mirror surface, and will generate 50 MW; that's enough to supply the energy needs of 200,000 people and avoid the production of 172,000 tonnes of carbon dioxide annually. Excess heat is stored in heat reservoirs containing 28,500 tonnes of molten salt apiece.

Spain has many other solar trough plants at various stages of construction with names such as PS10, PS20 and Solnova. Two contracts won by Israel-based Solel Solar Systems Ltd., which manufactures receiver tubes for solar trough plants, illustrate the vast scale of the technology. In May 2008, Solel announced sales of 70,000 receiver tubes for eight Spanish plants with 50 MW of output apiece plus 190,000 receiver tubes for an undisclosed customer (the metal tube in each receiver is 4 metres long and is made of S32109, containing 10% nickel).

At a 5-MW test plant in Albuquerque, New Mexico, U.S.A., Sandia National Laboratories conducted early work on solar tower technology and the use of molten salt circulating in the central receiver and as a storage medium. The molten salt, which consists of 60% sodium nitrate and 40% potassium nitrate, reaches 556° C in the 6.6-by-6-metre receiver. Meanwhile S31600 stainless steel tubing was used in the receiver and in storage tanks built for another solar tower research plant, Solar 2, whereas the cooler (about 400 °C) storage tank at Andasol 1 did not require the additional corrosion resistance of stainless steel. Stainless steel was also used in systems downstream of the central receiver at Sandia.

Building on the success of these U.S. solar tower projects, the Spanish engineering group SENAR launched Solar Tres, a 17-MW solar tower in Seville, about four years ago. It is the first commercial molten salt central receiver plant in the world.

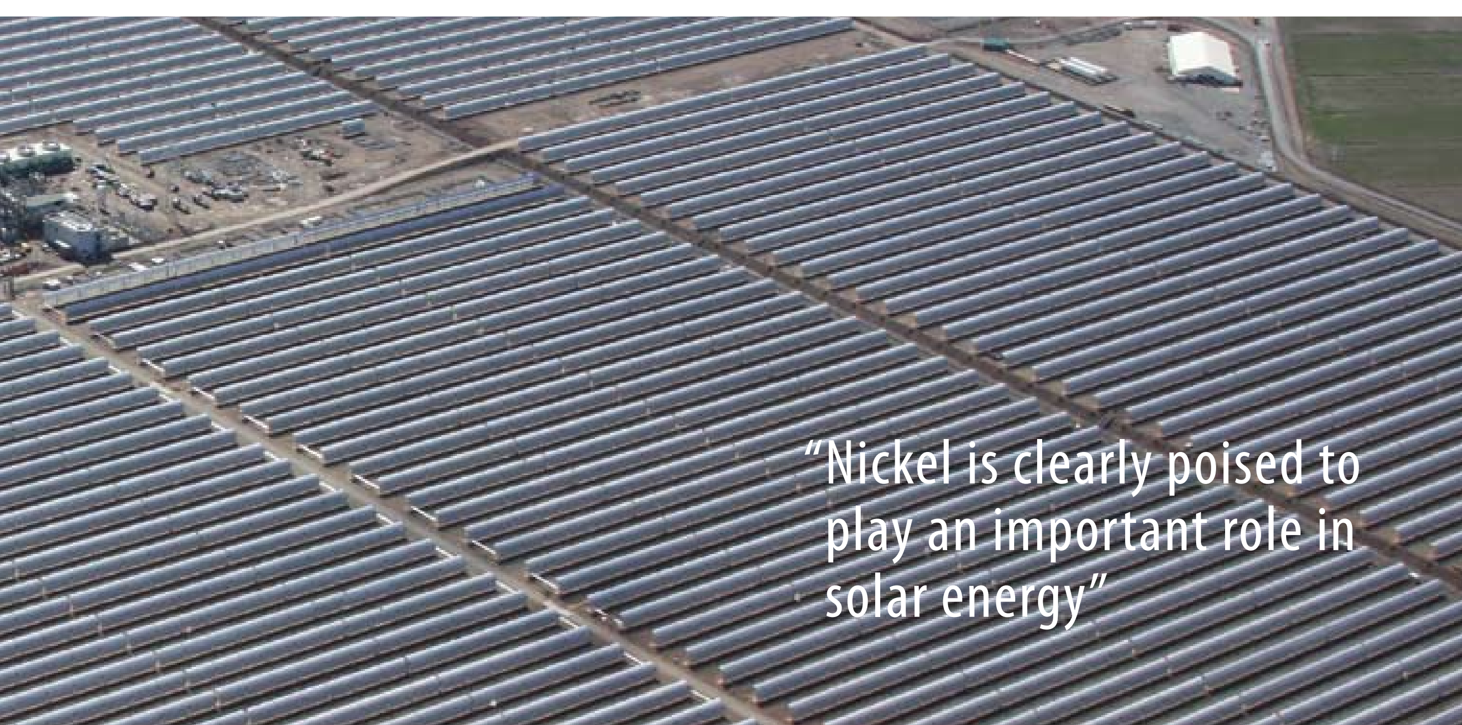
Solar tower employs stainless steel tubes in a central receiver.

SANDIA NATIONAL LABORATORIES

Dwarfing that is a projected 500-MW solar tower plant in South Africa to be built by California-based SolarReserve. Since the S31600 in the Albuquerque projects suffered from stress corrosion cracking, a decision was made to use a more resistant superalloy in the South African facility, according to Dr. Thomas Mancini, a solar power program manager with Sandia National Laboratories.

Figures vary, but Solar Millennium projects that solar thermal plants could be producing at least 20,000 MW and perhaps as much as 267,000 MW by 2040. The company adds that such plants will be able to deliver more than twice as much electricity as wind-based, photovoltaic, biomass and geothermal sources combined. Nickel is clearly poised to play an important role in the creation of that valuable source of power.

MORE INFORMATION:
www.nickelmagazine.org/solarenergy



"Nickel is clearly poised to play an important role in solar energy"

SOLAR MILLENNIUM

Stainless Steel Car Frames: The Next Generation

Austenitic stainless steels reduce the weight of individual components by about 20 percent

"Any customer can have a car painted any colour that he wants," automotive pioneer Henry Ford once famously quipped. "– so long as it is black."

Likewise, today's vehicle manufacturers could be soon producing cars and trucks with any frame the customer wants, so long as it contains plenty of stainless steel.

A consortium of European carmakers and stainless steel manufacturers has spent three years testing stainless steels for use in door pillars and other structural components of vehicle frame. The results show that stainless – particularly nickel-containing-austenitic grades which gain strength as they are formed or deformed – can replace carbon steel, saving weight without compromising the properties needed to protect occupants in a crash.

With gasoline prices on a roller coaster ride and demand growing for hybrid and fuel-efficient vehicles that cut greenhouse gas emissions, North American carmakers appear eager to change course.

"Weight costs money, it costs efficiency, and it costs fuel; it's as simple as that," says Roland Gustafsson, manager of the consortium's research project known as Next Generation Vehicle (NGV). "Every kilo you can lose results in savings over the life of the car. When you have lower weight, you can redesign other systems in the car. It's a beneficial spiral: you can reduce the engine size, you can reduce the gearbox."

The NGV project was launched in 2005 by nine companies that provided research and test facilities and brought together more than 150 engineers, scientists and software developers to explore ways to add stainless components to cars. Audi, BMW, Fiat, DaimlerChrysler, Saab Automobiles and Volvo Car joined forces with Outokumpu, ThyssenKrupp and ArcelorMittal Stainless Europe (Ugine & ALZ). The partners have so far invested 5 million euros in the project, on top of donating research time and facilities, says Gustafsson.

The results of the program were unveiled in late 2007 at the International Motor Show convention in Frankfurt, Germany. Four grades of stainless were tested to determine their suitability in carmaking based on mechanical properties, corrosion resistance, and their ability to be formed, machined and joined to other materials. Three were austenitic steels: 1.4376 (S20100), 1.4318 (S30153) and 1.4310 (S30100); the fourth, 1.4162 (S32101), was a duplex.

Stainless component under test

"The goal was to show the world it's possible to use stainless steel for this type of application," notes Eric Sörqvist, manager of research and development for Outokumpu Automotive, a division of Finnish stainless steel producer Outokumpu. Results for all four grades were excellent.

"The stainless steel lends itself well to making complicated components or components that require high localized strength levels," he says. "We know stainless steel can't replace all materials, but in certain spots and in certain applications, yes, there are advantages."

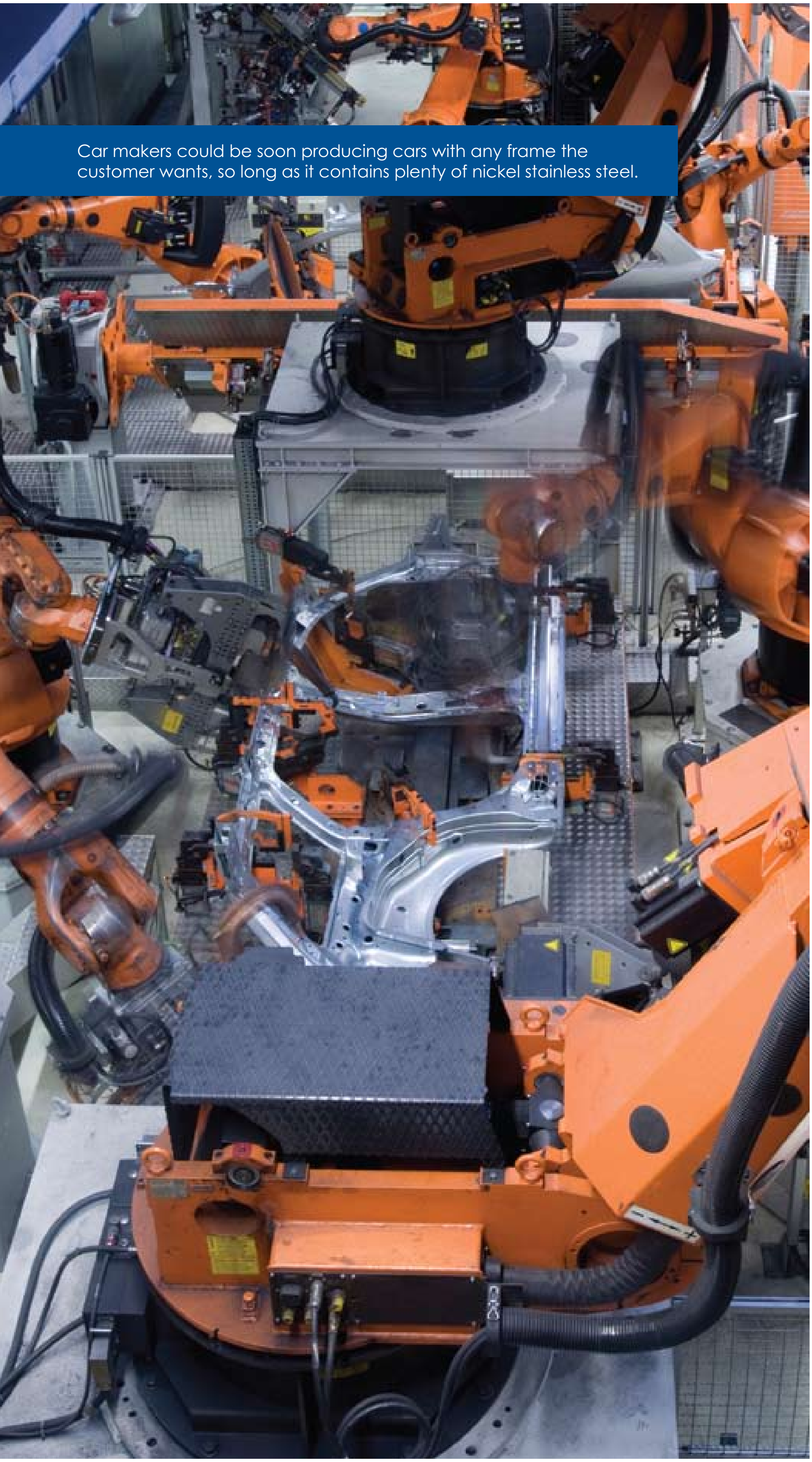
One major advantage is weight. The NGV project confirmed that replacing sections of vehicle frames with stainless can trim as much as 20 per cent off the weight of the component. Gustafsson, whose full-time position is head of Volvo Technology Corporation in Gothenburg, Sweden, says it's crucial that there be compensation for all the additional weight coming in with the next generation of vehicles. As the industry switches to building hybrid cars the weight savings achieved with stainelss compensates for the added weight of the electric motor and batteries that provide the second power source.

The austenitic grades, in particular, are well-suited to car manufacturing. They become stronger as they are hydro-formed or cold-rolled into the shape of components, and this strength is necessary to meet crash-safety standards. As well, the production processes create less scrap, saving material and reducing costs.

The NGV project showed that stainless can be welded to the carbon steels now used in car frames; as a result, carmakers can continue to use traditional metals while adding stainless where it works best. The grades tested are readily joinable with basically all other types of steels, says Sörqvist, adding that adhesives and waxes are used to prevent corrosion from developing at the joints.

Project engineers used nickel-containing stainless steel to build parts of a door post (known as a B-pillar) for a Volvo S40, confirming that the material can be formed and joined with conventional steels and is capable of withstanding crash testing. But Sörqvist says the project's most remarkable breakthrough may be the development of software programs that simulate all stages of production, taking metal through each step of forming and welding. The programs enable engineers to see how substituting grades and fabrication processes can improve the finished part.

NEXT GENERATION VEHICLE PROJECT



Car makers could be soon producing cars with any frame the customer wants, so long as it contains plenty of nickel stainless steel.

"Without the software, it wasn't really possible to simulate this in a proper way, taking into consideration the deformation hardening and the way that happens," he says. "It's a big step forward," enabling carmakers and other manufacturers to determine the best materials and applications without having to build and test parts that won't make the grade. "It's important for the use of austenitic materials in any kind of application."

As for automobiles, both Sörqvist and Gustafsson say the lighter weight of stainless steels and the fact that austenitic grades can be made stronger during forming mean it is now possible to design vehicles from the ground up, as it were.

"Weight costs money. It costs efficiency, and it cost fuel; it is as simple as that"

The next stage is to produce a prototype of a complete vehicle frame using stainless steel components. Toward that end, the NGV project is seeking North American carmakers as partners. Gustafsson says General Motors, which is struggling to cope with the global economic crisis and increased demand for fuel-efficient vehicles, has expressed interest.

"Our goal is to expand the Next Generation Vehicle project to North America," he adds. "I would love to be at the Detroit Motor Show in 2010 to show a complete vehicle structure made of these materials."

MORE INFORMATION:
www.nickelmagazine.org/nextgeneration

Adapting to Change

The nickel value chain in Canada is responsible for about 73,000 jobs and C$3.2 billion in salaries and wages

Historically, the Canadian nickel industry has contributed significantly to the country's economy and social fabric, but how significant is the industry today, how relevant will it be in the future, and how important is Canada's contribution to the global nickel industry?

A report titled Socio-economic Impact of the Nickel Industry and Nickel Value Chain in Canada, authored by PriceWaterhouseCoopers (PwC) for the Nickel Institute, goes some way toward addressing these questions. The report provides an overview of the Canadian nickel industry and outlines the industry's "value chain." Value chain analysis describes and analyzes activities needed to bring a product from inception through production to final use and disposal (or, in the case of nickel reuse).

In 2006, the base year for the PwC report, nickel reserves in Canada stood at 4.9 million tonnes or 7.65% of worldwide reserves, and Canada was the second-largest nickel producer with mine output of 233,461 tonnes of nickel in ore or 15.3% of the global total. What's more, nickel was Canada's leading mineral commodity in terms of production value.

In terms of usage, Canada ranked 19th, using only 7,500 tonnes of nickel or 0.56% of the world's total. Canadian-produced nickel was shipped primarily to the U.S., Norway and the United Kingdom for further smelting and refining.

Just as the flow of nickel can be followed through extraction, processing and production, so too can the economic transactions associated with each activity. The nickel value chain can be sub-divided into three tiers to show economic activity and its impact in Canada. These include:

- Direct Nickel Industry, which includes nickel mines, smelters and refineries as well as transport, logistical and recycling activities,
- First Use Sector, including production of stainless steel and nickel-containing alloys, plating and foundry, and
- End Use Sector, which comprises manufacturers of goods to be used by industry and consumers.

An important measure of the economic impact of Canada's nickel industry, shown by the PwC report, is the value-added contribution (which in turn is part of the nickel value chain). Value added is akin to gross domestic product (GDP) in that it reflects production activities that raise the value of a product.

The total economic impact of the nickel value chain in Canada in 2006 was $18.2 billion whereas the total value-added was $9.2 billion. This value-added component of the nickel value chain corresponded to 0.64% of Canadian GDP. The nickel value chain was responsible for about 73,000 jobs or C$3.2 billion in salaries and wages.

The Direct Nickel Industry dominated the nickel value chain in 2006, accounting for 67% of the value-added generated. The End Use and First Use accounted for 27.7% and 5.5%, respectively, of the value added.

The PwC report examines some of the challenges and opportunities faced by the nickel industry, and while these have economic implications, the (more far-reaching) social aspects should also be considered.

For example, aboriginal land claims need to be resolved before mining projects can proceed. Here, Canada's federal and provincial governments have made considerable progress establishing "final comprehensive land claim agreements" to resolve ownership issues with respect to aboriginal communities and mining companies. There is in fact a stable legal framework governing mineral development in large areas of Canada. Furthermore, efforts by mining companies and industry associations to communicate and interact with aboriginal peoples continue to bear fruit. Relations between industry and aboriginal groups have improved markedly over the past 20 years, resulting in collaborative mineral agreements and increased employment for native people. Successful agreements have proven to be win-win situations for all parties involved.

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Since the 1980s, the public, government, consumers, investors and activists have made increasing demands on mining companies. Companies have increased their efforts to protect employees' health and the environment while still generating sustainable benefits for the communities in which they operate.

The nickel industry in Canada continues to fund exploration and technology research. From post-consumer waste recycling and milling circuit technology to sulphur dioxide capture/abatement and energy efficiency projects, research has met with considerable success. Such programs support highly skilled employment and education while enabling companies to lower costs and increase efficiencies.

Economies and social systems are not static, and Canada's nickel industry, having matured and weathered previous transitions, continues to adapt.

MORE INFORMATION:
www.nickelmagazine.org/canada

The Raglan operation in northern Quebec is a model of cooperation between mining companies and aboriginal people.

XSTRATA NICKEL

The Value of Nickel Down Under

The nickel industry accounted for 45,000 Australian jobs in 2006 with associated salaries and wages of A$2.5 billion.

Australia holds the largest reserve base of nickel in the world and is the third-largest producer of nickel ore behind Russia and Canada, accounting for 12% of world mine production. And yet most of the nickel mined and refined in the country ends up at overseas destinations.

The reason is that Australia does not produce stainless steel, which is the primary use of nickel, and so the amount of nickel actually used in the country is minimal. (The amount of stainless steel imported into the country stands at around 134,000 tonnes, including 110,000 tonnes of austenitic types, for use in commercial and industrial products.)

Where, then, does all of Australia's exported nickel go?

In 2006, almost 40% of all nickel produced Down Under was shipped to China to meet that country's rapidly growing demand for stainless steel. China is now the world's largest user of nickel, with Japan and the United States ranking second and third respectively, and Australia trailing at 24th spot, according to a 2008 report by PriceWaterhouseCoopers (PwC) prepared for The Nickel Institute. The report, titled Socio-Economic Impact of the Nickel Industry and Nickel Value Chain in Australia, is based on data collected by the Australian Bureau of Agriculture and Resource Economics in 2006.

Besides China, the major markets for Australian nickel are Finland (accounting for 29% by dollar value), other European countries (11%), Japan (16%), and North America (5%).

The nickel product exported by Australia into China includes concentrates, nickel matte, and refined products. The astounding growth in China's stainless steel production is the reason that country has emerged as the key destination of Australia's nickel exports. This growth is reflected in total Asian production of stainless steel between 2001 and 2006, which rose from slightly more than 8 million tonnes to greater than 15 million tonnes.

A huge portion of Australia's nickel exports also ends up at the Norilsk-operated nickel refinery in Harjavalta, Finland. This refinery in turn supplies refined nickel products for use in stainless steel manufacturing in Finland and elsewhere.


A major exporter

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In 2006, there were 22 nickel mines operating in the country, as well as two refineries and one nickel smelter. In 2006, Australian nickel mines produced 185,000 tonnes, with 48,000 tonnes of intermediate production (including nickel matte and other smelter production) and 117,000 tonnes of refined production. Most of the mines are in Western Australia, though one of the major nickel refineries, BHP Billiton's Yabulu operation, is in the northwest of Queensland.

Some of Australia's nickel mines are among the world's largest. The Mount Keith, Murrin Murrin and Leinster operations alone account for about 60% of the country's mine production.

The US$2.2 billion Ravensthorpe open-pit mine in South West Australia recently began production and is expected to bolster the nation's nickel production significantly. At full capacity (not expected until two years from now), Ravensthorpe is projected to produce 35,000 tonnes of nickel and 1,300 tonnes of cobalt per year at a cash cost of about US95¢ per lb. of nickel. The project will use a combination of pressure-acid-leach and atmospheric leaching to process the ore. BHP is devoting significant resources to this sophisticated technology.

To meet the demands of this added production from Ravensthorpe, investments have been made to enhance capacity at the Yabulu refinery. A lateritic nickel and cobalt processing plant, Yabulu currently processes ore imported from third party mines in New Caledonia, Indonesia and the Philippines.

The nickel industry as a whole is investing considerably in nickel extraction technologies which reduce greenhouse gas emissions. The leaching process, for example, avoids the generation of gases produced by traditional nickel smelting processes. The industry is also investing in other sustainable mining technologies. Numerous nickel mining companies in Australia, for example, participate in Greenhouse Challenge Plus, a federal initiative aimed at improving energy efficiency and reducing greenhouse gas emissions.

Nickel-containing scrap is generated via the production of nickel-containing materials and products, and scrap generated at the end of a product's life. The latter is sometimes called "post-consumer waste" and includes nickel-containing products such as batteries. Since scrap materials contain highly valuable nickel, there is extensive recycling and trading of nickel-containing scrap materials.

Most of the scrap and nickel contained

The nickel industry is investing heavily in nickel extraction technologies which reduce greenhouse gas emissions.

in waste products end up as input for the production of stainless steel. This helps stainless steel producers to reduce their reliance on primary nickel by recycling stainless steel scrap.

Most of the nickel or stainless steel scrap collected in Australia is exported. According to the United Nations Commodity Trade Statistics Database, 988 tonnes of nickel contained in waste or scrap were exported in 2006. In addition, the Australian Stainless Steel Development Association estimates that 35,000 tonnes of stainless steel scrap were exported in 2006. Based on an average nickel content of 8%, nickel scrap from stainless steel would be equal to 2,800 tonnes. Combined, 3,788 tonnes of nickel scrap were exported from Australia.

"Nickel producers contribute to Australia's Economy not just by producing specialized jobs but by investing in environmental sustainability and related initiatives."

Although the volume of nickel exported abroad from Australia has stayed relatively level since 2000, total export value increased from A$3.5 billion in 2005-06 to A$8.4 billion in 2006-07. The value of these exports had been expected to moderate to A$5.8 billion in 2007-08, but that projection was made before the recent recession took hold.

Despite these setbacks, Australia's nickel industry continues to produce widespread economic and social benefits. These are estimated to be A$6.5 billion in value added, or 0.65% of Australia's gross domestic product, according to the PwC report. The nickel industry accounted for 45,000 jobs in 2006 with associated salaries and wages of A$2.5 billion.

Nickel producers contribute to Australia's economy by providing specialized jobs and contribute to the quality of life for all Australians by investing in environmental sustainability and related initiatives.

Australia is an important partner in the world nickel trade.

MORE INFORMATION:
www.nickelmagazine.org/australia

BHP BILLITON

Nickel a driving force in EU economy

Helping key industries remain competitive through innovation

A study commissioned by the Nickel Institute from an industry consulting firm in Europe has determined that the optical media, automotive, oil refining and aerospace industries (only four of at least eight major sectors that use nickel) employ a total of 18 million workers. That translates as 8.6% of total EU employment and shows that nickel, in all its commercially and industrially applied forms, underpins the competitiveness of a host of industries.

Nickel and nickel-based technologies provide a range of socio-economic benefits to the EU, chief among which are improved competitiveness, efficiency, innovation, and sustainability. For example, nickel-based electroforming, catalyst and battery technologies help the following industries to remain competitive through innovation:

Aerospace – Large complex parts of advanced composite materials moulded by nickel electroforming reduce weight, improve performance, and cut costs. (See: *Nickel Magazine*, March 2008.)

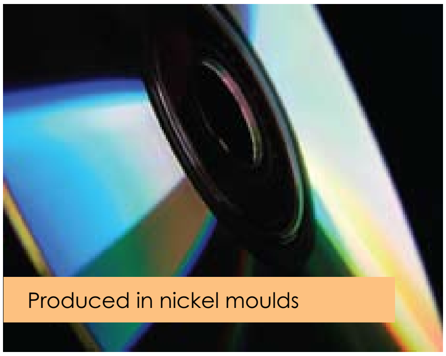
Automotive – This sector also benefits from electroforming technologies. In addition, the manufacture of hybrid cars that use nickel-based batteries is lowering emissions and expanding markets. (See: *Nickel Magazine*, March 2004.)

Oil Refining – Nickel-based catalysts for reforming, hydro-cracking and de-sulphurization broaden raw material supply options for the efficient treatment of complex feedstocks, including heavy, high-sulphur crude oils. (See *Nickel Magazine*, December 2007.)

Detergents – Catalyst technology provides access to surfactants which enable the production of concentrated products which have greater biodegradability and higher standards of washing efficiency. (See *Nickel Magazine*, December 2007.)

Power generation – Fuel cell technology that uses nickel compounds can facilitate the generation and distribution of power, as well as the co-generation of heat. Such technology could also serve as an economic and environmentally efficient way of meeting the demand for power while providing valuable export opportunities to developing nations. (See *Nickel Magazine*, November 2005.)

Optical Media – High-precision replication technologies can be achieved with nickel-based electroforming. Electroformed moulds are used to produce billions of CDs and DVDs which store music, film, games and software in the form of digital data. (See *Nickel Magazine*, May 2006.)



Produced in nickel moulds

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Banking – Nickel electroforming is used to create high-precision moulds for complex printmaking techniques in which the image is incised into a matrix or plate. This process, known as Intaglio, inhibits counterfeiting, increases the life of banknotes, and produces large numbers of small and detailed holograms for additional security. (See *Nickel Magazine*, March 2008.)

Textiles – The electroforming process is also used to produce rotary-screen drums for printing textiles, wallpaper and carpets, further contributing to the competitiveness of EU companies. (See *Nickel Magazine*, May 2006.)

> "Nickel and nickel-based technologies provide a range of socio-economic benefits to the EU, chief among which are improved competitiveness, efficiency, innovation, and sustainability."

A major benefit of these and other nickel-based technologies is the extent to which they contribute to innovation. In the entertainment industry, for example, DVD technology based on nickel electroforming has led to Blu-Ray and other new recording processes.

Taking another example, nickel-based fuel cell technology offers EU customers environmentally attractive options for small-scale, local power generation. Industry and government have supported these developments for the past 20 years; the next investment commitment by the private sector is for 3.2 billion euros, which will be matched by an additional 1.5 billion euros of public funds.

All of which demonstrates that nickel-based products are essential to many of the most important sectors of the EU economy.

MORE INFORMATION:
www.nickelmagazine.org/eueconomy

Nickel underpins the competitiveness of a host of EU-based industries

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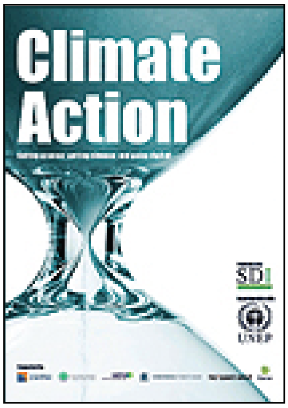
Investing in Sustainability: The Role of Nickel

The following is a brief summary of an article by Nickel Institute President Stephen Barnett that was featured in the December 2008 edition of Sustainable Development International's publication Climate Action. *It attempts to identify the sustainability challenges that the nickel industry is working on:*

Nations, corporations, cities and citizens are committing in unprecedented numbers to reducing their greenhouse gas (GHG) emissions. And while our focus is on technology and how nickel is enabling change, this would not be happening if there had not been the vital and necessary sea-change in human perception and acceptance of the necessity of change. There is a collective understanding of the need and a collective expectation that our actions must have a meaningful result.



Leading authorities from academia, government, industry and other organizations are taking urgent and innovative actions to, *inter alia*, improve the energy efficiency of buildings, electric generating plants, food production processes and transportation systems.

But behind these conceptual breakthroughs and innovative engineering are materials that are being asked to do new things in new ways. Reduced dimensional tolerances, higher operating temperatures, increased pressures, higher energy densities…all these tricks and more are needed in order to do more with less. A lot less. And, at the end of the useful life of the production plant, machine or product, the finite material that allowed them to be so productive or so light in their demands on the environment should be recoverable and fully recyclable.

Reaching these goals involves choices and trade-offs along the way. Often the materials used are fundamental to the success of the processes, products or policies that we collectively are counting on to make essential differences in how we impact the planet. In this context, it is remarkable how often nickel, in some form and quantities measured in tonnes or grams, is making a difference.

Finding, mining, concentrating, smelting and refining nickel is an energy-intensive business. While the per unit energy requirement for nickel is high, worldwide primary nickel production in 2006 accounted for only one-tenth of one percent of total GHG emissions, according to the Nickel Institute, an organization that represents primary nickel producers worldwide.

At the same time, nickel-containing materials contribute to longer product cycles and reduced emissions over multiple product life cycles. Before being able to determine the balance of advantage therefore, it is important to have comprehensive life cycle data for the nickel products. In addition, society needs to know where the nickel goes, how long it stays there, how much of it comes back into useful service time and again, and at what energy cost. Confidence in this sort of data and knowledge enables a true understanding of the return on investment and the nickel industry is working to improve the quality of knowledge and availability of data.

Whether in the production of nickel in the first place or in the typically more important use phase of nickel-containing products and infrastructure, much progress is being made on GHG reduction. Designers, engineers, architects and material specifiers looking for materials, products and processes that represent an investment in sustainability can look to nickel with confidence. And the primary nickel industry is a committed and engaged partner.

MORE INFORMATION:
www.climateactionprogramme.org/books/2008/

DESIGNED BY MARK CROZIER

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	Co	Cr	Cu	Fe	Mn	Mo	Nb	N	Ni	P	Pb	S	Si	Sn	TI	V	W	Zn	Zr	Other
N06625 p. 16	0.40 - max	-	0.10 max	-	20.0-23.0	-	5.0-max	0.50 max	8.0-10.5	3.15-4.15	-	rem	0.015 max	-	0.015 max	0.50 max	-	0.40 max	-	-	-	-	-
N07718 p. 16	0.20-0.80	0.006 max	0.08 max	1.00 max	17.0-21.0	0.30 max	rem	0.35 max	2.80-3.30	4.75-5.50	-	50.0-55.0	0.015 max	-	0.015 max	0.35 max	-	0.65-1.15	-	-	-	-	-
S20100 p. 6	-	-	0.15 max	-	16.00-18.00	-	-	5.50 7.50	-	-	0.25 max	3.50-5.50	0.060 max	-	0.030 max	1.00 max	-	-	-	-	-	-	-
S20910 p. 16	-	-	0.06 max	-	20.50-23.50	-	-	4.00 6.00	1.50-3.00	0.10-0.30	0.20-0.40	11.50-13.50	0.040 max	-	0.030 max	1.00 max	-	-	-	-	-	-	-
S30100 p. 6	-	-	0.15 max	-	16.00-18.00	-	-	2.00 max	-	-	-	6.00-8.00	0.045 max	-	0.030 max	1.00 max	-	-	-	-	-	-	-
S30153 p. 6	-	-	0.030 max	-	16.00-18.00	-	-	2.00 max	-	-	0.07-0.20	6.00-8.00	0.045 max	-	0.030 max	1.00 max	-	-	-	-	-	-	-
S30400 p. 16	-	-	0.08 max	-	18.00-20.00	-	-	2.00 max	-	-	-	8.00-10.50	0.045 max	-	0.030 max	1.00 max	-	-	-	-	-	-	-
S30464 p. 16	-	1.00 1.24	0.08 max	-	18.00-20.00	-	-	2.00 max	-	-	0.10 max	12.0-15.0	0.045 max	-	0.030 max	0.75 max	-	-	-	-	-	-	-
S31600 p. 4, 5, 16	-	-	0.08 max	-	16.0-18.0	-	-	2.00 max	2.00-3.00	-	-	10.00-14.00	0.045 max	-	0.030 max	1.00 max	-	-	-	-	-	-	-
S32101 p.6	-	-	0.040 max	-	21.0-22.0	0.10-0.80	-	4.00 6.00	0.10-0.80	-	0.20-0.25	1.35-1.70	0.040 max	-	0.030 max	1.00 max	-	-	-	-	-	-	-
S32109 p. 5	-	-	0.04-0.10	-	17.00-20.00	-	-	2.00 max	-	-	-	9.00-12.00	0.040 max	-	0.030 max	1.00 max	-	4 x C-0.60	-	-	-	-	-
S66286 p. 16	0.35 - max	0.0010 0.010	0.08 max	-	13.5-16.00	-	rem	2.00 max	1.00-1.50	3.15-4.15	-	24.0-27.0	0.040 max	-	0.030 max	1.00 max	-	1.90-2.35	0.10-0.50	-	-	-	-

Stainless Water Portal Updated

The Nickel Institute has re-launched its StainlessWater.org web portal.

Designed for the drinking, potable and wastewater treatment industry, the portal now provides significantly more information about the use of nickel stainless steels in these industries. Several new articles and presentations are available for downloading.

A presentation by Dr. Peter Cutler made at a British Stainless Steel Association meeting in June 2008, for example, is available. Entitled "Global Applications for Stainless Steel in the Water Industry," it outlines material requirements for maintaining water purity, the many attributes that nickel stainless steels provide, grade selection guidelines, several life cycle cost examples and other case histories.

Correction

In the last issue of Nickel Magazine some errors appeared in our story on earthquake testing in Japan. The story should have read as follows:

Earthquake-resistance tests have shown that stainless steel piping systems (joined by mechanical couplings) exhibit good air tightness and do not leak.

At a full-scale earthquake-testing facility, nicknamed "E-Defense," the tests were jointly conducted by Japan Stainless Steel Association (JSSA), Building Research Institute, an Incorporated Administrative Agency, and National Research Institute for Earth Science and Disaster Prevention to evaluate the earthquake resistance performance of building materials and components.

The evaluation entailed building a 21-story "skeleton" high-rise. Between the first and fourth floors, a system was built to simulate earthquake shocks on floors 5 to 21. The power of the simulated shocks was based on the strength of earthquakes anticipated to occur in the Tokai and Tonankai regions of Japan.

JSSA is working on the technical development for super durable all stainless piping system, and this development includes a research on earthquake resistance tests for stainless steel piping system for 200-year housing. Accordingly the test results greatly help JSSA to promote a broad 3-year program for expanding the life of Japanese residential high-rises. (See the March issue.)

We apologize for the errors.

COMING EVENTS

Hygienic Equipment

Welding and construction of hygienic process equipment in the pharmaceutical, bio-technology, semiconductor, personal care, food & beverage and dairy processing industries will be the topic of a 2-day conference being held in New Orleans, U.S.A., February 10-12, 2009. This Welding Research Council-EUROWELD conference is sponsored by the Materials Technology Institute, the Nickel Institute, 3-A Sanitary Standards and ASME BPE. Gary Coates, Technical Director, Nickel Institute, will chair a session on hygienic industry materials. In addition, Nickel Institute consultants Richard E. Avery and Donald Tillack will present papers. For more information, please contact: http://www.forengineers.org/conferences/WRC_CONFERENCE_BROCHURE%20.pdf

CORROSION 2009 CONFERENCE NACE International will hold its annual corrosion convention and tradeshow in Atlanta, Georgia, March 22-26, 2009. This annual event for corrosion professionals combines technical and research symposia, meetings, forums, networking and social events and a huge tradeshow of exhibitors. Of particular interest to the users of nickel alloy are sessions on bio-fuels corrosion issues, refining industry corrosion, recent experiences with corrosion-resistant materials, marine corrosion, high temperature issues and materials for the process industry and corrosion in the pulp and paper industry. For more information, please see: http://events.nace.org/conferences/c2009/index.asp

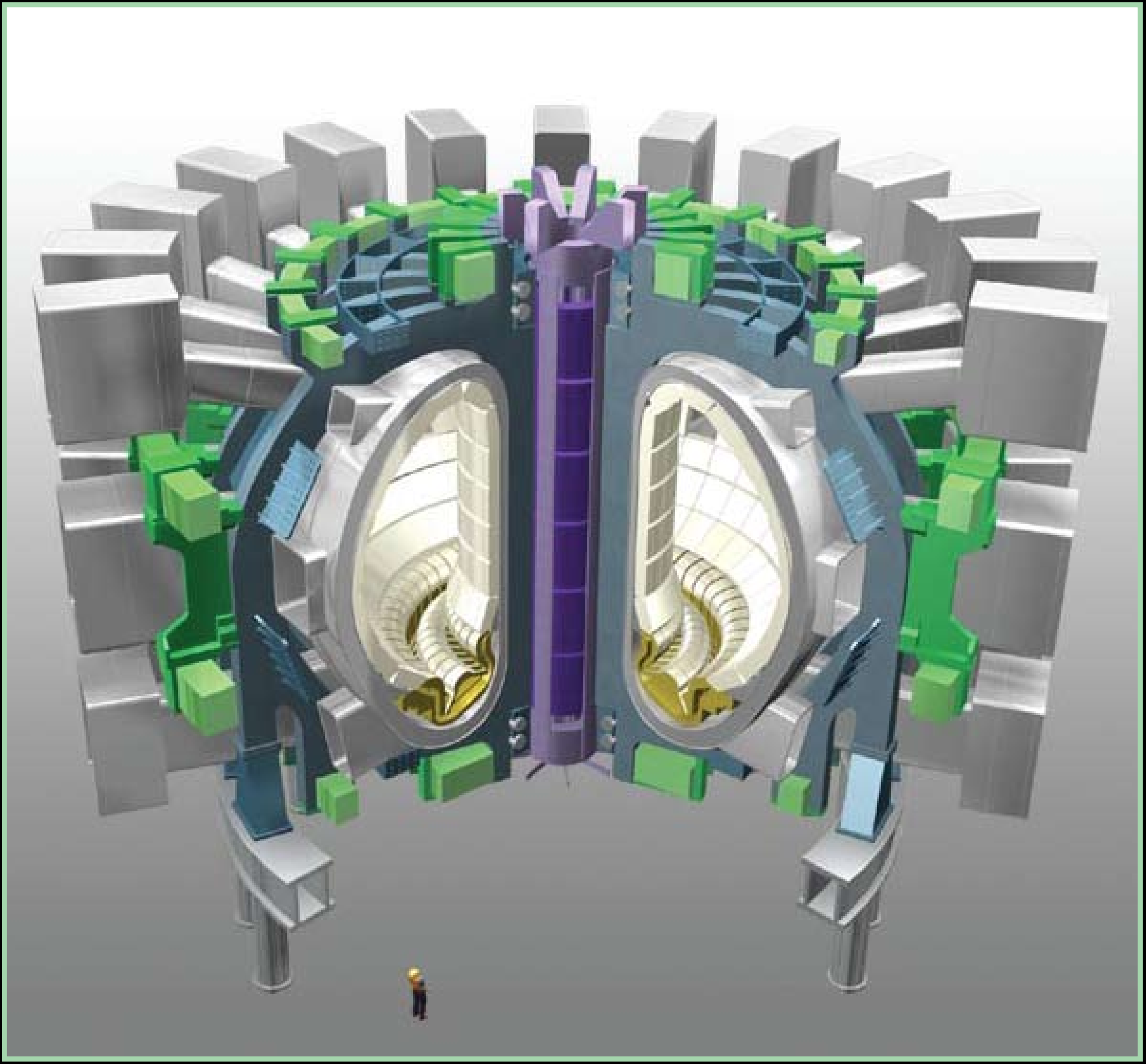
AUTOMOTIVE ENGINEERING Racing to green mobility is the theme of The Society of Automotive Engineers World Congress which will be held in Detroit, Michigan, U.S.A., April 20-23, 2009. Achieving light weight vehicles, castings design, diesel exhaust emission control, nanotechnology research, hydro forming, welding, joining and fastening are just some of the topics to be covered during the technical sessions. For more information, please see: http://www.sae.org/congress

NICKEL & CHINA The International division of Informa Australia will hold the 6th Annual China Nickel 2009 Conference in Shanghai, China on May 20-21, 2009. This annual event is an opportunity to gather information and forecasts about the nickel and stainless steel markets. For more information, please see: http://www.informa.com.au/conferences/mining/metals-minerals/china-nickel-2009

FOOD SAFETY Attendees at the National Restaurant Association show being held May 16-19, 2009 in Chicago, Il, U.S.A. can receive expert design advice for their restaurants and foodservice establishments (including stainless steel design elements) from some of the top design companies in the restaurant industry. This is just one of the many features of this event. For more information, please see: http://www.restaurant.org/show/index.cfm

METAL FINISHING The National Association of Surface Finishing will hold an important annual policy and lobbying meeting in Washington D.C., April 28-30, 2009. This event provides surface finishers with a means to learn about the new U.S. administration and Congress, receive updates on EPA and OSHA regulations, review international regulatory processes such as REACH in the EU and China's RoHS, and to discuss competitiveness issues. For more information, please see: http://www.nasf.org

SUSTAINABILITY The 5th International Conference/Industrial Ecology: Transitions Towards Sustainability will be held June 21-24, 2009 in Lisbon. Please see: http://isie2009.com/



INTERNATIONAL THERMONUCLEAR EXPERIMENTAL REACTOR

Testing the Future of Fusion

Nickel-containing materials selected for components of fusion test reactor

ITER, a joint international research and development project backed by seven partners (the U.S., E.U., Russia, China, Japan, India and South Korea), is planning to build a reactor in Cadarache, France. Known as the International Thermonuclear Experimental Reactor, it will test the concept of harnessing fusion energy to generate electricity. This monumental experiment, estimated to cost 6.2 billion Euros, will have profound implications for society. The key challenge for ITER is selecting combinations of materials that are suitable for plasma facing, heat sink and support structures.

The nickel-containing materials currently selected are as follows:

Structural Components:

- 316L(N)-IG has been selected for the vacuum vessel and ports, owing to its high minimum tensile mechanical properties (combined with good toughness). It will be used in the blanket shield modules, thin-walled tubes for first wall, cooling manifolds, and diverter body. This steel has adequate mechanical properties, good resistance to corrosion, weldability, and potential for forging and casting. It is industrially available in different forms and can be manufactured by well-established techniques.
- S30400 for the vacuum vessel ports
- S30464 (1.1% boron) and S30467 (2% boron) for neutron shielding (both of these grades contain more nickel than standard S30400 to ensure there is no ferrite in the steel)

Functional Components:

- S66286 (A-286) and S31600 for fastening components.
- S20910 (XM-19) for the diverter support.
- N07718 (Alloy 718) for bolts and diverter connections.
- N06625 (Alloy 625) for the blanket attachments.

MORE INFORMATION:
www.nickelmagazine.org/iter