Special Metals Corpora

Innovator of the future celebrat of excellence

View of the Technology Processing Center in Huntington, West Virginia USA.

At the turn of the 20th century, Ambrose Monell made a remarkable discovery: how to convert nickel and copper from ore directly into an alloy. In January 1906, he patented this process, and the world's first nickel-copper alloy, which became known as MONEL® alloy 400, is still used extensively today. To mark the 100th anniversary of that milestone invention, Special Metals Corporation is celebrating a century of innovations, many of which contributed to the expansion of the nickel alloy industry to what it is today. The future promises to continue that strong tradition of creativity and development that maintains the company at the forefront of its field.

By Joanne McIntyre & Sarah Thompson

...1906

The birth of an industry

MONEL® alloy 400

Industry's first corrosion-resistant nickel alloy

1924

MONEL®
alloy K-500
Keeping the U.S. Navy at sea

1931

INCONEL®
alloy 600
Developed for milk control now used in nuclear reactors

1940

NIMONIC®
alloy 70
Continuing to serve high-temperature turbine applications

1949

INCOLOY®
alloy 800
Setting the standard for performance in the thermal processing industry

1952

INCOLOY®
alloy 825
Industry's solution to sulphuric acid

oration:
orates 100 years

Each decade of the past century has brought its own innovations to the nickel alloy industry. Stainless Steel World talked to Special Metals Corporation (SMC) to hear how these innovations have shaped the business and what the future holds. Stan Kirk, Vice President, Sales & Marketing; Lesh Patel, Vice President for Research & Technology; Mike Simon, Corporate Manager of Product and Application Development; and Gaylord Smith, Technical Manager of New Products, outlined just what makes Special Metals a world leader in the invention, production and supply of high-nickel, high-performance alloys.

Alloys for the future

"We have a long history of innovation, and a reputation for producing high quality products," comments Mr. Kirk. "Our customers and key markets know that they will get a quality product from a group that is going to keep pace with them as their market and alloy needs evolve. Our alloys are highly engineered to offer superior heat resistance, high-temperature corrosion resistance, toughness and strength and are used in the world's most technically demanding industries and applications. This strong tradition of innovation provides a solid basis for our modern-day successes."

Forward thinking is essential in alloy development today. As Mr. Kirk explains: "The 'glory days' of first developing a new alloy and then finding an application for it are truly over, with market-driven requirements now dictating developments." Dr. Simon adds: "Most developments in alloys are now driven by the OEMs (original equipment manufacturers). In oil and gas exploration, for example, the next generation of oil wells will be deeper and subject to higher pressures and more corrosive environments, so new materials must be developed to meet these needs. The oil companies look to us for solutions. They are anticipating their requirements for the next level of investment, so our job is to develop new alloys and have them ready, fully approved, assessed and certified by the regulatory bodies in step with their developments. It's a long process; today we need to be thinking about alloys that may be needed in five years time."

An inevitable consequence for a large innovator like SMC is a new alloy displacing an old alloy, particularly if it is more cost effective or meets tougher requirements. However, SMC works closely with its customers in order to introduce new alloys that meet the evolving industry's demands. "One of our strengths over the years has been developing close working relationships with our customers," said Mr. Kirk. "As the pressure to improve efficiency and yield increases, the materials that inevitably limit their capability to perform need to be upgraded. We work closely on enhancing the performance of whatever properties are required to maintain a nickel alloy in a particular application. A whole host of our alloys are application specific having been developed in close cooperation with our customers. In fact, one of our technology department's key responsibilities is to work closely with customers to maintain a catalogue of products which meet the unique industry requirements."

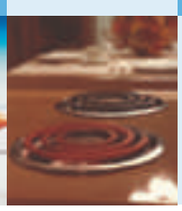
Alloys at work

These requirements are constantly changing and so is Special Metals Corporation. As a result, the number of alloys available has grown steadily. The 1970s, 1980s and 1990s were particularly innovative times for the business, with at least eight to ten alloys becoming commercially available in each of those decades. This rate of expansion has continued until today – SMC currently has two new alloys in different stages of commercialization.

Going back to the company's rich history of innovation, Gaylord Smith, Technical Manager of New Products, explains how throughout the company's history, there have been major breakthroughs in alloy development. This includes the discovery of gamma prime hardening, gamma double prime hardening, duc-

olution
acid

1962
INCONEL® alloy 718
The most widely used age hardenable aerospace alloy

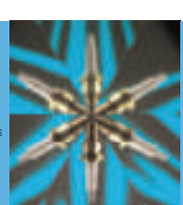


1964
INCONEL® alloy 625
Offering the widest versatility of uses in the process industries

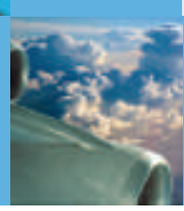
1967
INCONEL® alloy 690
The nuclear industry's solution to stress corrosion cracking

1971
INCONEL® alloy 601
Premium alloy for the thermal process industry

1972
INCONEL® alloy 706
For the land base gas turbines to supply power for the 21st century



1978
UDIMET® alloy 720
Strength and heat resistance for gas turbines



tilization of cast iron, maraging and mechanical alloying. “We have mentioned the displacement of old alloys. With such a multitude of new alloys, this is inevitable. Sometimes alloys have been invented for a certain application and prove to be extremely useful for another. For example, in early 1930s, INCONEL® alloy 600 was first adopted by the dairy and milk production industry and later it was widely used in the nuclear industry as sheathing for nuclear fuel cores. Later as an even more stress corrosion resistant alloy became necessary, INCONEL® alloy 690 was developed for this service. “Another example of this occurred in the UK in the 1940s when the first jet engine was invented. Henry Wiggin Co., now part of SMC, was approached to develop a material that was stronger than anything that already existed. The result was NIMONIC® alloy 80A, an alloy specifically designed for blade application in the early gas turbine engines. This made possible the launch of the modern jet engine industry,” explains Mr. Smith. “However, the alloy later became widely used in automobile engines,” Dr. Simon adds, “and is now a standard material for exhaust valves for every size of internal combustion engine from small motorbikes to large ships. While it’s still used in the aerospace industry, today it’s a major automotive alloy.”

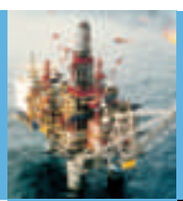
Newer alloys now dominate the aerospace industry, such as INCONEL® alloy 718, which was originally developed as a sheet alloy and is now the single most widely used bar alloy in aircraft engines for critical rotating components. In the 1970s SMC invented UDIMET® alloy 720, a higher strength version of 718, which is currently used in a number of gas turbine designs.

Dr. Patel notes: “Today engine manufacturers need a new alloy to achieve higher levels of efficiency. So we have helped one of the engine manufacturers to develop a new alloy using powder metallurgy, as conventional alloys cannot be melted to suit those needs. Now INCONEL® alloy 718 is also being widely used in the oil and gas industries because of its superior corrosion resistance under high pressure and temperature conditions.” He added, “Alloy evolution is a continuous process. As an industry develops its processes, equipment, furnaces and engines, they require better, cheaper, more corrosion resistant or stronger alloys, and we can meet that need.”

Technology Processing Centers

Although the differences between each new alloy may be slight, to those involved in the business they are significant. “Usually one specific characteristic is enhanced at a time, for instance, the grain size that determines the tensile and fatigue strength of an alloy,” explains Dr. Patel. "This feature was optimized for INCONEL® alloy 625 to improve the life of the heat recuperator used in the Abrams tank. Improvements range from a major modification of an existing alloy to an upgrade to enhance one particular property." SMC is one of the few companies with its own research and development staff capable of developing new alloys at such a rate as to meet the industry’s need in a timely basis. Helping to keep SMC at the forefront of nickel alloy development are its two pilot-scale facilities in the US in Huntington, West Virginia, and New Hartford, New York. Technology Processing Centers, known as “TPCs”, are among the best equipped pilot plant facilities in the world and form the infrastructure of SMC’s continued innovation. The facilities are outfitted with melting furnaces varying in capacity from 50 to 300 pounds and finishing equipment to make small scale products essentially driven by R&D needs. Dr. Patel explains further: “These facilities were developed to provide high-quality, cost-effective materials production and testing services in order to support rapid product and process development. Both locations also work together to supply high-integrity material production and toll services to customers for a fee. We are able to offer any kind of exotic, unusual, small compositions of products or alloys that cannot be found in small quantities anywhere else. Orders come in from all over the world.”

“The TPCs offer two things – brain power and a sufficiently sized facility to allow us to play with all the



1989

INCONEL® alloy 725
The first truly corrosion-resistant age hardenable alloy

1998

INCOLOY® alloy 864
The automotive industry's solution to hot salt corrosion

1982

INCOLOY® alloy 925
Strength and corrosion resistance for the oilfields

1991

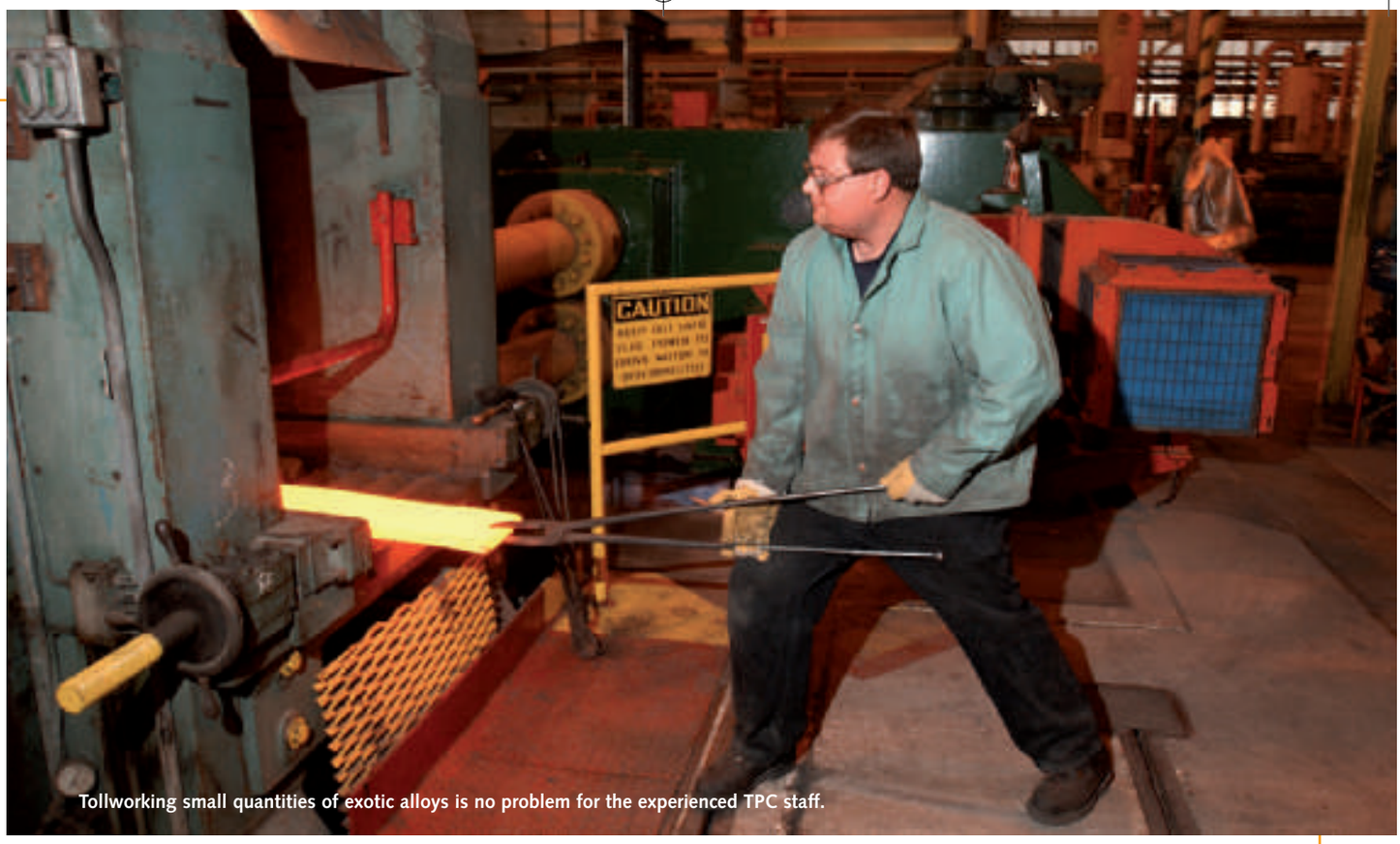
INCONEL® alloy 686
The ultimate in aqueous corrosion resistance

2005

INCOLOY® alloy 27-7MO
Corrosion resistance and strength at an economical price

2006...

Special Metals - meeting future challenges with alloy solutions



Tollworking small quantities of exotic alloys is no problem for the experienced TPC staff.

'what ifs?' you can think of," said Dr. Patel. "These facilities form the basis for continuing innovation into the future. Orders often come in from companies that have an idea for a new alloy, or a new product, which then turns into a product or an opportunity for SMC. An excellent example of this is a well-known pizza chain that asked us to make a wire composition for the internal heating elements of pizza delivery bags. This alloy was formed into a preheated wire to keep the pizzas warm. After testing the prototypes, they came back and placed a commercial-scale order with us. So the TPCs are an infrastructure for all kinds of innovation and are an integral part of the Specials Metals formula."
From pizza delivery bags to the aerospace industry, Specials Metals century's worth of discovery and innovation enables them to be the most creative force in the special alloys business today.

Infrastructure for innovation

"There are plenty of nickel-based alloys manufacturers, but only a handful are actively developing and inventing new alloys. We are at the forefront, with sufficient capability, staff and expertise," Mr Kirk said. We focus our efforts on getting the best possible return on investment of the alloy development opportunities that exist. This means working very closely with customers on specific alloy opportunities to meet their exact requirements."
This also involves continuous efforts to improve upon such strong foundations. Mr. Kirk: "Our area of focus in the coming years will be to add a higher level of manufacturing performance to our quality and innovation base. We are working on further strengthening our manufacturing, deliverability, and reliability. In the coming years we will continue to upgrade our facilities and production capabilities." This focus on continued improvement in the future has led SMC to look for new innovators to replenish the company's expertise and build on its successes of the past. The company already works with universities and researchers in national laboratories worldwide to develop alloys. It also enjoys the technology synergies of partnerships, such as the company's joint venture with Daido Steel Co. in Japan, Daido-Special Metals Ltd.

Mr. Kirk concludes: "On top of proven expertise, innovation and commitment to continuous improvements, relationships are very important in our industry. By this I mean building up a mutually beneficial relationship based firstly on trust and quality, closely followed by reliability, service and reputation. For SMC, being a trusted, reliable partner to our customers is critical."

Facts & Figures

Name:	Special Metals Corporation (SMC)
Head office:	Huntington, West Virginia, USA
Sales offices:	North America, UK, Germany, The Netherlands, India, China, Singapore, Hong Kong
Products:	Nickel and cobalt alloys as plate, sheet, strip, bar, billet, pipe, wire and welding products, etc.
Markets:	Aerospace, oil & gas, chemical and petrochemical processes, pollution control, power generation, electrical, automotive, nuclear, marine
Distributors:	Worldwide
Employees:	2,800