

NICKEL MAGAZINE

THE MAGAZINE DEVOTED TO NICKEL AND ITS APPLICATIONS

NICKEL, VOL. 38, N° 2, 2023

Transportation: nickel in motion

*India's rapid
rail advances*

*Nickel catalysts in
decarbonisation*

*Sustainable
marine fuels*





CASE STUDY 28

BRIDGE OVER WALBERT NALLA



ESDA

Location: Oshiwara District Centre, Mumbai

Project owner: Brihanmumbai Municipal Corporation (BMC)

Supplier: Jindal Stainless

Weight of stainless steel:

450 metric tonnes

Grade: Duplex 2205 (UNS S32205)

The slim peninsula of Mumbai has over 440 bridges to facilitate the connectivity of its 12.5 million citizens. The Mrinaltai Gore Flyover is a massive infrastructure project aimed at easing congestion in India's most populous city. The project has been executed in several phases. Recently an extension to the flyover, the bridge over Walbert Nalla, at Oshiwara District Centre has been constructed to meet the long term needs of this rapidly developing suburb.

Brihanmumbai Municipal Corporation (BMC), commissioned the project which was completed in 2022.

The goal was to build a new bridge that could meet the demanding conditions for decades to come including a combination of extreme weather, seawater and wastewater flowing below it. The new bridge would require a material with high corrosion resistance and high strength. Stainless steel was ideal for the challenge.

All the girders and structural

complements were made of duplex stainless steel 2205 (UNS S32205) supplied by Jindal Stainless. The grade was chosen because of its high strength and its superior corrosion resistance provided by the nickel and molybdenum content.

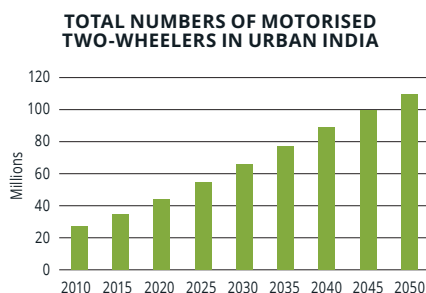
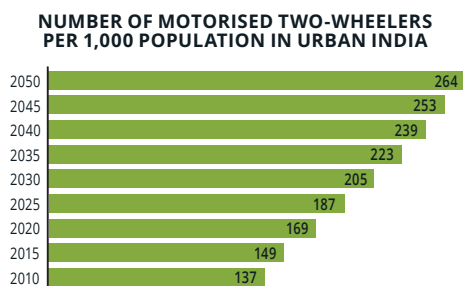
The nickel-containing stainless steel solution offers ease of maintenance over its lifetime. This makes it an economical choice and lowers the overall carbon footprint of the bridge. In total, 450 metric tonnes of stainless steel were used in the girders and structural components.



EDITORIAL: NICKEL IN MOTION

Artificial Intelligence might have helped write this editorial. That's probably not a high risk application for ChatGPT, a revolutionary technology which has become accessible in recent months. But when it comes to using AI for life or death scenarios, how accurate is the advice it gives? If you are an early adopter of AI, turn to Ask the expert on page 14 for some tips on how to use this emerging technology for material selection.

OECD

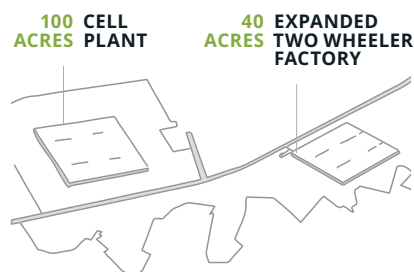


Specifying appropriate materials for the job is fundamental for achieving sustainable transport systems. In this edition of *Nickel* we look at the various contributions of our favourite metal to transportation and how it helps get people and goods from A to B in the most sustainable or lowest carbon way possible. The vital role it plays is hidden. Yet nickel brings durability and resilience to transport infrastructure, giving it a longer life and saving precious resources. In this issue we also show how nickel adds functionality to transport-related applications such as batteries for electric vehicles and catalysts in the production of renewable fuels.

A great example of where nickel helps keep things in motion is India. Read about how nickel in trains, scooters and bridges is helping to keep this vast country and its massive population mobile.

Although nickel has many roles in our everyday lives it is often overlooked. In a new series, *Why nickel?* our experts explain some of the interesting things nickel does in a way that people new to this amazing element will find accessible. Share it with the young people in your life – intelligence that is not artificial!

Clare Richardson
Editor, *Nickel*



00/ELECTRIC

Ola, a leading Indian motor scooter manufacturer is providing a solution to help shift India's most popular form of transport from petrol to electric. On page 16, read about the NMC battery and gigafactory that will help fuel the transition in the bid to combat climate change.

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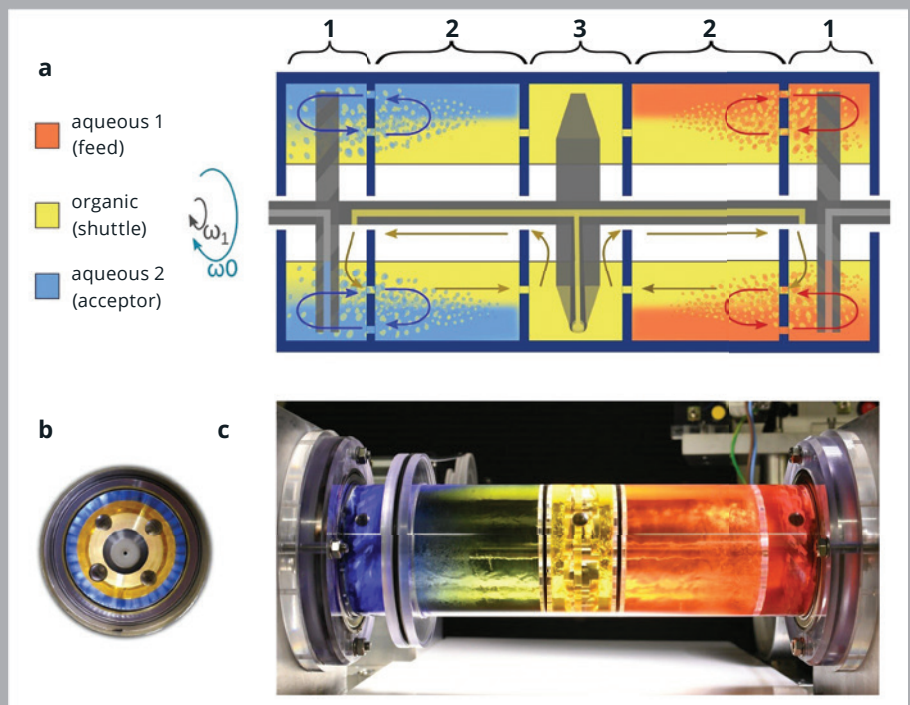
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NICKEL NOTABLES



A new spin



A research team at the Institute for Basic Science (IBS) in South Korea has created a new method to recycle valuable metals such as lithium, nickel, and cobalt from used lithium-ion batteries, using a horizontally rotating reactor that processes complex metal mixtures in a single vessel. Unlike other reactors that use membranes, this reactor can be vigorously stirred without mixing the different liquids. This process can perform the separation of metals in a matter of minutes. The study found that using the concentric liquid reactor can extract valuable metals from used batteries more efficiently and with less extractant than current methods and also works under a wider range of conditions.

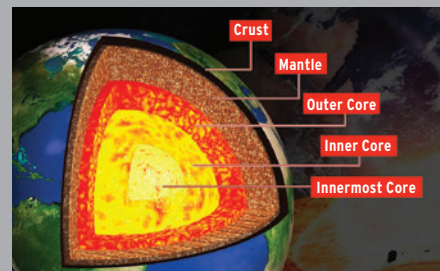
Meteoritic find

A team from the UK's University of Cambridge, working with colleagues in Austria, has found a new way to make a possible replacement for rare-earth magnets: tetrataenite, a 'cosmic magnet' that takes millions of years to develop naturally in meteorites. Professor Lindsay Greer explains "synthetic tetrataenite offers the potential of rare-earth-free permanent magnets made from the elements nickel, iron and phosphorus, which are found in abundance in the Earth's crust and thus avoids the need to extract a huge amount of material to get a small volume of rare earths. The addition of phosphorus enables tetrataenite to be produced within seconds." This could play an important role in low-carbon technologies, such as high-performance permanent magnets used in EVs.



WIKIMEDIA COMMONS

A fifth layer

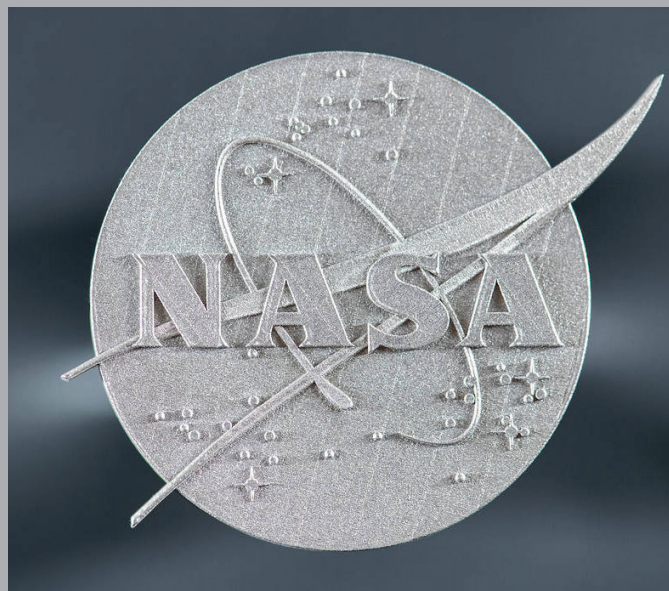


AUSTRALIAN NATIONAL UNIVERSITY

A team at Australian National University (ANU) has found evidence that planet Earth has a fifth layer, a solid iron-nickel alloy ball in the inner core. The scientists found the hidden core by studying seismic waves that travel up to five times across the Earth's diameter - previous studies only looked at single bounces. The earthquake waves probed places near the centre at angles that suggested a different crystalline structure deep inside. The findings published in the journal *Nature Communications*, states that probing the Earth's centre is critical for understanding planetary formation and evolution. The ANU researchers believe the innermost core could help explain the formation of the Earth's magnetic field.

New alloy blasts off

A team of innovators from NASA and Ohio State University have demonstrated a major breakthrough; a new 3D printable alloy for extreme environments. Called GRX-810, it is composed of nickel, cobalt and chromium. It could lead to stronger, more durable parts inside aircraft and spacecraft engines. Termed a "nano-scale oxide dispersion strengthened (ODS) alloy," GRX-810 can withstand temperatures over 1,080°C (2,000°F). Tiny particles containing oxygen atoms are spread throughout the alloy to enhance its strength, withstanding harsher conditions before reaching their breaking points. "This new alloy is a major achievement," says Dale Hopkins, deputy project manager of NASA's Transformational Tools and Technologies project.



NASA

FULL SPEED AHEAD

NICKEL IN INDIA'S RAPIDLY EXPANDING RAIL NETWORKS

RAIL



22 million
passengers
daily



3.5 million
tonnes of
freight daily



INDIAN RAILWAYS

Nickel-containing stainless steels offer unmatched advantages in terms of strength, durability, energy efficiency, and reduced maintenance requirements.

From metro to mainline, Indian Railways (IR) is one of the world's largest rail networks under a single administration, handling over 22 million passengers and approximately 3.5 million tonnes of freight daily. It is recognised as one of the world's largest commercial employers, with over 1.6 million employees. To keep up with the pace of change from population growth, urbanisation, and industrialisation, the Indian rail sector is undergoing rapid development, aiming to create a faster, more efficient, and expansive network. The ambitious future of India's rail infrastructure requires prudent investments that ensure its long-term viability. This is where nickel-containing steels play a vital role.

The modernisation of India's rail system, both metro and mainline, encompasses various aspects. These include increasing the speed of both freight and passenger systems, electrifying the entire network, and rapidly expanding rail lines within and between cities. Such a monumental shift necessitates the adoption of innovative train technologies and the development of stations and platforms on an unprecedented scale.

Metros multiplying in major cities

First opened in Delhi in 2002, metro rail systems have become a common sight in almost all major Indian cities, either operational or in various stages of construction. These metro systems rely extensively on unpainted austenitic stainless steels, with nearly 100% of metro coach shells made from

nickel-containing steels. These materials that offer lightweight, high-strength construction with exceptional durability and resilience. Each metro coach incorporates approximately 8 tonnes of Type 301LN (UNS S30153) stainless steel, exhibiting cold-worked yield strength levels ranging from 345 to 690 MPa (50 to 100 ksi). The benefits include reduced weight, enhanced energy efficiency, elimination of painting requirements, and significantly decreased maintenance needs.

Already, more than 3,000 metro coaches are in operation, with an additional 3,000 coaches scheduled to be added within the next three to five years. To meet this surging demand, three metro rail coach factories are in operation, two are in advanced stages of

construction, and two more are in the planning phase. These developments position India to potentially become a global hub for metro coach manufacturing.

Stainless steel in every station

The Indian metro network currently comprises 660 functional stations, with a further 228 under construction and 213 in the planning phase. In addition, another 500 stations will be built in the foreseeable future. Given that metro systems operate extensively throughout the day, maintenance of the infrastructure, particularly

the stations, becomes a costly and challenging task.

To minimise maintenance requirements and increase serviceability and lifespan, the use of nickel-containing stainless steels is highly recommended for railing systems, cladding, canopies, counters, signage, and various other utility functions. Tenders for all such applications specify the use of Type 304 (S30400) stainless steel.

To date, metro stations completed or under construction, have required about 30,000 tonnes of stainless steel.

The ongoing construction of new metro rail systems is rapidly transforming more than 20 Indian cities. Presently, Indian cities boast over 840 kilometres of operational metro routes, with an additional 480 kilometres under construction and approved plans for another 375 kilometres. Furthermore, approximately 1,060 kilometres of proposed routes are being considered for future development.



METRO

8 tonnes of Type 301LN stainless steel per coach



3,000 current stainless steel coaches

3,000 new stainless steel coaches in the next 3-5 years

840 km of current metro routes



480 km under construction

375 km proposed

660 current stations



228 stations under construction

213 stations planned

RAIL



60,000 current rail cars
7,000 rail cars in production
7,800 rail cars in 2024



29,000 tonnes of Type 304
nickel-containing stainless
steel each year
3,600 tonnes of Type 316L
for accessories



8,000 current stations
100 stations currently under
redevelopment
1,275 stations identified for
redevelopment



Mainline moves into high production

Mainline trains are a critical sector of Indian rail, facilitating passenger and freight haulage between cities. This part of the network operates over 60,000 rail cars.

Since 2018, Indian Railways has exclusively employed stainless steel for all of its coach production, including mainline and fast trains. Components prone to corrosion, such as the roof, trough-floor, toilet inlay, bio-toilet digester, water storage tanks, and entrance gangways, are all manufactured using nickel-containing austenitic grades of stainless steel. The side and end panels utilise utility stainless steels that are painted based on coach category requirements.

Indian Railways recently announced its annual coach production program, projecting an increase in stainless steel demand. This year, a total of 7,000 coaches are in production, with plans for 7,800 coaches next year. This will require over 29,000 tonnes of nickel-containing Type 304 stainless steel a year. An additional 3,600 tonnes of Type 316L (S31603) stainless steel will be used for accessories in coaches, such as bio-digester tanks.

As new coach designs are developed and the government's focus shifts towards reducing weight, temper-rolled nickel-containing austenitic stainless steels for side walls are being considered. This will expand their share in the market over the next two years.

Large scale redevelopment plans

With around 8,000 mainline and other train stations in India, a

comprehensive redevelopment plan was established to prioritise construction projects. Approximately 100 stations are undergoing redevelopment as self-sustaining commercial real estate ventures. Notably, major railway stations in Delhi, Ahmedabad, and Mumbai are undergoing redevelopment with a combined investment of over USD 1.25 billion. Extensive work is underway at five other prominent stations. In these large-scale government projects, nickel-containing stainless steels are the preferred choice for facades, railing systems, and various amenities due to their corrosion resistance, durability, ease of fabrication, and low or minimal maintenance requirements.

Earlier this year, Indian Railways announced the Amrit Bharat Station Scheme, identifying a further 1,275 railway stations across the country for redevelopment. With a budgetary outlay of USD 30 billion for the next fiscal year, it is anticipated that nickel-containing stainless steel will play a prominent role in these developments. This will ensure that India's vital rail network continues to provide sustainable solutions to the challenges of urbanisation and industrialisation in the world's most populous nation.

As India's rail infrastructure expands, incorporating nickel-containing materials becomes increasingly crucial. It ensures the long-term sustainability and success of the rail network, supports the nation's economic growth, and meets the demands of its burgeoning population. **NI**

The utilisation of nickel in India's rail sector is indispensable for its transformation into an efficient and resilient network that will serve the nation for decades to come.

NICKEL CATALYSTS

THE MANY ROUTES TO DECARBONISING TRANSPORT

Nickel-based catalysts are key to supplying energy to power our transportation of goods and people, whether by land, sea, or air. In addition to their role in the production of biodiesel, renewable diesel and SAF (sustainable aviation fuel), nickel catalysts are used for water electrolyzers for hydrogen production. Hydrogen can then be burned directly, used in fuel cells, used to hydrotreat other renewable fuels, or be converted to another fuel such as methanol or ammonia. Hydrogen can also be used in the net-zero production of other chemicals, or for production of steel from iron ore.

Electrolysers

AEM Anion exchange membrane

AWE Alkaline water electrolyser

PEM Polymer electrolyte membrane/
Proton-exchange membrane

SOEC Solid-oxide electrolyser cell

Electrolysers and fuel cells

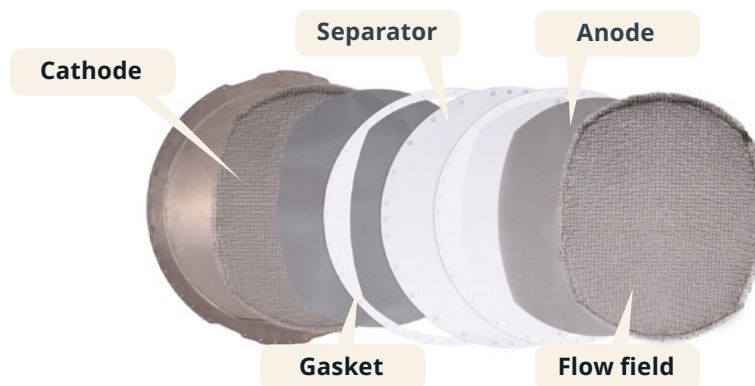
Electrolysers split water into oxygen and hydrogen. A fuel cell is an electrolyser in reverse, combining oxygen and hydrogen into water to produce electricity. When produced using renewable energy, this is called “green” hydrogen, and the International Energy Agency predicts that demand for it will explode over the next 25 years.

There are four types of electrolysers available today: polymer electrolyte membrane (also known as proton-exchange membrane,

PEM), alkaline water electrolyser (AWE), anion exchange membrane (AEM), and solid-oxide electrolyser cell (SOEC). While PEM electrolysers are the most efficient, they require the use of platinum and iridium as electrocatalysts, while the other three technologies use nickel-based electrocatalysts. Of the nickel-containing types, AWEs are the most commercially advanced. In AWEs, nickel is found in the anode, the cathode, and in the flow field components of the electrolyser cell.

Expanded view of AWE cell

In AWEs, nickel is found in the anode, the cathode, and in the flow field components of the electrolyser cell.



The flow field consists of a loose nickel mesh, to allow for easy transport of electrolyte and evolved gases. The anode is typically an engineered nickel mesh consisting of sintered fibres, while the cathode is a similar nickel fibre mesh coated with a catalyst. These catalysts are proprietary to the supplier, but NiFeOx is commonly used.

Pros and cons of different catalysts

The relatively low capital cost of AWEs has led to their increasing use, but in order to minimise production costs and meet the demand for renewable electricity, AEMs and SOECs are being introduced. AEMs have the benefit of higher electrical efficiency compared to AWEs, while using similar materials, and so are often thought of as an intermediate between AWEs and PEMs. Like AWEs, AEMs use nickel meshes to control flow and to deliver current, and also use nickel catalysts. In contrast to the relatively simple catalysts used in AWEs, AEM catalysts tend to be

more highly engineered. Proposed anode catalysts showing high performance include NiFe double layered hydroxides supported on carbon paper and NiCoSe alloys supported on Ni foam. Cathode catalysts tend to be NiFe and NiCo alloys supported on Ni mesh.

SOECs operate at very high temperatures (>600 °C) and offer high efficiency with the ability to integrate waste heat into industrial applications. In SOECs, the electro-catalyst, often Ni metal particles, is supported directly on the electrolyte, which is a metal oxide that becomes conductive to ions at the high operating temperature.

Irreplaceable nickel

These are just examples of the role that catalysts and other components using nickel will play in a decarbonised future. Nickel's relatively low cost, inertness to caustic substances, and specific performance features in electrolyzers make it an irreplaceable part of these emerging technologies. Ni

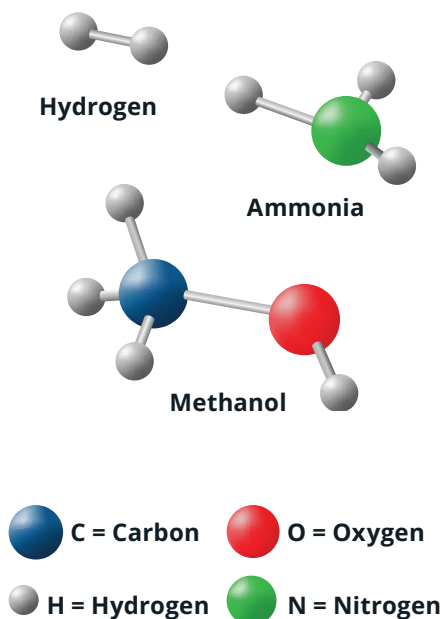
North America's first hydrogen-powered passenger train made its debut in 2023 on a route from Quebec City to Baie-Saint-Paul.



NAVIGATING THE DEVELOPMENT OF SUSTAINABLE MARINE FUELS



Nickel-containing stainless steels are essential in the production of sustainable marine fuels.



As the International Maritime Organization (IMO) aims to reduce total greenhouse gas emissions (GHG) by at least 50% by 2050, nickel-containing stainless steels will play an important role in the options being considered. To meet this target the marine industry needs low-carbon, carbon-neutral and zero carbon fuels. The three primary choices are hydrogen, ammonia, and methanol. Methanol is the easiest to handle as it is a liquid at room temperature, while ammonia and hydrogen are liquids at minus 33 °C and minus 253 °C, respectively.

Hydrogen

Hydrogen could be used as a fuel through combustion or electricity generation via a fuel cell. However, storage of liquid hydrogen at minus 253 °C is more complex, and its low volumetric energy density requires larger tanks than would be required for methanol and ammonia. Hydrogen as a fuel might be viable if dedicated marine tankers could be built where the hydrogen cargo also provides the fuel for the ship.

Currently hydrogen is produced by steam reforming of natural gas. In order for it to be carbon-neutral or zero-carbon requires production by electrolysis of water using renewable energy or nuclear, or by steam-reforming but including carbon capture.


The specific properties of hydrogen place high demands on the materials. For example, nickel-containing stainless steel is resistant to permeation and degradation of its properties by hydrogen, and storage of hydrogen at minus 253 °C requires the toughness of nickel-containing stainless steel at extreme cryogenic temperatures.

Ammonia

Ammonia has stimulated a great interest. Though highly toxic, it is routinely handled in the production of nitrogen-based fertiliser. Planned projects to use ammonia as a direct replacement in internal combustion engines include conversion of an existing tugboat to ammonia from LNG by Japan's NYK and Viking Energy's switch to an ammonia fuel-cell for an offshore supply vessel. Ammonia is produced by the Haber process which is the reaction of atmospheric nitrogen with hydrogen using a metal catalyst under high temperatures and pressures. Nickel-containing stainless steel is essential at several points in the process.

Methanol

Methanol is currently used as a marine fuel, but is a carbon-based fuel produced from natural gas. Though carbon-neutral methanol can be produced from biomass, technology also exists to produce methanol by reaction of carbon dioxide and hydrogen.

As development continues, nickel-containing stainless steels are essential in the production of sustainable marine fuels to reduce GHG. 

100 YEAR ANNIVERSARY FOR TYPE-B NICKEL-BASE (Ni-Mo) ALLOYS

Prior to the introduction of the workhorse C-family of nickel-base alloys (Ni-Cr-Mo) in the early 1930s, work had been conducted on nickel-molybdenum alloy compositions. This resulted in the award of a patent, in 1921, for a nickel-molybdenum alloy composition range, which ultimately led to the introduction of Alloy B (Ni-Mo) in 1923 with a nickel content of 60% and nearly 30% molybdenum.

B-type alloys possess exceptional resistance to reducing acids, such as hydrochloric, sulphuric, acetic, and phosphoric. Unfortunately, B-type alloys have poor corrosion resistance to oxidising environments. Hence, they are not recommended for use in oxidising media or in the presence of ferric or cupric salts which may cause rapid premature corrosion failure. These salts may develop when hydrochloric acid comes in contact with iron and copper.

Prior to the Second World War, Alloy B was used in supercharger turbine blades in aircraft engines to boost performance and increase horsepower. This application was eventually replaced by other superalloys.

Alloy B-2, introduced in the 1970s, was a modification of the original

B composition. It featured reduced silicon and carbon content, to improve thermal stability and resist the formation of grain boundary carbides. This improvement in corrosion resistance was particularly beneficial in the heat-affected zone after welding.

The composition was additionally optimised in Type B-3 to further enhance thermal stability and fabrication characteristics and resistance to stress corrosion cracking.

Molybdenum primarily provides the corrosion resistance to acidic reducing environments, but it is the nickel-base that provides the foundation for an engineering alloy that can be easily fabricated and welded into industrially useful equipment.



The B-type alloys have been used mainly in hydrochloric and sulfuric acid environments, as well as in acetic, phosphoric, and formic acids. Specific applications include reaction vessels, heat exchangers, valves, pumps, and piping.

Ni

Typical composition of the B-family alloys								
Alloy	(UNS)	Introduction	Ni	Mo	Cr	Si max	Fe	C max
B	(N10001)	1923	bal	28	1	1	5	0.05
B-2	(N10665)	1970s	bal	28	1	0.10	2	0.02
B-3	(N10675)	1990s	bal	28	2	0.10	2	0.01



ASK AN EXPERT FAQ FROM THE NICKEL INSTITUTE TECHNICAL ADVICE LINE

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

<https://inquiries.nickelinstitute.org/>

Q: How confident should I be in responses about properties and applications of nickel-containing materials that are generated by AI, such as ChatGPT?

A: ChatGPT is a Large Language Model, developed by OpenAI. It is trained using several datasets, the majority of which are web-based, but its training is non-supervised versus supervised, which would require guidance by subject matter experts and be incredibly costly and time consuming. AI generates its response by predicting the next word in a sequence based on probability. Since its results are based on probability it cannot reference the source of the data in its response. Thus, ultimately the quality of the response is dependent on the quality of the information provided during training.

Most information about nickel-containing materials is located behind paywalls, in publications

that are not freely available digitally or is the knowledge of subject matter experts. Nickel Institute publications are digitised and thus searchable, but to the best of our knowledge are not incorporated into the datasets used to train ChatGPT. These publications are freely available on our website: nickelinstitute.org.

We have tested ChatGPT with a number of simple questions and have been impressed by the responses. But in all cases, there are errors. Even OpenAI admits that answers can sometimes be misleading or inaccurate. Thus, responses can be helpful in guiding where to focus a search for information but should not be relied upon as the final word. **Ni**


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Nickel can be found in many forms from nanowires to stainless steel alloys. But what are the properties of nickel that make it an essential element in everyday objects?

Why nickel?

NICKEL IN YOUR TOASTER HEATING ELEMENTS

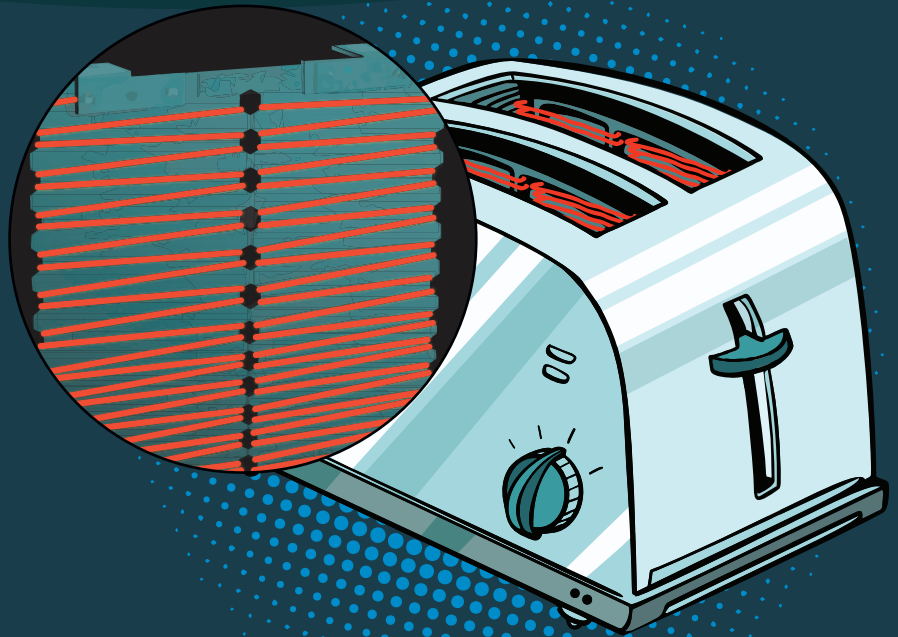
The common toaster

In countries where bread is commonly eaten and is often sold as sliced bread, most homes have an electric toaster in the kitchen. The toaster heats the bread to create a golden brown, crispy outer layer, changing both texture and taste.

But how does it work?

The heat comes from small diameter wires through which electricity is passed. Their high resistance to the electric current causes them to glow red, but the heat comes from the infrared waves, which we feel as heat, but cannot see with our eyes.

These wires are made of an alloy most often called nichrome, which contains about 80% nickel and 20% chromium. In use, the wires become extremely hot – up to 620 °C (1150 °F). However the air around the bread may only be 150 °C (300 °C), still hot enough to burn your fingers.



Why nickel?

The nickel in nichrome is needed to keep the wire from becoming brittle over the thousands of times it is heated and cooled. The combination of nickel and chromium gives the high electrical resistivity necessary to heat up rapidly and stay hot. The chromium allows the wire to resist reacting with the oxygen in the air, so doesn't lose thickness over time.

UNS DETAILS

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

UNS	C	Cr	Fe	Mn	Mo	N	Ni	P	S	Si
S30153 pg 6	0.03 max	16.0- 18.0	bal	2.00 max	-	0.07- 0.20	6.0- 8.0	0.045 max	0.030 max	1.00 max
S30400 pg 7	0.08 max	18.0- 20.0	bal	2.00 max	-	-	8.0- 10.5	0.045 max	0.030 max	1.00 max
S31603 pg 9	0.030 max	16.0- 18.0	bal	2.00 max	2.00- 3.00	-	10.0- 14.0	0.045 max	0.030 max	1.00 max
S32205 pg 2	0.030 max	22.0- 23.0	bal	2.00 max	3.00- 3.50	0.14- 0.20	4.50- 6.50	0.030 max	0.020 max	1.00 max
N06003 pg 15	0.15 max	19.0- 21.0	1.00 max	2.5 max	-	-	bal	-	0.01 max	0.75- 1.6



INDIA MOVING TO EV POWER

OLA ELECTRIC



Ola Electric says it is “committed to its mission of building mobility for a billion people” announcing ‘Mission Electric’, their pledge to support that no petrol two-wheeler be sold in India after 2025. Mass switching to electric scooters will have a significant positive impact on the climate crisis.

It’s the country’s most popular and convenient mode of personal transportation accounting for over 80% of vehicles on the road. Government subsidies sparked the switch from fossil fuels to electric and India now has more than 1.3 million EV two-wheelers on their bustling streets. That’s just 4.6%, with an ambitious goal of 80% in the next seven years.

One of the leading EV scooter manufacturers, Ola, is aiming to help grow the EV scooter production exponentially. According to Bhavesh Aggarwal, founder and CEO, Ola Electric “A cell is the heart of the EV revolution. Ola is building the world’s most advanced cell research centre that will enable us to scale and innovate faster and build the most advanced and affordable EV products in the world with speed.”

Ola Electric unveiled India’s first indigenously developed lithium-ion cell, NMC 2170 in July 2022.

Previously, India’s EV companies

were dependent on cells from Korea, Taiwan, China, and Japan.

Says Aggarwal “The state-of-the-art High Nickel Cylindrical Ola Cell uses NMC on the cathode side; and graphite and silicon on the anode side. The use of specific chemistry and materials enables the cell to pack more energy in a given space and also improves the overall life cycle of the cell. Which means it can go further on a single charge.”

Built in-house, Ola will begin the mass production of its NMC 2170 cell from when its gigafactory opens later in 2023.

Ni