

Nickel

Symbol	Ni
Atomic Number	28
Atomic Weight	58.6943
Melting Point	1728 K (1455°C or 2651°F)
Boiling Point	3186 K (2913°C or 5275°F)
Number of Protons/Electrons	28
Number of Neutrons	31
Density	8.912 g/cm ³ at 25°C
Classification	Transition Metal
Crystal Structure	Cubic
Phase at Room Temperature	Solid
Appearance	Lustrous, metallic, silvery tinge



HISTORY:

The use of nickel can be traced back many centuries - as far as 3500 BC. Bronzes from what is now Syria had a nickel content of up to two percent. Chinese manuscripts suggest that "white copper" was used in the Orient between 1400 and 1700 BC. It is also believed that some alloys were produced in prehistoric times. However, because the ores of nickel were easily mistaken for ores of silver, any understanding of this metal and its use dates to more contemporary times.

In 1751, Baron Axel Frederik Cronstedt was attempting to extract copper from kupfernickel (now called niccolite) and obtained instead a white metal that he called nickel. The name nickel comes from the German language and means "*Old Nick*," a name for the devil. Kupfernickel means "*Old Nick's copper*."

OCCURRENCE

Nickel is a transition element that exhibits a mixture of ferrous and nonferrous metal properties. It is both siderophile (i.e., associates with iron) and chalcophile (i.e., associates with sulphur). The bulk of the nickel mined throughout the world comes from two types of ore deposits:

- laterites where the principal ore minerals are nickeliferous limonite [(Fe,Ni)O(OH)] and garnierite (a hydrous nickel silicate), or
- magmatic sulphide deposits where the principal ore mineral is pentlandite [(Ni,Fe)₉S₈].

Nickel sulphide deposits are generally associated with iron- and magnesium-rich rocks called ultramafics and can be found in both volcanic and plutonic settings. Many of the sulphide deposits occur at great depth. Laterites are formed by the weathering of ultramafic rocks and are a near-surface phenomenon and are the ore deposits mined by Minara Resources Limited for processing at its Murrin Murrin plant.

Most of the nickel on Earth is believed to be concentrated in the planet's core. Nickel is present in most meteorites and it is also found in trace amounts in plants and animals.

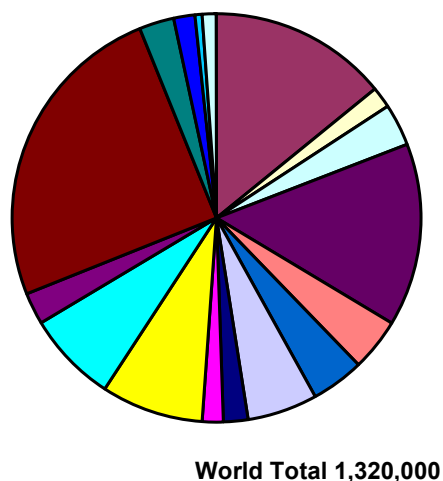
As at January 2003, the US Geological Survey reported that the world mine production, reserves and reserve base were as follows:

Nickel – World Mine Production, Reserves and Reserve Base

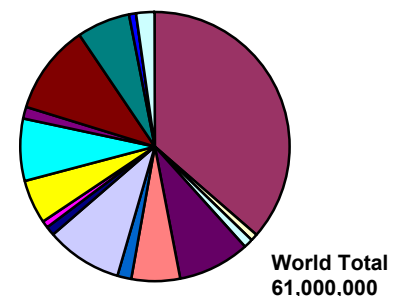
Country	Mine Production		Reserves	Reserve Base
	2001	2002		
Australia	197,000	186,000	22,000,000	27,000,000
Botswana	26,200	23,200	490,000	920,000
Brazil	45,400	44,900	670,000	6,000,000
Canada	193,361	188,000	5,200,000	15,000,000
China	51,500	55,700	3,600,000	7,600,000
Colombia	52,962	55,400	900,000	1,100,000
Cuba	70,662	73,100	5,600,000	23,000,000
Dominican Republic	31,000	24,300	690,000	1,000,000
Greece	20,830	22,400	490,000	900,000
Indonesia	102,000	105,000	3,200,000	13,000,000
New Caledonia	117,554	98,200	4,400,000	12,000,000
Philippines	27,359	31,800	940,000	5,200,000
Russia	325,000	328,000	6,600,000	9,200,000
South Africa	36,443	38,000	3,700,000	12,000,000
Venezuela	13,600	20,600	610,000	610,000
Zimbabwe	8,145	9,690	15,000	260,000
Other Countries	9,240	13,700	1,300,000	5,100,000
Total (tonnes)	1,330,000	1,320,000	61,000,000	140,000,000

- Australia
- Botswana
- Brazil
- Canada
- China
- Colombia
- Cuba
- Dominican Republic
- Greece
- Indonesia
- New Caledonia
- Philippines
- Russia
- South Africa

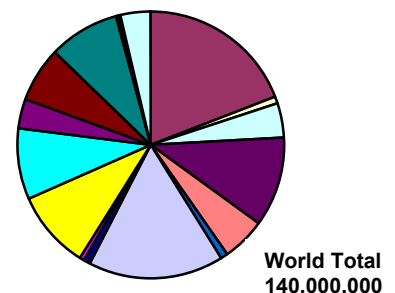
World Nickel Production 2002



World Mine Reserves - Nickel



World Mine Reserve Base - Nickel



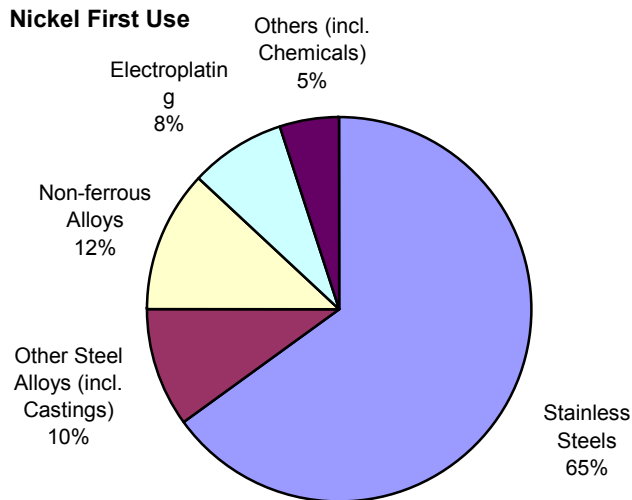
APPLICATIONS

Nickel is a hard, malleable, ductile, lustrous, silver-white metal that takes a high polish. It conducts heat and electricity and is slightly magnetic. In its magnetic properties and chemical activity it resembles iron and cobalt, the elements preceding it in group VIII of the periodic table. It is a fairly good conductor of heat and electricity. It forms numerous compounds, many of them

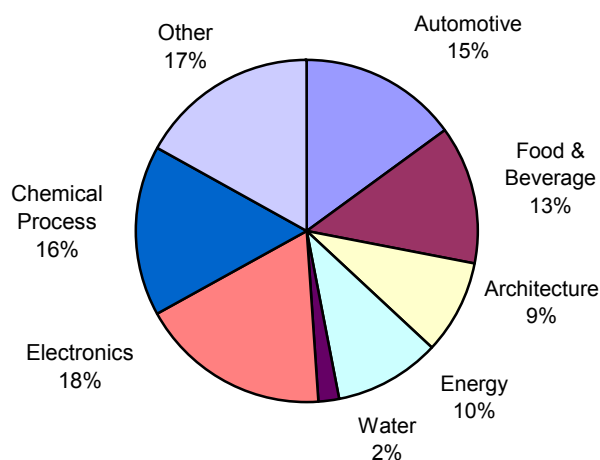
blue or green, and finely divided nickel can adsorb hydrogen. Adding nickel to glass gives it a green colour. A single kilogram of nickel can be drawn into 300 kilometres of wire.

Nickel is primarily sold for first use as refined metal (cathode, powder, briquette, etc.) or ferronickel. About 65% of the nickel consumed in the Western World is used to make austenitic stainless steel. Another 12% goes into superalloys or nonferrous alloys. Both families of alloys are widely used because of their corrosion resistance. The aerospace industry is a leading consumer of nickel-base superalloys. Turbine blades, discs and other critical parts of jet engines are fabricated from superalloys. Nickel-base superalloys are also used in land-based combustion turbines, such as those found at electric power generation stations. The remaining 23% of consumption is divided between alloy steels, rechargeable batteries, catalysts and other chemicals, coinage, foundry products, and plating.

Nickel First Use



Who uses nickel alloys and stainless steels?



In addition to its use in steel alloys, nickel forms useful alloys with other metals. Copper-nickel alloys offer a good compromise between strength and ductility and resist corrosion in saltwater, non-oxidizing acids, and alkalis. These alloys are used in industrial plumbing and petrochemical equipment. Nickel is alloyed with other metals to improve their strength and resistance to corrosion. Nickel is alloyed with steel to make armour plate, vaults and machine parts. It is alloyed with copper to make pipes that are used in desalination plants. Very powerful permanent magnets, known as Alnico magnets, can be made from an alloy of aluminium, nickel, cobalt and iron.



Nickel-copper is also the alloy of which coins are made. The U.S. nickel (or 5 cent piece) is 25% nickel and 75% copper.

Other useful alloys include nickel-chromium and nickel-molybdenum combinations that are the basis for materials that can withstand extremely corrosive chemical plant environments, such as hot sulphuric and phosphoric acids, hydrogen chloride gas, and other oxidative conditions.

Electroplating is the second largest use for this versatile metal. The process is used to produce corrosion-resistant and decorative finishes, as well as substrates for chromium coatings. Nickel can be plated on many surfaces, including plastics. There is also a process for plating nickel without an electric current. This "electroless" process makes very uniform plating. Other materials can be added to improve the finish, such as Teflon to increase lubricity or silicon carbide for wear resistance. This process is used on computer hard drives for a smooth, nonmagnetic base for the magnetic recording layer.

LINKS:

www.nidi.org

www.nipera.org

www.insg.org

www.usgs.gov