

Nickel

U.S. Geological Survey mineral commodity specialist Peter H. Kuck has compiled the following information on nickel, a critical constituent in key grades of stainless steel and superalloys.

Together with chromium, nickel makes steel more resistant to corrosion. Stainless steel thus accounts for more than 65 percent of primary nickel consumption in the world. One of the more common grades of stainless steel is Type 304, which contains 18 to 20 percent chromium and 10.5 to 12 percent nickel. Owing to their high corrosion resistance, nickel-bearing stainless steels are widely used in the transportation sector, the energy sector, the food preparation and processing industry, the beverage industry, the pharmaceutical industry and the medical community.

Architects are also increasingly specifying stainless steel for the exterior walls and roofing of public and commercial buildings. Stainless steel is frequently used for decorative indoor paneling, as well as for more traditional railings and plumbing fixtures. The Walt Disney Concert Hall at the new Music Center in downtown Los Angeles, Calif., illustrates how stainless steel can give futuristic buildings a dynamic appearance while reducing long-term maintenance costs.

Nickel has excellent plating properties and is widely used for decorative finishing or engineered coatings. Plating accounts for about 8 percent of world nickel demand. Plastics can be coated as well as base metals. The music industry uses a sophisticated nickel electroforming process to produce compact disc “masters” and “stampers.” A master can make 30 nickel stampers, each of which can produce up to a million polycarbonate CDs.

About one-third of the nickel used in the United States goes into superalloys. Superalloys can survive in many high-temperature environments where most other alloys melt or oxidize. Key uses include jet aircraft engines, industrial gas turbines, and space propulsion systems. High-nickel superalloys are used in critical jet engine parts, such as turbine blades.

Copper is frequently alloyed with nickel to produce cupronickel, an alloy that is less susceptible to saltwater corrosion than pure copper. The first U.S. cupronickel coin, a 3-cent piece, was made in 1865. The coin contained 75 percent copper and 25 percent nickel, a ratio that the U.S. Mint continues to use. The Monels, a family of nickel-copper engineering alloys used in marine engineering and pumping applications, typically contain from 52 to 66 percent nickel. Nickel is also alloyed with titanium to produce Nitinol, a “shape memory” alloy used in eyeglass frames, dentistry and medicine.

The United States has very few economically viable, high-grade nickel deposits and is almost totally dependent on foreign sources for primary nickel. The bulk of the nickel entering the global marketplace comes from Australia, Canada, Cuba, New Caledonia and Russia.

In 2005, at least 22 countries mined nickel ores. World production was about 1.3 million tons of contained nickel. About 39 smelting and refining complexes were in operation.

During the last five years, demand for nickel has frequently outstripped supply, despite the commissioning of several major mines, including the sulfide-rich Raglan and Voisey's Bay mines in the subarctic of northeastern Canada. Large projects to prepare land for mining are currently under development in Australia, Brazil, Kazakhstan and New Caledonia. The ongoing supply deficit resulted in record high nickel prices during the second quarter of 2006.

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Sample of nickeline. Image from *Minerals in Your World*.