Hard Creek Nickel
CORPORATION

What is Nickel?

TSX: HNC *The Turnagain Nickel Deposit*

Characteristics

Nickel is a silvery white metal that takes on a high polish. It belongs to the transition metals, and is hard and ductile. It occurs combined with sulfur in millerite, with arsenic in the mineral niccolite, and with arsenic and sulfur in nickel glance.

Because of its permanence in air and its inertness to oxidation, it is used in coins, for plating iron, brass, etc., for chemical apparatus, and in certain alloys, such as German silver. It is magnetic, and is very frequently accompanied by cobalt, both being found in meteoric iron. It is chiefly valuable for the alloys it forms, especially many superalloys.

Nickel is one of the five ferromagnetic elements. However, the U.S. "nickel" coin is not magnetic, because it actually is mostly (75%) copper. The Canadian nickel minted at various periods between 1922-81 was 99.9% nickel, and these were magnetic.

Occurrence

The bulk of the nickel mined comes from two types of ore deposits. The first are laterites where the principal ore minerals are nickeliferous limonite: (Fe,Ni)O(OH) and garnierite (a hydrous nickel silicate): $(Ni,Mg)_3Si_2O_5(OH)$. The second are magmatic sulfide deposits where the principal ore mineral is pentlandite: $(Ni,Fe)_9S_8$.

In terms of supply, the Sudbury region of Ontario, Canada, produces about 30 percent of the world's supply of nickel. The Sudbury Basin deposit is theorized to have been created by a massive meteorite impact event early in the geologic history of Earth. Russia contains about 40% of the world's known resources at the massive Norilsk deposit in Siberia. The Russian mining company MMC Norilsk Nickel mines this for the world market, as well as the associated palladium. Other major deposits of nickel are found in New Caledonia, Australia, Cuba, and Indonesia. The deposits in tropical areas are typically laterites which are produced by the intense weathering of ultramafic igneous rocks and the resulting secondary concentration of nickel bearing oxide and silicate minerals. Based on geophysical evidence, most of the nickel on Earth is postulated to be concentrated in the Earth's core.

Extraction and purification

Nickel can be recovered using extractive metallurgy. Most lateritic ores have traditionally been processed using pyrometallurgical techniques to produce a matte for further refining. Advances in hydrometallurgy have resulted in nickel processing operations being developed using these processes. Most sulphide deposits have traditionally been processed by concentration through a froth flotation process followed by pyrometallurgical extraction. Advances in hydrometallurgical processing of sulphides has led to some new projects being built around this technology.

Nickel is extracted from its ores by conventional roasting and reduction processes which yield a metal of >75% purity. Final purification in the Mond process to >99.99% purity is performed by reacting nickel and carbon monoxide to form nickel carbonyl. This gas is passed into a large chamber at a higher temperature in which tens of thousands of nickel spheres are maintained in constant motion. The nickel carbonyl decomposes depositing pure nickel onto the nickel spheres (known as pellets). Alternatively, the nickel carbonyl may be decomposed in a smaller chamber without pellets present to create fine powders. The resultant carbon monoxide is re-circulated through the process. The highly pure nickel produced by this process is known as carbonyl nickel.

A second common form of refining involves the leaching of the metal matte followed by the electro-winning of the nickel from solution by plating it onto a cathode. In many stainless steel applications, the nickel can be taken directly in the 75% purity form, depending on the presence of any impurities.

What is Nickel? cont'd

Nickel Usage

Two-thirds of all nickel produced goes into stainless steel, to promote a stable, ductile, austenitic structure as well as contribute to corrosion resistance. The combination of corrosion resistance, cleanability, ease of fabrication, appearance and availability means that these steels are the materials of choice for many hygienic applications in food processing, beverage production and medicine. Stainless steels are commonly found in many architectural applications and are widely used in the transport, chemical processing and energy industries.

Stainless steels are highly cost-effective when all costs, including maintenance and repair, are taken into consideration over the whole life of a product. This is partly why the use of stainless steels continues to grow. For example, some highway authorities are now considering selective use of stainless steel reinforcing bars in concrete bridges to avoid the corrosion problems caused by de-icing salt.

A major application of electroless nickel today is in computer hard discs. It forms an extremely uniform, smooth, stable, non-magnetic substrate for the magnetic recording layer, as well as providing corrosion protection for the underlying aluminium disc.

Nickel's resistance to corrosion is one of its most valuable properties. The estimated annual cost of corrosion in the U.S.A. alone is $300 billion -- equivalent to 4% of gross national product. Far and away the largest use of nickel alloys is in the area of corrosion prevention.

Copper-nickel alloys have a long history of combating corrosion in marine environments. Typical applications include large desalination plants, which provide the water essential to development projects in various parts of the world.

Nickel and its alloys also resist heat. The combination of a high melting point, a face-centered cubic crystal structure, an adherent oxide, and good alloying ability has allowed nickel to form the basis of a wide range of heat- and creep-resistant alloys that are essential materials in the chemical and aerospace industries.

Nickel also plays a part in portable power provision.

Nickel-cadmium rechargeable batteries containing nickel plates and nickel hydroxide have been in use for several years. More recently, we have seen the introduction of nickel metal-hydride batteries, which employ some nickel rare-earth alloys to absorb large amounts of hydrogen. These higher-performance rechargeable batteries have, in turn, led to improved performance from cordless power tools, portable computers and other mobile electronic equipment. The hydrogen storage alloys may find wider application if greater use is made of hydrogen as a fuel.

Nickel is used extensively in the automotive industry:

Stainless steels: catalyst supports, exhaust systems, safety belt springs, special truck bodies.

Stainless steels are excellent for structural uses - high strength, low weight and excellent crash energy absorption characteristics.

Nickel-based alloys: spark plugs, diesel valves, thermostats, turbochargers wheels and casings.

Nickel-containing alloy steels: gears, drive shafts, special vehicles for low temperature and/or high wear uses

.

Nickel-iron alloys: Electronics, special engineering uses

Nickel powders: gears, magnets, airbag valves, electromagnetic interference shielding (EMS) screening paints & coatings.

Nickel plating: anti-corrosion treatment for under hood components, piston/cylinder coatings, electronic cans & connectors.

Chromium-nickel plating: internal and external trim, handles, seatbelt fasteners, grills, wheels, customized components.

Nickel-metal hydride (NiMH) and nickel-cadmium (NiCd) batteries: electric vehicles and hybrids.

Molds for auto parts production - ferrous, non-ferrous and pure nickel (produced by electroforming or vapor deposition).

At the end of the useful life of an automobile, nickel-containing parts are fully recyclable into new stainless steel, nickel alloys and other starting materials.