

Cobalt

Symbol	Co
Atomic Number	27
Atomic Weight	58.933200
Melting Point	1768 K (1495°C or 2723°F)
Boiling Point	3200 K (2927°C or 5301°F)
Number of Protons/Electrons	27
Number of Neutrons	32
Density	8.86 g/cm ³ at 25°C
Classification	Transition Metal
Crystal Structure	Hexagonal
Phase at Room Temperature	Solid
Appearance	Lustrous, metallic, greyish tinge



HISTORY

Cobalt has been in use since at least 2250 BC, when the Persians used it to colour glass a rich blue. It has also been detected in ancient Egyptian statuettes and ancient Chinese pottery. The salts have also been used for centuries for the production of brilliant and permanent blue colours in porcelain, glass, pottery, tiles, and enamels.

It was not until 1735, however, that Swedish scientist George Brandt first isolated metallic cobalt and it was not until 1780 that it was recognized as an element. Brandt was able to show that cobalt was the source of the blue color in glasses, which previously had been attributed to the bismuth found with cobalt.

The word "cobalt" is derived from "Kobold," the name of a mischievous goblin in German mythology. Kobold was not really evil, but he loved to tease humans. Typically, he was blamed when ores that looked like those of valuable metals could not be smelted.

OCCURRENCE

Cobalt occurs in the minerals cobaltite, smaltite, and erythrite, and is often associated with nickel, silver, lead, copper and iron ores, from which it is most frequently obtained as a by-product. It is also present in meteorites. Important ore deposits are found in Zaire, Morocco, and Canada. The U.S. Geological Survey has announced that the bottom of the north central Pacific Ocean may have cobalt-rich deposits at relatively shallow depths in water close to the Hawaiian Islands and other U.S. Pacific territories.

Cobalt is a fairly rare metal, comprising only 0.001 percent of the earth's crust, but is widely dispersed and commonly found and obtained in association with other mining activities. It is found in ores of iron, nickel, copper, silver, manganese, zinc and arsenic.

Cobalt is usually mined as a co-product of either nickel, copper, or other more abundant metals. Most cobalt production is ultimately dependent on the production of copper and nickel. The mined ore often contains only 0.1% elemental cobalt. The ore is processed and the cobalt is extracted and converted to 99.9% cobalt metal. The metal is sold to a cobalt chemical manufacturer who converts the metal to cobalt carbonate, cobalt sulphate, or other cobalt salt derivatives.

It is a member of group VIII of the periodic table. Like iron, it can be magnetized. It is similar to iron and nickel in its physical properties. The element is active chemically, forming many compounds and the element rarely occurs uncombined in nature but is often found in meteoric metal.

APPLICATIONS

Cobalt (Co) is a strategic and critical metal used in many diverse commercial, industrial, and military applications. The largest use of cobalt is in superalloys, which are used to make parts for gas turbine aircraft engines. Cobalt is also used to make magnets; corrosion- and wear-resistant alloys; high-speed steels; cemented carbides (also called hardmetals) and diamond tools; catalysts for the petroleum and chemical industries; drying agents for paints, varnishes, and inks; ground coats for porcelain enamels; pigments; battery electrodes; steel-belted radial tires; and magnetic recording media

Cobalt metal is used in electroplating because of its appearance, hardness, and resistance to oxidation. It is alloyed with iron, nickel and other metals to make Alnico, an alloy of unusual magnetic strength with many important uses. Stellite alloys, containing cobalt, chromium and tungsten, are used for high-speed, heavy-duty, high temperature cutting tools, and for dies.

Cobalt salts have been used for centuries to produce brilliant and permanent blue colours in porcelain, glass, pottery, tiles, and enamels. Cobalt carefully used in the form of the chloride, sulphate, acetate, or nitrate has been found effective in correcting a certain mineral deficiency disease in animals. As an element in the diet of sheep, cobalt prevents a disease called swayback and improves the quality of the wool.

Cobalt compounds have been used for centuries to colour porcelain, glass, pottery, tile and enamel. Some of these compounds are known as: cobalt blue, cerulean, new blue, cobalt yellow and cobalt green. In addition to being used as a dye, cobalt is also important to human nutrition as it is an essential part of vitamin B₁₂

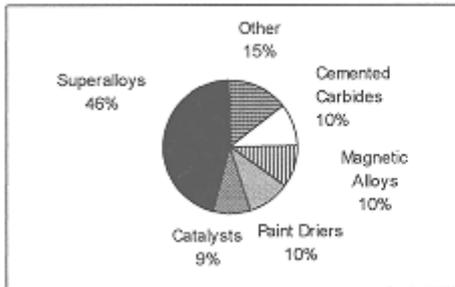
Cobalt in large doses is carcinogenic. Radioactive artificial cobalt-60 is an important gamma-ray source, and is used extensively as a tracer and radiotherapeutic agent used in the treatment of some forms of cancer. It is also used in industry for detecting flaws in metal parts.

Cobalt yellow, green, and blue are pigments of high quality that contain cobalt; another blue pigment, smalt, is made by powdering a fused mixture of cobalt oxide, potassium carbonate, and sand; these pigments are often used for colouring glass and ceramics. Cobalt chloride, used as an invisible ink, is almost colourless in dilute solution when applied to paper. Upon heating it undergoes dehydration and turns blue, becoming colourless again when the heat is removed and water is taken up.

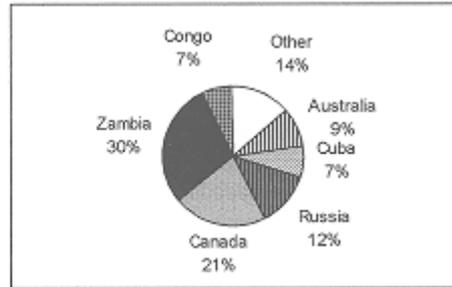
An emerging market for cobalt oxide is in lithium ion and cobalt rechargeable batteries, now in growing use in lap top computers and camcorders.

In 1982, about three quarters of the USA consumption of cobalt was in the production of steel and alloys, especially in so called superalloys used in jet engines and in magnetic materials used for various electronic applications. The remaining quarter went to different types of salts and driers. Superalloys, mainly for industrial and aircraft gas turbine engines, 37%; Magnetic materials, 17%; Driers, 10%; Catalysts, 10%; Metal cutting and mining tool bits, 6%; and Other, 23% (1985) Superalloys used mainly in industrial and aircraft gas turbine engines accounted for about 38% of reported consumption; paint driers, 15%; magnetic alloys, 12%; catalysts, 9%; and other, 26%.

The United States is the world's largest consumer of cobalt with no domestic mine or refinery production operations. Consequently, the U.S. is 100% dependent on imports for its supply of cobalt. A significant amount of the world's supply of cobalt was produced in Africa. In 1985, Zaire produced about 45% of the total world mine production of cobalt. By 1996, the Congo (formerly Zaire) represented only 7% of the world's production. Since 1991, U.S. imports from Africa have decreased; and, imports from Finland, Norway and Russia have increased.



(A) US Domestic Uses of Cobalt (1996)



(B) Cobalt Production (1996)

LINKS: www.usgs.gov