

Vanadium - V

Chemical properties of vanadium - Health effects of vanadium - Environmental effects of vanadium

Atomic number	23
Atomic mass	50.9414 g.mol ⁻¹
Electronegativity according to Pauling	1.6
Density	6.1 g.cm ⁻³ at 20°C
Melting point	1910 °C
Boiling point	3407 °C
Vanderwaals radius	0.134 nm
Ionic radius	0.074 nm (+3) ; 0.059 (+5)
Isotopes	5
Electronic shell	[Ar] 3d ³ 4s ²
Energy of first ionisation	649.1 kJ.mol ⁻¹
Energy of second ionisation	1414 kJ.mol ⁻¹
Energy of third ionisation	2830 kJ.mol ⁻¹
Energy of fourth ionisation	4652 kJ.mol ⁻¹
Discovered by	Nils Sefstrom in 1830



Vanadium

Vanadium is a rare, hard, ductile gray-white element found combined in certain minerals and used mainly to produce certain alloys. Vanadium resists corrosion due to a protective film of oxide on the surface. Common oxidation states of vanadium include +2, +3, +4 and +5.

Applications

Most of the vanadium (about 80%) produced is used as ferrovanadium or as a steel additive. Mixed with aluminium in titanium alloys is used in jet engines and high speed air-frames, and steel alloys are used in axles, crankshafts, gears and other critical components. Vanadium alloys are also used in nuclear reactors because vanadium has low neutron-adsorption abilities and it doesn't deform in creeping under high temperatures.

Vanadium oxide (V₂O₅) is used as a catalyst in manufacturing sulfuric acid and maleic anhydride and in making ceramics. It is added to glass to produce green or blue tint. Glass coated with vanadium dioxide (VO₂) can block infrared radiation at some specific temperature.

Vanadium in the environment

Vanadium is never found unbound in nature. Vanadium occurs in about 65 different minerals among which are patronite, vanadinite, carnotite and bauxite. Vanadium occurs in carbon-containing deposits such as crude oil, coal, oil shale and tar sands.

Various vanadium ores are known but none is mined as such for the metal, which is generally obtained as a byproduct of other ores. The largest resources of vanadium are to be found in South Africa and in Russia. World production of vanadium ore is around 45,000 tonnes a year. Production of the metal itself comes to about 7,000 tonnes per year. Watering is an important way in which vanadium is redistributed around the environment because vanadates are generally very soluble.

Vanadium is abundant in most soils, in variable amounts, and it is taken up by plants at levels that reflect its availability.

In biology, a vanadium atom is an essential component of some enzymes, particularly the vanadium nitrogenase used by some nitrogen-fixing microorganisms.

Health effects of vanadium

Vanadium compounds are not regarded as serious hazard, however, workers exposed to vanadium peroxide dust were found to suffer severe eye, nose and throat irritation.

The uptake of vanadium by humans mainly takes place through foodstuffs, such as buckwheat, soya beans, olive oil, sunflower oil, apples and eggs.

Vanadium can have a number of effects on human health, when the uptake is too high. When vanadium uptake takes place through air it can cause bronchitis and pneumonia.

The acute effects of vanadium are irritation of lungs, throat, eyes and nasal cavities.

Other health effects of vanadium uptake are:

- Cardiac and vascular disease
- Inflammation of stomach and intestines