The ToxGuide™ is developed to be used as a pocket guide. Tear off at perforation and fold along lines.

Sources of Exposure

General Populations

- The general population is most likely to be exposed to vanadium through ingestion of contaminated food.
- Foods naturally contain low concentrations of vanadium at levels that are not harmful. Seafood contains higher concentrations than meat from land animals.
- Vanadium is also found in commercial nutritional supplements and multivitamins. Consumption of these products can result in an excess intake of vanadium.
- People who live in areas with high levels of fuel oil consumption may be at higher risk of exposure.

Occupational Populations

- Occupational exposure is mainly due to inhalation of vanadium pentoxide dust.
- Occupational exposure is expected for boilermakers, production workers using ferrovanadium, and steel production workers.

Toxicokinetics and Normal Human Levels

Toxicokinetics

- A small amount of vanadium (3–20%) will enter the digestive tract through ingestions of food and water. The type of compound you are exposed to will determine absorption.
- Inhaled vanadium will enter the lungs, although the amount that will enter is unknown.
- It is unknown how much vanadium will enter the body through the skin, but it is likely that very little will be absorbed.
- Vanadium is transported mainly in the plasma. It is found in large amounts in the blood initially and only at trace levels 2 days after exposure.
- The bone has greater retention of vanadium than the kidneys.
- Vanadium is excreted from the body in urine.

Normal Human Levels

- Normal concentrations in blood and urine are 1 nmol/L (0.05 µg/L) and 10 nmol (0.5 µg/L), respectively.

Biomarkers/Environmental Levels

Biomarkers

- Vanadium in urine and blood can be used as biomarkers of exposure, but cannot quantitatively determine exposure levels.

Environmental Levels

Air

- Average concentration in Eastern cities is 620 ng/m^3.
- Average concentration throughout the United States is 11 ng/m^3.

Sediment and Soil

- The average concentration in U.S. soil is 300 mg/kg.

Water

- Concentration in surface water can range from 0.04 to 104 µg/L depending on location.
- Concentrations in tap water range from 1.2 to 1.0 µg/L.

Reference

Agency for Toxic Substances and Disease Registry (ATSDR). 2012. Toxicological Profile for Vanadium. Atlanta, GA: U.S. Department of Health and Human Services, Public Health Services.

ToxGuide™ for Vanadium

V

CAS# 7440-62-2

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U.S. Department of Health and Human Services
Public Health Service
Agency for Toxic Substances and Disease Registry
www.atsdr.cdc.gov

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ATSDR
AGENCY FOR TOXIC SUBSTANCES AND DISEASE REGISTRY

Chemical and Physical Information

Vanadium is a Metal

- Vanadium is a naturally occurring element that is widely distributed in the earth's crust. It is also present in soil, water and air. Pure vanadium is bright white, soft and ductile.
- It is the 22nd most abundant element in the earth's crust.
- Vanadium compounds exist in over 50 different mineral ores and in association with fossil fuels. The toxicologically significant compounds are vanadium pentoxide, sodium metavanadate, sodium orthovandate, vanadyl sulfate, and ammonium vanadate.
- Vanadium is used in the production of rust-resistant, spring, and high-speed tool steels
- Vanadium pentoxide is used in ceramics and as a catalyst. It is also used in the production of superconductive magnets.
- Vanadyl sulfate and sodium metavanadate have been used in dietary supplements.

Routes of Exposure

- Inhalation – Minor route of exposure for the general population. Predominant route of occupational exposure.
- Oral – Predominant route of exposure for the general population through ingestion of contaminated food and water.
- Dermal – Not expected to be a significant route of exposure to general or occupational populations.

Vanadium in the Environment

- Vanadium is released into the environment mainly as a result of its use as fuel oil and coal by oil refineries and power plants.
- Vanadium cannot be destroyed; it can only be changed into different forms in the environment.
- In air, vanadium particles are washed out by rain and settle to the ground.
- Transport and partitioning of vanadium in water and soil is influenced by acidity and presence of particulate. It can be dissolved in water as dissolved ions or may become absorbed to particulate matter.
- Vanadium bioaccumulates in aquatic plants and animals but does not appear to concentrate in above-ground portions of terrestrial plants.

Relevance to Public Health (Health Effects)

Health effects are determined by the dose (how much), the duration (how long), and the route of exposure.

Minimal Risk Levels (MRLs)

Inhalation

- An MRL of 0.0008 mg vanadium/m^3 has been derived for acute-duration inhalation exposure to vanadium pentoxide dust (≤14 days).
- No MRL was derived for intermediate-duration inhalation exposure (15–354 days).
- An MRL of 0.0001 mg vanadium/m^3 has been derived for chronic-duration inhalation exposure to vanadium pentoxide dust (≥1 year).

Oral

- No MRL was derived for acute-duration oral exposure to vanadium (≤14 days).
- An MRL of 0.01 mg vanadium/kg/day was derived for intermediate-duration oral exposure. (15–364 days).
- No MRL was derived for chronic-duration oral exposure to vanadium (≥1 year).

Health Effects

- The respiratory tract is the primary target of toxicity following inhalation exposure. The gastrointestinal tract, hematological system, and developing organism are the primary targets following oral exposure.
- Inhalation of vanadium pentoxide resulted damage to the lungs, throat and nose in rats. Coughing, which lasted for a number of days after exposure, was observed in humans exposed to vanadium pentoxide.
- Nausea, mild diarrhea, and stomach cramps have been observed in humans ingesting vanadium compounds.
- Oral exposure resulted in decreased number of red blood cells, increased blood pressure, and mild neurological effects in animals.
- Evidence of lung cancer has been found in animal studies. IARC has classified vanadium pentoxide as possibly carcinogenic to humans.

Children's Health

- It is unknown if children will be affected by vanadium poisoning in the same manner as adults.
- Oral exposure during pregnancy resulted in decreases in growth and increases in the occurrence of birth defects in animals; effects were usually associated with maternal toxicity.