

WATER TOXICOLOGY

Heavy metals

Cadmium

- Cadmium is another toxicologically important metal with no known biological need.
- In nature it is always associated with zinc, and is consequently an impurity of all zinc-containing products, such as galvanized steel.
- It is also a common impurity in coal and phosphate fertilizers.
- Cadmium is used in metal alloys and in batteries.

Heavy metals

Zinc

- Organisms need zinc in the active groups of several enzymes.
- However, in high concentrations it becomes toxic causing, for example, lamellar thickening in gill epithelia of fish.
- Oxygen uptake of water-breathing organisms can be impaired.
- A major use of zinc is in metal alloys and in galvanization.

Heavy metals

Iron

- The ferrous (iron(II)) ion is a part of heme, the active group of all globins and cytochromes.
- Thus, a significant amount is needed.
- The absorption, transport, and storage of iron all require specific associated proteins.
- Iron is transported in the circulation bound to transferrin, and taken up into cells with the help of transferrin receptors.

Heavy metals

Iron

- Iron is also a toxicant in high concentrations.
- Many small boreal lakes have a naturally high, toxic iron level.
- Iron can precipitate on gills as ferric oxide, impairing oxygen uptake.
- Iron can also undergo the Fenton Reaction, whereby the very reactive hydroxyl free radical is formed.

Heavy metals

Aluminium

- Aluminum is one of the most common elements of the earth's crust.
- Its importance in toxicology has mostly been associated with environmental acidification.
- At high pH values ($\text{pH} > 7$), it forms mostly insoluble hydroxides; at intermediate pH (5–7), sparingly soluble hydroxides; and at low pH values ($\text{pH} < 5$), the Al^{3+} ion.

Heavy metals

Aluminium

- Al^{3+} ion is an osmoregulatory toxicant, whereas the hydroxides may precipitate on gills, hindering oxygen uptake.
- Thus, aluminum is considered to be an osmoregulatory toxicant at low pH values but a respiratory toxicant at intermediary pH values.