

WATER TOXICOLOGY

TOXICITY TESTING

- The aim of toxicity testing is to evaluate toxicity using standard methods.
- In toxicity testing, both the test organism and the test water used are normally standardized.
- The ISO is the largest developer of voluntary international standards in the world.

Aquatic Contamination Causatives

- A general understanding that human actions cause deterioration of the aquatic environment at present, such a problem is climate change.
- Climate change and aquatic contamination are intimately intertwined.
- About 50% of all photosynthesis, which removes carbon dioxide, is carried out by photosynthetic aquatic organisms.
- Aquatic pollution has decreased the efficiency of photosynthesis, whereby toxicant effects on the aquatic environment facilitate climate change and ocean acidification.

IMPORTANCE OF A COMPOUND AS A POLLUTANT

- 1. The amount of the compound released
- 2. The water solubility of the compound.
- 3. The fugacity of the compound.
- 4. The transformation of the compound. Several organic compounds are biotransformed in organisms by specific pathways.
- 5. Complex formation by the compounds.

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- All compounds can become toxic, if an organism gets too much of them.
 - This is particularly well demonstrated with metals such as zinc and copper; they are important constituents of enzymes, and must be obtained in small amounts.
 - High concentrations are toxic, and aquatic toxicity studies on zinc and copper are very common.

Main Pollutants



Ammonia (NH₃)/Ammonium (NH₄)
(Agriculture, aquaculture, industry, urban)
Ammonia is highly toxic to fish and can convert into nitrates.

Nitrate (NO₃)/Nitrite (NO₂)
(Agriculture, industry, aquaculture, sewage)
These can accelerate aquatic plant growth leading to eutrophication.

Toxic metals
(Mining, urban, industry)
These include arsenic (As), mercury (Hg), selenium (Se) and lead (Pb) and can persist in the environment for decades. They can be poisonous to aquatic life and may slow down their development.

Crude oil (Hydrocarbons (HxCx))
(Urban, industry)
This mainly enters the marine environment in oil spills and can have detrimental effects on marine animals, plants and birds.

Phosphorous (P)/Phosphate (PO₄³⁻)
(Agriculture, urban)
Similar in effect to nitrates, these can also lead to eutrophication of water bodies.

Sulphates/sulphide minerals (minerals containing S²⁻)
(Mining)
Sulphur dioxide mixes with water particle in the air to form acid. This falls as acid rain leading to acidification of water bodies. Sulphide minerals can be unearthed during the mining process and are a leading cause of acidification of water in mines. When this acidic water is discharged it is known as acid rock drainage. The most common mineral associated with this process is pyrite (FeS₂).

Mine water treatment scheme

3 Making the case: Water of life



Taken from: The Chemistry of Water Pollution <https://www.sepa.org.uk/media/120299/chemistry-of-water-pollution.pdf>