# Corrosive Substance

From Wikipedia, the free encyclopedia



European Union standard symbol for corrosives. GHS and other symbols are similar.



DOT corrosive label

A **corrosive substance** is one that will destroy and damage other substances with which it comes into contact. It may attack a great variety of materials, including metals and various organic compounds, but people are mostly concerned with its effects on living tissue: it causes chemical burns on contact.

## Chemical terms

The word 'corrosion' is derived from the Latin verb *corrodere*, which means 'to gnaw', indicating how these substances seem to 'gnaw' their way through the flesh. Sometimes the word 'caustic' is used as a synonym but, by convention, 'caustic' generally refers only to strong bases, particularly alkalis, and not to acids, oxidizers, or other non-alkaline corrosives. The term 'acid' is often used imprecisely for all corrosives.

A low concentration of a corrosive substance is usually an irritant. Corrosion of non-living surfaces such as metals is a distinct process. For example, a water/air electrochemical cell corrodes iron to rust. In the Globally Harmonized System, both rapid corrosion of metals and chemical corrosion of skin qualify for the "corrosive" symbol.

Corrosives are different from poisons in that corrosives are immediately dangerous to the tissues they contact, whereas poisons may have systemic toxic effects that require time to become evident. Colloquially, corrosives may be called "poisons" but the concepts are technically distinct. However there is nothing which precludes a corrosive from being a poison; there are substances that are both corrosives and poisons.

## Effects on living tissue

Common corrosives are either strong acids, strong bases, or concentrated solutions of certain weak acids or weak bases. They can exist as any state of matter, including liquids, solids, gases, mists or vapors.

Their action on living tissue (e.g. skin, flesh and cornea) is mainly based on acid-base reactions of amide hydrolysis and ester hydrolysis. Proteins (chemically composed of amide bonds) are destroyed via amide hydrolysis while lipids (many of which have ester bonds) are decomposed by ester hydrolysis. These reactions lead to chemical burns and are the mechanism of the destruction posed by corrosives.

Some corrosives possess other chemical properties which may extend their corrosive effects on living tissue. For example, sulfuric acid (sulphuric acid) at a high concentration is also a strong dehydrating agent, capable of dehydrating carbohydrates and liberating extra heat. This results in secondary thermal burns in addition to the chemical burns and may speed up its decomposing reactions on the contact surface. Some corrosives, such as nitric acid and concentrated sulfuric acid, are strong oxidizing agents as well, which significantly contributes to the extra damage caused. Hydrofluoric acid does not necessary cause noticeable damage upon contact, but produces tissue damage and toxicity after being painlessly absorbed. Zinc chloride solutions are capable of destroying cellulose and corroding through paper and silk since the zinc cations in the solutions specifically attack hydroxyl groups, acting as a Lewis acid.

In addition, some corrosive chemicals, mostly acids such as hydrochloric acid and nitric acid, are volatile and can emit corrosive mists upon contact with air. Inhalation can damage the respiratory tract.

Corrosive substances are most hazardous to eyesight. A drop of a corrosive may cause blindness within 2–10 seconds through opacification or direct destruction of the cornea.

Ingestion of corrosives can induce severe consequences, including serious damage of the gastrointestinal tract, which can lead to vomiting, severe stomach aches, and even death.

## Common types of corrosive substances

Common corrosive chemicals are classified into:

* Acids
  + Strong acids — the most common are sulfuric acid, nitric acid and hydrochloric acid (H2SO4, HNO3 and HCl, respectively).
  + Some concentrated weak acids, for example formic acid and acetic acid
  + Strong Lewis acids such as anhydrous aluminum chloride and boron trifluoride
  + Lewis acids with specific reactivity, e.g. solutions of zinc chloride
  + Extremely strong acids (superacids)
* Bases
  + Caustics or alkalis, such as sodium hydroxide (NaOH) and potassium hydroxide (KOH)
  + Alkali metals in the metallic form (e.g. elemental sodium), and hydrides of alkali and alkaline earth metals, such as sodium hydride, function as strong bases and hydrate to give caustics
  + Extremely strong bases (superbases) such as alkoxides, metal amides (e.g. sodium amide) and organometallic bases such as butyllithium
  + Some concentrated weak bases, such as ammonia when anhydrous or in a concentrated solution
* Dehydrating agents such as concentrated sulfuric acid, phosphorus pentoxide, calcium oxide, anhydrous zinc chloride, also elemental alkali metals
* Strong oxidizers such as concentrated hydrogen peroxide
* Electrophilic halogens: elemental fluorine, chlorine, bromine and iodine, and electrophilic salts such as sodium hypochlorite or N-chloro compounds such as chloramine-T; halide ions are not corrosive, except for fluoride
* Organic halides and organic acid halides such as acetyl chloride and benzyl chloroformate
* Acid anhydrides
* Alkylating agents such as dimethyl sulfate
* Some organic materials such as phenol ("carbolic acid")

## Personal protective equipment

Use of personal protective equipment, including items such as protective gloves, protective aprons, acid suits, safety goggles, a face shield, or safety shoes, is normally recommended when handling corrosive substances. Users should consult a material safety data sheet for the specific recommendation for the corrosive substance of interest. The material of construction of the personal protective equipment is of critical importance as well. For example, although rubber gloves and rubber aprons may be made out of a chemically resistant elastomer such as nitrile rubber, neoprene, or butyl rubber, each of these materials has different resistance to different corrosives and they should not be substituted for each other.

## Uses

Some corrosive chemicals are valued for various uses, the most common of which is in household cleaning agents. For example, most domestic drain openers contain either acids or alkalis due to their capabilities of dissolving greases and proteins inside water pipes such as limescale.

In chemical uses, high chemical reactivity is often desirable, as the rates of chemical reactions depend on the activity (effective concentration) of the reactive species. For instance, catalytic sulfuric acid is used in the alkylation process in an oil refinery: the activity of carbocations, the reactive intermediate, is higher with stronger acidity, and thus the reaction proceeds faster. Once used, corrosives are most often recycled or neutralized. However, there have been environmental problems with untreated corrosive effluents or accidental discharges.

* This page was last modified on 17 January 2014 at 16:08.