# Salt (chemistry)

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Jump to: navigation, search

*This article is about the term as used in chemistry. For the chemistry of table salt, see Sodium chloride.*



The blue salt copper(II) sulfate in the form of the mineral chalcanthite

In chemistry, **salts** are ionic compounds that can result from the neutralization reaction of an acid and a base. They are composed of related numbers of cations (positively charged ions) and anions (negative ions) so that the product is electrically neutral (without a net charge). These component ions can be inorganic such as chloride (Cl−), as well as organic such as acetate (C2H3O2−) and monatomic ions such as fluoride (F−), as well as polyatomic ions such as sulfate (SO42−).

There are several varieties of salts. Salts that hydrolyze to produce hydroxide ions when dissolved in water are *basic salts* and salts that hydrolyze to produce hydronium ions in water are *acidic salts*. *Neutral salts* are those that are neither acid nor basic salts. Zwitterions contain an anionic center and a cationic center in the same molecule but are not considered to be salts. Examples include amino acids, many metabolites, peptides, and proteins.

Usually non-dissolved salts in standard temperature and pressure are in solid state of matter, but there are exceptions (see Molten salts and ionic liquids).

Molten salts and solutions containing dissolved salts (e.g., sodium chloride in water) are called electrolytes, as they are able to conduct electricity. As observed in the cytoplasm of cells, in blood, urine, plant saps and mineral waters, mixtures of many different ions in solution usually do not form defined salts after evaporation of the water. Therefore, their salt content is given for the respective ions.

## Properties

### Color



Potassium dichromate, a bright orange salt used as a pigment

Salts can appear to be clear and transparent (sodium chloride), opaque, and even metallic and lustrous (iron disulfide). In many cases the apparent opacity or transparency are only related to the difference in size of the individual monocrystals. Since light reflects from the grain boundaries (boundaries between crystallites), larger crystals tend to be transparent, while the polycrystalline aggregates look like white powders.

Salts exist in many different colors, for example:

* yellow (sodium chromate)
* orange (potassium dichromate)
* red (potassium ferricyanide)
* mauve (cobalt chloride hexahydrate)
* blue (copper sulfate pentahydrate, ferric hexacyanoferrate)
* purple (potassium permanganate)
* green (nickel chloride hexahydrate)
* colorless (sodium chloride, magnesium sulfate heptahydrate)—may appear white when powdered or in small pieces

Most minerals and inorganic pigments as well as many synthetic organic dyes are salts. The color of the specific salt is due to the presence of unpaired electrons in the d-orbital of transition elements.

### Taste

Different salts can elicit all five basic tastes, e.g., salty (sodium chloride), sweet (lead diacetate, which will cause lead poisoning if ingested), sour (potassium bitartrate), bitter (magnesium sulfate), and umami or savory (monosodium glutamate).

### Odor

Salts of strong acids and strong bases ("strong salts") are non-volatile and odorless, whereas salts of either weak acids or weak bases ("weak salts") may smell after the conjugate acid (e.g., acetates like acetic acid (vinegar) and cyanides like hydrogen cyanide (almonds)) or the conjugate base (e.g., ammonium salts like ammonia) of the component ions. That slow, partial decomposition is usually accelerated by the presence of water, since hydrolysis is the other half of the reversible reaction equation of formation of weak salts.

### Solubility

See also: Solubility#Solubility of ionic compounds in water

Many ionic compounds can be dissolved in water or other similar solvents. The exact combination of ions involved makes each compound have a unique solubility in any solvent. The solubility is dependent upon how well each ion interacts with the solvent, so there are certain patterns. For example, all salts of sodium, potassium and ammonium are soluble in water, as are all nitrates and many sulfate salts except barium sulfate, calcium sulfate (sparingly soluble) and lead(2) sulfate. However, ions that bind tightly to each other and form highly stable lattices are less soluble, because it is harder for these structures to break apart for the compounds to dissolve. For example, most carbonate salts are not soluble in water, such as lead carbonate and barium carbonate. Soluble carbonate salts are: sodium carbonate, potassium carbonate and ammonium carbonate.

## Nomenclature

The name of a salt starts with the name of the cation (e.g., *sodium* or *ammonium*) followed by the name of the anion (e.g., *chloride* or *acetate*). Salts are often referred to only by the name of the cation (e.g., *sodium salt* or *ammonium salt*) or by the name of the anion (e.g., *chloride salt* or *acetate salt*).

Common salt-forming cations include:

* Ammonium NH4+
* Calcium Ca2+
* Iron Fe2+ and Fe3+
* Magnesium Mg2+
* Potassium K+
* Pyridinium C5H5NH+
* Quaternary ammonium NR4+
* Sodium Na+

Common salt-forming anions (parent acids in parentheses where available) include:

* Acetate CH3COO− (acetic acid)
* Carbonate CO32− (carbonic acid)
* Chloride Cl− (hydrochloric acid)
* Citrate HOC(COO−)(CH2COO−)2 (citric acid)
* Cyanide C≡N− (hydrocyanic acid)
* Fluoride F− (hydrofluoric acid)
* Nitrate NO3− (nitric acid)
* Nitrite NO2− (nitrous acid)
* Phosphate PO43− (phosphoric acid)
* Sulfate SO42− (sulfuric acid)

## Formation



Solid lead(II) sulfate (PbSO4)

Salts are formed by a chemical reaction between:

* A base and an acid, e.g., NH3 + HCl → NH4Cl
* A metal and an acid, e.g., Mg + H2SO4 → MgSO4 + H2
* A metal and a non-metal, e.g., Ca + Cl2 → CaCl2
* A base and an acid anhydride, e.g., 2 NaOH + Cl2O → 2 NaClO + H2O
* An acid and a basic anhydride, e.g., 2 HNO3 + Na2O → 2 NaNO3 + H2O
* Salts can also form if solutions of different salts are mixed, their ions recombine, and the new salt is insoluble and precipitates (see: solubility equilibrium), for example:

Pb(NO3)2(aq) + Na2SO4(aq) → PbSO4(s) + 2 NaNO3(aq)

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