Salt (chemistry)

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In chemistry, a **salt** is an ionic compound that results from the neutralization reaction of an acid and a base.[1] Salts 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^-), or organic, such as acetate ($CH_3CO_2^-$); and can be monatomic, such as fluoride (F^-), or polyatomic, such as sulfate (SO_4^{2-}).

The salt copper(II) sulfate as the mineral chalcanthite.

There are several varieties of salts. Salts that hydrolyze to produce hydroxide ions when dissolved in water are *basic salts*, whilst those 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 centre and a cationic centre in the same molecule, but are not considered to be salts. Examples of zwitterions include amino acids, many metabolites, peptides, and proteins.[2]

Usually, non-dissolved salts at standard temperature and pressure are solid, 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.

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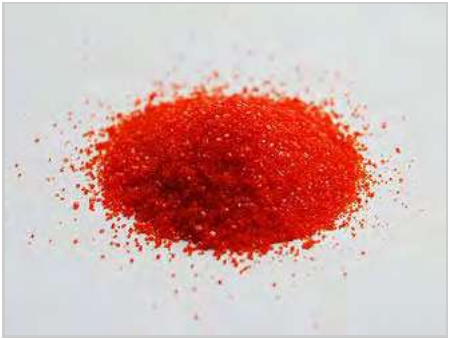

Potassium dichromate, a bright orange salt used as a pigment.

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 (cobalt nitrate)
- 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 electronic structure in the d-orbitals of transition elements or in the conjugated organic dye framework.

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

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 on 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 sulfates – barium sulfate, calcium

sulfate (sparingly soluble) and lead(II) sulfate are examples of exceptions. 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. Some soluble carbonate salts are: sodium carbonate, potassium carbonate and ammonium carbonate.

Conductivity

Solid salts do not conduct electricity. However, liquid salts do. Moreover, solutions of salts also conduct electricity.

Chemical Compound

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 NH_4^+
- Calcium Ca^{2+}
- Iron Fe^{2+} and Fe^{3+}
- Magnesium Mg^{2+}
- Potassium K^+
- Pyridinium $C_5H_5NH^+$
- Quaternary ammonium NR_4^+, R being an alkyl group or an aryl group
- Sodium Na^+

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

- Acetate CH_3COO^- (acetic acid)
- Carbonate CO_3^{2-} (carbonic acid)
- Chloride Cl^- (hydrochloric acid)
- Citrate $HOC(COO^-)(CH_2COO^-)_2$ (citric acid)
- Cyanide $C{\equiv}N^-$ (hydrocyanic acid)
- Fluoride F^- (hydrofluoric acid)
- Nitrate NO_3^- (nitric acid)
- Nitrite NO_2^- (nitrous acid)
- Oxide O^{2-}
- Phosphate PO_4^{3-} (phosphoric acid)
- Sulfate SO_4^{2-} (sulfuric acid)

Formation

Salts are formed by a chemical reaction between:

- A base and an acid, e.g., $NH_3 + HCl \rightarrow NH_4Cl$
- A metal and an acid, e.g., $Mg + H_2SO_4 \rightarrow MgSO_4 + H_2$
- A metal and a non-metal, e.g., $Ca + Cl_2 \rightarrow CaCl_2$
- A base and an acid anhydride, e.g., $2\ NaOH + Cl_2O \rightarrow 2\ NaClO + H_2O$
- An acid and a basic anhydride, e.g., $2\ HNO_3 + Na_2O \rightarrow 2\ NaNO_3 + H_2O$
- 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:

$$\mathbf{Pb(NO_3)_2 + Na_2SO_4 \longrightarrow PbSO_4{\downarrow} + 2\,NaNO_3}$$

Solid lead(II) sulfate ($PbSO_4$)

See also

- Acid salt *also known as* Hydrogen salt
- Alkali salts *also known as* Basic salt
- Bresle method *(The method used to test for salt presence during coating applications.)*
- Edible salt
- Electrolyte
- Fireworks / Pyrotechnics *(Salts are what give color to fireworks)*
- Halide
- Hypertension
- Ionic bonds
- Kosher salt
- Natron
- Old Salt Route
- Road salt
- Salinity
- Salting the earth *(the deliberate massive use of salt to render a soil unsuitable for cultivation and thus discourage habitation)*
- Sea salt
- Sodium
- Table salt
- Zwitterion
- Brønsted–Lowry acid–base theory

References

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2. Voet, D. & Voet, J, G. (2005). *Biochemistry* (3th ed.). Hoboken, NJ: John Wiley & Sons Inc. p. 68. ISBN 9780471193500.

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