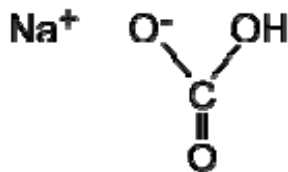


Sodium bicarbonate

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Sodium bicarbonate or **sodium hydrogen carbonate** is the chemical compound with the formula NaHCO₃. Sodium bicarbonate is a white solid that is crystalline but often appears as a fine powder. It has a slightly salty, alkaline taste resembling that of washing soda (sodium carbonate). It is a component of the mineral natron and is found dissolved in many mineral springs. The natural mineral form, nahcolite, is found in dissolved form in bile, where it serves to neutralize the acidity of the hydrochloric acid produced by the stomach, and is excreted into the duodenum of the small intestine via the bile duct. It is also produced artificially.

Since it has long been known and is widely used, the salt has many related names such as **baking soda**, **bread soda**, **cooking soda**, **bicarbonate of soda**. Colloquially, its name is shortened to *sodium bicarb*, *bicarb soda*, or simply *bicarb*. The word *saleratus*, from Latin *sal aeratus* meaning "aerated salt", was widely used in the 19th century for both sodium bicarbonate and potassium bicarbonate. The term has now fallen out of common usage.

History

The ancient Egyptians used natural deposits of natron, a mixture consisting mostly of sodium carbonate decahydrate and sodium bicarbonate. The natron was used as a cleansing agent like soap.

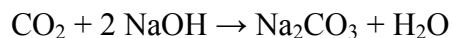
In 1791, a French chemist, Nicolas Leblanc, produced sodium carbonate, also known as soda ash. In 1846 two New York bakers, John Dwight and Austin Church, established the first factory to develop baking soda from sodium carbonate and carbon dioxide.^[1]

Production

Main article: Solvay process

NaHCO₃ is mainly prepared by the Solvay process, which is the reaction of calcium carbonate, sodium chloride, ammonia, and carbon dioxide in water. It is produced on the scale of about 100,000 tonnes/year (as of 2001).^[2]

NaHCO₃ may be obtained by the reaction of carbon dioxide with an aqueous solution of sodium hydroxide. The initial reaction produces sodium carbonate:



Further addition of carbon dioxide produces sodium bicarbonate, which at sufficiently high concentration will precipitate out of solution:



Commercial quantities of baking soda are also produced by a similar method: soda ash, mined in the form of the ore trona, is dissolved in water and treated with carbon dioxide. Sodium bicarbonate precipitates as a solid from this method:

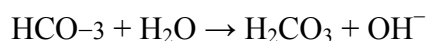


Mining

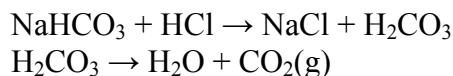
Naturally occurring deposits of nahcolite (NaHCO₃) are found in the Eocene-age (55.8–33.9 Ma) Green River Formation, Piceance Basin in Colorado. Nahcolite was deposited as beds during periods of high evaporation in the basin. It is commercially mined using in-situ leach techniques involving dissolution of the nahcolite by heated water which is pumped through the nahcolite beds and reconstituted through a natural cooling crystallization process.

Chemistry

Sodium bicarbonate is an amphoteric compound. Aqueous solutions are mildly alkaline due to the formation of carbonic acid and hydroxide ion:



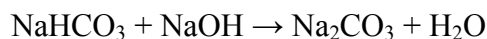
Sodium bicarbonate can be used as a wash to remove any acidic impurities from a "crude" liquid, producing a purer sample. Reaction of sodium bicarbonate and an acid to give a salt and carbonic acid, which readily decomposes to carbon dioxide and water:



Sodium bicarbonate reacts with acetic acid (found in vinegar) and presents a simple and showy demonstration of a chemical reaction. The products of the ensuing two-stage reaction are sodium acetate, water, and carbon dioxide:



Sodium bicarbonate reacts with bases such as sodium hydroxide to form carbonates:



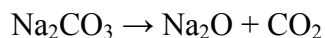
Sodium bicarbonate reacts with carboxyl groups in proteins to give a brisk effervescence from the formation of CO_2 . This reaction is used to test for the presence of carboxylic groups in protein.

Thermal decomposition

Above $70\text{ }^\circ\text{C}$, sodium bicarbonate gradually decomposes into sodium carbonate, water and carbon dioxide. The conversion is fast at $200\text{ }^\circ\text{C}$.^[3]



Most bicarbonates undergo this dehydration reaction. Further heating converts the carbonate into the oxide (at around $1000\text{ }^\circ\text{C}$):



These conversions are relevant to the use of NaHCO_3 as a fire-suppression agent ("BC powder") in some dry powder fire extinguishers.

Cooking

Main article: Leavening agent

Sodium bicarbonate is primarily used in cooking (baking) where it reacts with other components to release carbon dioxide, that helps dough rise. The acidic compounds that induce this reaction include phosphates, cream of tartar, lemon juice, yogurt, buttermilk, cocoa, vinegar, etc. Sodium bicarbonate can be substituted for baking powder provided sufficient acid reagent is also added to the recipe.^[4] Many forms of baking powder contain sodium bicarbonate combined with one or more acidic phosphates (especially good) or cream of tartar. It can also be used for softening peas ($\frac{1}{8}$ tsp. per pint of water and bring to boil for one hour)

Sodium bicarbonate was sometimes used in cooking vegetables, to make them softer, although this has gone out of fashion as most people now prefer firmer vegetables which contain more nutrients, and fibre. Bicarb destroys acids in food, including Vitamin C.

Thermal decomposition causes sodium bicarbonate alone to act as a raising agent by releasing carbon dioxide at baking temperatures. The carbon dioxide production starts at temperatures above $80\text{ }^\circ\text{C}$. The mixture for cakes using this method can be allowed to stand before baking without any premature release of carbon dioxide.

Neutralization of acids and bases

Many laboratories keep a bottle of sodium bicarbonate powder within easy reach, because sodium bicarbonate is amphoteric, reacting with acids and bases. Furthermore, as it is relatively innocuous in most situations, there is no harm in using excess sodium bicarbonate. Lastly, sodium bicarbonate powder may be used to smother a small fire.^[5]

A wide variety of applications follows from its neutralization properties, including reducing the spread of white phosphorus from incendiary bullets inside an afflicted soldier's wounds.^[6] Sodium bicarbonate can be added as a simple solution for raising the pH balance of water (increasing total alkalinity) where high levels of chlorine (2–5 ppm) are present as in swimming pools and aquariums.^[7]

Medical uses

Sodium bicarbonate is used in an aqueous solution as an antacid taken orally to treat acid indigestion and heartburn.^[8] It may also be used in an oral form to treat chronic forms of metabolic acidosis such as chronic renal failure and renal tubular acidosis. Sodium bicarbonate may also be useful in urinary alkalization for the treatment of aspirin overdose and uric acid renal stones. It is used as the medicinal ingredient in gripe water for infants.^[9]

Bicarb has been known to be used in first aid, in treating scalding, to prevent blistering and scarring. Cover scald area with a liberal layer of bicarb and seek medical assistance.

An aqueous solution is sometimes administered intravenously for cases of acidosis, or when there are insufficient sodium or bicarbonate ions in the blood.^[10] In cases of respiratory acidosis, the infused bicarbonate ion drives the carbonic acid/bicarbonate buffer of plasma to the left and, thus, raises the pH. It is for this reason that sodium bicarbonate is used in medically supervised cardiopulmonary resuscitation. Infusion of bicarbonate is indicated only when the blood pH is marked (<7.1-7.0) low.^[11]

It is used as well for treatment of hyperkalemia. Since sodium bicarbonate can cause alkalosis, it is sometimes used to treat aspirin overdoses. Aspirin requires an acidic environment for proper absorption, and the basic environment diminishes aspirin absorption in the case of an overdose. Sodium bicarbonate has also been used in the treatment of tricyclic antidepressant overdose.^[12] It can also be applied topically as a paste, with three parts baking soda to one part water, to relieve insect bites.^[13]

Adverse reactions to the administration of sodium bicarbonate can include metabolic alkalosis, edema due to sodium overload, congestive heart failure, hyperosmolar syndrome, hypervolemic hypernatremia, and hypertension due to increased sodium. In patients who consume a high calcium or dairy-rich diet, calcium supplements, or calcium-containing antacids such as calcium carbonate (e.g., Tums), the use of sodium bicarbonate can cause milk-alkali syndrome, which can result in metastatic calcification, kidney stones, and kidney failure.

Sodium bicarbonate is also used as an ingredient in some mouthwashes. It works as a mechanical cleanser on the teeth and gums, neutralizes the production of acid in the mouth and also as an antiseptic to help prevent infections occurring.

Sodium bicarbonate can be used to cover an allergic reaction of poison ivy, oak, or sumac to relieve some of the itching that is associated with it (an alternative to buying hydrocortisone cream).^[14]

Sodium bicarbonate can be used as an exfoliant. Its particles are rounded and fine in texture, making it both effective and gentle on the skin. Using baking soda as an exfoliating scrub will remove dead skin cells, which can be discolored from hyperpigmentation and scarring.

Personal hygiene

A paste made from sodium bicarbonate and a 3% hydrogen peroxide solution can be used as an alternative to commercial non-fluoride toothpastes, and sodium bicarbonate in combination with other ingredients can be used to make a dry or wet deodorant. Sodium bicarbonate is a common ingredient in alternative and natural brands of toothpaste and deodorant. It may also be used as a shampoo.^[15]