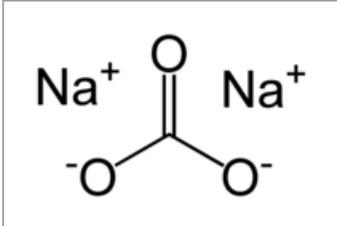


Sodium carbonate

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Sodium carbonate	
	
General	
Other names	Soda ash Washing soda
Molecular formula	Na ₂ CO ₃
Molar mass	105.99 g/mol
Appearance	White solid
CAS number	[497-19-8]
Properties	
Density and phase	2.5 g/cm ³ , solid
Solubility in water	30 g/100 ml (20 °C)
Melting point	851 °C
Boiling point	<i>decomposes</i>
Basicity (p <i>K</i> _b)	4.67

Structure	
Coordination geometry	trigonal bipyramidal
Crystal structure	triclinic
Hazards	
MSDS	External MSDS]
EU classification	Irritant (Xi)
NFPA 704	<div style="border: 1px solid black; width: 80px; height: 60px; margin: 0 auto;"></div> <p style="text-align: center; margin: 0;">0</p> <p style="text-align: center; margin: 0;">2</p> <p style="text-align: center; margin: 0;">0</p>
R-phrases	R36
S-phrases	(S2), S22, S26
Flash point	non flammable
RTECS number	VZ4050000
Supplementary data page	
Structure and properties	n , ϵ_r , etc.

Thermodynamic data	Phase behaviour Solid, liquid, gas
Spectral data	UV , IR , NMR , MS
Related compounds	
Other anions	Sodium bicarbonate
Other cations	Lithium carbonate Potassium carbonate
<p>Except where noted otherwise, data are given for materials in their standard state (at 25 °C, 100 kPa). Infobox disclaimer and references</p>	

Sodium carbonate (also known as **washing soda** or **soda ash**), [Na₂CO₃](#), is a [sodium salt](#) of [carbonic acid](#). It most commonly occurs as a [crystalline](#) heptahydrate which readily [effloresces](#) to form a white powder, the monohydrate. It has a cooling [alkaline](#) taste, and can be extracted from the ashes of many [plants](#). It is synthetically produced in large quantities from [table salt](#) in a process known as the [Solvay process](#).

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[\[edit\]](#) **Uses**

Sodium carbonate's most important use is in the chemical make-up of [glass](#). When heated at very high temperatures, combined with sand (SiO₂) and calcium carbonate (CaCO₃), and cooled very rapidly, glass is produced.

Sodium carbonate is also used as a relatively strong base in various settings. For example, sodium carbonate is used as a pH regulator to maintain stable alkaline conditions necessary for the action of the majority of [developing agents](#).^[*citation needed*] It is a common additive in municipal pools used to neutralize the acidic effects of [chlorine](#) and raise pH.^[1] In [cooking](#), it is sometimes used in place of [sodium hydroxide](#) for [lying](#), especially with [German pretzels](#) and [lye rolls](#). These dishes are treated with a solution of an alkaline substance in order to change the pH of the surface of the food and thus improve browning.

In chemistry, it is often used as an electrolyte. This is because electrolytes are usually salt based, and sodium carbonate acts as a very good conductor in the process of electrolysis. It is also used as a [primary standard](#) for [acid-base titrations](#) because it is solid and air-stable, making it easy to weigh accurately.

Domestically it is used as a water softener during laundry. It competes with the ions [magnesium](#) and [calcium](#) in [hard water](#) and prevents them from bonding with the detergent being used. Without using washing soda, additional detergent is needed to soak up the magnesium and calcium ions. Called **Washing Soda** or **Sal Soda**^[2] in the detergent section of stores, it effectively removes oil, grease, and alcohol stains. Sodium carbonate is also used as a descaling agent in boilers such as found in coffee pots, espresso machines, etc.^[*citation needed*]

[\[edit\]](#) Other uses

Sodium carbonate is used by the brick industry as a wetting agent to reduce the amount of water needed to extrude the clay.^[*citation needed*] It is used in [instant noodles](#) to make it "instant".^{[3][4]}

In casting, it is referred to as "bonding agent" and is used to allow wet [alginate](#) to adhere to gelled alginate.^[5]

Sodium carbonate is a food additive (E500) used as an acidity regulator, anticaking agent, raising agent and stabilizer. Sodium carbonate is also used in the production of sherbet lollies. The cooling and fizzing sensation results from the endothermic reaction between sodium carbonate and a weak acid, commonly citric acid, releasing carbon dioxide gas, which occurs when the sherbet is wetted by saliva.

Sodium carbonate is used to encapsulate and kill mold when mixed with water and put in a spray bottle its sold for its anti mold cleaning ability. It also is used to blast off mold from wood or other construction.^[*citation needed*]

[\[edit\]](#) Occurrence

Sodium carbonate is soluble in [water](#), but can occur naturally in arid regions, especially in the [mineral](#) deposits (*evaporites*) formed when seasonal [lakes](#) evaporate. Deposits of the mineral [natron](#), a combination of sodium carbonate and [sodium bicarbonate](#), have been mined from dry lake bottoms in [Egypt](#) since ancient times, when [natron](#) was used in the preparation of [mummies](#) and in the early manufacture of glass. Sodium carbonate has three known forms of hydrates: sodium carbonate decahydrate, sodium carbonate heptahydrate and sodium carbonate monohydrate.

[\[edit\]](#) Production

[\[edit\]](#) Mining

[Trona](#), hydrated sodium bicarbonate carbonate ($\text{Na}_3\text{HCO}_3\text{CO}_3 \cdot 2\text{H}_2\text{O}$), is mined in several areas of the United States and provides nearly all the domestic sodium carbonate. Large natural deposits found in 1938 near the [Green River, Wyoming](#) have made mining more economical than industrial production in [North America](#).

It is also mined out of certain alkaline lakes such as [Lake Magadi](#) in [Kenya](#) by using a basic dredging process and it is also self regenerating so will never run out in its natural source.

[\[edit\]](#) Barilla and kelp

Several "[halophyte](#)" (salt tolerant) plant species and of seaweed species can be processed into an impure form of sodium carbonate, and these sources predominated in Europe and elsewhere until the early 19th Century. The land plants (typically [glassworts](#) or [saltworts](#)) or the seaweed (typically [fucus](#) species) were harvested, dried, and burned. The ashes were then "lixiviated" (washed with water) to form an alkali solution. This solution was boiled dry to create the final product, which was termed "[soda ash](#);" this very old name refers to the archetypal plant source for soda ash, which was the small annual shrub [Salsola soda](#) ("barilla plant").

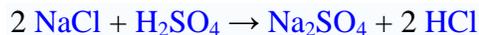
The sodium carbonate concentration in soda ash varied very widely, from 2-3% for the seaweed-derived form ("[kelp](#)"), to 30% for the best [barilla](#) produced from [saltwort](#) plants in Spain. Plant and seaweed sources for soda ash, and also for the related [alkali](#) "[potash](#)," became increasingly inadequate by the end of the 18th Century, and the search for commercially viable routes to synthesizing soda ash from salt and other chemicals intensified.^[6]

[\[edit\]](#) Leblanc process

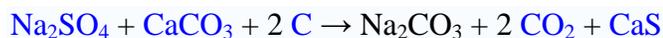
Main article: [Leblanc process](#)

In 1791, the [French](#) chemist [Nicolas Leblanc](#) patented a process for producing sodium carbonate from [salt](#), [sulfuric acid](#), [limestone](#), and [coal](#). First, sea salt ([sodium chloride](#))

was boiled in sulfuric acid to yield [sodium sulfate](#) and [hydrogen chloride](#) gas, according to the [chemical equation](#)



Next, the sodium sulfate was blended with crushed limestone ([calcium carbonate](#)) and coal, and the mixture was burnt, producing sodium carbonate along with [carbon dioxide](#) and [calcium sulfide](#).



The sodium carbonate was [extracted](#) from the ashes with water, and then collected by allowing the water to evaporate.

The hydrochloric acid produced by the [Leblanc process](#) was a major source of [air pollution](#), and the calcium sulphide byproduct also presented waste disposal issues. However, it remained the major production method for sodium carbonate until the late 1880s.^{[6][7]}

[\[edit\]](#) Solvay process

Main article: [Solvay process](#)

In 1861, the [Belgian](#) industrial chemist [Ernest Solvay](#) developed a method to convert sodium chloride to sodium carbonate using [ammonia](#). The [Solvay process](#) centered around a large hollow tower. At the bottom, calcium carbonate (limestone) was heated to release carbon dioxide:



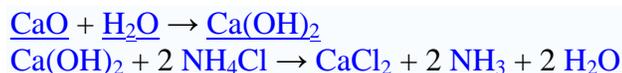
At the top, a concentrated solution of sodium chloride and ammonia entered the tower. As the carbon dioxide bubbled up through it, sodium bicarbonate precipitated:



The sodium bicarbonate was then converted to sodium carbonate by heating it, releasing water and carbon dioxide:



Meanwhile, the ammonia was regenerated from the ammonium chloride byproduct by treating it with the lime ([calcium hydroxide](#)) left over from carbon dioxide generation:



Because the Solvay process recycled its ammonia, it consumed only brine and limestone, and had [calcium chloride](#) as its only waste product. This made it substantially more economical than the Leblanc process, and it soon came to dominate world sodium carbonate production. By 1900, 90% of sodium carbonate was produced by the Solvay process, and the last Leblanc process plant closed in the early 1920s.

[\[edit\]](#) Hou's process

Developed by a Chinese chemist [Hou Debang](#) in 1930s. It is the same as the Solvay process in the first few steps. But instead of treating the remaining solution with lime, carbon dioxide and ammonia is pumped into the solution and sodium chloride is added until it is saturated at 40 °C. Then the solution is cooled down to 10 °C. [Ammonium chloride](#) precipitates and is removed by filtration, the solution is recycled to produce more sodium bicarbonate. Hou's Process eliminates the production of [calcium chloride](#) and the byproduct [ammonium chloride](#) can be used as a fertilizer. Hou's Process is the most common current process in the world to produce sodium carbonate.

[\[edit\]](#) References

1. [^] North Carolina Department of Environmental Health. "[Water Chemistry for Swimming Pools](#)".
2. [^] Definition: sal soda [\[1\]](#)
3. [^] <http://www.instantramen.or.jp/english/outline/outline12.html> "Kansui"
4. [^] "[Hydrolysis adjustment liquid](#)"
5. [^] Mark Alfrey. *Mark Alfrey's Prosthetic Make-up for Beginners* [DVD].
6. [^] ^{*a*} ^{*b*} Clow, Archibald and Clow, Nan L. (1952). *Chemical Revolution*, (Ayer Co Pub, June 1952), pp. 65-90. [ISBN 0836919092](#).

7. [^] Kiefer, David M. (2002). "[It was all about alkali.](#)"
Today's Chemist at Work, Vol. 11, No. 1, pp. 45-6.

[[edit](#)] External links

- [International Chemical Safety Card 1135](#)
- [American National Soda Ash Company](#)
- [European Chemicals Bureau](#)
- [Use of sodium carbonate in dyeing](#)

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