

Carbonates

Carbonate is a polyatomic anion with the formula CO_3^{2-} and has a trigonal planar molecular structure which consists of a carbon atom surrounded by three oxygen atoms. The carbonate ion is a moderately strong base, so by definition of a [Lewis base](#), it attracts protons in aqueous solutions. It carries a formal charge of -2. Carbonate bonds to metal cations, generally forming insoluble compounds.

Introduction

The term "carbonate" is usually used to refer to one of its salts or carbonate minerals. The more commonly known carbonates are calcium carbonate (CaCO_3) and sodium carbonate (Na_2CO_3).

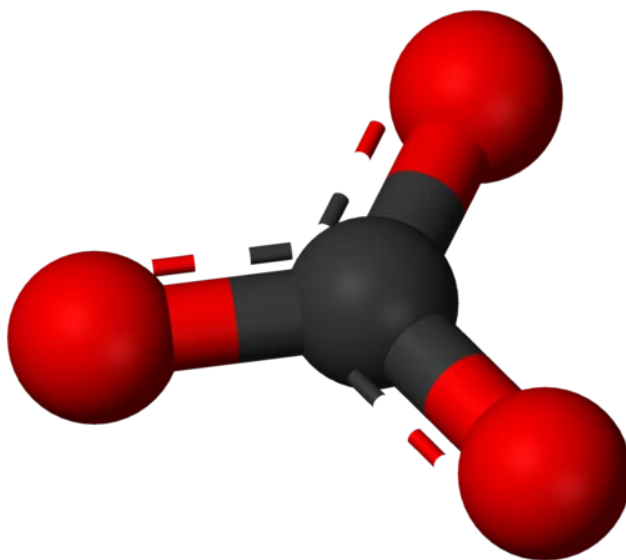
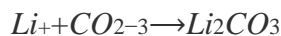


Figure 1. Ball-and-stick model of the carbonate ion, CO_3^{2-}

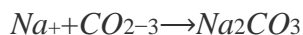
Reaction with Group 1 Elements

All of the [alkali metals](#) react with carbonate ions and create thermally stable compounds. The exception to that rule is Li_2CO_3 . Lithium and magnesium have very similar properties. Their similarities are referred to as a **diagonal relationship**, possibly due to their comparable size. Therefore, lithium and its compounds do not react the same as other group 1 elements. Some of the examples of alkali metal carbonates are shown below:

Lithium carbonate, Li_2CO_3 , can be used to treat patients who are manic depressive.

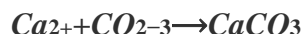


Sodium carbonate (soda ash), Na_2CO_3 , can be used to manufacture glass.



Reaction with Group 2 Elements

The group 2 carbonates are the most important minerals of the [alkaline earth metals](#). Their insolubility in water and their solubility in acidic solution makes them ideal reservoirs for petroleum. One of the most significant group 2 carbonates is calcium carbonate, which is the chief constituent of **limestone**. Limestones are used primarily for building stones. They also help in the manufacturing of glasses, Portland cement, and in the formation of limestone caves. Here is the reaction of carbonate calcium:

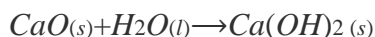


To obtain pure $CaCO_3$ from limestone, three steps must be taken:

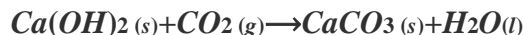
- 1) **Calcination**: decomposing limestone with thermal energy



- 2) **Slaking**: adding water to $CaO(s)$



- 3) **Carbonation**: Converting $Ca(OH)_2$ in aqueous form to a precipitated $CaCO_3$



Practical Applications of Carbonates

Permanent hard water contains HCO_3^- . By adding Na_2CO_3 (washing soda), the water is softened and hard water precipitates calcium and magnesium. Ammonium sulfide group filtrate, when treated with CO_3^{2-} , yields precipitate from the fourth group (Mg, Ca, Sr, Ba). Aqueous carbonate anion is the key reagent, earning the name carbonate group. After the series of precipitations, the solution will contain Na, K, NH_4^+ (common water soluble salts). Bicarbonates are used in the lab to prevent injury or damage from use of strong acids; for instance, by laying out bicarbonate powder in areas of potential acid leakage, accidental spills get neutralized.

Interesting Facts about Carbonates

- Carbonate is a moderately strong base.
- Alkali metals can be mined in the form: Na_2CO_3 , sodium carbonate.
- Except for Li_2CO_3 , alkali metal carbonates are thermally stable.
- Lithium Carbonate was used to treat individuals who are manic depressive.
- Sodium Carbonate (soda ash) is used in the production of glass.
- Calcium Carbonate is limestone.
- Sodium Bicarbonate can be isolated and sold or converted to sodium carbonate by heating.