

15.3: Common Bases and Their Uses

Learning Objectives

- Identify sources and uses of common bases.

Bases are less common as foods, but they are nonetheless present in many household products. Many cleaners contain ammonia, a base. Sodium hydroxide is found in drain cleaner. **Antacids**, which combat excess stomach acid, are comprised of bases such as magnesium hydroxide or sodium hydrogen carbonate. Several common bases and their corresponding uses are described below.

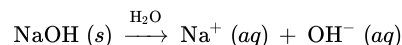
Sodium Hydroxide

Sodium hydroxide, also known as lye and caustic soda, is an inorganic compound with formula NaOH. It is a white solid ionic compound consisting of sodium cations, Na^+ , and hydroxide anions, OH^- .



Figure 15.3.1: A sample of sodium hydroxide as pellets in a watch glass. (Public Domain; Walkerma.)

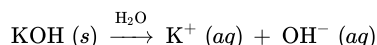
Dissolution of solid sodium hydroxide in water is a highly exothermic reaction:



The resulting solution is colorless and odorless and feels slippery when it comes in contact with skin.

Potassium Hydroxide

Potassium hydroxide is an inorganic compound with the formula KOH, and is commonly called caustic potash. Along with sodium hydroxide, NaOH, this colorless solid is a prototypical strong base. It has many industrial and niche applications, most of which exploit its caustic nature and its reactivity toward acids. Its dissolution in water is strongly exothermic.



A concentrated aqueous solution is sometimes called *potash lye*.

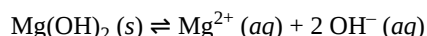
Magnesium Hydroxide

Magnesium hydroxide is the inorganic compound with the chemical formula $\text{Mg}(\text{OH})_2$. Magnesium hydroxide is a common component of antacids, such as milk of magnesia, as well as laxatives.



Figure 15.3.2: Bottle of antacid tablets. (CC BY 2.5; Midnightcomm).

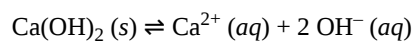
It is a white solid with low solubility in water. Combining a solution of many magnesium salts with basic water induces precipitation of solid $\text{Mg}(\text{OH})_2$. However, a weak concentration of dissociated ions can be found in solution:



Calcium Hydroxide

Calcium hydroxide (traditionally called slaked lime) is an inorganic compound with the chemical formula $\text{Ca}(\text{OH})_2$. It is a colorless crystal or white powder. It has many names including hydrated lime, caustic lime, builders' lime, slaked lime, cal, or pickling lime. Calcium hydroxide is used in many applications, including food preparation. Limewater is the common name for a saturated solution of calcium hydroxide.

Calcium hydroxide is relatively insoluble in water, but is large enough that its solutions are basic according to the following reaction:



Ammonia

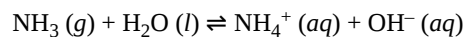
Ammonia is a compound of nitrogen and hydrogen with the formula NH_3 and is a colorless gas with a characteristic pungent smell. It is the active product of "smelling salts," and can quickly revive the faint of heart and light of head. Although common in nature and in wide use, ammonia is both caustic and hazardous in its concentrated form.

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JSmol

Figure 15.3.3: Jsmol rendering of the ammonia molecule.

In aqueous solution, ammonia acts as a base, acquiring hydrogen ions from H_2O to yield ammonium and hydroxide ions:



Ammonia is also a building block for the synthesis of many pharmaceutical products and is used in many commercial cleaning products.

Summary

Table 15.3.1: Common Bases and Their Uses

Chemical Name	Common Name	Uses
sodium hydroxide, NaOH	lye or caustic soda	Used in the manufacture of soaps and detergents, and as the main ingredient in oven and drain cleaners.
potassium hydroxide, KOH	lye or caustic potash	Used in the production of liquid soaps and soft soaps. Used in alkaline batteries.
magnesium hydroxide, $\text{Mg}(\text{OH})_2$	milk of magnesia	Used as an ingredient in laxatives, antacids, and deodorants. Also used in the neutralization of acidic wastewater.
calcium hydroxide, $\text{Ca}(\text{OH})_2$	slaked lime	Used in the manufacture of cement and lime water. Also added to neutralize acidic soil.
ammonia, NH_3		Used as a building block for the synthesis of many pharmaceutical products and in many commercial cleaning products. Used in the manufacture of fertilizers.

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