UNIT-3

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GASTRO-INTESTINAL AGENT

What are antacids?

Antacids either directly neutralize acidity, increasing the pH, or reversibly reduce or block the secretion of acid by gastric cells to reduce acidity in the stomach.[1] When gastrichydrochloric acid reaches the nerves in the gastrointestinal mucosa, they signal pain to the central nervous system. This happens when these nerves are exposed. In addition to the reduction of gastric acidity, antacids also alter the profile of prostaglandins produced by gastroduodenal mucosa and this may promote mucosal healing and be related to its therapeutic effect.

Sodium bicarbonate [$NaHCO_3$] – Sodium bicarbonate is a weak, short-acting antacid

Bicarbonate reacts with stomach hydrochloric acid to release carbon dioxide gas (CO_2) that is quickly absorbed..

Aluminum Hydroxide [$Al(OH)_3$] – Compared to magnesium hydroxide, aluminum hydroxide is a weak, slow-acting antacid, and its acid-neutralizing effect varies among commercial products.

Calcium Carbonate [$CaCO_3$] – Calcium Carbonate (chalk) is the most potent usable antacid. It can completely neutralize stomach acid. Nonetheless, it is not always the best choice for regular use.

A systemic alkalosis from prolonged and aggressive use infrequently produces metabolic consequences. [Alkalosis is excess base (alkali) in the body fluids. This is the opposite of excess acid (acidosis).]

Another disadvantage of calcium carbonate may be the tendency for gastric acid secretion to rebound after calcium is given.

Magnesium hydroxide

Magnesium hydroxide is an inorganic compound with the chemical formula of hydrated $Mg(OH)_2$. As a suspension in water, it is often called **milk of magnesia** because of its milk-like appearance. The solid mineral form of magnesium hydroxide is known asbrucite.

Magnesium hydroxide is a common component of antacids and laxatives

Properties	
Molecular formula	$Mg(OH)_2$
Molar mass	58.3197 g/mol
Appearance	White solid
Odor	odorless
Density	2.3446 g/cm^3
Melting point	350 °C (662 °F; 623 K) decomposes

Preparation

Magnesium hydroxide can be precipitated by the metathesis reaction between magnesium salts and sodium, potassium, or ammonium hydroxide:

$$Mg^{2+} (aq) + 2\ OH^{-} (aq) \rightarrow Mg(OH)_2 (s)$$

Natural magnesium hydroxide exists in the form of brucite, which is used commercially as a fire retardant. However, most industrially used magnesium hydroxide is chemically produced from sea water or brine. Magnesium chloride in the sea water is reacted with lime or dolomitic lime to form a precipitated magnesium hydroxide

Uses

Suspensions of magnesium hydroxide in water are used as an antacid to neutralize stomach acid, and as a laxative. The diarrhoeacaused by magnesium hydroxide carries away much of the body's supply of potassium, and failure to take extra potassium may lead to muscle cramps.[11] Magnesium hydroxide is also used as an antiperspirant underarm deodorant.[12] Milk of magnesia is useful against canker sores (aphthous ulcer) when used topically.[13]

Milk of magnesia is sold for medical use as chewable tablets, capsules, and as liquids having various added flavors. It is primarily used to alleviate constipation, but also to relieve indigestion and heartburn. When taken orally as a laxative, the osmotic force of the magnesia suspension acts to draw fluids from the body and to retain those already within the lumen of the intestine, serving to distend the bowel, thus stimulating nerves within the colon wall, inducing peristalsis and resulting in evacuation of colonic contents. It is also used as an antacid, though more modern formulations such as Maalox combine the antimotility effects of equal concentrations of aluminum hydroxide to avoid unwanted laxative effects.

Magnesium hydroxide powder is used industrially as a non-hazardous alkali to neutralize acidic wastewaters.[14] It also takes part in the Biorock method of building artificial reefs.

Aluminium hydroxide

Aluminium hydroxide, $Al(OH)_3$, archaically called hydrate of alumina or alumina trihydrate ($Al_2O_3 \cdot 3H_2O$), is found in nature as the mineral gibbsite (also known as hydrargillite) and its three, much more rare polymorphs: bayerite, doyleite and nordstrandite

Properties	
Molecular formula	$Al(OH)_3$
Molar mass	78.00 g/mol
Appearance	White amorphous powder
Density	2.42 g/cm³, solid
Melting point	300 °C (572 °F; 573 K)

Production

Virtually all the aluminium hydroxide used commercially is manufactured by the Bayer process[5] which involves dissolving bauxite in sodium hydroxide at temperatures up to 270°C. The remaining solids, which is a red mud, is separated and aluminium oxide is precipitated from the remaining solution. This red mud is damaging to the environment and highly toxic. It is usually stored in large artificial lakes, this is what led to the Ajka alumina plant accident in 2010 in Hungary, killing nine people and injuring 122. The dam holding back the red mud burst allowing it to contaminate large areas of land and waterways.[6] The aluminium oxide that is produced can be converted to aluminium hydroxide through reaction with water.

Pharmaceutical Use

This compound is used as an antacid under names such as Alu-Cap, Aludrox or Pepsamar. The hydroxide reacts with excess acid in the stomach, reducing its acidity.[12] This decrease of acidity of the contents of the stomach may in turn help to relieve the symptoms of ulcers, heartburn or dyspepsia. It can also cause constipation and is therefore often used with magnesium hydroxide or magnesium carbonate, which have counterbalancing laxative effects. This compound is also used to control phosphate (phosphorus) levels in the blood of people suffering from kidney failure.

Precipitated aluminium hydroxide is included as an adjuvant in some vaccines (e.g. anthrax vaccine). One of the well-known brands of aluminium hydroxide adjuvant is Alhydrogel, made by Brenntag. Since it absorbs protein well, it also functions to stabilize vaccines by preventing the proteins in the vaccine from precipitating or sticking to the walls of the container during storage. Aluminium hydroxide is often mis-called "alum" even by researchers; however, "alum" properly refers to aluminium potassium sulfate(alum).[citation needed] The aluminium hydroxide causes adsorption of antigens made of proteins, which slows the release of the antigen from the injection site (the "depot effect"), as well as causing a nonspecific irritation to the immune system.[13] Vaccine formulations containing aluminium hydroxide stimulates the immune system by inducing the release ofuric acid, an immunological danger signal. This strongly attracts certain types of monocytes which differentiate into dendritic cells. The dendritic cells pick up the antigen, carry it tolymph nodes, and stimulate T cells and B cells.[14] It appears to contribute to induction of a good Th2 response, so is useful for immunizing against pathogens that are blocked by antibodies. However, it has little capacity to stimulate cellular (Th1) immune responses, important for protection against many pathogens,[15] nor is it useful when the antigen ispeptide-based.

Calcium carbonate

Calcium carbonate is a chemical compound with the formula $CaCO_3$. It is a common substance found in rocks in all parts of the world, and is the main component of shells of marine organisms, snails, coal balls, pearls, and eggshells. Calcium carbonate is the active ingredient in agricultural lime, and is created when Ca ions in hard water react with carbonate ions creating limescale. It is commonly used medicinally as a calcium supplement or as an antacid, but excessive consumption can be hazardous.

Properties	
Molecular formula	$CaCO_3$
Molar mass	100.0869 g/mol
Appearance	Fine white powder; chalky taste
Odor	odorless
Density	2.711 g/cm^3 (calcite) 2.83 g/cm^3 (aragonite)
Melting point	825 °C (aragonite) 1339 °C (calcite)[1

Preparation

The vast majority of calcium carbonate used in industry is extracted by mining or quarrying. Pure calcium carbonate (e.g. for food or pharmaceutical use), can be produced from a pure quarried source (usually marble).

Alternatively, calcium carbonate is prepared from calcium oxide. Water is added to give calcium hydroxide, and carbon dioxide is passed through this solution to precipitate the desired calcium carbonate, referred to in the industry as precipitated calcium carbonate (PCC):[5]

$$CaCO_3 \rightarrow CaO + CO_2$$

$CaO + H_2O \rightarrow Ca(OH)_2$
$Ca(OH)_2 + CO_2 \rightarrow CaCO_3 + H_2O$

USES

Calcium carbonate is widely used medicinally as an inexpensive dietary calcium supplement or gastric antacid.[20] It may be used as aphosphate binder for the treatment of hyperphosphatemia (primarily in patients with chronic renal failure). It is also used in the pharmaceutical industry as an inert filler for tablets and other pharmaceuticals.[21]

Calcium carbonate is used in the production of toothpaste and has seen a resurgence as a food preservative and color retainer, when used in or with products such as organic apples or food.[22]

Excess calcium from supplements, fortified food and high-calcium diets, can cause milk-alkali syndrome, which has serious toxicity and can be fatal. In 1915, Bertram Sippy introduced the "Sippy regimen" of hourly ingestion of milk and cream, and the gradual addition of eggs and cooked cereal, for 10 days, combined with alkaline powders, which provided symptomatic relief for peptic ulcer disease. Over the next several decades, the Sippy regimen resulted in renal failure, alkalosis, and hypercalcaemia, mostly in men with peptic ulcer disease. These adverse effects were reversed when the regimen stopped, but it was fatal in some patients with protracted vomiting. Milk-alkali syndrome declined in men after effective treatments for peptic ulcer disease arose. During the past 15 years, it has been reported in women taking calcium supplements above the recommended range of 1.2 to 1.5 g daily, for prevention and treatment of osteoporosis, and is exacerbated by dehydration. Calcium has been added to over-the-counter products, which contributes to inadvertent excessive intake. Excessive calcium intake can lead to hypercalcemia, complications of which include vomiting, abdominal pain and altered mental status.[23]

As a food additive it is designated E170;[24] INS number 170. Used as an acidity regulator, anticaking agent, stabiliser or colour it is approved for usage in the EU,[25] USA[26] andAustralia and New Zealand.[27] It is used in some soy milk and almond milk products as a source of dietary calcium; one study suggests that calcium carbonate might be asbioavailable as the calcium in cow's milk.[28] Calcium carbonate is also used as a firming agent in many canned or bottled vegetable products.

Magnesium oxide

Magnesium oxide (MgO), or **magnesia**, is a white hygroscopic solid mineral that occurs naturally as periclase and is a source ofmagnesium (see also oxide). It has an empirical formula of MgO and consists of a lattice of Mg^{2+} ions and O^{2-} ions held together byionic bonding. Magnesium hydroxide forms in the presence of water ($MgO + H_2O \rightarrow Mg(OH)_2$), but it can be reversed by heating it to separate moisture.

Production

Magnesium oxide is produced by the calcination of magnesium carbonate or magnesium hydroxide or by the treatment of magnesium chloride with lime followed by heat. Calcining at different temperatures producs magnesium oxide of with different reactivity. High temperatures 1500 - 2000 °C produces dead-burned (often called dead burnt) magnesia, an unreactive form used as a refractory. Calcining temperatures 1000 - 1500 °C produce hard-burned magnesia which has limited reactivity, lower temperature, (700-1000°C) calcining produces light-burned magnesia, a reactive form, which is sometimes called caustic magnesia.

Properties	
Molecular formula	MgO
Molar mass	40.3044 g/mol
Appearance	White powder
Odor	Odorless
Density	3.58 g/cm^3
Melting point	2,852 °C (5,166 °F; 3,125 K)

USES

In medicine, magnesium oxide is used for relief of heartburn and sore stomach, as an antacid, magnesium supplement, and as a short-term laxative. It is also used to improve symptoms of indigestion. Side effects of magnesium oxide may include nausea and cramping.[9] In quantities sufficient to obtain a laxative effect, side effects of long-term use include enteroliths resulting in bowel obstruction

Magnesium carbonate

Magnesium carbonate, $MgCO_3$, is an inorganic salt that is a white solid. Several hydrated and basic forms of magnesium carbonate also exist as minerals.

Preparation

- Magnesium carbonate is ordinarily obtained by mining the mineral magnesite.
- Laboratory synthesis is simple: a metathesis reaction combining any soluble magnesium salt with sodium carbonate in solution, precipitating magnesium carbonate.
  $MgSO_4(aq) + Na_2CO_3(aq) \rightarrow MgCO_3(s) + Na_2SO_4(aq)$

- High purity industrial routes include a path through magnesium bicarbonate: combining magnesium hydroxide and carbon dioxide.[4] A slurry of magnesium hydroxide is treated with 3.5 to 5 atm of carbon dioxide below 50°C, giving the soluble bicarbonate, then vacuum drying the filtrate, which returns half of the carbon dioxide as well as water.
  $Mg(OH)_2 + 2\ CO_2 \rightarrow Mg(HCO_3)_2$
  $Mg(HCO_3)_2 \rightarrow MgCO_3 + CO_2 + H_2O$

Properties	
Molecular formula	$CMgO_3$
Molar mass	84.31 g mol^{-1}
Appearance	white solid hygroscopic
Odor	odorless
Taste	salty

Uses

The primary use of magnesium carbonate is the production of magnesium oxide by calcining..[4] $MgCO_3$ is also used in, cosmetics, dusting powder, and toothpaste. Other applications as a laxative to loosen the bowels, and color retention in foods. In addition, high purity magnesium carbonate is used as antacid and as an additive in table salt to keep it free flowing.

Magnesium carbonate, most often referred to as 'chalk', is used as a drying agent for hands inrock climbing, gymnastics, and weight lifting.

As a food additive magnesium carbonate is known as E504, for which the only known side effect is that it may work as a laxative in high concentrations.[12]

Magnesium carbonate is also used in taxidermy for whitening skulls. It can be mixed with hydrogen peroxide to create a paste, which is then spread on the skull to give it a white finish.

Cathartics

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In medicine, a **cathartic** is a substance that *accelerates* defecation. This is in contrast to a laxative, which is a substance which *eases* defecation, usually by softening feces.[1] It is possible for a substance to be both a laxative and a cathartic. However, agents such as psyllium seed husks increase the bulk of the feces.[2]

Cathartics such as sorbitol, magnesium citrate, magnesium sulfate, or sodium sulfate were previously used as a form of gastrointestinal decontamination following poisoning via ingestion. They are nolonger routinely recommended for poisonings.[3] High-dose cathartics may be an effective means of ridding the lower gastrointestinal tract of toxins; however, they carry a risk of electrolyte imbalances and dehydration.

Saline cathartics or **purgatives** are agents that quicken and increase evacuation from the bowl.

Laxatives are mild cathartics. Cathartics are used: to ease defecation in patients with painful hemorrhoids or other rectal disorders.

Four types of laxatives are known:

1. Stimulants 2. Bulk forming

3. Emollient 4. Saline cathartics

Stimulants act by local irritation on the intestinal tract which increase peristaltic activity. They include cascara extract, rhubarb extract, senna extract, castor oil, etc.

Bulk forming laxatives are made from cellulose, sodium carboxyl methyl cellulose and karaya gum.

The emollient laxatives act either as lubricants facilitating the passage of compacted fecal material or as stool softeners. E.g mineral oil,an anionic surface active agent.

Saline cathartics act by increasing the osmotic load of the GIT. They are salts of poorly absorbable Anions like(biphosphate), (phosphate), sulphates, tartarates, and soluble magnesium salt. Saline cathartics are water soluble and are taken with large quantities of water. This prevents excessive loss of water from body fluids. They act in the intestine and a full cathartic dose produces a water evacuation within 3-6 hrs. Because of their quick onset of action they are given early in the morning before breakfast. They are used for bowel evacuation before radiological, endoscopic and surgical procedures and also to expel parasite and toxic materials.

Disodium Hydrogen Phosphate (phosphor soda)

Na2HPO4 .12H2O M.W. = 358.14

I.P limit: It contains not less than 98.0% and not more than 101% of NaH2PO4 calculated with reference to the dried substance.

Properties: Colorless, odorless, crystalline powder. Soluble in water and practically in soluble in alcohol. The pH of disodium hydrogen phosphate water solution is between 8.0 and 11.0, meaning it is moderately basic

Preparation:

It can be generated by neutralization of phosphoric acid with sodium hydroxide:

$$H_3PO_4 + 2\ NaOH \rightarrow HNa_2PO_4 + 2\ H_2O$$

Industrially It is prepared in a two-step process by treating dicalcium phosphate with sodium bisulfate, which precipitates calcium sulfate:[2]

$$CaHPO_4 + NaHSO_4 \rightarrow NaH_2PO_4 + CaSO_4$$

In the second step, the resulting solution of monosodium phosphate is partially neutralized:

$$NaH_2PO_4 + NaOH \rightarrow HNa_2PO_4 + H_2O$$

Assay: Weigh accurately 4gm of substance and dissolve in 25ml of water add 25ml 1N HCl and titrate potentiometrically with 1M NaOH

.

Use: Widely used as saline cathartic. Orally as antihypercalcemic It is a pharmaceutical aid used as buffering agent. It is also found in some detergents and cleaning agents.

It is used as an in conjunction with trisodium phosphate in foods and water treatment. In foods, it is used to adjust pH. Its presence prevents coagulation in the preparation of condensed milk. Similarly, it is used as an anti-caking additive in powdered products.[3] It is used in desserts and puddings, e.g. Cream of Wheat to quicken cook time, and Jell-O Instant Pudding for thickening. In water treatment, It retards calcium scale formation,

Magnesium Sulphate $MgSO_4 \cdot 7H_2O$ commonly called as **Epsom salt**, I.P. limit: It contains not less than 99.0% and not more than 100.5% of magnesium sulphate calculated with reference to dried substance.

Properties: It forms colorless , odorless prismatic crystals. It dissolves in water, is practically insoluble in alcohol. It has cooling saline bitter taste. Magnesium sulfate is highly soluble in water. The anhydrous form is strongly hygroscopic, and can be used as a desiccant.

Preparation:

1) It can be prepared by neutralizing hot dilute sulphuric acid with magnesium or its oxides or carbonate. The solution is filtered; the filtrate is concentrated and recrystallized.

2) On commercial scale it is manufactured by reacting sulphuric with dolomite. Magnesium sulphate so formed is dissolved in the solution and the sparingly soluble calcium sulphate is deposited. The liquid is filtered the filtrate is concentrated and crystallized.

Test for Identification:

For magnesium: To solution of sample add dilute nitric acid solution a white precipitate is produced that is redissolved by adding 1ml of 2M ammonium chloride, add 0.25M disodium hydrogen phosphate a white crystalline precipitate is produced.

For sulphate: To 5ml of sample solution add 1ml of dilute HCl and 1ml barium chloride solution white precipitate. Add 1ml of iodine solution to the suspension, the suspension remains yellow (distinction from sulphites and dithionites) but decolorizes on adding stannous chloride (distinction from iodates).

Assay: Weigh accurately about 6.3gm of sample dissolve in 50ml of water, add 10ml of strong ammonia ammonium chloride solution and titrate with 0.05M disodium EDTA using 0.1gm of moderate black II mixture as indicator until blue color is obtained.

Each ml of 0.05M disodium EDTA≡ 0.00602 gm of $MgSO4$

Uses: It is used as osmotic laxative, in treatment of electrolyte deficiency, in wet dressing in boils, in treatment of cholecystitis, sea sickness, hypertension etc.

Oral magnesium sulfate is commonly used as a saline laxative or osmotic purgative. Magnesium sulfate is the main preparation of intravenous magnesium.

Indications for internal use include the following:

- Replacement therapy for hypomagnesemia.[4]
- Magnesium sulfate is the first-line antiarrhythmic agent for torsades de pointes in cardiac arrest under the 2005 ECC guidelines and for managing quinidine-induced arrhythmias.[5]

- As a bronchodilator after beta-agonist and anticholinergic agents have been tried, e.g. in severe exacerbations of asthma.[6]Studies conducted have revealed that magnesium sulfate can be nebulized to reduce the symptoms of acute asthma.[6] It is commonly administered via the intravenous route for the management of severe asthma attacks.
- Magnesium sulfate can be used to treat eclampsia in pregnant women.[7]
- Intravenous magnesium sulfate has been shown to prevent cerebral palsy in preterm babies.[8] A recent systematic review suggests that antenatal intravenous magnesium sulphate can reduce the risk of cerebral palsy and gross motor dysfunction in preterm infants by on average 30%.[9]
- Magnesium sulfate has been used as an experimental treatment of Irukandji syndrome caused by envenomation by certain species of Irukandji jellyfish, however the efficacy of this treatment remains unproven.[10]
- Solutions of sulfate salts such as Epsom salt may be given as first aid for barium chloride poisoning.[11]

An overdose of magnesium causes hypermagnesemia.

Adsorption

Adsorption is the adhesion of atoms, ions, or molecules from a gas, liquid, or dissolved solid to a surface.[1] This process creates a film of the *adsorbate* on the surface of the *adsorbent*. This process differs from absorption, in which a fluid (the *absorbate*) permeates or isdissolved by a liquid or solid (the *absorbent*).[2] Adsorption is a surface-based process while absorption involves the whole volume of the material.

Adsorption is present in many natural, physical, biological, and chemical systems, and is widely used in industrial applications such as activated charcoal, capturing and using waste heat to provide cold water for air conditioning and other process requirements (adsorption chillers), synthetic resins, increase storage capacity of carbide-derived carbons, and water purification.

Activated carbon[edit]

Activated carbon is a highly porous, amorphous solid consisting of microcrystallites with a graphite lattice, usually prepared in small pellets or a powder. It is non-polar and cheap. One of its main drawbacks is that it reacts with oxygen at moderate temperatures (over 300 °C).

Activated carbon can be manufactured from carbonaceous material, including coal (bituminous, subbituminous, and lignite), peat, wood, or nutshells (e.g., coconut). The manufacturing process consists of two phases, carbonization and activation. The carbonization process includes drying and then heating to separate by-products, including tars and other hydrocarbons from the raw material, as well as to drive off any gases generated. The process is completed by heating the material over 400 °C (750 °F) in an oxygen-free atmosphere that cannot support combustion. The carbonized particles are then "activated" by exposing them to an oxidizing agent, usually steam or carbon dioxide at high temperature. This agent burns off the pore blocking structures created during the carbonization phase and so, they develop a porous, three-dimensional graphite lattice structure. The size of the pores developed during activation is a function of the time that they spend in this stage. Longer exposure times result in larger pore sizes. The most popular aqueous phase carbons are bituminous based because of their hardness, abrasion resistance, pore size distribution, and low cost, but their effectiveness needs to be tested in each application to determine the optimal product.

Activated carbon is used for adsorption of organic substances and non-polar adsorbates and it is also usually used for waste gas (and waste water) treatment. It is the most widely used adsorbent since most of its chemical (e.g. surface groups) and physical properties (e.g. pore size distribution and surface area) can be tuned according to what is needed. Its usefulness also derives from its large micropore (and sometimes mesopore) volume and the resulting high surface area.

Aluminium sulfate

Aluminium sulfate, alternatively spelled either **aluminum** or **sulphate**, is a chemical compound with the formula $Al_2(SO_4)_3$. It is soluble in water and is mainly used as a flocculating agent in the purification of drinking water[2][3] and waste water treatment plants, and also in paper manufacturing.

Aluminium sulfate is sometimes referred to as a type of alum. Alums are double sulfate salts, with the formula $AM(SO_4)_2 \cdot 12H_2O$,

where A is a monovalent cation suchas potassium or ammonium and M is a trivalent metal ion such as aluminium.[4] The anhydrous form occurs naturally as a rare mineral millosevichite, found e.g. in volcanic environments and on burning coal-mining waste dumps. Aluminium sulfate is rarely, if ever, encountered as the anhydrous salt. It forms a number of different hydrates, of which the hexadecahydrate $Al_2(SO_4)_3$•$16H_2O$ and octadecahydrate $Al_2(SO_4)_3$•$18H_2O$ are the most common.

Properties	
Molecular formula	$Al_2(SO_4)_3$
Molar mass	342.15 g/mol (anhydrous) 666.42 g/mol (octadecahydrate)
Appearance	white crystalline solid hygroscopic
Density	2.672 g/cm^3 (anhydrous) 1.62 g/cm^3(octadecahydrate)
Melting point	770 °C (decomp, anhydrous) 86.5 °C (octadecahydrate)
Solubility in water	31.2 g/100 mL (0 °C) 36.4 g/100 mL (20 °C) 89.0 g/100 mL (100 °C)

Preparation

Aluminium sulfate may be made by adding aluminium hydroxide, $Al(OH)_3$, to sulfuric acid, H_2SO_4:

$$2\ Al(OH)_3 + 3\ H_2SO_4 \rightarrow Al_2(SO_4)_3{\cdot}6H_2O$$

or by heating aluminum metal in a sulfuric acid solution:

$$2\ Al_{(s)} + 3\ H_2SO_4 \rightarrow Al_2(SO_4)_3 + 3\ H_{2\ (g)}$$

Uses

Aluminium sulfate is used in water purification and as a mordant in dyeing and printing textiles. In water purification, it causes impurities to coagulate into larger particles and then settle to the bottom of the container (or be filtered out) more easily. This process is called coagulation or flocculation. Research suggests that in Australia, aluminum sulfate used this way in drinking water treatment is the primary source of hydrogen sulfide gas in sanitary sewer systems.[5]

When dissolved in a large amount of neutral or slightly alkaline water, aluminium sulfate produces a gelatinous precipitate ofaluminium hydroxide, $Al(OH)_3$. In dyeing and printing cloth, the gelatinous precipitate helps the dye adhere to the clothing fibers by rendering the pigment insoluble.

Aluminium sulfate is sometimes used to reduce the pH of garden soil, as it hydrolyzes to form the aluminium hydroxide precipitate and a dilute sulfuric acid solution. An example of what changing the pH level of soil can do to plants is visible when looking at theHydrangea macrophylla. The gardener can add aluminium sulfate to the soil to reduce the pH level which in turn will result in the flowers of the Hydrangea turning a different color.

Aluminium potassium sulfate and another form of alum, aluminium ammonium sulfate are the active ingredients in someantiperspirants; however, beginning in 2005 the US Food and Drug Administration no longer recognized it as a wetness reducer.

Aluminium potassium sulfate is usually found in baking powder, where there is controversy over its use due to concern regarding the safety of adding aluminium to the diet.

In construction industry it is used as waterproofing agent and accelerator in concrete. Another use is a foaming agent in fire fighting foam.

It is also used in styptic pencils, and pain relief from stings and bites.

Activated charcoal (medication)

Activated carbon, also called **activated charcoal**, **activated coal**, or **carbo activatus**, is a form of carbon processed to have small, low-volume pores that increase the surface area available for adsorption or chemical reactions.[1] *Activated* is sometimes substituted with *active*.**Activated carbon** is used as a medication to treat poisonings following excessive oral ingestion of certain medications or poisons. Side effects may include aspiration into the lungs.

Production

Activated carbon is carbon produced from carbonaceous source materials such as nutshells, coconut husk, peat, wood, coir, lignite, coal, and petroleum pitch. It can be produced by one of the following processes:

1. **Physical reactivation**: The source material is developed into activated carbons using hot gases. This is generally done by using one or a combination of the following processes:
    - *Carbonization*: Material with carbon content is pyrolyzed at temperatures in the range 600–900 °C, in absence of oxygen (usually in inert atmosphere with gases likeargon or nitrogen)
    - *Activation/Oxidation*: Raw material or carbonized material is exposed to oxidizing atmospheres (oxygen or steam) at temperatures above 250 °C, usually in the temperature range of 600–1200 °C.
2. **Chemical activation**: Prior to carbonization, the raw material is impregnated with certain chemicals. The chemical is typically an acid, strong base, or a salt [11] (phosphoric acid, potassium hydroxide, sodium hydroxide, calcium chloride, and zinc chloride 25%). Then, the raw material is carbonized at lower temperatures (450–900 °C). It is believed that the carbonization / activation step proceeds simultaneously with the chemical activation. Chemical activation is preferred over physical activation owing to the lower temperatures and shorter time needed for activating material.

Properties

A gram of activated carbon can have a surface area in excess of 500 m^2, with 1500 m^2 being readily achievable.[13] Carbon aerogels, while more expensive, have even higher surface areas, and are used in special applications.

Activated carbon does not bind well to certain chemicals, including alcohols, diols, strong acids and bases, metals and most inorganics, such as lithium, sodium, iron, lead, arsenic,fluorine, and boric acid.

Activated carbon adsorbs iodine very well.

Medical uses

Toxin ingestion

While it is used for many toxic ingestion, there is not good evidence that it improves outcomes.[1] It is not effective for a number of poisonings including: strong acids or bases, iron, lithium, arsenic, methanol, ethanol or ethylene glycol.[1]

Gas

Charcoal biscuits were sold in England starting in the early 19th century, originally as an antidote to flatulence and stomach trouble.[2]

Tablets or capsules of activated carbon are used in many countries as an over-the-counter drug to treat diarrhea, indigestion, andflatulence.[3] There is some evidence of its effectiveness to prevent diarrhea in cancer patients who have received irinotecan.[4] It can interfere with the absorption of some medications, and lead to unreliable readings in medical tests such as the guaiac card test.[5] Activated carbon is also used for bowel preparation by reducing intestinal gas content before abdominal radiography to visualize bile and pancreatic and renal stones. A type of charcoal biscuit has also been marketed as a pet care product.

Side effects

Incorrect application (e.g. into the lungs) results in pulmonary aspiration which can sometimes be fatal if immediate medical treatment is not initiated.[6] The use of activated carbon is contraindicated when the ingested substance is an acid, an alkali, or a petroleum product.

Mechanism of action

It is thought to bind the poison and prevent its absorption by the gastrointestinal tract. In cases of suspected poisoning, medical personnel administer activated carbon on the scene or at a hospital's emergency department. In rare situations activated carbon is used in Intensive Care to filter out harmful drugs from the blood stream of poisoned patients. Activated carbon has become the treatment of choice for many poisonings, and other decontamination methods such as ipecac-induced emesis or stomach pumping are now used rarely.

While activated carbon is useful in acute poisoning, it has been shown to not be effective in long term accumulation of toxins, such as with the use of toxic herbicides.[7]

Mechanisms of action:

- Binding of the toxin to prevent stomach and intestinal absorption. Binding is reversible so a cathartic such as sorbitol may be added as well.
- It interrupts the enterohepatic and enteroenteric circulation of some drugs/toxins and their metabolites.

Expectorants:

It works by signaling the body to increase the amount or hydration of secretions, resulting in more yet clearer secretions and as a byproduct lubricating the irritated respiratory tract. One expectorant guaifenesin is commonly available in many cough syrups. It is a type of Mucolytic Agent.

A **mucolytic agent** is an agent which dissolves thick mucus and is usually used to help relieve respiratory difficulties. It does so by dissolving various chemical bonds within secretions, which in turn can lower the viscosity by altering the mucin-containing components.

An expectorant increases bronchial secretions and mucolytics help loosen thick bronchial secretions.

Ammonium chloride

Ammonium chloride, an inorganic compound with the formula NH_4Cl, is a white crystalline salt, highly soluble in water. Solutions ofammonium chloride are mildly acidic. Sal ammoniac is a name of the natural, mineralogical form of ammonium chloride. The mineral is commonly formed on burning coal dumps, due to condensation of coal-derived gases. It is also found around some types of volcanic vents. It is used as a flavouring agent in some types of liquorice. It is the product from the reaction of hydrochloric acid and ammonia.

Preparation:

It is a product of the Solvay process used to produce sodium carbonate.[3]

$$CO_2 + 2\ NH_3 + 2\ NaCl + H_2O \rightarrow 2\ NH_4Cl + Na_2CO_3$$

In addition to being the principal method for the manufacture of ammonium chloride, this method is used to minimize ammonia release in some industrial operations. Ammonium chloride is prepared commercially by combining ammonia (NH_3) with either hydrogen chloride(gas) or hydrochloric acid (water solution):[3]

$$NH_3 + HCl \rightarrow NH_4Cl$$

Ammonium chloride occurs naturally in volcanic regions, forming on volcanic rocks near fume-releasing vents (fumaroles). The crystals deposit directly from the gaseous state, and tend to be short-lived, as they dissolve easily in water.

Properties	
Molecular formula	H_4ClN
Molar mass	53.49 g mol^{-1}
Appearance	White solid, hygroscopic
Odor	Odorless
Density	1.5274 g/cm^3[1]
Melting point	338 °C (640 °F; 611 K) decomposes, sublimes
Boiling point	520 °C (968 °F; 793 K)

Sublimationconditions	Sublimes at 337.6 °C[2] $\Delta_{\mathrm{subl}}H^{\circ}$ = 176.1 kJ/mol[3]
Solubility in water	244 g/L (−15 °C) 294 g/L (0 °C) 391.8 g/L (25 °C) 454.4 g/L (40 °C) 740.8 g/L (100 °C)[4]

Medicine

Ammonium chloride is used as an expectorant in cough medicine. Its expectorant action is caused by irritative action on the bronchial mucosa. This causes the production of excess respiratory tract fluid which presumably is easier to cough up. Ammonium salts are an irritant to the gastric mucosa and may induce nausea and vomiting.

Ammonium chloride is used as a systemic acidifying agent in treatment of severe metabolic alkalosis, in oral acid loading test to diagnose distal renal tubular acidosis, to maintain the urine at an acid pH in the treatment of some urinary-tract disorders.

Food

In several countries, ammonium chloride, known as sal ammoniac, is used as food additive under the E number E510, commonly as a yeast nutrient in breadmaking. It is a feed supplement for cattle and an ingredient in nutritive media for yeasts and many microorganisms.

Ammonium chloride is used to spice up dark sweets called salty liquorice, in baking to give cookies a very crisp texture, and in the vodka Salmiakki Koskenkorva for flavouring. In India and Pakistan, it is called "Noshader" and is used to improve the crispness of snacks such as *samosas* and *jalebi*.

In the laboratory

Ammonium chloride is used to produce low temperatures in cooling baths. Ammonium chloride solutions with ammonia are used asbuffer solutions.

In paleontology, ammonium chloride vapor is precipitated on fossils, where the substance forms a brilliant white, easily removed and fairly harmless and inert layer of tiny crystals. This covers up any coloration the fossil may have, and if lighted at an angle highly enhances contrast in photographic documentation of three-dimensional specimens.[1] The same technique is applied in archaeologyto eliminate reflection on glass and similar specimens for photography.[2]

Potassium iodide

Potassium iodide is an inorganic compound with the chemical formula KI. This white salt is the most commercially significant iodide compound, with approximately 37,000 tons produced in 1985. It is less hygroscopic (absorbs water less readily) than sodium iodide, making it easier to work with. Potassium iodide occurs naturally in kelp.[1] Kelp's iodide content can range from 89 μg/g to 8165 μg/g.[2]

Aged and impure samples are yellow because of the slow oxidation of the salt to potassium carbonate and elemental iodine.[3]

$$4\ KI + 2\ CO_2 + O_2 \rightarrow 2\ K_2CO_3 + 2\ I_2$$

Potassium iodide is medicinally used for thyroid blockade, thyroid storm and also as an expectorant.

Properties	
Molecular formula	KI
Molar mass	166.0028 g/mol
Appearance	white crystalline solid
Density	3.123 g/cm^3
Melting point	681 °C (1,258 °F; 954 K)
Boiling point	1,330 °C (2,430 °F; 1,600 K)
Solubility in water	128 g/100 ml (0 °C) 140 g/100 mL (20 °C) 176 g/100 mL (60°C) 206 g/100 mL (100°C)
Solubility	2 g/100 mL (ethanol) soluble in acetone (1.31 g/100 mL) slightly soluble in ether,ammonia
Refractive index(n_D)	1.677
Viscosity	1.0227 cP (733 °C)

Production:

It is produced industrially by treating KOH with iodine

Pharmaceutical applications

Tablet

Potassium iodide is medicinally supplied in 130 mg tablets (each containing 100 mg iodine as iodide and 30 mg potassium) for emergency purposes related to blockade of radioiodine uptake, a common form of radiation poisoning due to environmental contamination by the short-lived fission product iodine-135.[13] Potassium iodide may also be administered pharmaceutically for thyroid storm.

SSKI

Potassium iodide can be conveniently prepared as a saturated solution, abbreviated SSKI. This method of delivering potassium iodide does not require a method to weigh out the potassium iodide so it can be used in an emergency situation.

Respiratory Stimulants

A respiratory stimulant is primarily used in addition to noninvasive ventilation as a means to help increase the urge to breathe. It works by stimulating the central nervous system, resulting in an increase in respiratory rate and tidal volume, which is the amount of air that is inhaled or exhaled during a normal breath.

Patients with a chronic obstructive pulmonary disease, or COPD, are often treated with respiratory stimulants.

Here is what they are, how they work and what you need to know:

How Are Respiratory Stimulants Used?

Respiratory stimulants are used in four primary ways:

- Respiratory failure
- Apnea of prematurity (apnea and bradypnea spells)
- To antagonize the effects of general anesthetics
- To treat barbiturate poisoning

How Do Respiratory Stimulants Work?

Medications classified as airway stimulants that may be used with COPD include:

- **Theophylline** is a bronchodilator (dilating the large airways of the lungs) that works by relaxing smooth muscle in the bronchial tubes. This medication may be used for those with asthma or COPD, but is usually used as only a second or third-line option.
- **Caffeine** is used in premature babies, especially those born before 30 or 31 weeks gestation, who have periods of slow breathing (bradypnea) and periods in which they stop breathing (apnea) also known as "A and B spells."
- **Doxofylline** is a methylxanthine category medication and is related to theophylline and caffeine.

- **Doxapram (Dopram, Stimulex or Respiram)** works by stimulating chemoreceptors (receptors that pick up substances traveling in the blood) on the carotid body in the neck.
- Respiratory stimulants may also cause some side effects, which can vary depending on the specific drug that is used. Some side effects may include dizziness, nausea, and headache. More severe side effects that require urgent medical attention may include an irregular or rapid heartbeat, seizures, or fainting. Patients have also reported muscle spasms, loss of bladder control, and hyperactivity.

Ammonium hydroxide

Ammonia solution, also known as **ammonium hydroxide**, **ammonia water**, **ammonical liquor**, **ammonia liquor**, **aqua ammonia**,**aqueous ammonia**, or simply **ammonia**, is a solution of ammonia in water. It can be denoted by the symbols NH_3(aq). Although the name ammonium hydroxide suggests an alkali with composition $[NH_4^+][OH^-]$, it is actually impossible to isolate samples of NH_4OH, as these ions do not comprise a significant fraction of the total amount of ammonia except in extremely dilute solutions.

Methods of Manufacturing

DIRECT REACTION OF HYDROGEN AND NITROGEN OVER A CATALYTIC SURFACE BASED ON METALLIC IRONFOLLOWED BY ADDITION OF THE RESULTING AMMONIA TO WATER

Properties[1]	
Chemical formula	NH_4OH
Molar mass	35.04 g/mol
Appearance	Colourless liquid
Odor	"Fishy", highly pungent / Acrid taste
Density	0.91 g/cm^3 (25 % w/w) 0.88 g/cm^3 (35 % w/w)
Melting point	−57.5 °C (−71.5 °F; 215.7 K) (25% w/w) −91.5 °C (35% w/w)
Boiling point	27 °C (81 °F; 300 K) (25% w/w)

Solubility in water	Miscible

Ammonium hydroxide is** alkaline**, meaning it has a high pH, so it can be used to neutralize acids.pH= 11.6

Applications[edit]

Household cleaner[edit]

Household ammonia is dilute ammonium hydroxide, which is also an ingredient of numerous other cleaning agents, including many window cleaning formulas.

Furniture darkening[

In furniture-making, ammonium hydroxide was traditionally used to darken or stain wood containing tannic acid. After being sealed inside a container with the wood, fumes from the ammonium hydroxide react with the tannic acid and iron salts naturally found in wood, creating a rich, dark stained look to the wood. This was commonly used during the arts and crafts movement in furniture- a furniture style which was primarily constructed of oak and stained using these methods.[6]

Food production[

Ammonium hydroxide is used as a leavening agent or acidity regulator and is classified by the Food and Drug Administration as generally recognized as safe (GRAS).[7] Its pH control abilities make it an effective antimicrobial agent.

Tobacco processing[

According to Phillip Morris USA, quantities of up to 0.3% ammonium hydroxide are used in tobacco for flavor enhancement and as a processing aid. [8]

Aquarium Fishless cycling[

Ammonium hydroxide is used by aquarists for the purposes of fishless cycling, but this requires that there are no surfactants or scents, it should be colorless and shouldn't foam when shaken up.

Therapeutic Uses

10% ammonia water as a reflex respiratory stimulant; MEDICATION (VET): externally on bites & stings; As rubefacient on bruises, sprains; Inhalant; Internally as an antacid & carminative /Ammonia water-10%/

SAGAR BANSAL