Hydroxides of alkali metals

The alkali hydroxides are a class of chemical compounds which are composed of an alkali metal cation and the hydroxide anion (OH), e.g., Lithium hydroxide (LiOH), Sodium hydroxide (NaOH) .They all are basic in nature.

Halides of alkali metals

The alkali metal halides exist as colourless crystalline solids, although as finely ground powders appear white. They melt at high temperature, usually several hundred degrees to colorless liquids.

Their high melting point reflects their high lattice energy. At still higher temperatures, these liquids evaporate to give gases composed of diatomic molecules.

Polarization effect

When alkali metals combine with non-metals, the elctronegative non-metal attracts the electrons of metal towards it self. This is called as polarization effect.

Salts of oxoacids of alkali metals

Alkali metals are highly electropositive, therefore, their hydroxides are strong bases and they form salts with all acids. They are generally soluble in water and stable towards heat.

Difficulties during extraction of alkali metals

The production of pure alkali metals is difficult due to their extreme reactivity with commonly used substances, such as water. The alkali metals are so reactive that they can not be displaced by other elements and must be isolated through high-energy methods such as electrolysis.

Uses of alkali metals

Lithium, sodium, and potassium have many applications, while rubidium and caesium are very useful in academic contexts but do not have many
applications.

Lithium is often used in batteries, and lithium oxide can help process silica.
Lithium can also be used to make lubricating greases, air treatment, and aluminum production.
Pure sodium has many applications, including use in sodium-vapor lamps which produce very efficient light .
Potassium has a vital rolel in biological system. KCl used as a fertilizer while KOH is used in the manufacture of soap.
Caesium is used making photoelectric cells

Anomalous behaviour of lithium

Lithium shows anomalous behavior due to its small size.The polarizing power of lithium ion is highest of all the alkali metal ion .Because of small size, Lithium is very hard, less reactive as compare to other alkali metals like sodium and potassium.

Dignonal relationship of lithium with magnesium

In the alkali metal series lithium shows smallest size because of that the polarization power of lithium is highest and it is similar to Magnesium of next series which is diagonally placed in the next series. Both Li and Mg forms monoxide when heated in air or oxygen while other forms peroxide or super oxide. Hence, because of same properties they exhibit diagonal relationship.

Methods involved in extraction of lithium

The mineral forms of lithium are heated to a high enough temperature (1200 K - 1300 K) in order to crumble them and thus allow for subsequent reactions to more easily take place. The use of sulfuric acid and sodium carbonate to allow the iron and aluminum to precipitate from the ore, from there, more sodium carbonate is applied to the remaining material allow the lithium to precipitate out, forming lithium carbonate. This is treated with hydrochloric acid to form lithium chloride.

Uses of lithium

In its mineral forms it accounts for only 0.0007% of the earth's crust.
Uses:

Its compounds are used in certain kinds of glass and porcelain products.
More recently lithium has become important in dry-cell batteries and nuclear reactors.
It is used for producing thermonuclear energy required for propelling rockets and guided missiles.
Li-Mg alloy (with 14% Li) is extremely tough and corrosion-resistant.

Extraction of sodium from fused sodium chloride

On passing electricity through fused sodium chloride, sodium cations are produced which migrate towards the cathode. Sodium ions are reduced to sodium metal which is deposited at the cathode.

Manufacturing of sodium carbonate

Sodium carbonate is prepared by solvay process. In this process, CO_2 is bubbled through the solution of brine saturated with ammonia when hydrogen carbonate precipitates due to common ion effect.

Potassium carbonate can not be prepared by solvay process

Potassium carbonate can not prepared by solvay process because potassium hydrogen carbonate being highly soluble in water cannot be precipitated.

Uses of sodium carbonate or washing soda

1. For the manufacture of glass.
2. For washing purposes in laundries.
3. As a household cleansing agent.
4.. For the softening of water.
5. In paper and soap/detergent industries.

Methods of prepration of common salt

It can be obtained by evaporation of sea water.
It is also prepared by electrolysis method.
Crude sodium chloride, generally obtain by crystallisation of brine solution.

Properties and uses of sodium chloride

Sodium chloride melts at 1801 K. It has a solubility of 36.09 in 100g water at 273 K. When heated with sulphuric acid and manganese dioxide, it liberates chlorine. It is used as a common salt or table salt, preservatives and also used in process of soap production.

Uses of sodium hydroxide

1. In the refining of petroleum and vegetable oils.
2. In the purification of bauxite for the extraction of aluminium.
3. As a cleansing agent and in washing powder for machines, metal sheets etc.

Methods of prepration of baking soda

Sodium hydrogen carbonate (baking soda) is made by saturating a solution of sodium carbonate with carbon dioxide. The white crystalline powder of sodium hydrogen carbonate being less soluble, gets separated out.

Properties and uses of sodium thiosulphate

It is used as antidote in cyanide poisoning, used as medicine in end stage kidney diseases.Used in iodometry titration, Gold extraction etc.

Chemical formula	Na2S2O3
Molar mass	158.11 g/mol (anhydrous) 248.18 g/mol (pentahydrate)
Appearance	White crystals
Odor	Odorless

Properties of potassium chloride

The crystal structure of potassium chloride is like that of NaCl. It adopts a face-centered cubic structure. Its lattice constant is roughly 6.3 A . Crystals cleave easily in three directions.
Transmission range: 210 nm to 20 m
Transmittivity = 92% at 450 nm and rises linearly to 94% at 16 m
Refractive index = 1.456 at 10 m

Properties and uses of potassium hydroxide

Many potassium salts are prepared by neutralization reactions involving KOH. Although more expensive than using sodium hydroxide, KOH works well in the manufacture of biodisel. It is used in manufacture of soft soaps etc.
Potassium hydroxide can be found in pure form by reacting sodium hydroxide with impure potassim. It is usually sold as translucent pellets, which will become tacky in air because KOH is hygroscopic. Consequently, KOH typically contains varying amounts of water (as well as carbonates, see below). Its dissolution in water is strongly exothermic. Concentrated aqueous solutions are sometimes called potassium iyes. Even at high temperatures, solid KOH does not dehydrate readily.

Sodium bicarbonate or Baking soda

Formula: $NaHCO_3$
Properties:
Sodium hydrogen carbonate is a white crystalline solid having a density of about 2.2 g/mL. It has alkaline taste and is sparingly soluble in water. The solubility of sodium hydrogen carbonate increases with the rise of temperature.

Uses of sodium bicarbonate or Baking soda

1. As a component of baking powder.
2. In fire extinguishers.
3. In medicines as a mild antiseptic for skin diseases and to neutralize the acidity of the stomach.
4. As a reagent in laboratory.

Bilogical importance of sodium and potassium

A typical 70 kg man contains 90g sodium and 170g potassium. This two alkali metals play a vital role in biological system. Sodium is major cation in blood plasma of vertebrates and potassium is a major cation in cytoplasm.

Occurance of alkali earth metals

Alkaline earth metals are obtained in the form of their ore in earth's crust. Of the alkaline earth metals calcium and magnesium rank fifth and sixth in abundance respectively, in earth crust. Beryllium is rare and radium is rarest of all.

Atomic properties of alkaline earth elements

The atomic and ionic radii of the alkaline earth elements are smaller than those of the corresponding alkali metals of the same period. This is due to increase in atomic number as well as increased nuclear charge in these elements.

Physical properties of alkaline earth elements

shiny.
silvery-white
somewhat reactive metals at standard temperature and pressure.
readily lose their two outermost electrons to form cations with a 2^+ charge.
low densities
low melting points
low boiling points

Electrode potential of alkaline earth metals

All the alkaline earth metals are highly reactive as they have tendency to lose 2 electrons from s-orbitals. This high reactivity is due to low ionization energy and high negative values of standard electrode potential.
The chemical reactivity of alkaline earth metals increases on moving down the group from Be to Ba, because the ionization enthalpy decreases and the electrode potential become more negative with increasing atomic number from Be to Ra.
Thus Be is least reactive and Ra is most reactive element.

Reactivity of alkaline earth metals towards water

They react with water to evolve hydrogen gas. The chemical reactivity of metal with water increase as we move from Mg to Ba.

Tendency of alkaline earth metal to form complexes

Alkaline earth metals have stronger tendency to form complexes then alkali earth metal. This is because of their smaller size and high charge. The tendency of complex formation decrease down the group.

Oxides of alkaline earth metals

All the elements of group 2 burns with oxygen gas to produce metallic oxide. The oxides of alkaline earth metals are less basic. Oxides become more basic on increas in electropositive character.

Hydroxides of alkaline earth metal

Alkaline earth metals have tendency to form hydroxides which decrease as moving down in the group. All the hydroxides are basic in nature which decreases on moving down the group.

Halide of alkaline earth metals

Alkaline earth metals directly combine with halogen to form metal halides of type MX_2. They can be prepare by treating metal or their carbonates with halogen acid.

Uses of alkaline earth metals

Some important uses of alkaline earth metals are:
1. Be is used in the manufacture of alloys. Cu-Be alloys are used in the preparation of high strength springs.
2. Mg is used to prepare alloys with Al, Zn, Mn and Sn. Mg-Al alloys are used in construction of aircrafts.
3. Ca is used in the extraction of metals from their oxide.
4. Radium salt are used in radiotherapy. e.g., treatment of cancer.

Anomalous behaviour of beryllium

Beryllium, the first member of the group-2 metals, shows anomalous behavior as compared to magnesium and rest of the member. Be differ from rest of member due to smaller atomic and ionic size and higher electro negativity. Be is a hard metal while others are soft and it is least metallic among all, due to higher electronegativity .

Properties and uses of calcium oxide

Calcium oxide is a white amorphous solid. It has a melting point of 2870 K. When it is exposed to atmosphere, it absorbs moisture and carbon dioxide. It is used in the manufacture of sodium carbonate from caustic soda.

Properties and uses of calcium hydroxide

Its suspension in water is called as milk of lime. When dry slaked lime is subjected to the action of chlorine, bleaching powder is formed. It is used in the purification of sugar and in the manufacture of dye stuff.

Method of prepration of magnesium oxide

Magnesium oxide is produced by the calcination of magnesium carbonate or by the treatment of magnesium chloride with lime followed by heat. Calcining at different temperatures produces magnesium oxide of different reactivity. High temperatures 1500 - 2000 C diminish the available surface area and 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 and calcining at lower temperature, (700-1000 C) produces light-burned magnesia, a reactive form, also known as caustic calcined magnesia. Although some decomposition of the carbonate to oxide occurs at temperatures below 700 C, this appears rapidly reversible due to absorption of carbon dioxide from the air.

Methods of prepration of magnesium sulphate

The heptahydrate can be prepared by neutralizing sulphuric acid with magnesium carbonate or oxide, but it is usually obtained directly from natural sources. Anhydrous magnesium sulfate is prepared only by the dehydration of a hydrate.

Properties and uses of magnesium sulphate

Magnesium sulfate is highly soluble in water. The anhydrous form is strongly hygroscopic, and can be used as a desiccant. It is the primary substance that causes the absorption of sound in seawater.
Magnesium sulphate is commonly used mineral in pharmaceutical industries.It is used to fullfill deficiency magnesium sulphate in soil.

manufacturing of superphosphate

Superphosphate is manufactured by the reaction of phosphate rock with sulfuric acid to convert the insoluble form of calcium phosphate in a soluble form, which is able to be used by plants.

Cement

A powdery substance made by calcining lime and clay, mixed with water to form mortar or mixed with sand, gravel and water to make concrete.

Manufacturing of cement

Cement is obtain by the mixture of calcium silicate and aluminates along with small quantities of gypsumvwhich sets into a hard stone when treated with water.
Process involved in manufacturing:
(i) Wet Process and (ii) Dry process

Setting of cement and its substitutes

Cement hardens when it comes into contact with water. This hardening is a process of crystallization. Crystals form and interlock with each other. Recycled fly ash, when mixed with lime and water, forms a compound similar to Portland cement and is extremely strong and durable. High-volume fly ash concrete displaces more than 25% of the cement used in traditional concrete, reducing the amount of emissions needed to make the concrete mix

Biological importance of magnesium and calcium

An adult contains 25g of Mg and 1200g of Ca. The main pigment for the absorption of light in plants is chlorophyll which contains megnesium. Maximum percentage of calcium is present in bones and teeth.

Occurrence and abundance of s-block elements

Among the alkali metals, sodium and potassium are abundant and lithium, rubidium and cesium have lower abundance. Francium is highly radioactive.
Of the alkaline earth metals, calcium and magnesium rank fifth and sixth in abundance respectively in the earth crust. BeBe is rare, SrSr and BaBa is lower in abundance.

Occurence of alkali metals

Among the alkali metals, sodium and potassium are abundant and lithium, rubidium and cesium have lower abundance. Francium is highly radioactive.

Electronic configuration of alkali metals

All the alkali metals have one valence electron (ns11) outside the noble gas core. The loosely held electron in the outermost valence shell of these elements makes them most electro-positive metals.

General characterisitic of alkali metals

Ionization enthalpies of alkali metals are low and decrease down the group from Li to Cs. Melting and boiling point of alkali metals are high.

Atomic properties of alkali metal

The alkali metal atoms have the largest size in their respective periods of the periodic table. Atomic radii and ionic radii increase with atomic number as we move from Li to Cs.

Physical propeerties of alkali metals

All the alkali metals are soft and have low densities, melting and boiling points, as well as heats of sublimation, vapourisation, and dissociation. They all crystallize in the body-centered cubic crystal structure, and have distinctive flame colors, because their outer s-electron is very easily excited.

Chemical properties of alkali metals

The reactivities of the alkali metals increase going down the group. This is the result of a combination of two factors: ionization energies and atomization energy of the alkali metals. Because the first ionization energy of the alkali metals decreases down the group, it is easier for the outermost electron to be removed from the atom and participate in chemical reaction, thus increasing reactivity down the group.

Reactivity and electrode potential of alkali metals

The standard reduction potentials (E) of the alkali metals do not follow the trend based on ionization energies. Unexpectedly, lithium is the strongest reductant, and sodium is the weakest. Therefore reducing character sequences is Na < K < Rb < Cs < Li. Because Li^+ is much smaller than the other alkali metal cations, its hydration energy is the highest.
Li has the most negative standard electrode potential ($E_o = -3.04$).
In general strong reducing agents have higher reactivity.