APEC PetroTechnic
HIGHER COLLEGE

Topic 4.3. Elements of group 2 (IIA).

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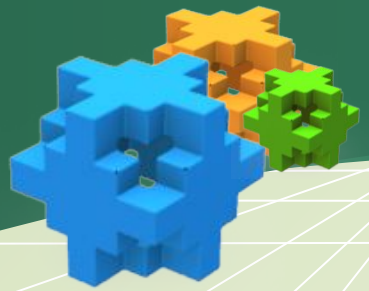
Outline

- **Introduction**
- **Main part**
- 1. Alkaline earth metals: general characteristics, structure; properties and obtaining
- 2. Oxides and hydroxides of alkaline earth metals
- 3. Salts of alkaline earth metals
- 4. Application and biological role of alkaline earth metals and their compounds
- **Conclusion**
- **Literature**



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Группа → / ↓ Период	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1	1 H																	2 He
2	3 Li	4 Be											5 B	6 C	7 N	8 O	9 F	10 Ne
3	11 Na	12 Mg											13 Al	14 Si	15 P	16 S	17 Cl	18 Ar
4	19 K	20 Ca	21 Sc	22 Ti	23 V	24 Cr	25 Mn	26 Fe	27 Co	28 Ni	29 Cu	30 Zn	31 Ga	32 Ge	33 As	34 Se	35 Br	36 Kr
5	37 Rb	38 Sr	39 Y	40 Zr	41 Nb	42 Mo	43 Tc	44 Ru	45 Rh	46 Pd	47 Ag	48 Cd	49 In	50 Sn	51 Sb	52 Te	53 I	54 Xe
6	55 Cs	56 Ba		72 Hf	73 Ta	74 W	75 Re	76 Os	77 Ir	78 Pt	79 Au	80 Hg	81 Tl	82 Pb	83 Bi	84 Po	85 At	86 Rn
7	87 Fr	88 Ra		104 Rf	105 Db	106 Sg	107 Bh	108 Hs	109 Mt	110 Ds	111 Rg	112 Cn	113 Nh	114 Fl	115 Mc	116 Lv	117 Ts	118 Og
Лантаноиды				57 La	58 Ce	59 Pr	60 Nd	61 Pm	62 Sm	63 Eu	64 Gd	65 Tb	66 Dy	67 Ho	68 Er	69 Tm	70 Yb	71 Lu
Актиноиды				89 Ac	90 Th	91 Pa	92 U	93 Np	94 Pu	95 Am	96 Cm	97 Bk	98 Cf	99 Es	100 Fm	101 Md	102 No	103 Lr

Electronic structure of atoms

At the external energy level, the atoms of the **IIA** metals have two electrons.

Therefore, for all alkaline earth metals, the oxidation state is **+2.**
This explains the similarity of their properties.

For metals of the **IIA** group (from top to bottom) it is typical:
-increasing the radius of atoms;
-decrease in electronegativity;
-strengthening of redusing, metallic properties.

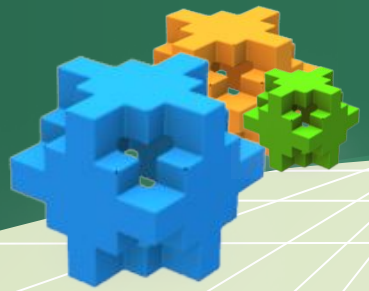
Minerals in nature

Of the alkaline earth metals, calcium is the most abundant in nature, and radioactive radium is the least.

All alkaline earth metals are highly reactive, therefore they occur in nature only in the form of compounds.

The main sources of calcium are its carbonates $CaCO_3$ (chalk, marble, limestone).

In free form, simple substances are typical metals from gray to silver color.



Physical properties of simple substances

In the solid state of aggregation, the atoms are bound by a metallic bond. This determines the general physical properties of simple metal substances: metallic luster, malleability, ductility, high thermal and electrical conductivity.

However, metals of the I I A group have different values of melting point, density and other physical properties.

Chemical properties

Alkaline earth metals have high chemical activity, react with oxygen, hydrogen, other non-metals, oxides, acids, and salts.

They are powerful reducing agents.
Alkaline earth metals react actively with:

-water to form the corresponding hydroxides and release hydrogen:

$Ba + 2H_2O = Ba(OH)_2 + H_2\uparrow$;

acids, easily dissolving in their solutions with the formation of the corresponding salts:

$Ba + 2HCl = BaCl_2 + H_2 \uparrow$;

with non-metals, forming oxides or corresponding salts (hydrides, halides, sulfides, etc.):

$2Ca + O_2 = 2CaO$,

$Ca + H_2 = CaH_2$,

$Ba + Cl_2 = BaCl_2$,

$Ba + S = BaS$.

Obtaining

Alkaline earth metals are obtained mainly by electrolysis of molten halides. Chlorides of metals are used more often.

In this case, cations are reduced at the cathode, and anions are oxidized at the anode.
The overall reaction equation for the electrolysis of a calcium chloride melt:

$$CaCl_2 \xrightarrow{\text{el. Current}} Ca + Cl_2\uparrow .$$

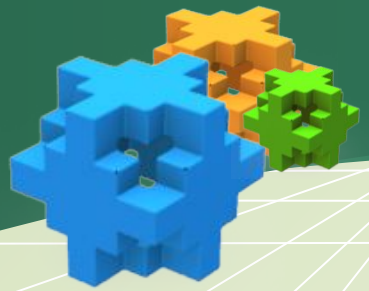
2. Oxides and hydroxides of alkaline earth metals

Oxides

Alkaline earth metals form oxides of the general formula EO:

CaO, SrO, BaO, RaO.

All oxides have pronounced basic properties.
In the series from calcium oxide to barium oxide, the basic properties are enhanced.

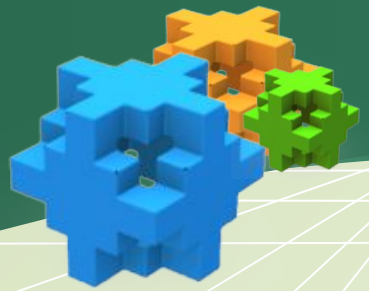


Alkaline earth metal oxides react with:

water:

$CaO + H_2O = Ca(OH)_2$.

Pay attention!
Calcium oxide react with water with the release of a large amount of heat. It is called a **lime slaking reaction**, since calcium oxide is part of **quicklime**, and calcium hydroxide is a part of **slaked lime**.



acid oxides:

$CaO + CO_2 = CaCO_3$.

acids:

$BaO + 2HCl = BaCl_2 + H_2O$.

Barium sulphate

Barium sulfate is used in medicine.

It is used as an X-ray contrast agent due to the fact that barium does not transmit X-rays, and barium sulfate is not toxic to humans, has no odor and taste

Hydroxides

Alkaline earth metals, when they interact (or their oxides) with water, form basic hydroxides (bases).
The strength of the bases increases in the group from top to bottom.
Hydroxides of alkaline earth metals are strong bases, soluble in water - alkalis.

Hydroxides of alkaline earth metals exhibit all the characteristic properties of bases, interacting with acidic (and amphoteric) oxides, acids (and amphoteric hydroxides), and salts.
When heated, hydroxides decompose into the corresponding oxide and water:

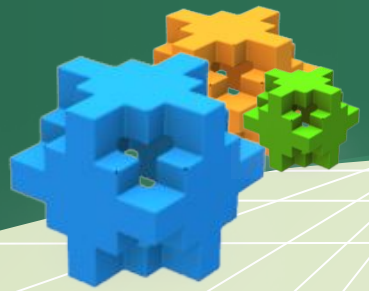
$$Ca(OH)_2 \xrightarrow{t} CaO + H_2O.$$

Calcium hydroxide is a strong base, but slightly soluble in water. Its saturated solution is called lime water.

In air, the solution gradually becomes cloudy, as it absorbs carbon dioxide, from which calcium carbonate is formed:

$$Ca(OH)_2 + CO_2 = CaCO_3\downarrow + H_2O.$$

This reaction is used as a qualitative reaction to detect carbon dioxide.



3. Salts of alkaline earth metals

Obtaning salts

Salts of alkaline earth metals can be obtained by reacting metal oxides or hydroxides with the corresponding acids:

$CaO + 2HCl = CaCl_2 + H_2O$,

$Ba(OH)_2 + 2HCl = BaCl_2 + 2H_2O$.

Salts of anoxic acids are formed by the direct interaction of simple substances:

$Ca + S = CaS$,

$Ba + I_2 = BaI_2$.

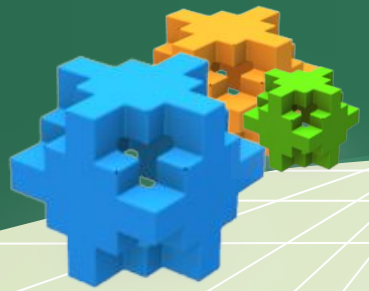
The most important calcium salts are its carbonates and sulfates.

Calcium carbonate $CaCO_3$ (chalk, marble, limestone),

calcium bicarbonate $Ca(HCO_3)_2$,

calcium sulfate $CaSO_4$ and its crystalline hydrates:

$CaSO_4 \cdot 2H_2O$ (gypsum), $CaSO_4 \cdot 0.5H_2O$ (alabaster).



Chemical properties

Salts of alkaline earth metals react with acids, salts.

When heated, some salts decompose:

$$CaCO_3 \xrightarrow{t} CaO + CO_2.$$

Qualitative analysis

Calcium compounds color the flame a brick-red color.

Barium ions can be detected in solution using a solution of sulfuric acid or its salts. In this case, insoluble barium sulfate is formed, which precipitates:

Qualitative reaction to barium ions:

$Ba^{2+} + SO^{2-}_4 \rightarrow BaSO_4$.

4. Application and biological role of alkaline earth metals and their compounds

Calcium

Metallic calcium is used in the production of steel, cast iron, for their purification from oxygen, sulfur and phosphorus, for the production of alloys.

Due to its chemical activity, metallic calcium also finds application in the reduction of some refractory metals (titanium, zirconium, etc.) from their oxides.

The biological role of calcium

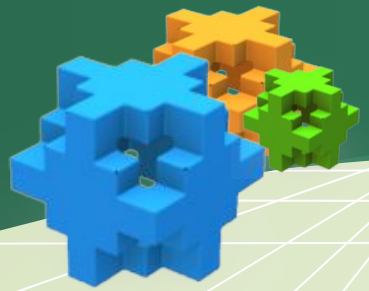
The human body contains about 1% calcium, mainly in bones and teeth (in the form of orthophosphate with admixtures of carbonate and fluoride).

Calcium ions are important elements in the life of the cell. Calcium ions activate extracellular enzymes.

The daily human need for calcium is about 1 g.

Calcium oxide

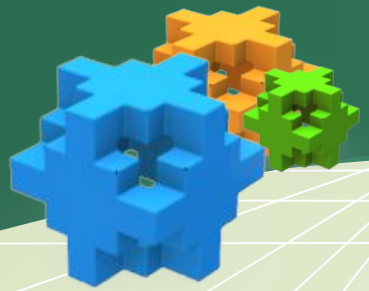
Calcium oxide is the main component of quicklime used in construction.



Calcium hydroxide

Calcium hydroxide (slaked lime) is of great practical importance.

It is used as a mixture with cement, water and sand in construction.
Of great importance is bleach, which is obtained by the interaction of slaked lime with chlorine. Bleach is used for bleaching and disinfection.

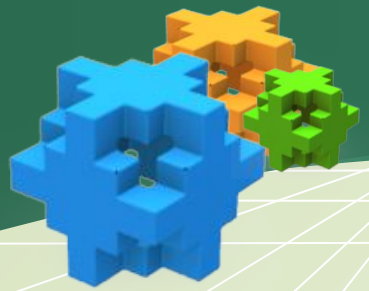


Calcium carbonate

Calcium carbonate (chalk, marble, limestone) is used in construction and agriculture, used in the production of lime, cement, glass.

School crayons are made of calcium carbonate.

Shells, eggshells, shells of marine animals are formed mainly from calcium carbonate.



Gypsum and alabaster

Gypsum and alabaster are used in construction and medicine.

When mixing alabaster with water, a semi-liquid mass is formed, which hardens quickly. Alabaster mixed with lime, sand and water is used as plaster.

Pure alabaster is used for the manufacture of art products and in medicine for the application of plaster casts.

Quections for self control

1.Choose which of the listed elements belongs to alkaline earth metals?

A)All metals located in the second A group of the periodic table of D.I.Mendeleev, except for beryllium
B)Cu
C)Elements of the second A group of D. I. Mendeleev's Periodic Table
D)P

2. Choose the correct statement regarding alkaline earth metals:

A)calcium is a low-active metal
B)alkaline earth metals have a metallic luster
C)heat is absorbed in the reaction of calcium with water
D)calcium is a rare element

3.Indicate which pairs of substances interact to form calcium hydroxide:

A)all options are suitable

B)Ca oxide and water

C)metal and hydrochloric acid

D)Ca and water

4. Check all statements that are true for calcium carbonate:

A)it is obtained by the interaction of calcium with carbon

B)used for lime production

C)solid

D)can be converted into bicarbonate when passed through a solution of carbon dioxide

5.Check all statements that are true of barium sulfate:

A)insoluble in sulfuric acid

B)used for canning vegetables

C)it can be obtained by the interaction of barium oxide and sulfuric acid

D)Odorless

6. In the proposed list, choose the correct judgment about alkaline earth metals in the series strontium - barium - radium:

A)electronegativity decreases

B)there is no right answer

C)metallic properties at first weaken, then strengthen

D)the number of energy levels is two

Literature

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8.Эектронные ресурсы с www.bilimland.kz

Do you have any questions?