BERYLLIUM

Prepeared: Gigant Aikun

Cheeked: Yeskendirova M.M

PLANE

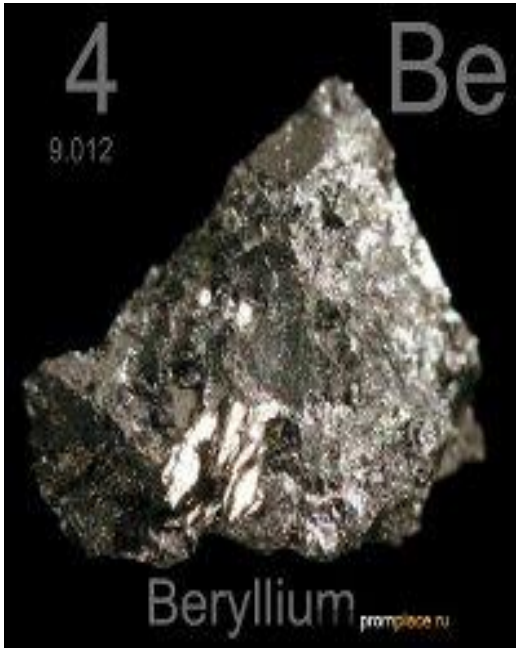
- Beryllium
- The physical and chemical properties of beryllium
- Methods of processing beryllium minerals
- Beryllium minerals
- Sphere of application

BERYLLIUM

Beryllium Be was opened in 1797 by French chemist Voklen. For the first time beryllium was received by Veler in 1828. Manufacture of metal beryllium, its compounds and alloys has arisen in 20-30 years of XX century.

THE PHYSICAL PROPERTIES OF BERYLLIUM

Beryllium is the metal of light grey color, the easiest constructional material. Melting point – 1285^0C, boiling point – 2970^0C, density – 1,847 g/sm^3. Beryllium has rather high melting point, significant electroconductivity (approximately 40 % from copper electroconductivity), beryllium is heat-resistant metal.



CHEMICAL PROPERTIES OF BERYLLIUM

In dry air the pure compact beryllium is oxidized only at 600^0C, forming the protective oxide film BeO.

$2Be + O2 = 2BeO$

Nitrogen reacts with beryllium at temperatures above 700^0C with formation of beryllium nitride Be_3N_2.

$3Be + N2 = Be3N2$

Halogens actively react with beryllium with formation BeX_2. Fluorine cooperates with powder beryllium at room temperature, chlorine, bromine and iodine - at heating up to $300\text{-}500^0$C.

$Be + Cl2 = BeCl2$

Beryllium is dissolved in hydrochloric and sulphuric acids of any concentration.

$BeO + H2SO4 = BeSO4 + H2O$

Beryllium is dissolved in solutions of caustic alkalis with formation of beryllate solution.

$BeO + 2NaOH = Na2BeO2 + H2O$

METHODS OF PROCESSING BERYLLIUM MINERALS

The sulphatic way is based on transition of beryllium (together with aluminium and iron) in sulphuric acid solution. Silicon oxide remains in the insoluble residue. As beryllium reacts with sulfuric acid slowly even at 200-250^{0}C, the concentrate is preliminary processed for transition of beryllium in other compounds which easily react with sulfuric acid. For preliminary processing of beryl the follo wing methods are used: sintering of concentrate with alkaline agents (soda, lime) and thermal activation of beryl. After preliminary processing beryl concentrate is processed by the concentrated sulfuric acid in steel reactor with a mixer. Sulfates of Be, Mg, Fe, Al pass in the solution. The insoluble residue ($CaSO_4$ + silicon acid H_2SiO_3) is separated by filtration.

Then aluminium as exsiccated alum (ferriammonium sulphate) is allocated from sulphatic solution. Alum are formed at addition of surplus $(NH_4)_2SO_4$ in the hot sulphatic solution.

After aluminium allocation, $Be(OH)_2$ is precipitated from solution:

$$BeSO_4 + 2NaOH = Be(OH)_2 + Na_2SO_4$$

Technical beryllium hydroxide serves as the initial material for production of beryllium oxide BeO of various degree of purity.

TECHNOLOGICAL SCHEME OF BERYLLIUM OXIDE PRODUCTION BY SULPHATE METHOD

- Melting in arc furnce
- Granulation in water
- Heating up to 900-950°C
- Grinding in ball mill
- Air classifying
- Mixing
- Sulphatiza-tion
- Crystallization of alum $(NH_4)_2SO_4*Al_2(SO_4)_3*24H_2O$
- Centrifuga-tion
- Hydrolysis of sodium beryllate
- $Be(OH)_2$
- Separation of Al as alum
- Evaporation of solution and crystallization

BERYLLIUM MINERALS

The average beryllium content in the earth's crust is $2 \cdot 10^{-4}$-$4{,}2 \cdot 10^{-4}$ % (on weight). On occurrence in the earth's crust it occupies the 32d place. It is known about 40 beryllium minerals which represent the various complex silicates. Among them beryl ($3BeO \cdot Al_2O_3 \cdot 6SiO_2$), chrysoberyl, phenakite, gelvine, berntrandite and danalite have industrial value.

SPHERE OF APPLICATION

- The basic application fields
  - jet aircraft and rocket technics
  - nuclear technics (technical equipment)
  - manufacture of alloys
  - refractory materials.

NUCLEAR TECHNICS

- The small section of neutron capture and the big cross section of neutron dispersion causes application of beryllium, beryllium oxide and beryllium carbide in quality of moderator and reflector of neutrons in nuclear power installations. The small density of beryllium gives the special advantages at its use in nuclear reactors of sea-crafts, submarines, planes.

JET AIRCRAFT AND ROCKET TECHNICS

Owing to combination of small density, refractoriness and elasticity beryllium is the good constructional material for aircraft and rocket technics (supersonic planes covering, nose parts of rockets).

High durability in combination to small density and low factor of expansion allow using beryllium in designs of sensitive devices, for example in control devices of rockets and artificial satellites.

MANUFACTURE OF ALLOYS

Beryllium is the alloying additive for many alloys. Major of them are alloys on the basis of copper – copper-beryllium bronze (0,5-2 % Be). These alloys have the mechanical properties much more surpassing the mechanical properties of copper. The important details of machines and devices are made from copper- beryllium bronze (springs, valves, etc.). Beryllium bronze do not give sparking at impact, therefore these alloys can use for manufacturing of the nonsparking tool (hammers, chisels) for work in conditions of explosion hazard and with flammable materials.