

OXYGEN

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General information about oxygen

Symbol: O

Atomic Number: 8

Atomic Weight: 15.9994

Electron Configuration: $1s^2 2s^2 p^4$

Classification: Non-metal

Group: Chalcogen

Number of Protons/Electrons: 8

Isotopes: O-15 (half-life 122.2 sec.), O-16 (stable), O-17 (stable), O-18 (stable)

Crystal Structure: Cubic

Name Origin: from Greek: *oxys* (acid) + *genes* (former, producer)

Oxygen (O) is the most abundant element of the earth crust (about 48% by weight) and it is the third most abundant element in the universe. Oxygen forms 21% of the earth atmosphere.

Oxygen was discovered in 1774 by Joseph Priestley (and independently by Carl Wilhelm).

Oxygen is chemically active element easily combining with most of other elements. Molecules of gaseous oxygen are normally diatomic O_2 , however oxygen may form triatomic molecule form O_3 (**ozone**).

Gaseous oxygen is a colorless, odorless, tasteless gas.

Liquid and solid oxygen has a light blue color.

All forms of oxygen are paramagnetic.

Extraction (isolation) of oxygen

- ▣ **Cryogenic Distillation of air**

Cryogenic Distillation is the most popular method of extraction of oxygen.

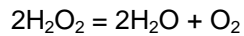
Cryogenic distillation utilizes differences in rates of boiling of the air components.

The air is cooled down to the state of boiling liquid. The vapors are condensed and reboiled for several times. Compositions of the liquid and the vapors are different. This technique permits to separate air to its constituents: nitrogen, oxygen and argon.

Decomposition of hydrogen peroxide

This method is used for laboratory preparation of oxygen.

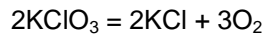
The method uses manganese dioxide as a catalyst of the decomposition reaction:



Decomposition of potassium chlorate

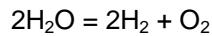
This method is used for laboratory preparation of oxygen.

Potassium chlorate is mixed with manganese dioxide. The latter serves as a catalyst of the decomposition reaction:



Electrolysis of water

Acidified water is decomposed in an electrolytic cell. Hydrogen is evolved at the negative electrode and oxygen is evolved at the positive electrode:



Applications of oxygen

Steel making

Oxygen is used in steel making processes such like Basic Oxygen Process (BOP), Argon Oxygen Decarburization (AOD), Open Hearth Furnace. The main purpose of oxygen blowing in the steel making processes is oxidation and removal of excessive carbon and other impurities (silicon, manganese and phosphorous) from pig iron.

Gas Welding (GW)

Gas Welding process uses a combustion mixture of oxygen with either acetylene (Oxyacetylene Welding (OAW)) or hydrogen (Oxyhydrogen Welding (OHW)) for producing gas welding flame.

Liquid oxygen is used as oxidizer for rocket fuel (liquid hydrogen).

Water treatment

Oxygen in form of ozone (O_3) is very effective (much more effective than chlorine) biocide. The extra (third) atom of ozone destroys bacteria viruses and fungi in water.

Synthesis of ammonia, methanol, ethylene oxide and other materials

Glass production

Properties of oxygen

(Materials Data)

Oxygen (properties)