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Fundamentals Of Inorganic Substances Basic Classes of Inorganic Compounds Nomenclature

Hamidov Abdullaxon Fayzullayevich
Professor Ramazanov N.Sh

Annotation: Classification of inorganic chemical reactions. In inorganic chemistry, reactions are distinguished: 1) compounds, 2) decomposition (both may or may not be oxidation-reduction reactions), 3) exchange, 4) exchanges, they are always redox. The following article looks into the basic classes of inorganic compounds.

Key words: Inorganic, amphoteric, oxide, salt-forming, oxidation.

Introduction

Diversity of inorganic substances in chemistry: it is customary to divide into two groups - simple and complex. Simple substances are divided into metals and non-metals. Compounds, on the other hand, are made up of oxygen, water, and simple ones that interact with each other. This classification of inorganic substances is schematically described as follows: Oxides (oxides) are complex substances consisting of two elements, one of which is equal to oxygen -2 in the oxidation state. The general formula for any oxide is E x O y -2. Separation salt-forming (Main: Li_2O, CaO, MgO, FeO; amphoteric: ZnO, Al_2O_3, SnO_2, Cr_2O_3, Fe_2O_3; acidic: B_2O_3, SO_3, CO_2, P_2O_5 Mn_2O_7) and non-salt-forming: N_2O, NO, CO oxides. The variable elements of the oxidation state form several oxides (MnO, MnO_2, Mn_2O_7, NO, N_2O_3, NO_2, N_2O_5). In high oxide, as a rule, the element is in an oxidation state equal to the group number.

According to modern international nomenclature, the names of oxides are as follows: the word "oxide", then the Russian name of the element in the genitive case, the state of oxidation (if it is variable). For example: FeO - iron (II) oxide, P_2O_5 - phosphorus (V) oxide.

Basic oxides These are the basis of hydroxides. Basic oxides interact with acids to form salts and water. Basic oxides are formed only from metals in the oxidation state of +1, +2 (sometimes +3), for example: BaO, SrO, FeO, MnO, CrO, Li_2O, Bi_2O_3, Ag_2O.

Obtaining basic oxides:

1) Oxidation of metals when heated in an oxygen environment:

For alkali metals, which usually give peroxides during oxidation, this method is not used in practice, so it is very difficult to obtain Na 2 O, K 2 O oxides.2) roasting of sulfides:

$$2CuS + 3O_2 = 2CuO + 2SO_2;$$
$$4FeS_2 + 11O_2 = 2Fe_2O_3 + 8SO_2.$$

3) decomposition of hydroxides:

$$Cu(OH)_2 = CuO + H_2O.$$

It is not possible to obtain alkali metal oxides from this method.

4) decomposition of salts of oxygen acids:

$$BaCO_3 = BaO + CO_2,$$
$$2Pb(NO_3)2 = 2PbO + 4NO_2 + O_2$$

Basic properties of oxide. Most of the basic oxides are ionic solid crystalline substances; metal ions are located in the crystal lattice nodes, which are sufficiently tightly bound to O_2- ions, so that oxides of typical metals have high melting and boiling points.

Let us consider the specific properties of oxides. The proximity of the ionic radii of many metal ions leads to the replacement of some metal ions in the crystal lattice of oxides with other metal ions. This indicates that the law of continuity of composition for oxides is often not fulfilled and can be oxides of variable composition.

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1) Attitude to water.

The process of attaching water is called hydration, and the substance formed is called hydroxide. Of the basic oxides, only alkalis (Li, Na, K, Rb, Cs, Fr) and alkaline earth metal oxides (Ca, Sr, Ba, Ra) interact with water.$Li_2O + H_2O = 2LiOH$;

$$BaO + H_2O = Ba(OH)_2.$$

Most of the basic oxides are insoluble in water and do not interact with it. Their corresponding hydroxides are obtained indirectly - as a result of the action of alkalis on salts (see below).

2) Reaction to acids.

$$CaO + H_2SO_4 = CaSO_4 + H_2O;$$
$$FeO + 2HCl = FeCl_2 + H_2O.$$

3) Reaction to acidic and amphoteric oxides.

The basic oxides of alkali and alkaline earth metals interact with solid acidic and amphoteric oxides as well as with gaseous acid oxides when they solidify. Normal conditions. Acidic oxides are oxides that, when they interact with bases, form salts and water. Acidic oxides correspond to hydroxides - acids. Acidic oxides are non-metallic oxides with different oxidation states or metal oxides in high oxidation state (+4 and above). Examples: SO_2, SO_3, Cl_2O_7, Mn_2O_7, CrO_3.

The chemical bond in acidic oxides is covalently polar. Under normal conditions, non-metallic acid oxides can be gaseous (CO_2, SO_2), liquid (N_2O_3, Cl_2O_7), solid (P_2O_5, SiO_2).

Obtaining acidic oxides.

1) Non-metallic oxidation:

2) oxidation of sulfides:

$$2ZnS + 3O_2 = 2ZnO + 2SO_2$$

3) Displacement of salts of fine weak acids:

$$CaCO_3 + 2HCl = CaCl_2 + CO_2 + H_2O.$$

Properties of acidic oxides.

1) Attitude to water.

Most acidic oxides are soluble in water, with which they react chemically and form acids: $SO_3 + H_2O = H_2SO_4$,

$$CO_2 + H_2O = H_2CO_3.$$

2) dependence on grounds.

Acid oxides form salts and water by interacting with soluble bases - alkalis.

$$SO_2 + 2NaOH = Na_2SO_3 + H_2O;$$
$$P_2O_5 + 6NaOH = 2Na_3PO_4 + 3H_2O$$

fusion

3) Reaction to basic and amphoteric oxides.

When solid acid oxides combine, they react with basic and amphoteric oxides. Liquid and gaseous oxides normally interact with alkaline and alkaline earth metal oxides.

$$P_2O_5 + 3CuO = Cu_3(PO_4)_2;$$

fusion

$$3SiO_2 + Al_2O_3 = Al_2(SiO_3)3$$

fusion

Results And Discussions

Amphoteric oxides interact with acids and alkalis to exhibit the properties of acidic and basic oxides. They are suitable for amphoteric hydroxides. They are all solid, insoluble in water. Examples of amphoteric oxides are: ZnO, BeO, SnO, PbO, Al_2O_3, Cr_2O_3, Sb_2O_3, MnO_2.

Properties of amphoteric oxides.

Amphoteric oxides react mainly with acids:

$$Al_2O_3 + 6HCl = 2AlCl_3 + 3H_2O,$$

and with alkalis - acidic. The composition of the reaction products depends on the conditions. During melting:

$$ZnO + 2NaOH = Na_2ZnO_2 + H_2O;$$

Sodium syncate

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In an alkaline solution, a soluble complex salt containing a hydroxycomplex ion is formed:

$$ZnO + 2NaOH + H_2O = Na_2$$

Sodium tetrahydroxosincate

Non-salt oxides are hydroxides and non-metallic oxides that do not correspond to salts. Examples: CO, N_2O, NO.

Oxides are common in nature. Thus, water, the most common oxide, occupies 71% of the planet's surface. Silicon oxide (IV) in the form of 400 varieties of quartz makes up 12% of the mass of the earth's crust. Carbon monoxide (IV) (carbon dioxide) is present in the atmosphere - in the amount of 0.03%, as well as in natural waters. The most important ores: hematite, magnetite, brown iron ore are composed of various iron oxides. Bauxite contains aluminum oxide and others.

Bases are complex substances with one or more OH-hydroxo groups on each metal atom. The oxidation state of metal atoms is usually +1, +2 (rarely -3 +). The general formula for the bases is Me (OH) x, where x is the number of hydroxo groups and the acidity of the base. (MeOH - one acid base, Me (OH) 2 - two acid base, Me (OH) 3 - three acid base).

The names of the bases are given as follows: "hydroxide", then the Russian name of the metal in the genitive case, and in Roman numerals in parentheses - the state of oxidation, if it is variable. For example: KOH - potassium hydroxide, Ni (OH) 2 - nickel (II) hydroxide. SiO_3 is a three acidic base).

Under normal conditions, the bases are solids, with the exception of ammonium hydroxide - an aqueous solution of NH_4OH ammonia (NH 4 + - ammonium ion, which is part of the ammonium salt).

Classification of bases. Depending on the relationship to water, the bases are divided into soluble (alkaline) and insoluble, $Ba(OH)_2$, $Ra(OH)_2$) as well as aqueous ammonia solution. All other bases are almost insoluble in water.

From the point of view of the theory of electrolytic dissociation, the bases are electrolytes, which are separated in an aqueous solution and form only hydroxide ions:

Me (ON) x Me x + + xON -.

The presence of hydroxide ions in the solution is determined using indicators: litmus (blue), phenolphthalein (raspberry), methyl orange (yellow). Insoluble bases do not change the color of the indicators. All other substances are inorganic.

Inorganic substances are divided into simple and complex in composition.

Simple substances consist of atoms of a single chemical element and are divided into metals, non-metals, and noble gases. Compounds consist of atoms of various elements bound together by chemical elements.

Conclusion

Complex inorganic substances in terms of composition and properties are divided into the following most important classes: oxides, bases, acids, amphoteric hydroxides, salts.

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