2.5. CATALYSIS IN CHEMICAL PRODUCTION

The importance of catalysis in the chemical industry. Catalysis and catalysts. Homogeneous and heterogeneous catalysis. Properties of solid catalysts (shape, degree of dispersion, porosity, strength, etc.). Methods for the preparation of industrial catalysts. Types of industrial catalysts

In the chemical industry and related industries (petrochemistry, etc.), more than 90% of existing and newly introduced technologies are catalytic processes. With the use of catalysts, tens of thousands of names of inorganic and organic products are produced, including such as ammonia, nitric and sulfuric acids, methanol, butadiene, styrene, etc., promising methods of production of motor fuels, wastewater treatment and gas emissions are carried out.

Most catalytic processes can be organized as continuous, waste-free, low-energy. They are characterized by high technical and economic indicators, provide a high yield of the target product.

The use of catalysts allows to:

- intensify chemical-technological processes;
- carry out transformations that cannot be implemented in practice without a catalyst due to the very high activation energy;
- direct the process in the right direction;
- regulate the structure and properties of manufactured products (for example, stereospecific catalysts in the production of synthetic rubbers and plastics).

Of particular importance is the use of catalysts in reversible exothermic processes, in which an increase in temperature in order to accelerate the reaction sharply reduces the equilibrium degree of conversion and makes the reaction thermodynamically unresolved. In such processes, the role of catalysts is paramount.

Unlike other factors intensifying the chemical process, the catalyst only affects the rate of the chemical reaction and does not affect the thermodynamics, only accelerating the achievement of the equilibrium state.

At the same time, the catalyst does not accelerate diffusion processes and affects only the rate of processes occurring in the kinetic region.

Catalytic processes are divided into:

- homogeneous, in which the reacting substances and the catalyst comprise one phase;
- heterogeneous, in which the reacting substances and the catalyst are in different phases;
- microheterogeneous, flowing in the liquid phase with the participation of catalysts in the colloidal state;
- enzymatic, occurring in biological systems under the influence of enzymes.

In the chemical industry, heterogeneous catalytic processes in which the phase boundary is the surface of a solid catalyst in contact with a gaseous or liquid phase are most common.

Chemical reactions on the surface of the catalyst are a complex process consisting of several successive elementary stages, differing in chemical and physical nature:

- diffusion of reagents from the stream to the surface of the catalyst grains (stage of external diffusion);
- diffusion of reagent molecules into the pores of the catalyst (stage of internal diffusion);
- absorption of reagent molecules on the surface of the catalyst, proceeding in the form of physical absorption or chemisorption (activated absorption);
- the stage of chemisorption consists in the formation of an activated complex of the reagent and catalyst and determines the specificity of the action of the catalyst in catalytic reactions;
- surface chemical reaction as a result of rearrangement of an activated complex or interaction of molecules of one adsorbed reagent with molecules of another;
- desorption of the resulting reaction products from the surface of the catalyst;
- diffusion of products from the pores of the catalyst to its outer surface (reverse internal diffusion);