

Chemical reactors for conducting heterogeneous catalytic processes are called *contact devices*.

Depending on the state of the catalyst and the mode of its movement in the apparatus, they are divided into:

- contact apparatuses with a fixed catalyst bed;
- contact apparatuses with a moving bed;
- contact apparatuses with a fluidized bed.

In addition, contact devices differ in:

- the structure of the material flows of the components;
- a method of supplying or removing heat;
- and a number of other design features.

In contact devices with a *fixed catalyst layer* (contact mass), the contact mass in them is placed in several layers on shelves (*shelf units*) or in pipes (*tubular devices*).

*Multi-shelf contact apparatuses* containing several catalyst layers are used in processes with a high positive or negative thermal effect. To maintain the optimal thermal regime of the process, after passing through each catalyst layer, it is heated or cooled by feeding cold gas into the space between the layers, or in external and built-in heat exchangers.

The combination of a contact apparatus with devices for removing or supplying heat is called a *contact node*.

For processes occurring at very high speeds, designs are used in which the contact masses are placed in the grids, which ensures their best contact with the reagents.

*The disadvantages of contact devices with a fixed catalyst bed* include:

- low productivity of the catalyst due to difficulties in using the inner surface of its grains;
- the inability to use a fine-grained catalyst due to its caking;
- the difficulty of maintaining optimal thermal conditions;
- complexity (layering) of the structure;
- the need to stop the contact apparatus for replacing the spent catalyst.

*Contact devices with a moving catalyst layer* operate in the mode of continuous and periodic reactors. In them, the catalyst is sprayed in a moving stream of gas or liquid and transferred with it. In this case, to provide a counterflow, the gas enters the apparatus from below, and the catalyst from above.

*Contact devices with a fluidized bed of the catalyst* are used mainly in the production of organic synthesis, in which the catalyst quickly loses activity and requires continuous regeneration.

Therefore, in these installations, as in installations with a moving catalyst layer, the contact device is coupled to the catalyst regenerator.

*The advantages of contact devices with a moving and fluidized bed of the catalyst* include:

- the ability to supply reagents with a temperature below the ignition temperature of the catalyst;
- easy regeneration and replacement of the catalyst;
- possibility of using fine-grained catalysts;
- more complete use of the inner surface of the catalyst grains and, as a result, high performance of its;
- optimal temperature mode of the device.

*The disadvantages of these types of contact devices* include:

- rapid abrasion of catalyst grains;
- contamination of reaction products with catalyst dust.

*The operating mode and performance of the contact device* depends on such parameters as the contact time, the volume velocity of the gas (liquid) and the specific performance of the catalyst.

*Contact time* - the contact time of the reactants with the catalyst is determined as follows:

$$t_c = V_g / V_c,$$