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CATALYTIC PROCESSES INVOLVING ALUMINA

Андаев С. Р.
базовый докторант, Ташкентский государственный технический университет имени Ислама Каримова, Узбекистан, Ташкент

Уринов У. К.
профессор, Ташкентский государственный технический университет имени Ислама Каримова, Узбекистан, Ташкент

Тураева Н. Т.
ассистент, Ташкентский государственный технический университет имени Ислама Каримова, Узбекистан, Ташкент

Abstract:

Alumina-based catalysts are mainly used in petrochemistry and oil refining for hydrotreating, reforming, cracking, and isomerization processes (73%). The share of aluminium oxide for drying gases and air is 17%. Sulfur catalysts, acid gas adsorbents and other sorbents account for 10%. The market for catalysts and sorbents based on aluminum oxide is specific: manufacturers work to order, and prices are formed individually.

Keywords: aluminium oxide, adsorbent, catalyst, reforming.

Introduction

The catalytic properties of the transition forms of aluminum oxides are determined by a number of interrelated properties, such as surface acidity, structure, surface hydroxylation degree, textural properties, namely, specific surface area, pore volume, pore size distribution. It is obtained by calcining granules of raw aluminium hydroxide, obtained in the so-called "reprecipitation process", which consists of a stage of dissolving the aluminium-containing raw material followed by purification and reprecipitation of aluminium hydroxide. When dissolved in alkalis, acids, acidic salts and gases serve as precipitating agents; when dissolved in acids, similar alkaline agents. In this process, it is possible to obtain aluminium hydroxides of various modifications and textures, depending on the pH and temperature of the solution. However, the target product of this process is pseudobemite. Pseudoboehmite is an aluminium hydroxide that has a boehmite structure with a low degree of crystallization. It has a developed surface and high cohesive ability.

Catalysts can be produced by two main methods: co-precipitation and impregnation. In the co-precipitation method, metal salts are introduced into the original aluminium hydroxide and then calcined. At the same time, aluminium hydroxide and salts of active metals decompose. According to the impregnation method, metal salts are applied to calcined granular aluminum

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oxide.

Thus, the distribution of the active phase metals over the carrier granule, and, consequently, the properties of the catalyst, largely depend on the properties of the carrier, aluminum oxide.

Alumina is a carrier for catalysts of various industrial processes, such as hydrogenation in the production of caprolactam, aniline, alcohols, and fats. Hydrogenation uses Ni and W catalysts based on alumina, as well as silver on aluminosilicate and metals of the Pt-group.

The main catalytic processes of oil refining industry enterprises are:

- Catalytic cracking (CC).
- Catalytic reforming (CR).
- Hydrotreating of various distillate oil fractions.
- Hydrocracking of medium and heavy distillates (HA).
- Catalytic dewaxing.
- Catalytic hydrodewaxing (GPD).
- Alkylation of hydrocarbons.

In all of these processes, alumina can be used as a catalyst or (mainly) as a carrier for catalysts. Let's take a closer look at the first three of them.

The feedstock for catalytic reforming (CR) is gasoline fractions of direct distillation. Through CR reactions, high-octane gasoline is obtained. In addition, the reforming process makes it possible to obtain petrochemical raw materials such as aromatic hydrocarbons, benzene (the most valuable product), toluene and xylenes (BTK), as well as to produce hydrogen-containing gas.

Catalytic reforming is based on the use of multifunctional aluminoplatin catalysts. In aluminoplatin catalysts, the acidic function is performed by a carrier — aluminum oxide, promoted by chlorine or fluorine. Pt particles (0.3−0.8%) with a size of 1−5 to 10−12 nm are deposited on its surface. Platinum occupies about 1% of the surface area of aluminum oxide. The activity, selectivity, and stability of the catalyst are increased by metal promoters, which are various metals: Re (0.3−0.4%), Ir, Ge, etc., as well as halogen promoters: fluorine (up to 0.3%) or chlorine (from 0.4−0.5 to 2.0%).

When replacing the platinum catalyst with a platinum-rhenium catalyst, it is possible to achieve not only a softening of the regime (pressure reduction), but also an increase in the inter-regeneration period to 720 days or more.Catalysts are made in the form of tablets (extrudates) with a diameter of 1.6−2.6 mm and a height (length) of 4−6 mm or in the form of spherical granules with a diameter of 1.6 or 2.1 mm with a bulk density of 600−820 kg/m3 and a specific surface area of 180−300 m2/g.

Metallic iron promoted by oxides of aluminum, calcium, potassium and other substances is used in the synthesis of ammonia.Platinum and platinum-rhenium catalysts based on aluminum oxide are used in the production of monomers for synthetic rubber.

Literature

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