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Use of Acetone in Organic Synthesis and its Importance for Industrial Chemistry

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Abstract

This study examines the methods of using acetone in organic synthesis and is dedicated to the study of its importance in industrial chemistry. Improving the production and utilization of acetone to reduce waste and increase efficiency is a key focus for future industry development. Acetone is one of the most tommon solvents in construction. Technical acetone production is carried out by vapor phase hydration of acetylene, purification and rectification of acetone on ZnO·Fe2O3·Cr2O3·MnO2·V2O5/HZS catalyst According to this technology, it is possible to obtain acetone of high purity, i.e. not less than 99.5%.

Keywords: acetone, isopropylbenzene, acetylene, Kume method, isopropanol, isopril, rectification, acrylnitrocellulose.

Introduction

Acetone is distinguished by its ability to dissolve various organic substances and mix with water in any ratio, which makes it very useful in industry. Its production is often carried out in the process of phenol-acetone synthesis or as a by- product in the production of phenol. Improving the production and utilization of acetone to reduce waste and increase efficiency is a key focus for future industry development. Acetone is one of the most common solvents in construction. It is primarily used to dilute acetates and nitrates. and due to its very low toxicity, it is also used in the food and pharmaceutical industries. Acetone is also a raw material for the synthesis of acetic anhydride, methyl methacrylate, isofrone, methyl isobutyl ketone, oxide, ketene, mesityl, diacetone alcohol and other compounds. In industrial conditions and on a scale, this substance is acetic acid, film, plexiglass, lacquers are used in the production of plastics and paints.

The Main Part

Acetone is a natural compound also known as propanone. Acetone, composed of the elemnents carbon, hydrogen, and oxygen, is a clear liquid that is highly flammable and is often used as a cleaning agent in industrial settings is used as Acetone is produced and used in normal metabolic processes in the human body. Ketogenic diets that increase blood levels of ketone bodies (acetone, ß-hydroxybutyric acid, and acetoacetic acid) can relieve seizures in infants and children with refractory epilepsy. Used to achieve Acetone is a colorless, volatile, flammable organic solvent.

Acetone occurs naturally in plants, trees, forest fires, car exhaust, and as a breakdown product of animal fat metabolism. Acetone is completely miscible with water and most organic solvents and oils. Thus, acetone is an important industrial cleaning solvent, organica common building block in chemistry and serves as a precursor to polymers. Acetone is obtained in relatively small quantities by dry distillation of wood together with acetic acid. Obtained by fermentation of carbohydrates in the presence of special bacteria (acetone-buty| fermentation) for a long time.

Fermentation products contain 30.5% acetone, 62% n-butyl alcohol, 7.5% ethyl alcohol and other substances. Currently, this method is rapidly being replaced by synthetic methods of acetone production, where oil is the raw material. petroleum gases and coal processing products are used, there are many industrial methods of synthetic acetone production. The most common are the oxidative dehydrogenation of isopropyl alcohol and the cumene method (production of acetone together with phenol). The cumene method is often used to separate acetone, which involves 3 steps. At the initial stage, propene decomposes into cumene hydroperoxide in the presence of a catalyst created by mixing sulfuric acid with phenol and retaining 60-80% at high temperature and in a separate reactor:

$$C_6H_6+CH_3CH=CH_2 \sim C_6H_5CH(CH_3)_2$$

In the next two stages, as a result of hydrolyzing the substances formed in an acidic environment when heated to 90 and adding a small amount of water, 2 components acetone and phenol are formed:

$$C_6H_5CH(CH_3)_2+O_2\text{-}C_6H_5C(OOH)(CH_3)_2$$

$$C_6H_5C(OOH)\ (CH_3)_2\text{-}C_6H_5OH+\ (CH_3)\ 2CO$$

The use of the cumene method helps to reduce the release of dimethyl ketone, which has a negative effect on the quality of phenol. 450-600 isopropanol or secondary monohydric alcohol in acetone gas phase obtained by oxidation at:

$$(CH_3)_2CH\text{-}OH+O_2\text{-}\ (CH_3)_2CO+H_2O$$

Production of technical acetone in $ZnO{\cdot}Fe_2O_3{\cdot}Cr_2O_3{\cdot}MnO_2{\cdot}V_2O_5$/HZS catalyst vapor phase hydration of acetylene, acetone purification and rectification is carried out. Acetone production is obtained using the following technology. (With 99.8 .8%) Acetylene (1) from the tank (2) through the compressed acetylene pipe under a pressure of 0.18 MPa throughs the compressor to t the t top of the reactor (hydrolysis device) supplied for hydration. For the safe t transportation of compresseda acetylene, steam iS supplied to the acetylene pipeline, and it is heated to a temperature of 270°C in a heating furnace. In order to prevent local heating of the steam acetylene mixture at the point where the transport steam is introduced, the acetylene pipeline mixture should be recirculated. equipped with a lid for water cooling.

The superheater (3) furnace is a rectangular chambered firebox in which a set of steel pipes is installed. The furnace consists of 2 parts - radiant, where the steam is superheated due to the combustion of natural gas, and conversion, where the steam is superheated due to exhaust gases The steam entering the conversion section of the steam superheater is 270°C heated to temperature and divided into two streams. A stream to transport it safely sent to mix with acetylene. Another steam stream from the conversion section of the furnace enters the coils of the radiation section, where it is heated to a temperature of 500 °C. When the temperature exceeds 350-400C, catalyst dust starts to come out. Steam heated to 500C in a heating furnace to reduce catalyst expulsion

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and (2) acetylene from the compressor are mixed in a ratio (1:4) in a mixer (4) installed at the top of the reactor. Reactor (5) is a vertical apparatus, inside which 10 layers of $ZnO{\cdot}Fe_2O_3{\cdot}Cr_2O_3{\cdot}MnO_2{\cdot}V_2O_5$/HZS catalyst are placed and 10 plates are installed above the catalyst layer of each layer. The plates are designed to prevent condensate delivered to the hydrator through the nozzles to dissipate the heat of reaction from reaching the catalyst surface the acetylene-steam mixture entering the upper part of the reactor passes through 10 successive layers with a solid catalyst, on its surface the reaction takes place. The process of acetylene hydration is carried out at a temperature of 425-430°C. At the beginning of the reaction period, the temperature is maintained at 425°C. As the activity of the catalyst decreases, the temperature of the hydration process gradually increases to 435°C Contact gases formed as a result of the reaction from the bottom of the reactor (6) are cooled to a temperature of 185°C in a steam boiler. After the steam boiler, the gases enter the cooler of the refrigerator (7), where they are cooled by circulating water to a temperature of 100C and sent to the next cooler (8). Here they are cooled again with circulating water to a temperature of 75°C. In this case, the main part of acetone, acetic acid and crotonic acid dissolved in water in'the condenser is condensed. Non-condensable gases with a temperature of 75°C enter the next cooler (9), where they are cooled to 35°C with cold water. The obtained acetone water is condensed in coolers (7), (8) and (9) and sent to tank (11). Acetone and flue gases containing carbon dioxide (C02), nitrogen (N2), oxygen (O2), methane (CH2), carbon monoxide (CO) washed from the reaction products are released into the atmosphere through a 40-meter-high chimney (10).

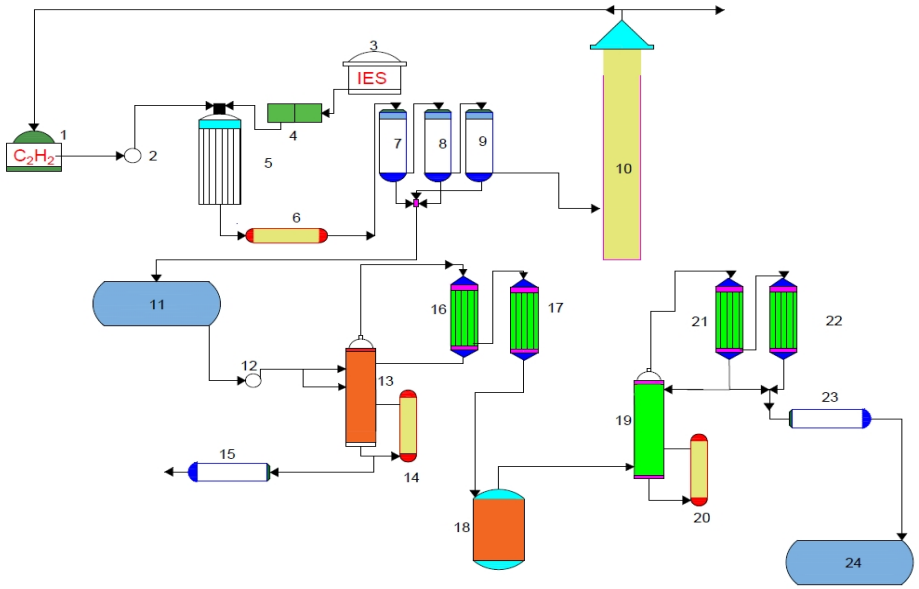


Figure 14. Technological scheme of obtaining acetone from acetylene and water 1-acetylene; 2, 12th pump; 3-water; 4-evaporator; 5th reactor, lo' 14 and 20-heater; 7, 8 and 9-coolers; 10-gas processing tower; 11th collector; 13, 19- rectification column; 15 and 23-small cooler; 16, 17, 21 and 22 deflegator, 24 collector

Catalyst regeneration

In the process of hydrogenation of acetylene, carbon and tar products accumulate on the surface of the catalyst, which leads to a decrease in its activity. After 72 hours of contact, the catalyst is regenerated using a mixture of steam and air heated to a temperature of 500-550 °C. Before

supplying air to the hydrator, the system is vaporized and purged with nitrogen, blowing off acetylene, as well as combustible organic products formed during the hydration reaction and deposited on the catalyst surface. Catalyst regeneration takes 20-24 hours.

Rectification of an aqueous acetone solution. Aqueous acetone (3-7% acetone, 0.1% croton aldehyde, 0.01% acetic aldehyde) collected in tank (11) with a temperature of 50-70°C is fed from the upper part of the rectification column (13) through a pump (12). In the lower part of the rectification column (14), the temperature is heated up to 130°C using steam. The temperature at the top of the column is 115-120°C. The fusel water (15) from the lower part of the column is cooled to 40-45C through the cooler and goes to BXO The main function of this rectification column is to separate acetone from aqueous acetone.

The number of organic impurities in fusel water should be within the following limits:

-acetaldehyde, not more than 0.01%;

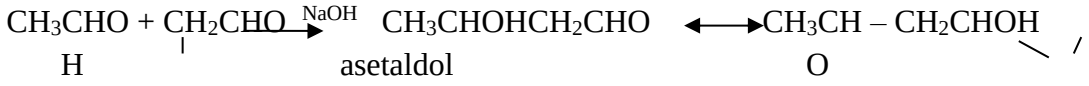
- acetone, not more than 0.02%;

-acetic acid, not more than 0.05%;

-COD-not more than 3000 mg0/dm2;

-not less than pH-3.

Acetone (16) in a par state from the top of the column is cooled by circulating water through the dephlegmator and given as phlegm (saturation) from the top of the column. Gases that have not turned into liquid are cooled by cooled water in the next (17) dephlegmator. (16-17) in dephlegmators, a part of the cooled acetone is given as phlegm to saturate the column, and the remaining part is passed through a 40% NaOH solution in (18). The temperature in Mishalka is 56-60°C. Acetaldehyde is resinified under the action of alkali, designed for the process of saponification of esters in acetone with alkali. In the presence of a base, two molecules of acetaldehyde undergo a condensation reaction. One of the three hydrogen atoms in the first aldehyde molecule is attached to the oxygen atom of the second aldehyde molecule. The remainder of the first molecule combines with the carbon atom of the carbonyl group of the second molecule.



The aldol reaction is alkaline. At temperatures below 100°C, condensation occurs on high molar mass resins. The circulation of the alkaline solution in the tank is carried out until the mass fraction of sodium hydroxide in the solution is 7-8%, then the solution is replaced Acetone vapors (19) at 45-50C purified from acetaldehyde are sent to the lower part of the rectification column. This is heated to a temperature of 80-82C using a heater in the lower part of the rectification column (20). The temperature at the top of the column is 55-58°C. Acetone vapors at the top of the column are cooled and condensed in reflux condensers through dephlegmators installed in series (21-22). Part of the technical acetone is returned to the top of the column as phlegm. The rest (23) is in the refrigerator cooled and (24) pressed with nitrogen into the accumulator. According to this technology, it is not less than 99.5% pure acetone can be obtained.

Conclusion

Effective use of acetone is important for industry. Acetone's role in organic synthesis and industrial chemistry cannot be denied. This organic compound serves as an important raw material for the production of various products. Effective use of acetone, optimization of its production methods and minimization of environmental impact are important factors for industrial development. In general, acetone is an integral part of organic synthesis and industrial chemistry, and is widely used in pharmaceuticals, polymers, coatings and many other fields. One of the main innovations in the field of acetone production was the development of environmentally friendly methods of its production. Modern research is aimed at minimizing the negative impact of production processes on the environment, reducing greenhouse gas emissions, and using renewable sources of raw materials for synthesis. Eco-friendly solvent manufacturer A popular method of prodluction is biotechnological, it is bioorganic based on fermentation processes of components. So, acetone is a universal substance that is actively used in various fields.

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