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Processes and Importance of Producing Polyvinyl Chloride Based on Monomer

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Abstract: The article examines the production of polyvinyl chloride cables and electrical wires, artificial leather, hoses, packaging materials, and insulating materials for linoleum. Polyvinyl chloride is used to protect reservoirs, tanks, chemical equipment, and pipelines from the effects of chlorine, hydrochloric, and sulfuric acids.

Keywords: Monomer, polymer, polymerization, vinyl chloride, polyvinyl chloride, dichloroethane, thermoplasticity, insulating materials, artificial leather, acetone, ethyl alcohol.

Introduction:

Polymerization (ancient Greek: πολυμερής — consisting of many parts) is the process of forming a high-molecular substance (polymer) by repeatedly adding molecules of a low-molecular substance (monomer, oligomer) to active centers in a growing polymer molecule. A monomer molecule that is part of a polymer forms a so-called monomer (structural) unit. The elemental composition (molecular formulas) of a monomer and a polymer are approximately the same. Monomers are usually compounds containing multiple bonds or cyclic fragments that can open and form new bonds with other molecules, ensuring chain growth.

Literature Review

Polyvinyl chloride polymerizes in the presence of an indicator at a temperature of 20-500C and a pressure of 2-6 atmospheres:

$$n CH_2 = CHCl \longrightarrow \cdots CH_2 - CHCl - CH_2 - CHCl - CH_2 - CHCl - CH_2 - CHCl - \cdots$$

поливинилхлорид

The molecular weight of polyvinyl chloride is 30,000 - 400,000, density 1.4 g / cm3. In industry, polyvinyl chloride is used to obtain different substances with and without adding a plasticizer. Polyvinyl chloride obtained without adding a plasticizer is called viniplast [1]. Viniplast is mechanically and chemically stable, 5 times lighter than cast iron and 8 times lighter than lead. Chlorinated polyvinyl chloride is used to obtain chlorine fiber, it does not burn, and is not affected by acids and alkalis. Polymerization is a process in which the same monomers combine at high temperature and pressure, forming a high-molecular compound without the formation of intermediate compounds.

Polyvinyl chloride (PVC) is a thermoplastic material obtained by polymerization of vinyl chloride. Polyvinyl chloride occupies a key place among polymer products worldwide. More than 3,000 items are made from this polymer. In 1912, a patent was issued for the industrial production of vinyl halide polymers. In 1935, Regno obtained vinyl chloride by treating dichloroethane with an alcoholic solution of alkali. Polyvinyl chloride has been available as a commercial product since 1935. During storage, it is exposed to heat, light, moisture, oxygen, ozone, aggressive substances and mechanical forces [2-3].

RESULTS

The main raw material for the production of polyvinyl chloride is vinyl chloride (VCC). In demand, it ranks second after ethylene. At room temperature, it is a colorless gas with an ethereal odor, the boiling point is 13.90 C, the density is 970 kg / m^3.

Vinyl chloride is soluble in acetone, ethyl alcohol, and insoluble in water. When mixed with air, it is flammable and explosive. When burning, caustic substances and toxic phosgene are released. Vinyl chloride has a strong negative effect on the human body.

It affects the central nervous system, skeletal system, connective tissue, brain, and heart. It causes immune

changes in tumors. It damages the liver. Observations show that it causes cancer of various tissues and organs, including the liver, brain, and lungs.

Vinyl chloride is obtained in various ways. It is obtained by hydrochlorination of ethylene in the presence of a catalyst, dehydrochlorination with an alcohol solution of alkali, and chlorination of ethylene at high temperatures.

$$CH_2 = CH_2 + CI_2 \longrightarrow CH_2CI - CH_2CI$$

этилен дихлорэтан

The resulting dichloroethane undergoes pyrolysis, initially forming vinyl chloride and hydrogen chloride [5]. The released hydrogen chloride is sent to chlorinate ethylene and vinyl chloride is formed:

$$CH_2 = CH_2 + \tfrac{1}{2} O_2 + HCI \xrightarrow{CuCI} CH_2 = CHCI + H_2O$$

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If oxygen and an initiator are not used, thermal polymerization of vinyl chloride does not occur, it proceeds quickly in the presence of oxygen. As a result of observations, it was found that oxygen combines with vinyl chloride and forms peroxide, then decomposes into radicals and causes polymerization. Experiments show that even at a temperature of 20-1100 °C for 50-100 hours, if there is no oxygen, the polymer does not form. The polymerization process in the presence of peroxides occurs very quickly. The polymerization reaction is very sensitive to various impurities. When acetylene, methyl and ethyl alcohol, hydrochloric acid are added, polymerization proceeds very slowly, and when styrene, hydroquinone, aniline, phenol, bromine or potassium permanganate are added, the polymerization process stops. A small amount of styrene also slows down the reaction and reduces the molecular weight of the polymer. When 1% styrene is added, the reaction stops completely. Vinyl chloride must be stored away from heat and flame sources, so it is stored for 14 hours at a temperature of 220 degrees in special containers buried deep in the ground, and with the addition of a stabilizer. Equipped with a pressure control device and a spark arrester [7]. Containers with substances are stored in conditions of air exchange with the external environment, at a temperature of no more than 500 C. Contact with copper, flame, heat, oxidizers, caustic soda and active metals is not allowed. Copper should not be exposed to fire, heat, oxidizers, caustic soda or active metals. Stabilized vinyl chloride is transported in liquid form in steel tanks equipped with a cooling liquid. The steel tank must be well dried and filled with nitrogen.

DISCUSSION

In industry, polyvinyl chloride is produced in the following ways: 1. By suspension polymerization according to a periodic scheme. An aqueous solution containing 0.02 - 0.05% of a protective colloid is mixed with an aqueous solution of vinyl chloride in the presence of 0.02 - 0.05% of a diazo compound initiator. The mixture is heated at a temperature of 45 - 650C. It is maintained until it becomes homogeneous.

PVC particles of 100-300 µm in size are formed. When the pressure in the reactor decreases, the unreacted monomer is removed, the polyvinyl chloride is filtered and dried under the influence of hot air. The sifted polyvinyl chloride will be packed. Polymerization is carried out in a 200 m3 reactor. In the second method, polymerization is carried out in two stages:

In the first stage, vinyl chloride with an initiator content of 0.02-0.05% by weight is polymerized to form 10%. As a result of polymerization, small, fine particles of polyvinyl chloride are formed, it is passed through the reactor and the monomer and initiator are added again and slowly mixed until 80% of polyvinyl chloride is formed. After holding at the required temperature, in the second stage, the polyvinyl chloride particles grow and porous granules of polyvinyl chloride with a size of 100-300 µm are formed.

Vinyl chloride that did not participate in the reaction is removed and returned back. Polychlorinated vinyl is sprayed with nitrogen and filtered. The resulting polymer is dispersed and easily processed.

Polymerization by the second method is preferable to the first, since energy consumption, maintenance fees and capital costs are reduced. With the second method, the heat resistance of polyvinyl chloride, unevenly distributed over the walls of the apparatus during the production of polyvinyl chloride, is significantly lower than with the first polymerization method.

In the third method, polymerization is carried out by emulsification. The process is carried out with the participation of a water-soluble initiator (H2O2) emulsifier surfactant. The process in an aqueous solution occurs with 0.5% by weight of the aqueous phase and vinyl chloride.

CONCLUSION

Polymerization continues at a temperature of 45-600 C with gentle stirring. 40-50% of the latex particle size, polyvinyl chloride of 0.3-0.5 µm in size from the bottom of the reactor is removed. 90-95% of the vinyl chloride obtained as a result of the reaction is converted into polyvinyl chloride. After the unreacted vinyl chloride is returned to the reactor, the polyvinyl chloride is dried and filtered in a dust chamber [8].

Polyvinyl chloride in the form of an emulsion is

contaminated with secondary substances and is used in the production of pastes and plastisols. Polyvinyl chloride is an important polymer. The correct choice of initiator, temperature, emulsifiers in the process of its production is of great industrial importance. If vinyl chloride, not participating in the process, is fed back to the reactor, the production efficiency will increase.

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