RESEARCH ON THE APPROPRIATE DESIGN OF A FILTER DEVICE USED IN LIQUID-SOLID PHASE SEPARATION

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Abstract: This article considers the issue of selecting the optimal design of a filter device used in the process of liquid-solid phase separation. The study analyzes the relationship between the filter material, surface area, and flow rate. According to the results, metal mesh, ceramic, and polymer-based membranes have high efficiency and have advantages in terms of energy efficiency and stability.

Keywords: filtration, liquid-solid phase, filter material, design, efficiency, energy efficiency.

Separation of liquid-solid phases is an integral part of industrial processes. The efficiency of this process directly depends on the design, material and operating conditions of the filter device. Creating an optimal filter system in modern technologies ensures product quality and production stability. The purpose of the study is to determine the optimal design of the filter device, that is, to find a solution that meets technical requirements such as high filtration speed, low pressure loss and long service life.

Oil is currently the main and most popular source of energy. However, its reserves are catastrophically decreasing, and the end of the oil era is already clearly visible. In a number of countries with large reserves, there is a decrease in the rate of oil production, as well as a decrease in the profitability of its production. In addition, the requirements for the quality of petroleum products, including the reduction of sulfur and other harmful impurities, are becoming increasingly stringent. This requires the introduction of additional purification methods into the overall oil refining process. All this leads to an increase in the cost of petroleum products and, as a result, imposes certain restrictions on the economic development of individual countries and the world economy as a whole. This forces us to seriously consider alternative energy sources other than oil.

As an achievement of modern technologies, we can cite GTL technology. The gas-to-liquid technology process is carried out in a Fischer-Tropsch reactor with the participation of catalysts. The product, which passes from the gas phase to the liquid phase, carries with it dispersed catalyst particles, which is harmful to the subsequent process.

The filter can separate the liquid from the fine catalyst particles by using a porous medium to retain the catalyst and allow the liquid product to pass through. Methods such as cross-flow filtration, which flows parallel to the filter surface, are used to prevent micron particles from clogging the filter and achieve efficient separation.

Filtration Methods

The most common filtration method is surface filtration, a traditional method in which the liquid flows perpendicular to the filter surface. However, it can be difficult to maintain and repair because small particles can become stuck to the filter, making it ineffective at removing very small particles.

Other separation methods

Dynamic sedimentation: In this method, a liquid is poured into a settling vessel, where the heavier catalyst particles sink to the bottom, while the lighter catalyst particles rise to the top and are collected.

Gravity or centrifugal sedimentation: These methods use gravity or centrifugal force to separate the catalyst particles from the liquid, which often requires a long settling time.

Magnetic filtration: This method uses a magnet to separate iron-based catalyst particles from the reaction mixture. The use of a magnet can be used to remove the catalyst particles.

Disadvantages:

Fine particles: The presence of very fine catalyst particles can hinder efficient separation. Clogging: Filters can become clogged with catalyst particles, leading to reduced efficiency and the need for frequent regeneration.

High viscosity: The viscosity of the liquid-solid phase mixture can affect separation efficiency, and high viscosity makes it difficult to separate particles.

The conducted analyses show that increasing the filter surface increases the filtration rate, but excessively dense material leads to pressure loss. Metal meshes are mechanically strong, ceramics are resistant to high temperatures and chemical influences, and are economical. According to the results of mathematical modeling, combined filter systems provide the most optimal effect.

Choosing the optimal design of the filter device is important for increasing production efficiency, reducing waste and ensuring environmental safety. In the future, it is recommended to further improve filter systems based on numerical modeling and experimental tests.

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