DOI - 10.32743/UniTech.2023.110.5.15452

INCREASING THE EFFICIENCY OF HEAT EXCHANGE BY CHANGING THE CONSTRUCTION OF A SHELL AND TUBE HEAT EXCHANGER

Ganisher Rakhimov
Associate professor
Karshinsky Engineering and Economic Institute,
Republic of Uzbekistan, Karshi
E-mail: ganisher.raximov@inbox.ru

ПОВЫШЕНИЕ ЭФФЕКТИВНОСТИ ТЕПЛООБМЕНА ЗА СЧЕТ ИЗМЕНЕНИЯ КОНСТРУКЦИИ КОЖУХОТРУБНОГО ТЕПЛООБМЕННИКА

Рахимов Ганишер Бахтиёрович
доцент
Каршинский инженерно-экономический институт,
Республика Узбекистан, г. Карши

ABSTRACT

Is to increase the efficiency of the heat exchange process by increasing the degree of distribution of raw materials in the distribution chamber and, accordingly, its distribution through the pipes, which is achieved by installing a fixed structure that creates centrifugal forces at the inlet fitting located in the cap part of the shell-and-tube heat exchanger.

АННОТАЦИЯ

Рассматривается повышение эффективности процесса теплообмена за счёт увеличения степени распределения сырья в распределительной камере и, соответственно, распределения его по трубам, которое достигается за счет установки неподвижной конструкции, создающая центробежные силы на входном штуцере, расположенный в крышечной части кожухотрубчатого теплообменника.

Keywords: shell-and-tube heat exchanger, union, centrifugal force, pipe networks, inter-pipe gap.

Ключевые слова: кожухотрубный теплообменник, штуцер, центробежная сила, трубопроводные сети, межтрубное пространство.

In the world, scientific research is being carried out aimed at raising the production to a new level, modernizing and diversifying it, introducing innovative technologies, increasing the volume and quality of the produced products, and expanding their types.

In the chemical and oil and gas industry, the process of processing products under the influence of heat is widely used. The heat exchange process is carried out for the following purposes: 1) maintaining the process temperature at the given level; 2) cold, heating the product or cooling the hot product; 3) steam condensation; 4) condensation of solutions, etc. These processes are carried out in separate heat exchangers or in the technology device itself.

In the technology of primary and deep chemical processing of oil and gas, gasses and electricity generated from the combustion of fuels are often used as a direct heat source.

Industrial heat exchangers have a very wide nomenclature of types, sizes, parameters and materials. For this reason, it is possible to choose a device that is optimal in terms of all its parameters for each specific condition. It is advisable to follow the following general rules when choosing heat exchange devices.

1. If the pressure of heat transfer agents is high, pipe heat exchangers should be used; in such conditions, a heat-carrying agent with a higher pressure is sent into the pipes, because the diameter of the pipes is small compared to the diameter of the device shell, so they can withstand a slightly higher pressure;

2. The corrosive heat transfer agent is supplied through the tubes of the tube heat exchanger, because the shell of the device is not changed when the tubes are corroded due to corrosion.

3. When using corrosive heat transfer agents, heat exchangers made of corrosion-resistant polymer materials (for example, fluoroplast and its copolymers) should be used.

4. If one of the heat transfer agents is dirty or has the property of giving the surface of the device, it is necessary to send such heat carrier to the side of the heat exchange surface that is easy to clean (for example, the inner surface of the tubes in shell-and-tube devices, and the outer surface of the tubes in coiled devices).

5. Improving heat exchange conditions does not always depend on the speed of the heat carrier (for example, the rate of steam condensation depends on the correct transfer of condensate from the heat exchange

Библиографическое описание: Rakhimov G. INCREASING THE EFFICIENCY OF HEAT EXCHANGE BY CHANGING THE CONSTRUCTION OF A SHELL AND TUBE HEAT EXCHANGER // Universum: технические науки : электрон. научн. журн. 2023. 5(110). URL: *https://7universum.com/ru/tech/archive/item/15452*

surface), therefore It is necessary to choose a device with an appropriate design for a specific situation.

Approximately 80% of the heat exchangers produced in the CIS for the oil and gas industry and related industries are shell-and-tube devices. Such heat exchangers are easy to make and convenient to use. Shell and tube devices are universal and are used for external heat exchange between gas, steam and liquids, when pressure and temperature change over a wide range. In addition, the direction of movement of heat-carrying agents can be different in shell-pipe devices.

There are the following methods of intensification of heat exchange devices used in industry:

1. Reducing the dimensions and mass of the heat exchanger;

2. Permitted energy costs for intensifying the heat exchange process and the type of energy available for its implementation;

3. Changing the hydrodynamic regimes of the flow intensifying heat transfer. That is, creating a turbulent regime or increasing the value of the Reynolds criterion. Distribution of heat flow density or temperature field in the heat conductor;

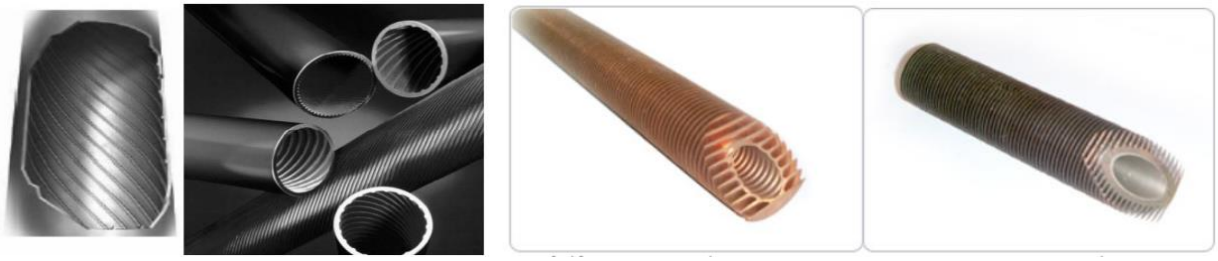
4. Propensity to the manufacturing technology of the heat exchanger, as well as convenience and reliability during operation.

In addition, the analysis of the design and process of the device allows to determine the permissible energy consumption for heat transfer. Usually, the power consumption refers to the power of the pump.

Therefore, when the sum of the pressure losses during the transfer of the heat conductor through the device is unchanged, it is necessary to create methods of intensification that ensure the reduction of its overall dimensions. It is known that in all methods of intensification of turbulent flows, the flow is additionally artificially turbulized to accelerate heat transfer. However, at the same time, the coefficient of hydraulic resistance also increases. Therefore, in order to know the degree of intensification, it is appropriate to compare the results obtained by the intensification method with the experimental data obtained in a straight pipe. The Nu/Nu_T ratio can be used for this.

Knowing the hydrodynamic composition of the turbulent flow and the specific characteristics of heat exchange from it helps to determine in which area of the flow it is necessary to intensify the turbulent fluctuations. According to the information of many scientists, no one denies that it is necessary to accelerate the movement of liquids near the pipe wall.

In the shell-and-tube heat exchanger, the inner and outer surfaces of the tubes are shaped like screws to create artificial tubular vibrations (Fig. 1).



a) *b)* *d)*

a) The external and internal parts have been changed; b) the external part is changed; d) the internal part is changed

Figure 1. Views of internal pipes of shell-and-tube heat exchangers

In addition, scientists have developed a screw-shaped barrier that acts as a support in the pipes for artificial turbulization in the inter-tube space of the shell-and-tube heat exchanger (Fig. 2).

In the heat exchanger of the construction shown in Figure 1 above, the heat exchange efficiency increases. But the formation of deposits in the external and internal channels of the pipes accelerates, and at the same time, the hydraulic resistance increases. In the construction of the heat exchanger shown in Figure 2, the hydraulic resistance is lower than in the straight segment barrier. The level of precipitation is also low. Based on this, we can say that by placing the pipe barrier in a spiral manner, the value of thermal indicators increases, the indicators of the hydrodynamic regime of the flow improve, and the level of sediment formation decreases.

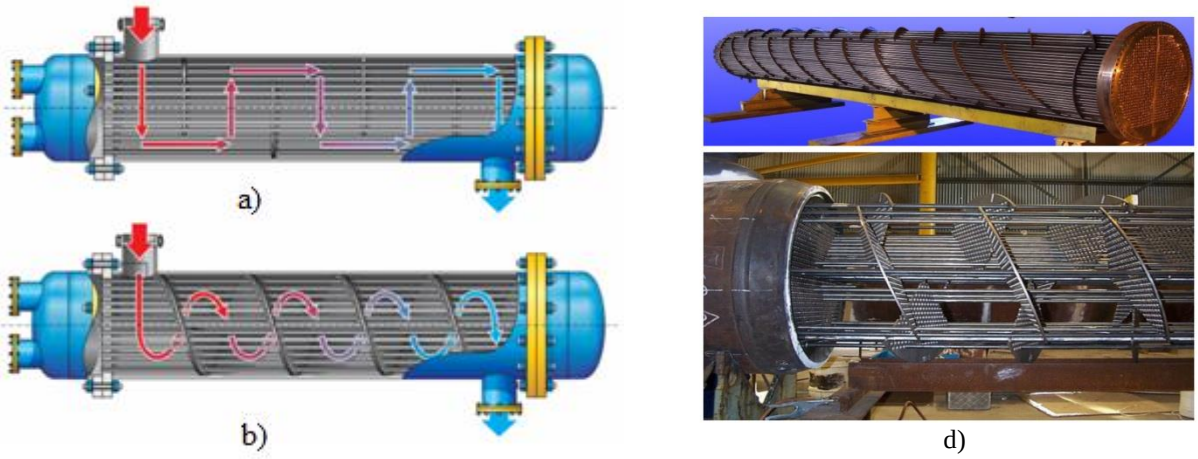


Figure 2. Location of obstacles in the inter-tube space in the shell-and-tube heat exchanger: *vertical segment barriers; b, d - screw-shaped barriers*

Methods of increasing the efficiency of heat exchange by changing the internal structure of the shell-and-tube heat exchanger have been sufficiently studied, and some scientific research is being conducted in this regard even now.

It is possible to increase the heat exchange efficiency of the shell and tube heat exchanger by increasing the level of flow distribution in the chamber where the pipe networks are located. We can see that the inlet union on the cover of the shell-and-tube heat exchanger is perpendicular to the cover. In this case, if the raw material or product inlet nozzle is located vertically on the cover of the device, the velocity in the part of the pipe networks close to the nozzle is high and the level of distribution to the pipes is low.

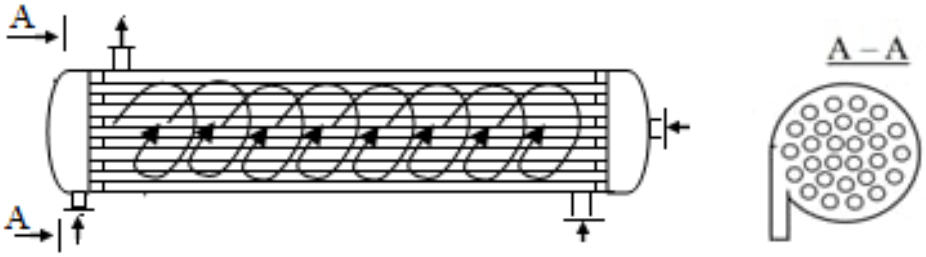


Figure 3. Centrifugal shell and tube heat exchanger

In this case, it is possible to create a centrifugal force by placing the union located on the cover of the device against the circle of the cover. By this, the current distribution in the distribution chamber of the device increases.

The following results can be achieved by transferring the flow motion using centrifugal force:

The level of supply of raw materials in the distribution chamber of the heat exchange device additionally increases and the level of precipitation in the device decreases;

under the influence of centrifugal force, the coefficient of heat transfer from the heat carrier to the outer wall of the pipe increases, and the coefficient of heat transfer from the pipe wall to the heated liquid also increases;

by ensuring the circulation of the flow in the distribution chamber of the heat exchange device, it was determined that the heat transfer coefficients and the amount of transferred heat increase, resulting in a decrease in heat and electricity consumption;

by improving the designs of heat exchange devices used in oil and gas processing enterprises, that is, by directing the flow movement under the influence of centrifugal force, by organizing the optimal hydrodynamic regimes of the movement of raw materials, it is possible to extend the time between repairs and increase their economic efficiency.

References:

1. Физические основы и промышленное применение интенсификации теплообмена: Интенсификация теплообмена: монография / И.А. Попов, Х.М. Махянов, В.М. Гуреев; под общ. ред. Ю.Ф. Гортышова. – Казань: Центр инновационных технологий, 2009. – 560 с.

2. ҲУРМАМАТОВ А.М., РАХИМОВ Ғ.Б., МУРТАЗАЕВ Ф.И. ИНТЕНСИФИКАЦИИ ПРОЦЕССОВ ТЕПЛООБМЕНА В ТРУБЧАТЫХ ТЕПЛООБМЕННИКАХ // МЕЖДУНАРОДНЫЙ НАУЧНЫЙ ЖУРНАЛ «UNIVERSUM: ТЕХНИЧЕСКИЕ НАУКИ». – МОСКВА, 2021.– № 11 (92). – С. 11-15. (02.00.00; №1).
3. Ҳурмаматов А.М., Рахимов Ғ.Б. Calculation of heat transfer and heat transfer in a pipeapparatus in heating gas conden. Наманган муҳандислик-технологияинститути илмий-техника журнали.VOL 6 – Issue (1) Наманган-2021. 187-191 б.
4. Yusupbekov N.R., Nurmuhamedov H.S., Zokirov S.G. Kimyoviy texnologiya asosiy jarayon va qurilmalari. - Toshkent, O‘qituvchi, 2003. - 557 b.
5. Khurmamatov A.M., G.B.Rakhimov, Murtazayev F.I. Intensifications of heat exchange processes in pipe heat exchangers / AIP Conference Proceedings **2432**, 050021 (2022); https://doi.org/10.1063/5.0096336Published Online: 16 June 2022.
6. ҲУРМАМАТОВ А.М., РАХИМОВ Ғ.Б. РАСЧЕТ ГИДРАВЛИЧЕСКОГО СОПРОТИВЛЕНИЯ ПРИ ПЛАВНОМ РАСШИРЕНИИ И СУЖЕНИИ ГОРИЗОНТАЛЬНОЙ ТРУБЫ // МЕЖДУНАРОДНЫЙ НАУЧНЫЙ ЖУРНАЛ «ТЕХНОЛОГИИ НЕФТИ И ГАЗА». – МОСКВА, 2021.–№6(137). – С. 62-64. (05.00.00; №80).