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REDUCTION OF ENERGY CONSUMPTION DURING BUILDING MATERIALS PRODUCTION

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Abstract. At present, in the production of building materials, which is one of the most energy-intensive industries, an increasingly urgent issue is the reduction in fuel consumption due to the use of secondary energy resources. The paper presents options for reducing energy costs through the use of heat from gases from furnaces in the ceramic industry.

The production of building materials occupies a leading position as an energy consumer and energy saving becomes the main task of the industry. On average, 1 ton of the finished product at building materials enterprises consumes 50 ... 100 kg. d.t.

The total heat utilization of the enterprise consists of useful heat perception of individual technological processes. The most important direction of energy saving is the creation of complex technologies ensuring the use of the potential of waste streams of various stages of the technological process [1].

Essential fuel economy, and as a consequence of reducing the pollution of the environment, can be achieved by utilizing the heat of waste gases, the use of which is still insufficient and an average of 30 ... 40%, while their share in general, the balance of possible use thermal secondary energy resources is 75% [2]. Furnaces are the largest industrial consumer of energy resources, and therefore energy-saving technologies must be used here [5].

Heat recovery systems for furnaces attract the greatest attention, especially waste heat, the so-called secondary energy resources. The possibility of using the heat of off-gases for technological and energy purposes depends on their temperature, the heat potential of the waste and the mode of their supply to the heat-using plant. In addition to the use of secondary energy resources, saving of consumption of primary energy resources is carried out by increasing the efficiency of process units and units [3].

In those industries where there are productive high-temperature installations, the step wise utilization of the temperature potential of the outgoing gases of furnaces and other aggregates allows in a number of cases to exclude the use of fuel for carrying out low-temperature processes, for example, drying [6].

In this paper, we discussed the possibilities of using the heat of gases emitted from furnaces in the ceramic industry.

The subject of the study was a tunnel kiln for burning clay bricks with a capacity of 17 million pieces per year. As a result of calculating the heat balance of the furnace, the temperature of the exhaust gases was determined to be 75 ° C and the flue gas volume was 10.68 nm^3 / nm^3. The clay bricks before the baking are dried in tunnel dryers using a low-potential drying agent.

The drying process is energy intensive and uneconomical in terms of heat[6]. An objective characteristic of the energy efficiency of drying plants is the specific consumption of thermal energy per 1 kg of evaporated moisture. Theoretically, the required amount of heat for evaporation of 1 kg of moisture is at the usual conditions of 2200 ... 2700 kJ / kg. The efficiency of drying plants is 30 ... 33%. An increase in the efficiency of drying installations would double the annual savings of up to 60 million tons of equivalent fuel [4].

At the same time, drying a brick in a tunnel dryer requires a drying agent with a temperature of the same order. But as a drying agent, gases that escape from the tunnel kiln are undesirable, since their use has a number of negative consequences:

- gas contamination of industrial premises is created because of looseness in dryers;
- metal part of trolleys is damaged because of metal corrosion;

- aluminum frames of trolleys are also damaged due to the presence of sulfur compounds in flue gases;
- quality of the dried bricks deteriorates.

Therefore, it is most advisable to use the heat of the waste gases to heat the drying agent [7]. The most effective way for this is often the use of regenerative heat exchangers. The industry uses regenerators with a rotating and fixed nozzle. Regenerators with fixed packing are regenerators of periodic action and are used at high temperatures of waste gases. Regenerators with a rotating nozzle are used mainly at low temperatures of exhaust gases and are devices of continuous operation.

Since for the dryer it is necessary to continuously supply the drying agent, we settled on a regenerative air heater with a rotating nozzle, which are used at low gas temperatures. The rotating nozzle consists of corrugated steel sheets. These regenerators are quite expensive, since their design consists of metal. Traditionally, vertical and horizontal regenerators are used in industry. Recently, sectional vertical regenerators are increasingly used. The main advantage of sectional regenerators in comparison with regenerators with a common chamber is that they can change the nozzle without disturbing the operation of the furnace.

The industry uses regenerators with rotating on-the-box three types: a nozzle in the form of a matrix, made of woven metal mesh (made of aluminum or stainless steel), a corrugated nozzle resembling honeycombs with a shallow cell and nonmetallic nozzles known as hygroscopic. The nozzle itself has a low cost, but at the same time it has a high thermal efficiency. The disadvantage of such attachments is a higher aerodynamic resistance. Also, unlike other types, they are more intensely contaminated.

To use the heat of the waste gases and to improve the efficiency of the heat technological scheme, a variant of a regenerative air heater with a second type nozzle was chosen, since it has less hydraulic resistance, allows reducing pollution and facilitate cleaning.

As a result of heat engineering and design calculations, we obtained that at a regenerator capacity of 40,200 Nm^3 / h, the necessary heat ex-change surface of 489,2 m^2, the nozzle volume of 0,245 m^3 and the mass of the nozzle is 1911 kg. The air temperature after the regenerator, with such parameters, reaches 57 ° C, which is quite acceptable for drying bricks. The fuel economy in the production of ceramic bricks was 23% with a payback period of less than a year.

The second option is the utilization of the heat of waste gases at a temperature of 200 ° C from the zone of heating of tunnel kilns in a spray dryer. This dryer is designed to produce a special morphological structure from the clay slip of a press powder, which is necessary for the semi-dry pressing of ceramic tiles. Drying in these devices is characterized by high intensity and the process ends extremely quickly (in about 15 ... 30 seconds). But in this case, despite the high temperature of the gases, the surface temperature of the material is only slightly higher than the adiabatic evaporation temperature, and the drying takes place under mild temperature conditions, obtaining a qualitative product that does not require further grinding [2].

As a result of the calculation of the spray dryer, the necessary volumetric flow of the coolant, the design dimensions of the dryer and the calculation and selection of auxiliary equipment were determined. According to the calculations made and the set values, a general purpose spray dryer with a diameter of 6,5 m was selected, a cylindrical section of 10 m in height, with a working volume of: V = 330 m^3, equipped with 6 pneumatic nozzles. The results of the feasibility study fully confirm the feasibility of this option, because The unit cost of production decreased by 148 rubles / thousand units for brick, the payback period was 0,5 years.

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