MODERN TECHNOLOGIES OF PIECE WALL PRODUCTS MANUFACTURING

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Abstract. The most relevant building materials and their constructions used in heat-efficient walls are described in this article. Some of them are up-grading of traditional building materials, others are a modern in the construction industry.

Keywords: construction materials, efficiency, wall, concrete, brick.

СОВРЕМЕННЫЕ ТЕХНОЛОГИИ ПРОИЗВОДСТВА ШТУЧНЫХ СТЕНОВЫХ ИЗДЕЛИЙ

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Аннотация. В этой статье описаны наиболее актуальные строительные материалы и их компоновки, используемые в теплоэффективных стенах. Некоторые из них – это модернизация традиционных строительных материалов, другие – современные в строительной индустрии.

Ключевые слова: строительные материалы, эффективность, стена, бетон, кирпич.

To the modern building materials refers an effective brick – a clay hollow brick (slatted or holey). It has 250x120 mm size and in height it could be single (65 cm), one-and-a-half or double. The using of air voids made it possible to reduce the weight of bricks as well as improve its thermal properties. But there are not all improvement of the brick properties.

Thus, the use of modern technology has made it possible to obtain from the oldest building material - clay, almost new construction products with better characteristics.

The use of such materials in comparison with traditional masonry from conventional brick allows:

- reduce the materials intensity of walls;
- improve the quality of construction; reduce the consumption of mortar for masonry seams;
- reduce transportation costs by reducing the weight of bricks;
- extremely improve wall thermal characteristics, with the same thickness.

For example, the St.Petersburg construction company «Pobeda Knauf» has mastered the production of a 2NF ultra-efficient porous ceramic stone with a size of 250x120x138 mm, as well as a large-format ceramic stone of 510x260x219 mm. Nowadays, small wall blocks of cellular concrete are widely used in low-rise construction.

Cellular concrete blocks (foam concrete, aerated concrete) are used for external walls masonry and internal partitions of buildings and structures. Cellular concrete masonry with a bulk density of $\gamma = 600\,\mathrm{kgF/m^3}$ has a coefficient of thermal conductivity $\mathrm{k} = 0.21\,\mathrm{w/mK}$. Usually, wall blocks made of cellular concrete have dimensions of 600x200x300 mm and 600x100x300 mm [1, p. 21].

The use of wall blocks of cellular concrete in construction can significantly reduce the labor intensity of work, increase productivity, save on the cost of expensive materials (without degrading the quality of construction).

The use of cellular concrete wall blocks also has a number of advantages:

- the load on the foundation is reduced, due to the relatively low weight; have good sound insulation;
- have good thermal insulation;
- does not burn;
- does not freeze;
- does not violated by rodents and microorganisms;
- well processed (saw, cut, bored, etc.);
- environmentally clean (must be confirmed by radiation-hygienic conclusion);
- well plastered and painted with different compositions.

It should be noted that effective wall materials (hollow brick, porous ceramic stone, large-format ceramic stone, cellular concrete blocks and other construction materials with voids), except for the advantages listed above, have one limitation: they cannot be used in sauna or bathhouses where high humidity and temperature contribute to the gradual penetration of moisture into the voids and pores of the wall, which leads to a gradual destruction of the walls.

In bathrooms of apartment houses on walls it is necessary to put a layer of a plaster solution in the thickness of 30-35 mm. Proceeding from the aforesaid, the walls of the bathhouses should be made only of solid clay bricks [2].

As a heater for multilayer walls effective insulants with a low volumetric weight and very low thermal conductivity are usually used, such as, for example, mineral wool boards, expanded polystyrene sheet or sheet foamed polyethylene.

Practice has shown that despite the apparent high cost of effective heaters, their use in masonry reduces the total cost of construction without deteriorating the thermal characteristics of the walls. And the more effective the heater is used in its characteristics, the cheaper it will eventually be to build it, cause using such a heater can reduce the thickness of the walls.

The design and thickness of walls are determined by heat engineering calculation and directly depend on the estimated winter temperature of the outside air of the climatic region where the construction is being carried out [3, p. 251].

The main direction of the development of ceramic bricks production is the increase in the output of facial products and a reduction in the costs of its production. The commissioning of the imported delivery plants (Novomoskovsky ZSM, Taruskiy KZ, Noyabrsky KZ, etc.) built and put into operation in recent years and equipped with highly efficient technological equipment has shown that the composition and properties of the raw materials have the greatest influence on the production of facial products. The best result is achieved when the properties of the main raw material, characterized by the montmorillonite composition of the clay substance. And, as a consequence, the high sensitivity to drying (and this is the majority of the clay deposits in Russia), are corrected by the using of light clays of kaolinite hydro-mace composition rather than by the addition of depleting materials. In this case, the extrudable material has a uniform structure (plasticity), while not only its molding properties but also drying properties are significantly improved the strength of the burned products increases. The addition of light-clay clays allows to have products from red to pink and light cream colour, to manufacture high-quality products, and every 10 % of the voidness of the brick reduces fuel consumption by an average of 7 %. There was developed the technical documentation of the forming tooling (cavities) with a voidness of up to 42 %, which is adjusted depending on the properties of the raw materials in the factory conditions while processing the technological parameters of molding.

The development of the regime parameters of drying and firing in thermal units of modern plants with automated systems for not only burning fuel but also for the technological process of heat treatment is carried out proceeding from the properties of raw materials by determining the temperature, aerodynamic parameters of drying and baking brick, the actual performance of the ventilation and heating equipment in the current production. On the basis of the data obtained, taking into account the properties of raw materials, optimal regimes are calculated for the factory`s operating conditions, for example, operation of the dryer in a semi-continuous mode for loading and unloading with a two-shift operation of the molding compartment, production of full-bodied bricks, intervals for regulating the productivity of ventilation equipment. Recommendations are given on the

Upon completion of the work, it is guaranteed to create the regime parameters of drying and roasting, which ensure the production of high-quality brick. To create the production of ceramic bricks on domestic equipment, a technology and a complete line for manufacturing facing ceramic bricks by the method of semi-dry pressing, including preparation and granulation of raw materials, drying granules in the drying drum, grinding them in a rod mixer, pressing, drying and firing, has been developed on domestic equipment. To obtain dense products ensuring high frost resistance of bricks (more than 50 cycles), technical documentation of conical molds with through voids for pressing ordinary and thickened bricks (CM81085 press) has been developed, including chamfering. On the production line, it is possible to produce ceramic wall products from both clay raw materials and from industrial waste (coal cleaning waste, ashes of thermal power plants, etc.).

Depending on the layout of the factory, the methods of processing raw materials and forming bricks, it is effective, from the point of view of fuel economy and quality improvement, to reconstruct the tunnel kilns, which involves changing the preparation zone to allow the loading of bricks with high humidity of the raw material, as well as changing the cooling zone for full utilization Heat of cooling the brick. All changes in heating and ventilation schemes of furnaces are achieved under the condition of creating direct-counter flow zones, reducing the absolute values of aerodynamic pressures and the possibility of operation without prechamber and doors. At the same time, full use of waste gas heat and removal of atmospheric air sludge, qualitative mixing and recirculation of gases in the furnace working space without the use of high-temperature fans are ensured. In the zones of preparation and cooling of furnaces, regimes close to optimal are achieved.

The bricks in the drying area are not only dried in kiln cars to an absolutely dry state, but also heated and enter the preparation zone of the furnace with a temperature of about 100 ^{o}C, which allows improving the conditions and uniformity of its heating and burning, and reducing fuel consumption by up to 30 %. This principle has been used to reconstruct a tunnel kiln for baking rigid bricks (a dryer of G.Y. Dudenkov was designed and put into operation). For simple countercurrent tunnels, the determining value for calculating the drying regimes is the initial maximum permissible moisture output of the products, which does not allow the moisture gradient between the surface and the middle of the articles to reach values above the critical one at which cracks develop. Tunnels dryers are loaded trolleys with products periodically, and products with a certain temperature fall into the medium of the coolant with its temperature and humidity.

When the temperature of products exceeds the level of air, intensive moisture release from the surface occurs (due to cooling of the products) and possibly their cracking.

At a low temperature of the products, condensation of air moisture on their surface occurs. Warm up the product with increasing its average humidity and create a moisture drop between the surface and the middle, which also leads to cracking of products. Thus, for high-quality drying with minimal heat consumption, it is necessary: the brick is laid on the frame with a uniform gap of at least 3 cm; the maximum cross section of the tunnel should be filled with brick; apply steam heating of clay mass before pressing.

The heat consumption for heating the mass is compensated by a reduction in the heat consumption for drying. In counter flow dryers, the level of sludge even with solid doors is less than 20 % of the capacity of the suction fans, and sometimes exceeds the amount of coolant passing through the tunnels and depends on the vacuum at the loading doors. Experience shows that with tunnel lengths of more than 34-35 m, single-zone counter flow dryers operate inefficiently and their conversion to other principles of coolant motion in the nozzle of the products (cross current, forward flow, counter flow, etc.) is necessary. In order to improve the quality of bricks, provided the molding department has been working in 1-2 shifts (semi continuous brick loading mode in tunnels), modernization of tunnel dryers has been developed, which consists of: in the creation of a two-zone aerodynamic scheme of the dryer, taking into account the possibility of autonomous regulation of temperature and humidity regimes and the rate of moisture transfer of bricks by zones; providing zero pressures (equal or close pressures at the ends of tunnels and in the shop), which will eliminate spurious suspensions on loading in tunnels and knocking out the coolant at the unloading.

This scheme of dryers allows to dry bricks with large volumes of drying agent at low temperature and high humidity. The heat consumption per 1 kg of evaporated moisture is reduced and will be the smaller the higher the temperature of the brick being loaded into the dryer. The reconstruction of dryers at «Pobeda Knauf», Gusevskiy brick factory «Steklostroy», Shakhtinsky brick factory «Rostov shahtostroy», which was carried out under this scheme, allowed the brick to be defectively dried during the work of the molding department in 2 shifts. Specific heat consumption for evaporation of 1 kg of moisture was 1200-1300 kcal. Thus, the work on expanding the raw materials base, the range and methods of manufacturing construction ceramics products, including roof tiles and floor tiles, are aimed at improving technology and reducing production costs [4].

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