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THERMAL INSULATION MATERIALS: ADVANTAGES AND PRODUCTION

Abstract: *The article describes that the use of heat-insulating materials is one of the most important methods of energy saving, and also has an important technological significance, allowing to reduce the thickness of structural elements. Thermal insulation materials are materials characterized by low thermal conductivity and used for thermal insulation of building structures, industrial equipment and pipelines. The range of currently used heaters is quite wide - from foam plastics to mineral wool compositions based on polymer and inorganic binders.*

Key words: *thermal insulation materials mineral wool, basalt fiber, stone wool, fiberglass, glass wool.*

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Introduction

All thermal insulation materials and products from them are classified according to various criteria into several groups. By the type of the main raw materials, they are distinguished: organic (polystyrene foam, polyurethane foam, polyvinyl chloride foam, expanded polyethylene, fiberboard insulation boards, wood-concrete products, etc.) and inorganic (basalt fiber, mineral, ceramic and glass wool and products made of them, diatomite, expanded perlite and vermiculite, expanded clay, foam glass, aerated concrete, etc.). By structure: fibrous, granular (loose), cellular. By shape: flat (slabs, mats, felt), loose (cotton wool, perlite), cord (cords, bundles), shaped (segments, cylinders, half-cylinders, etc.). By binder content: containing and not containing. By heat resistance: non-combustible, hardly combustible and combustible.

METHODS

Currently, the following types of thermal insulation materials are most widely used: mineral wool, basalt fiber, glass wool and products from them, perlite thermal insulation materials, foam diatomite thermal insulation materials, foam glass, aerated concrete (foam concrete and aerated concrete) and expanded clay. And with the development of modern technologies for facade decoration of buildings and structures, the Uzbek market for insulation made of fibrous thermal insulation materials on composite polymer and inorganic binders, one of the components of which is polyvinyl acetate dispersions, is growing especially rapidly.

The solid phase and the main component of all fibrous heat-insulating materials is fibrous wool obtained from melts of various rocks and other silicate materials, as well as from blast-furnace and open-hearth slags and from other waste of metallurgical production. Fibrous wool consists of glassy fibers and non-fibrous inclusions formed as a result of solidification of silicate melt. The fibers, on average, have a diameter of 1 - 10 microns and a length of 2 - 3 to 20 - 30 cm. Mineral wool is obtained from a melt of low-melting rocks, silicate industrial waste, blast-furnace slags and mixtures thereof. Mineral wool is intended for the manufacture of heat-insulating, sound-insulating and sound-absorbing products, as well as as a heat-insulating material in construction and industry with a maximum operating temperature of up to 600 - 700 °C. At higher temperatures, sintering of mineral wool fibers is observed. Basalt fiber and stone wool are obtained from the melt of basalt rocks (basalts and similar metamorphic rocks and marls) at a temperature of about 1500 °C. Unlike

mineral wool, produced mainly from a mixture of low-melting rocks with industrial mineral waste, heat-insulating materials made from basalt fiber have a longer service life, increased vibration resistance, thermal and water resistance. Basalt thermal insulation does not change its initial properties during the entire period of operation, does not emit harmful substances into the environment, and does not form toxic compounds with other materials. The main components for the production of fiberglass and glass wool are cullet, sand, soda, dolomite, limestone and other components. The fiberization process takes place from a glass mass melted at about 1400 °C, which is defibred, usually by centrifugal force in centrifuges.

RESULTS AND DISCUSSIONS

Currently, three main fiber-forming technologies are used in the production of fibrous heat-insulating materials: centrifugal blowing, multi-roll and spun-vertical blowing. The most common is the centrifugal blowing method. It should be noted that the cotton wool produced by this method is of low quality, with a large (up to 25%) amount of non-fibrous inclusions and fiber-forming waste. The spun-vertical-blowing method provides waste-free processing of the melt, but due to the low power and high cost of the platinum-rhodium alloy feeders used in the technological process, it is used mainly on low-productivity lines. The centrifugal-roll method (centrifugal-multi-roll) is the most widespread in foreign practice and is based on the supply of melt to rapidly rotating rolls. In Uzbekistan, this technology has also been introduced at a number of large Uzbek enterprises.

The quality of products made from fibrous thermal insulation materials is determined by many parameters. Among the most significant are the chemical composition of the solid phase, the content of non-fibrous inclusions, the geometry and orientation of fibers in space, and a high-quality, environmentally friendly binder.

The chemical composition of the solid phase primarily determines such characteristics of heat-insulating materials as strength, heat resistance, and chemical resistance. The strength of heat-insulating materials is also determined by the parameters of the pore structure of the product and the orientation of the fibers in the direction of stress. Homogeneous pore volume distribution and a decrease in their average diameter increase the strength of thermal insulation materials. Compressive strength increases with the number of vertically oriented fibers. The selection of a binder with improved adhesion properties in relation to aggregates also has a positive effect on strength.

The fibrous structure also provides another important property of fibrous heat-insulating materials - low thermal conductivity, as well as negligible shrinkage and preservation of the geometric dimensions of products during the entire period of operation. The thermal conductivity of different types of mineral wool at normal temperatures is 0.034 - 0.045 W/ (mm/°C) and largely depends on the geometry and orientation of the fibers in space. The most effective heat insulators are those with randomly oriented fibers.

Most of the products made of fibrous thermal insulation materials have high temperature resistance, effectively prevent the spread of flame and are used as fire insulation and fire protection. More acidic formulations are more stable than basic ones. Fibrous products from rocks of the basalt group can be used in very high temperatures. Basalt fiber materials are able to withstand temperatures up to 1000°C and above, and even after the destruction of the binder component; their fibers remain intact and bound together, retaining their strength and creating fire protection.

Modern multicomponent binders are an important component of fibrous heat-insulating materials, which has a great influence on the operational and thermo physical characteristics of fibrous heat-insulating materials. Fibrous thermal insulation materials are characterized by high water absorption, reaching up to 600% when immersed in water. And, as you know, an increase in the moisture content of a heat-insulating material significantly impairs its heat-insulating properties. The use of hydrophobizing impregnations in the binder composition can reduce water absorption to 1.5 - 2%. Studies on the selection of a binder for the production of thermal insulation boards have shown the effectiveness of using compositions from components of organic and inorganic origin for these purposes. Combined binders currently used, containing in their composition a polyvinyl acetate dispersion, synthetic resins, sodium water glass, surfactants, water repellents, dedusting and other additives, provide high operational properties of the resulting products, with increased thermal and water resistance, effective water-repellent properties, invariability of structure, stability of geometric dimensions for the entire service life.

The technology of production of heat-insulating materials from polyurethane foam is a special case of manufacturing materials for thermal insulation of various production methods and applications. The use of heat-insulating materials is one of the most important methods of energy saving, and also has an important technological significance, allowing to reduce the thickness of structural elements. Thermal insulation materials are those characterized by low thermal conductivity and used for thermal insulation of building structures, industrial equipment and pipelines... The range of insulation materials currently used is quite wide - from foams to mineral wool compositions based on polymer and inorganic binders. All thermal insulation materials and products

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CONCLUSION

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