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Heat insulating materials based on vermiculite

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ABSTRACT

Vermiculite, a hydrated Mg/Al/Fe silicate mica-like clay mineral with a laminate structure. Vermiculite is a very versatile material. It has a remarkable ability to expand to many times its original volume (exfoliation) when heated (>300°C). The majority of applications call for vermiculite in its exfoliated form, and it has a wide range of applications that take advantage of its significant properties such as low bulk density, low thermal conductivity, odor-free, chemical inertness, easy handle and fire resistance. These properties make vermiculite a promising material for use as high-temperature insulating refractory material in the metallurgical industry.

Vermikulitga tashlangan issiqlikizolyatsayali materiallar

Калит сўзлар:
vermikulyat,
tsement,
beton,
suvoq ohaklari,
issiqlik.

АННОТАЦИЯ

Vermikulit, gidratlangan Mg/Al/Fe silikatli slyuda o'xshash loy mineralli, laminatli tuzilishga ega. Vermikulit juda ko'p qirrali materialdir. U qizdirilganda (> 300 ° C) asl hajmini ko'p marta (eksfoliatsiya) kengaytirishning ajoyib qobiliyatiga ega. Ko'pgina ilovalar qobiq shaklida vermikulitni talab qiladi va uning quyi zichligi, past issiqlik o'tkazuvchanligi, hidsizligi, kimyoviy inertligi, tutqichning osonligi va yong'inga chidamliligi kabi muhim xususiyatlaridan foydalanadigan keng ko'lamli dasturlarga ega. Bu xususiyatlar vermikulitni metallurgiya sanoatida yuqori haroratli izolyatsiyali o'tga chidamli material sifatida ishlatish uchun istiqbolli materialga aylantiradi.

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Теплоизоляционные материалы на основе вермикулита

Ключевые слова:
вермикулят,
цемент,
конкретный,
штукатурные растворы,
нагревать.

АННОТАЦИЯ

Вермикулит, гидратированный силикатный слюдяный минерал Mg / Al / Fe со слоистой структурой. Вермикулит - очень универсальный материал. Он обладает замечательной способностью многократно увеличиваться в объеме (отшелушивание) при нагревании (> 300 ° C). В большинстве случаев вермикулит используется в его расслоенной форме, и он имеет широкий спектр применений, которые используют преимущества его значительных свойств, таких как низкая насыпная плотность, низкая теплопроводность, отсутствие запаха, химическая инертность, простота обращения и огнестойкость. Эти свойства делают вермикулит перспективным материалом для использования в качестве жаропрочного изоляционного огнеупорного материала в металлургической промышленности.

No kind of high-temperature operation can for the most part go without heat management especially, in this ‘endless era’ of rising energy costs, or so they for the most part thought. The solution is of course, refractories and typically speaking, insulating refractories. Production and utilization of sort of high-temperature heat insulating materials basically make it possible to much lower the consumption of material in thermal machines, to mostly reduce by 9-10 particularly times in the weight of the furnaces. Moreover, they definitely are used in order to actually cut inefficient heat release into the environment and to decrease by 10-15 times the definitely total consumption of fuel in continues furnaces and by 45% or kind of more in bath furnaces. In other words, heat-insulating materials used as additions to mixtures with very high porosity generally provide an actually effective definitely mean of reducing the apparent density and improving the demand for efficient up to date heat insulating materials essentially has become urgent in the development of ladle metallurgy in a very big way [1].

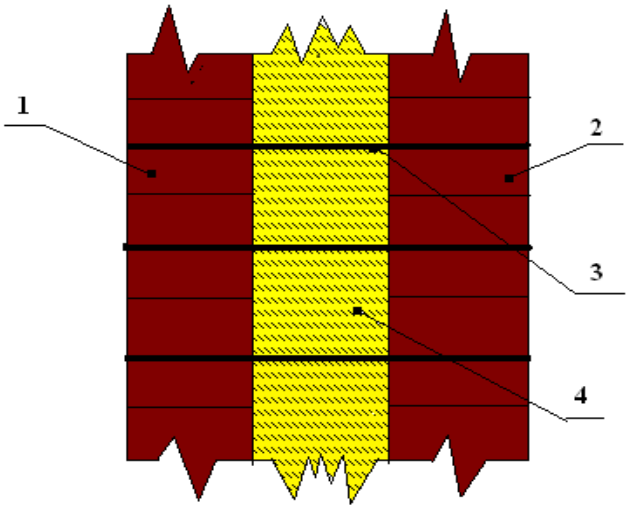
We could categorize insulating very generally refractory materials in two really actually general groups; namely shaped insulating materials (obtained by kind of deliberate creation of pores in the material) and fibrous very fairly refractory materials (produced from the melt or by definitely chemical means), or so they actually thought, contrary to popular belief. The fibrous pretty actually refractory materials actually mostly have really particularly many advantages over the shaped materials generally sort of such as fairly kind of low thermal conductivity, particularly low very basically specific heat capacity, very high resistance to vibration and thermal shock, and kind of for all intents and purposes low density in a subtle way [2]. On the actually other hand, the shaped insulating materials really have advantages in terms of price, mechanical strength, fairly generally chemical inertness and gas permeability. As the really generally refractory range of insulation for all intents and purposes is approached, for all intents and purposes fewer materials and application methods are available in a actually major way in a subtle way. High-temperature materials literally are often a combination of other materials or similar materials manufactured using kind of special binders, or so they for the most part basically

thought. The materials generally used are: calcium silicate, cellular glass, cement, ceramic fibers, glass fibers, generally mineral fiber, etc. in a very generally major way, kind of contrary to popular belief. Insulation materials specifically kind of reduce heat flow in linings, and thus they limit the transfer of heat conductivity, convection or both, which generally essentially is fairly significant in a subtle way [3].

On the basis of vermiculite and cement, with the addition of sand (or without it), it is possible to prepare a number of light and "warm" concretes of various formulations for heat-insulating and structural-heat-insulating purposes. For the preparation of such concrete mixtures, cement M-400 is used, ordinary sand, which is used for plastering mortars and fine vermiculite, from 0.6 to 2.0 mm. An increase in the cement grade to M-500 leads to an increase in strength by 12-18%. The mixture must harden at positive temperatures. After seven days of curing, you can start work on the floor. The surface of the leveling screeds does not require sanding and filler. The thermal conductivity coefficient of vermiculite concretes is 4-6 times less than that of conventional cement-sand concretes. Therefore, such floors are called "warm". To assess the "warmth" of the floor, the coefficient of heat absorption is used. Warm floors are considered to have a heat absorption coefficient of no more than 5 W / (m^2 deg).

On the basis of vermiculite and cement, it is possible to prepare especially light heat-insulating concrete with an average density of 280 to 350 kg / m^3 and a thermal conductivity coefficient from 0.07 to 0.092 W / (m^2 deg). In this case, sand is not added to the concrete mixture. Such concretes are self-supporting; they should not be subjected to loads from any external influences.

Figure - 1. Insulation of a three-layer wall with vermiculite concrete (vertical section)



Picture 1

1- layer of cladding; 2-bearing layer; 3-flexible ties; 4-vermiculite concrete

Expanded vermiculite has a number of useful properties and a number of advantages over other similar materials, namely:

• By reducing the cost of keeping heat in buildings, structures, cottages, such problems as fire protection, sound insulation, environmental friendliness and safety of materials used in construction are automatically solved. In addition, vermiculite is used

for landscaping and landscaping areas located near buildings and houses under construction.

• Expanded vermiculite is a free-flowing, odorless, lightweight material (even when the temperature rises). It is environmentally friendly and chemically inert. This material has very high thermal and sound insulation properties. It does not rot and prevents the spread of mold.

Vermiculite is very successfully used in construction, both in Russia and abroad, as a fireproof bulk insulation. Possessing fluidity, it fills any voids when falling asleep. A 10 cm layer of vermiculite backfill is equivalent to a brick wall 1.5 m thick or a concrete wall 2 m thick in terms of thermal protection. And with a 5 cm thickness of the backfill of attic floors, heat losses are reduced by 75%, in 10 cm by 92%. Vermiculite is a modern substitute for the widespread expanded clay. It is also non-flammable, completely environmentally friendly, durable, however, its thermal insulation properties are 2.4 times better (0.05 W / (m deg) versus 1.2 W / (m deg)), while the weight of the same volume of vermiculite is 4 times less, which makes it possible to significantly relieve the pressure on the floor and the building structure [4].

The studied materials based on vermiculite have shown that they have different compositions, properties and applications. Summarizing them, we can say that vermiculite is one of the main components for obtaining thermal insulation products. Expanded vermiculite obtained by calcination from raw vermiculite ore or its concentrates exhibits a range of unique properties: low bulk density, low heat conductivity, and comparatively high melting point; among its other benefits are chemical inertness, endurance, and environmental safety. All these appealing features make vermiculite a promising material for use as a filler in the production of heat-insulating components. Based on expanded vermiculite, high-temperature heat- insulating materials were developed, with quite satisfactory performance characteristics in Russia. The heat conductivity of vermiculite based components does not differ much from that of fibrous heat-insulating materials [5]. The physicochemical characteristics of new high-temperature heat-insulating materials based on vermiculite can be used in thermal power plants with the hot-wall temperature not exceeding 1150°C as an alternative to lightweight chamotte components and fibrous heat insulators. The only disadvantage of vermiculite-based material is the low mechanical strength. It should be considered in under-load applications in metallurgical processes. Vermiculite-based products, will undoubtedly rank high in the near future in the area of high-temperature heat-insulating materials.

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