

PREFABRICATED INSULATING FIBRE COMPOSITE BLOCK
FOR FURNACE LINING

This invention relates to a refractory composite for heat insulation of various kinds of furnaces and vessels, and the object of the invention is to provide an insulating refractory composite block having excellent heat insulating properties and a long life and a refractory structure in which the insulating refractory composite block is applied to the inner and outer faces of furnaces and vessels.

At present heat insulation of various kinds for furnaces and vessels takes into consideration saving of resources and energy.

Conventionally there are used, as such heat insulating materials, insulating bricks or an inorganic, insulating fibrous material. However, such materials have disadvantages in that, in the case of insulating bricks the heat insulation at high temperatures is insufficient and the shape is small thereby requiring a long construction time, and in the case of the fibrous material the heat insulation at high temperatures is excellent but if used for long periods of time the fibre crystallizes and becomes powdery, and when applied to the inner faces of a heating furnace the powdered fibre contaminates the products in the furnace.

Another problem is that if the insulating bricks or the inorganic fibrous materials are applied to the inner faces of a heating furnace, the insulation is subject to abrasion by gas flow, and erosive abrasion by corrosive gas.

Attempts have been made to prevent oxidation of the iron shell of a furnace or vessel, as well as to heat insulate it, by applying a heat insulating material to the inner walls of the furnace or vessel, but the two kinds of insulating materials mentioned above have a substantial gas permeability so that although they provide heat insulation they have the disadvantage that they cannot prevent oxidation of the iron shell. It is also known to coat the surface of the fibrous insulating material with a refractory material, but this is troublesome in constructing the furnace.

A main object of the invention is to provide an insulating material which overcomes these problems.

According to the invention there is provided an insulating refractory composite block comprising a refractory fibre block having at least one face covered with a refractory board which consists of:-

- (a) 100 parts by weight of refractory material selected from alumina, magnesia, silica, grog and silicon carbide,
- (b) 1 to 20 parts by weight of an organic fibre and/or an inorganic fibre, and
- (c) a proportion of a binder comprising, for a flexible refractory board, 3 to 50 parts by weight of solid parts of a vinyl polymer emulsion having a minimum film forming temperature lower than 30°C.

Some embodiments of the invention will now be described, by way of example, with reference to the accompanying drawing which is a cross-sectional view showing essential portions of some insulating refractory composite blocks according to the invention.

Figure 1 is a cross-sectional view showing the essential portion of an insulating refractory composite block which consists of a flexible refractory board 2 and a fibre block 1. The fibre block 1 is sheet-like and is soft like cotton. It is therefore small in strength, but if the fibre is stacked in laminated form as shown, it may be easily handled, with the flexible refractory board as core, and in applying the block it can be easily deformed to adapt to curved faces. For a long period of use, powdering of the fibre block, due to crystallization and abrasion and erosion by gas flow, may be prevented thereby providing enduring heat insulation over a long period of time.

Such insulating refractory composite blocks are not flexible, but even for longer periods of use the fibre blocks are prevented from powdering by crystallization and substantial heat insulation is provided over a long period of time. Further, they can be used for a lining which is contacted by molten metals. When these blocks are used for heat insulation between a refractory lining material of a furnace or vessel and an iron shell, they do not shrink, even if subjected to the expansion of the lining material or stresses such as the static pressure of the molten metal, thereby providing a furnace structure having a sustained insulating property.

The flexible refractory board 2 is based on powdery refractory and inorganic fibre, and preferably is flexible and shrinkable under pressure at room temperature during construction. Such a flexible refractory board is completely, and closely adhered to curved faces when constructing a furnace, and because of the composite structure with the fibre block 1 it is possible to use such board as it is, without losing its natural properties, as part of an insulating refractory composite block according to the invention.

The flexible refractory board is a board which is manufactured by mixing 100 parts by weight of a powdery refractory raw material, 1 to 20 parts by weight of an organic or inorganic fibre, and 3 to 50 parts by weight (based on solid parts) of polymer emulsion as a binder, which emulsion is flexible after drying. The fibre for the flexible refractory board may be inorganic fibres such as slagwool, asbestos, glass fibre and ceramic fibre and organic fibres such as wood pulp, and flocks of hemp thread, cotton and synthetic fibres. Preferably the fibre length is shorter than 10 mm, to ensure that the fibre is uniformly dispersed in the mix for the board.

The inorganic fibres provide strength at normal temperature or medium temperature, but decrease the refractory property of the board so that preferably the amount of the inorganic fibre present is less than 20 parts by weight.

The organic fibres provide strength at normal temperature, increase the porosity because of burning when used, and improve the heat insulating property. Preferably the amount of organic fibre present is less than 5 parts by weight. With more than 5 parts by weight the board texture deteriorates by the burning which takes place in use.

The vinyl resin emulsion used as binder is preferably a mixture of one or more aqueous emulsions such as poly vinylacetate emulsion, poly ethylene-vinylacetate emulsion and poly vinylacetate-acrylic ester emulsion. It is preferable that the minimum film forming temperature (MFT) of the binder is lower than 30°C. If the MFT exceeds 30°C the refractory board, after drying, may not always be sufficiently flexible.

The greater the amount of the binder present, the more the board becomes pliable and has increased flexibility. With less than 3 parts by weight of the binder the flexibility may not be sufficient so that the insulating composite block applied to the surface of the fibre block may not deform enough to be applied to curved faces and cracks may occur.

However, if more than 50 parts by weight of the binder are present, the board texture deteriorates due to thermal decomposition of the binder when the temperature rises after construction, and the board loses resistance to the abrasion and erosion caused by gas flow.

The inorganic fibres provide strength at normal temperature and medium temperature, but they reduce the refractory property of the board, and they are preferably added in amounts less than 20 parts by weight.

The organic fibres provide strength at normal temperatures, increase the porosity because of burning when used, and improve the heat insulation. Preferably their additive amount is less than 5 parts by weight and in excess of 5 parts by weight there is the drawback that the board texture deteriorates owing to burning in use.

Referring to the amount of binder present, the strength will be small if there are less than 2 parts by weight, but with more than 10 parts by weight a problem occurs in that the refractory property is reduced and the resistance to melting when contacted with molten steel slag is also reduced.

The fibre block 1 can have various forms. For example, it may be in the form of slagwool felt, ceramic fibre, glass fibre, or a laminate thereof. Its form is selected depending on temperature condition at the place of use.

The insulating, refractory composite block is moulded by adhering, with a refractory adhesive, a fibre block to a flexible refractory board. Otherwise it is produced by coating the upper surface of the fibre block, for example by pouring, with a mix for the flexible refractory board. Thereafter the mix is dried for more than 2 hours at a temperature higher than 100°C.

The insulating, refractory composite block of the invention can be applied, as it is, by fixing it with known mortar or bolts to the hot faces and/or the cool faces (iron shell side) of furnaces and other vessels. To improve working speed, it may be preferable to apply pressure sensitive adhesive at the working faces.

For example, the speed of application of the composite unit will be further improved by applying to the working faces, a pressure sensitive adhesive consisting of a mixture of a powdery refractory, an inorganic binder and a synthetic resin or a rubber type adhesive, and applying a release backing paper.

Example 1

To the walls of a heating furnace for hot rolling there were applied insulating refractory composite blocks, each having a structure as shown in the drawing, and consisting of a ceramic fibre block 1, 50 mm thick, and having 55% Al_2O_3 content, and a flexible refractory board 2, 5 mm thick, and having 95% Al_2O_3 content. A conventional ceramic fibre block having 55% Al_2O_3 content would become powdery after three months use, and in the past there was no alternative but to replace the block. But when using the insulating refractory composite block according to the invention there was no noticeable powdering, and a life of more than six months was obtained.



Claims

1. An insulating refractory composite block comprising a refractory fibre block having at least one face covered with a refractory board which consists of:-
 - (a) 100 parts by weight of refractory material selected from alumina, magnesia, silica, grog and silicon carbide,
 - (b) 1 to 20 parts by weight of an organic fibre and/or an inorganic fibre, and
 - (c) a proportion of a binder comprising, for a flexible refractory board, 3 to 50 parts by weight of solid parts of a vinyl polymer emulsion having a minimum film forming temperature lower than 30°C.
 2. An insulating refractory composite block as claimed in Claim 1, when used as a refractory structure which is directly applied to the lining of hot face of a furnaces or vessels, or the faces of inner walls of the iron shell of furnaces or vessels.
 3. An insulating refractory composite block substantially as herein described in Examples 1.
 4. An insulating refractory composite block substantially as herein described with reference to the accompanying drawing.
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