

The invention relates to a waterproof and weatherproof fire prevention material in loose form, particularly in a flexible, not completely filled pack.

Building regulations require minimum fire resistance periods for numerous components, such as walls, ceilings and lightweight partitions. If such components contain openings or breaks for installation purposes, e.g. for the passage of cables, pipes and ventilation lines, then there is a risk of the fire being passed on through the said openings into the next constructional sections and building. Thus, in the past at the end of the installation work, such openings and breaks were cement stabilized, which made it very difficult to retighten new cables, lines and pipes. Asbestos bags in the form of bags or sacks made from asbestos fabric with loose asbestos fibre fillings obviated this problem. However, of late these bags have been ever less frequently used in view of the fact that asbestos fibres are prejudicial to the health.

In addition, polyethylene bags with mineral fibre fillings are known. The envelope is burnable and can pass the fire through the opening. If the polyethylene envelope is destroyed by fire or parts dropping down during the latter, then there is a risk of the opening losing its tightness due to the running out or dropping out of the no longer cohesive mineral fibres. The same applies with respect to canvas sacks with a mineral fibre filling.

Jute sacks filled with mineral fibres and coated with a fire protection coating of insulating layer-forming material are tight. Despite the fact that the envelope material is flammable per se the passing on of the fire can be prevented in that in the fire the insulating layer-forming material constitutes an insulating foam. However, as insulating layer-forming fire prevention coatings are not waterproof and can be destroyed by water within 10 to 48 hours, such coated sacks cannot be used in wet or damp rooms, particularly on building sites, where there is a permanent risk from rainwater and other water resulting from cleaning, cement stabilizing and plastering work.

A fire prevention material comprising a porous core material, which is impregnated or covered with a heat-foaming inorganic material is described in FR-A-2 315 489. Incorporated into resin it is used for producing solid components. However, the said inorganic materials are not waterproof and weatherproof and the composition does not contain a heat-active binder.

Intumescence materials, which can optionally be foamed and produced by reacting organic compounds such as polyisocyanates, polyethers, polyesters, melamine phosphates, optionally water and isocyanate-reacting compounds and suitable for the production of mouldings are described in EP-A-0 120 253. Inorganic materials are possibly only contained in small amounts.

The problem of the invention is to provide fire prevention materials which are physiologically unobjectionable during handling, which satisfy the building fire prevention requirements and also withstand the severe demands made on them under practical conditions.

The inventive fire prevention material is characterized in that it contains at least one material which is thermally insulating at temperatures up to 1100°C in the form of inflammable, pulverulent, granular and/or fibrous materials having an inorganic base, at least one material irreversibly expanding at temperatures above 150°C and in particular above 200°C, based on inorganic, inflammable compounds or materials or mixtures therefrom and/or organic, water-resistant compounds, which swell at elevated temperatures and which in particular decompose, accompanied by the formation of a carbon skeleton or carbon foam and at least one, preferably finely divided binder, which is heat-active at temperatures of 100 to 300°C and bonds the other components, in which the thermally insulating and the expanding material are contained in a proportion of more than 90% by weight in the fire prevention material and that the latter has an expansion capacity on heating from ambient temperature to 1100°C of at least 5% by volume and all the constituents are waterproof and weatherproof, at least in the unheated state.

The inventive fire prevention material, which is preferably completely free from asbestos, can be poured in loose form into cavities, but is preferably packed in flexible and in particular pad-like envelopes, which makes it easier to handle. In addition, the said pads, in much the same way as sandbags in the formation of dikes, can be placed over one another in layers in building block-like manner, so that it is possible to close larger openings or breaks. Under the action of heat the fire prevention material expands and consequently seals an opening closed by it, so that not only is it possible to stop the fire front, but it is also possible to prevent harmful gases penetrating through the fire prevention layer. The advantage of the invention is that the fire prevention material is also subject to no change as a result of long lasting water and weather action and is in particular not deteriorated from the fire prevention standpoint. The heat insulating material is heat-resistant up to temperatures of at least 700°C and in particular up to 1100°C and has at the same time heat insulating properties. The latter preferably already exist at normal temperature, but in an embodiment may only evolve during the heat action. The material expanding under heat action swells or expands, preferably in the temperature range 200 to 1000°C. Thus, the aforementioned sealing action occurs at an early time, so as to obtain a good protection of heat-sensitive materials, which are surrounded by the fire prevention material.

The heat-active binder evolves adhesive properties at temperatures above 100°C, which ensures that the fire prevention material remains movable for handling purposes. However, in the case of a fire, i.e. under heat action, it is no longer fluid.

Particularly if the envelope is porous, the fire prevention material advantageously also contains a dedusting agent. The latter can have electrostatic binding properties, but is more simply liquid and/or tacky. Even small amounts of the dedusting agent of 0.5 to 5% by weight and in particular 1 to 3% by weight are adequate to ensure a dust-free handling of the fire prevention material. Suitable dedusting agents are e.g. mineral and/or silicone oil.

The envelope is appropriately at least difficultly flammable and is preferably not burnable. It can comprise organic fibrous material in the form of a knitted, woven or non-woven material, preference being given to a woven material. Glass fibres are suitable for this purpose, but it is also possible to use more heat resistant fibres such as mineral fibres, e.g. basalt fibres, or ceramic fibres. It is fundamentally possible to use fibres of inherently flammable material, such as jute. However, it is then necessary to provide the envelope with a fire prevention coating or to impregnate it, which is also preferred due to the dust sealing effect. Mixtures for waterproof fire prevention coatings are known.

The binders preferably melt at temperatures above 100°C or decompose accompanied by the formation of a tacky substance. Suitable for this purpose are in particular thermoplastics such as polyamide (PA), low density polyethylene (LDPE), high density polyethylene (HDPE), ethylene vinyl acetate (EVA), polypropylene (PP), polystyrene (PS), polycarbonate (PC) and polyoxymethylene (POM). At temperatures above 600°C part of the heat insulating material undergoes hardening due to the decomposition of the binder and/or sintering. Small binder quantities are sufficient, generally 0.1 to 6% by weight and preferably 0.5 to 3.5% by weight.

The heat insulating material and/or the material expanding under heat action are contained in the fire prevention material in quantities of more than 90% and preferably more than 95% by weight. Both materials can be identical, i.e. the heat insulating material can also have an irreversible expansion capacity. However, preference is given to the use of different materials, in order to permit a favourable matching. The fire prevention material also advantageously contains at least 80 and in particular at least 95% by weight of non-flammable materials.

The expansion capacity of the inventive fire prevention material is of great importance, because this automatically leads to a solidification of the filling of openings or holes. As a result e.g. the bags are wedged in a wall opening, so that they do not drop out in the case of vibrations or through falling objects. As a result of the expansion behaviour sealing is additionally obtained of leaks in the opening, which can result from burning off, melting or other volume contractions of objects passing through the opening (cables or pipes). Advantageously the degree of filling of the bags or sacks is a function of the expansion capacity of the fire prevention mixture, which avoids any bursting of the bags due to expansion. However, due to the strong thermal insulation of the fire prevention material, the bags are generally not heated with their total content to higher temperatures and instead this only applies to the outer layers directly exposed to the heat or fire, it is possible to keep the unused volume of the bag or sack during the filling of the fire prevention material lower than the maximum expansion capacity of said material. The composition of the fire prevention material can be matched in such a way that it has an expansion capacity of up to 600% by volume. However, for normal uses an expansion capacity of 10 to 80% by volume is adequate. The quantity of the material expanding under heat action is also dependent on this. As a function of the expansiveness, it is contained in the material preferably in quantities of 1 to 50 and more particularly 3 to 25% by weight. Preference is given to

expanding materials having an inorganic base and in particular a mineral base, such as unexpanded vermiculite and/or perlite.

In special embodiments the material expanding under heat action can also be of an organic nature and can decompose accompanied by expansion and solidification. Binder characteristics can evolve, so that an additional binder is rendered superfluous. As such an organic material expanding under heat action are in particular suitable certain thermosetting plastics, such as urea-formaldehyde resins or melamine formaldehyde resins, as well as melamine-phosphoric acid compounds such as monomelamine phosphate and they can optionally be mixed together.

With particular advantage are used inorganic and organic swelling agents in mixed form, use being made of the expansion of the organic substances occurring between 200 and 500°C and the expansion of the inorganic additives occurring between 500 and 1000°C.

If organic materials are used as the heat expansion agents, then their weight proportion is appropriately so low that the fire prevention material is not made flammable or burnable by them. However, fundamentally a certain content of organic material, which cokes or carbonizes under heat action is advantageous. Generally the content of organic constituents is 0.5 to 20 and preferably 1 to 10% by weight.

The heat insulating material normally present in the fire prevention material in a proportion of more than 80% by weight, preferably has an inorganic base. It is present in pulverulent, granular and/or fibrous form. Particular suitability exists in the case of mineral materials such as kieselguhr, expanded clay, pumice, chalk, expanded perlite or expanded vermiculite and inorganic fibres, in which the fibres preferably have a length of 1 to 15 mm. However, they can also be longer if they are wound and consequently do not impair the mobility or flow characteristics of the loose fire prevention material. In a preferred embodiment the heat insulating material is formed from fibres, which can be shaped to a deformable lumpy to ball-like structure, in which the lumps have a particle size of approximately 1 to 17 mm. The lumps or rolls are at least partly elastic, so that they have resilient properties. As a result large cavities are formed, which are also not lost in the case of multiple handling of the fire prevention material or the bags filled with it. This means that the material retains its low bulk density of less than 500 and preferably less than 400 g/l even after a long period of time. These loose lumps can also enclose the binder and at least part of the material expanding under heat action, so that as a result a demixing during handling and refilling is prevented. The fibres can be reciprocally fixed in the lumps, which can e.g. be brought about by a dedusting agent. The individual constituents of the fire prevention material and also the envelope are preferably free from halogen.

Further features of the invention can be gathered from the following description of preferred embodiments in conjunction with the subclaims. The individual features, either singly or in the form of combinations, can be realized in the different embodiments.

Example 1.

A 20 cm wide, 35 cm long glass fabric tubular bag, which is impregnated with a conventional fire prevention coating, is filled with a mixture of 30% by weight glass fibres (fibre length 1.0 to 10 mm), 55% by weight ceramic fibres (fibre length 1.0 to 6.0 mm), 10% by weight perlite, 3% by weight formaldehyde urea resin, 1% by weight low density polyethylene (LDPE), powder and 1% by weight mineral oil to the extent that it can still easily be manually shaped and several filled bags, are stacked flat over one another without any risk of falling over.

The inserted fibres are in the form of flat oval to spherical voluminous lumps, which have a diameter of 1 to 15 and mainly 2 to 6 mm. In said lumps are bound the binder, the dedusting agent, part of the perlite and the formaldehyde urea resin. For producing the filling the solid constituents are initially dry premixed and after this the mineral oil is fed in, whilst continuing the mixing process, the lumps are formed and their stability maintained.

In the case of one-sided heating of the bag to above 100°C firstly the low density polyethylene (LDPE) serving as the binder softens. At temperatures just above 200°C, at the heated points there is a local expansion of the bag content, which leads to a tight sealing of the opening. On further heating decomposition takes place of the melted, fibre-bonded low density polyethylene (LDPE). If, under the very strong heat action, the glass fabric melts, then the fire prevention material behind it has already solidified on its surface to such an extent that the bag content does not flow out. Under even more marked heat action above 600°C the fibres start to sinter and this is accompanied by skin formation and incrustation of the surface parts, which are directly exposed to the flame or heat rays, without the insulating action of the lower-lying material being impaired. As a result the heat can only slowly penetrate the fire prevention material, so that the wall openings withstand a fire or objects protected by the fire prevention material are not damaged.

Example 2.

A glass fabric tubular bag corresponding to Example 1 is filled with a mixture of 82% by weight mineral fibres (fibre length 1.0 to 8.0 mm), 5% by weight vermiculite, 10% by weight perlite, 2% by weight EVAc powder and 1% by weight silicone oil in the manner indicated hereinbefore.

Once again the mineral fibres are in the form of flat oval to spherical voluminous lumps with a size of 1 to 17 and mainly 2 to 7 mm. The binder, dedusting agent and part of the vermiculite and perlite are once again bound into these lumps. What was stated in Example 1 applies with respect to the formation of the mixture. On heating one side of the bag to above 100°C firstly the ethylene vinyl acetate serving as the binder softens. At temperatures above 200°C the bag content starts to expand. With a further temperature rise the melted ethylene vinyl acetate bonded to the mineral fibres decomposes and then at roughly 500°C the perlite starts to expand. At temperatures of more than 600°C the mineral fibres start to solidify, so that the bag content cannot flow out due to the melting of the glass fabric under very severe heat action.

Example 3.

A glass fabric tubular bag in accordance with Example 1 is filled with a mixture of 45% by weight glass fibres (fibre length 1.0 to 10.0 mm), 15% by weight expanded vermiculite, 31% by weight ceramic fibres (fibre length 1.0 to 6.0 mm), 5% by weight vermiculite, 1% by weight formaldehyde urea resin, 2% by weight polyamide powder and 1% by weight mineral oil in the manner described hereinbefore. The fibres are again in the form of flat oval to spherical voluminous lumps having a size of 1 to 15 and mainly 2 to 6 mm. Into these lumps are bound the binder, the dedusting agent and part of the expanding substances. The mixture is prepared in the aforementioned manner.

On heating the bag to over 100°C firstly the polyamide serving as the binder softens. At temperatures over 200°C the local expansion of the bag content at the heated points starts. As at temperatures over 600°C the glass fibres start to sinter, there is a solidification of the entire bag content, which prevents any outflow of the mixture in the case of severe heat action on the glass fabric and consequently melting does not take place.

CLAIMS



1. Waterproof and weatherproof fire prevention material in loose form, characterized in that it contains
 - a) at least one material which is thermally insulating at temperatures up to 1100°C in the form of inflammable, pulverulent, granular and/or fibrous materials having an inorganic base,
 - b) at least one material irreversibly expanding at temperatures above 150°C and in particular above 200°C, based on inorganic, inflammable compounds or materials or mixtures therefrom and/or organic, water-resistant compounds, which swell at elevated temperatures and which in particular decompose accompanied by the formation of a carbon skeleton or carbon foam and
 - c) at least one preferably finely divided binder, which is heat-active at temperatures of 100 to 300°C and bonds the other components,

in which the thermally insulating and the expanding material are contained in a proportion of more than 90% by weight in the fire prevention material and that the latter has an expansion capacity on heating from ambient temperature to 1100°C of at least 5% by volume and all the constituents are waterproof and weatherproof at least in the unheated state.

2. Fire prevention material according to claim 1, characterized in that it contains a preferably liquid and/or tacky dedusting agent.

3. Fire prevention material according to claims 1 or 2, characterized in that it is contained in a flexible, particularly a pad-like envelope, which is preferably difficultly flammable to inflammable and which is in particular made from fibrous material, preferably in the form of a fabric, the envelope being in particular dust-tight and being preferably provided with a watertight and at least difficultly flammable coating.

4. Fire prevention material according to one of the preceding claims, characterized in that the binder is contained in quantities of 0.1 to 6% by weight and in particular 0.5 to 3.5% by weight and is in powder or granule form and preferably meltable plastics decomposing at temperatures over 200°C are provided as binders.



5. Fire prevention material according to one of the preceding claims, characterized in that at least one constituent hardens after heat action, particularly at temperatures over 600°C and after previously making tacky and accompanied by decomposition, so that the fire prevention material solidifies to form a porous, hard block.
6. Fire prevention material according to one of the preceding claims, characterized in that the thermally insulating material and the expanding material are contained in a proportion of more than 95% by weight in the fire prevention material.
7. Fire prevention material according to one of the preceding claims, characterized in that on heating to temperatures in the range 200 to 1100°C it has an expansion capacity of 5 to 600 and preferably 10 to 80% by volume and that the material expanding under heat action is preferably contained in quantities of 1 to 50 and in particular 3 to 25% by weight.
8. Fire prevention material according to one of the preceding claims, characterized in that as the inorganic material expanding under heat action perlite and/or vermiculite are provided.
9. Fire prevention material according to one of the preceding claims, characterized in that as the organic material expanding under heat action are provided urea-formaldehyde resins, melamine-formaldehyde resins and melamine-phosphoric acid compounds, such as monomelamine phosphate, in water-insoluble form or brought into a water-insoluble form.
10. Fire prevention material according to one of the preceding claims, characterized in that it contains as the thermally insulating material kieselguhr, expanded clay, pumice, chalk, swollen perlite, swollen vermiculite and/or inorganic fibres, particularly mineral fibres, slag fibres, glass fibres or ceramic fibres and the thermally insulating material preferably has a deformable lumpy to ball-like structure and in particular the fibres are shaped or wound to form balls or lumps.
11. Fire prevention material according to one of the preceding claims,



characterized in that the balls or lumps of thermally insulating material have a size of 1 to 17 mm and preferably contain the binder, at least part of the material expanding under heat action and optionally the dedusting material.