INSULATING MORTAR COMPOSITION

The present invention relates to a lightened insulating mortar and the use thereof in the construction field for coating and/or treating surfaces or walls of buildings, in particular façades, both for new structures and for the renovation of existing structures. It relates in particular to a mortar that can easily be applied to surfaces by standard application means, such as for example by pneumatic spraying using a mortar pump.

External thermal insulation (ETICS) has major advantages by enabling energy savings, reductions in the emission of carbon dioxide and an improvement in the comfort of the dwelling. ETI systems conventionally comprise an insulator to which one or more layers of finishing renders are applied. These are generally complex systems that are very thick.
The insulating capacities of these systems are in particular dependent on the choice of the insulating material and the thickness thereof. Expanded polystyrene boards having a thickness that varies between 20 and 500 mm are currently used. The greater the thickness of the board, the better the insulation. However, a too great thickness of insulator leads to a loss of ground area and also many additional costs. It is therefore necessary to find a compromise between a material having the best insulation characteristics with the smallest thicknesses.

Current insulating renders or mortars incorporate insulating materials such as expanded polystyrene beads or exfoliated vermiculite. They are generally applied in several layers. Even though they enable an improvement in the insulation of the surface to which they are applied, they do not make it possible to achieve technical performance equivalent to those of other techniques and ETICS systems and do not make it

possible to do away with insulation boards. The expanded polystyrene boards used in conventional ETICS systems have a thermal conductivity of around 37 mW/m.K. In order for an insulating mortar to be able to achieve similar thermal performances, it would be necessary for it to contain only lightening insulating aggregates, of perlite or vermiculite type, the thermal conductivity values of which are respectively 50 mW/m.K and 70 mW/m.K. However, such a mortar would not be able to be used as a façade render due to too low a mechanical strength. Moreover, the insulation solutions that envisage installing insulation boards have the drawback of the existence of inevitable thermal bridges at the joints between the boards and around singular points (openings, French windows…).

The present invention has sought to develop a lightened insulating mortar that can be used as a façade coating that makes it possible to obviate the aforementioned drawbacks. The insulating mortar according to the present invention has the advantage of combining good thermal insulation properties, comparable to those of expanded polystyrene boards, and good mechanical strength properties, compatible with the envisaged applications. It also has the advantage of having very good fire resistance, greater than the EPS boards alone.

Thus, the present invention provides a lightweight insulating mortar having a density of less than 300 kg/m^3 in the dry state comprising:

at least one mineral binder chosen from cement and lime, in a quantity comprised between 50and 95% by weight relative to the total composition of the mortar,

at least 1% by weight of a polymeric admixture relative to the total composition of the mortar,

at least 0.2% by weight of a rheological adjuvant relative to the total composition of the mortar, and

~~optionally aggregates,~~

said mortar comprising at least 70% by volume of lightening fillers having a thermal conductivity of less than 55 mW/m.K, chosen from expanded polystyrene, aerogels, hollow glass microspheres, expanded glass beads, cenospheres, vermiculite and perlite and wherein at least 10% by weight of said mineral binder is substituted by a pozzolanic agent.

The percentages of the binder, polymeric or rheological admixtures, lightening fillers or ther fillers and/or additives are given by weight or by volume relative to the total composition of the mortar. Only the percentage of the pozzolanic agent is expressed relative to the quantity of the mineral binder, since a part of this one is substituted by this agent.admixture

The mortar is lightened and has a density of less than 300 kg/m^3 in the hardened state. Conventionally, the density measurement is carried out after setting, hardening and drying of the mortar. The expression "lightened mortar" is understood to mean that it is a low-density mortar, comprising a large amount of air. The lightening may be obtained through various means. It is possible to introduce into the composition lightening fillers, for which the bulk density, that is to say the mass of material contained in a given volume, including the volume of interstitial air, is conventionally less than 300 kg/m^3. Another way of lightening the mortar is to use it in foam form, either by introducing into its composition a preformed foam, as described for example in patent application WO 2011/095718, or by introducing into its composition a pore-forming agent that creates pores during its decomposition as for example described in application EP 0 485 814. The various means of lightening the mortar may be combined together.

The mortar according to the present invention comprises at least 70% by volume of lightening fillers having a thermal conductivity of less than 55 mW/m.K, relative to the composition of the mortar. Said lightening fillers are chosen from expanded polystyrene, aerogels, hollow glass microspheres, expanded glass beads, cenospheres, vermiculite and perlite. For the purposes of the present invention, the expression "lightening fillers" is understood to mean that it is a constituent that makes it possible to lighten the mortar, without acting as a binder.

More preferably, the mortar according to the present invention comprises 75% by volume, relative to the total composition, of expanded polystyrene beads.

The mortar composition has the advantage of being able to be manually applied and sprayed onto the surfaces to be rendered with conventional spraying machines. It has good workability and makes it possible to obtain renders that have good mechanical strengths, in particular good crack resistance. The mortar is both lightened and insulating. The solution provided by the present invention presents a great facility for implementation and can be used in particular for already existing constructions, in particular in the domain of renovation.

This mortar composition thus makes it possible to have a low thermal conductivity, without giving rise to a reduction in the mechanical performances. The presence of pozzolanic agent in the large proportions described above makes it possible in particular to obtain this compromise.

The presence of rheological admixture advantageously makes it possible to give the mortar good workability

and a thixotropic consistency enabling the vertical use thereof.

The presence of polymeric admixture advantageously makes it possible to give the mortar the desired mechanical strength, and also a good cohesion. This additive makes it possible in particular to improve the crack resistance.

The binder that makes it possible to ensure the cohesion of the various constituents of the mortar and the hardening thereof is a mixture comprising cement and/or lime, and a pozzolanic agent. In order to be able to obtain the properties that are desired from a thermal and mechanical viewpoint, it is essential that the amount of pozzolanic agent is sufficient. At least 10% of the mineral binder chosen from cement and lime is substituted by a pozzolanic agent. In a traditional way, the total quantity of binder present in the composition of mortar represents between 50 and 95% in weight of the composition of the mortar.

The mortar may comprise a pore-forming agent that makes it possible to release air and therefore to increase the porosity of the mortar during the formation thereof. The decomposition of the pore-forming agent is generally carried out when this agent comes into contact with a decomposition catalyst. The pore-forming agent may be based on peroxides, on aluminium powder or on any other component known for its decomposition capacities. This pore-forming agent could act as the lightening means of the mortar. It is also possible to have a mortar comprising both lightening fillers and pore-forming agent.

The cement used in the mortar according to the present invention is chosen from Portland cement, cements of ~~pozzolanic mixtures optionally comprising fly ash,~~

blast-furnace slags, silica fume and/or natural, calcined or synthetic pozzolans, high alumina cements, sulphoaluminate cements, ground industrial residues, belite cements, alone or as a mixture.

The presence of the pozzolanic agent is necessary for any type of mineal binder that is used in the mortar, to obtain the expected performances. Even if the mineral binder comprises a cement of pozzolanic mixtures, at least 10% of this binder is substituted by the pozzolanic agent.

The pozzolanic agent is chosen from metakaolin, blast-furnace slags, fly ash and silica fumes. Preferably, the pozzolanic agent is chosen from metakaolin and blast-furnace slags. These agents have the advantage of being able to react with the free lime generated during the cement hydration reaction in order to form stable hydration products and thus improve the mechanical properties. The minimum amount of pozzolanic agent that makes it possible to achieve the desired mechanical and thermal performances varies depending on the type of agent. According to one embodiment, at least 25% by weight of the mineral binder is substituted by metakaolin. According to another embodiment, at least 15% by weight of the mineral binder is substituted by blast-furnace slags.

The lime may be hydraulic lime or air-slaked lime.

Advantageously, the binder consists of a mixture of cement, lime and pozzolanic agent in the following proportions : from 20% to 70% by weight of cement, from 0 to 50% by weight of lime and from 3% to 50% by weight of pozzolanic agent, relative to the total composition of the mortar.

More preferably still, the binder consists of a mixture of from 30% to 60% by weight of cement, from 20% to 40% by weight of lime and from 5% to 25% by weight of pozzolanic agent, relative to the total composition of the mortar.

The polymeric admixture is a redispersible polymer powder and/or a latex. The expression "redispersible polymer powder" is understood to mean a polymer powder which, once mixed with an aqueous medium, divides into particles of small size, forming a stable dispersion in water. Among the polymers that go into the composition of such a powder, mention may be made of vinyl and/or acrylic polymers. The term "latex" denotes in particular latex polymers customarily used in construction materials. The term "latex" is understood to mean an aqueous emulsion or dispersion of one or more natural or synthetic polymer substances. Mention may be made, for example, of elastomer latices, thermoplastic latices and thermosetting latices. By way of example, mention may be made of polyethylene, polyisoprene, polystyrene, polyvinyl chloride, polybutadienes, alkali metal polyacrylates, polyacrylic acid, polymethyl methacrylate, polyvinyl acetate, polyvinyl laurate, a polyvinyl acid such as polyvinyl versatate, an organic terpolymer such as a vinyl acetate/ethylene copolymer, a styrene/acrylic acid copolymer derivative, a styrene/butadiene copolymer, a vinyl acetate/vinyl versatate copolymer, an acrylonitrile/acrylic ester copolymer, a silanized styrene/acrylic acid copolymer or a silanized styrene/acrylic ester copolymer.

The polymeric admixture represents at least 2% by weight, preferably at least 7% by weight of the total composition of the mortar.

The rheological admixture present in the mortar according to the present invention is chosen from cellulose ethers, starch ethers and mixtures thereof, such as ethyl cellulose, hydroxyethyl cellulose, hydroxypropyl cellulose, hydroxyethyl methyl cellulose and hydroxypropyl methyl cellulose. It represents preferably between 0.3% by weight and 1.5% by weight of the total composition of the mortar.

The mortar may comprise aggregates or sands, that act in particular on the rheology, the thickness, the hardness, the final appearance and the permeability of the mortar. They are generally formed of siliceous, calcerous and/or silico-calcerous sands, generally having a particle size between 100 µm and 5 mm. The amount of such aggregates may represent between 0 and 10% by weight relative to the total composition of the mortar.

The mortar may comprise calcerous and/or siliceous inert fillers that are generally in powder form, the particle size of which is less than 120 µm. The content of fillers in the mortar composition represents between 0 and 20% by weight relative to the total composition of the mortar.

The mortar according to the invention may also comprise additives or admixtures that impart particular properties. They are chosen from rheological agents such as plasticizers or superplasticizers, water-retaining agents, thickeners, biocidal protective agents, dispersing agents, pigments, accelerators and/or retarders, hydrophobic agents and from other agents that make it possible to improve the setting, the hardening and/or the stability of the mortar or concrete after application, to adjust the colour, ~~workability, implementation or impermeability.~~ The

total content of additives conventionally varies between 0.1% and 5% by weight.

The mortar according to the present invention is in the form of a dry mix, preferably in a ready-mix form. Once mixed with the mixing water, the mortar thus becomes able to be applied onto the surface to be coated. The application may be carried out manually or by spraying. The mortar according to the present invention has the advantage of being able to be sprayed onto the surface.

Another subject of the present invention is a wall coating or render obtained by application of the mixed mortar described above. The coating is deposited over all or some of a support such as a building wall or façade in the form of one or more layers. The total thickness of the coating may vary between 1 and 12 cm.

The coating has a compressive strength of at least 0.35 MPa and a thermal conductivity of less than or equal to 55 mW/m.K. Preferably, the coating has a compressive strength of at least 0.4 MPa and a thermal conductivity of less than or equal to 45 mW/m.K. the compressive strength measurements and the thermal conductivity measurements are made classically after 28 days.

The support onto which the mixed mortar is applied may be made of various materials, such as concrete, brick, board, cement, polystyrene panel, wood, fibro-cement, glass wool or rock wool, blocs, perpend stones, etc. The application may be carried out directly onto the support or after application of an adhesion primer if necessary.

The coating according to the present invention may be integrated into any external thermal insulation process and meets the safety standards in this field. It has

the advantage of being a continuous coating, which makes it possible to avoid thermal bridges. It has in particular a durability and an ageing that are compatible with its use as a façade mortar, exhibiting neither degradation nor cracks at the end of ageing cycles described by the EOTA guide used for external thermal insulation processes with mortar and/or at the end of the artificial ageing tests according to the standards NF T 30-049, NF P 84-402 and/or EN1015-21.

The examples below illustrate the invention without limiting the scope thereof.

Examples

Example 1 (according to the invention)

Two formulations of mortars according to the present invention are produced by mixing the different constituents listed in Table 1 in a Hobart-type mixer.
Composition 1 comprises a mineral binder consisting of a mixture of cement, metakaolin (pozzolanic agent) and air-slaked lime.
Composition 2 comprises a mineral binder consisting of a mixture of cement, slag (pozzolanic agent) and hydraulic lime.

Table 1

	Composition A1			Composition A2		
Constituents	% (weight)	Volume (unit)	% (volume)	% (weight)	Volume (unit)	% (volume)
White cement 42.5 (CEMEX)	52.72	58.58	7.73	54.5	60.55	10.35
Air-slaked lime (Llierca)	10.0	27.78	3.66	---	---	---
Hydraulic lime (Saint Astier)	---	---	---	14.94	16.6	2.84

Metakaolin (Newchem)	13.92	34.80	4.59	---	---	---
Slag (Ecocem)	---	---	---	10.0	11.11	1.90
Expanded polystyrene beads (Manofacturas Pals)	12.3	615.0	81.12	9.5	475	81.16
Yellow pigment	0.94	1.18	0.15	0.94	1.18	0.20
Vinyl acetate/ethylene copolymer type resin (Wacker)	9.0	18.0	2.38	9.0	18.0	3.07
Magnesium stearate (Union Derivan) (hydrophobic agent)	0.56	1.60	0.21	0.56	1.60	0.27
Silipon™ RN7002 (air-entraining agent) (Ashland)	0.036	0.19	0.02	0.036	0.19	0.03
Walocel MK10000 PF30 (cellulose ether) (Dow Chemical)	0.524	1.05	0.14	0.524	1.05	0.18

The mortars are prepared by mixing the various constituents with water. The fresh paste is poured into suitable moulds, then cured for 28 days (at a temperature of 22°C and 55% relative humidity) before undergoing a final drying in an oven at 70°C, for several days, until the mass of the sample becomes stable (corresponding to the elimination of free water).

The thermal conductivity is then determined on samples of dimensions 25 × 25 × 4 cm, using a TCA 300DT

conductivity meter from Taurus Instruments GmbH, according to the EN NF 12664 standard.

The compressive strength is determined before the final drying step at 70°C on samples with dimensions 4 × 4 × 16 cm, according to the EN 196.1 standard, using a Zwick Z020 measuring machine.

The results obtained are given in Table 2:

Table 2

	Thermal conductivity (mW/m.K)	Mechanical strength (MPa)	Density in the hardened state (kg/m^3)
Composition A1	44	0.43	157
Composition A2	42	0.4	153

These two formulations make it possible to obtain good results in terms of thermal insulation, and also as regards their mechanical strength.

Example 2 (comparative)

Formulations of mortar not in accordance with the invention were prepared by the same process as in Example 1, and are described in Table 3 below.

Composition	C1	C2	C3	C4	C5	C6	C7
% White cement 42.5 (CEMEX)	41	38.92	47.24	37.23	36.81	46.71	39.51
% Air-slaked lime (Llierca)	49.19	34	34	32.52	32.15	23.35	29.9
% Metakaolin (Newchem)	-	-	-	-	-	-	7.83
% Expanded polystyrene beads (Manofacturas Pals)	5.8	8	10	12	12	14.48	13.03
% Calcium carbonate filler (Omya Clariana)	-	10.32	-	9.86	9.76	-	
Yellow pigment	1.25	1.26	1.26	1.21	1.19	-	1.11
% Vinyl acetate/ethylene copolymer type resin (Dow)	0.84	6	6	5.74	5.67	14.01	5.28
Magnesium stearate (hydrophobic agent) (Union Derivan)	0.75	0.75	0.75	0.72	0.71	0.82	0.66
Silipon™ RN7002 (air entraining agent) (Ashland)	0.05	0.05	0.05	0.05	0.05	0.05	0.04
% Tylose MH10001P4 (cellulose ether) (Shinetsu)	1.12	0.7	0.7	0.67	0.66	0.58	0.62
Volume % of binder	62.83	24.3	22.12	17.35	19.66	13.38	22.49
Volume of binder/volume of lightening fillers ratio	60.41	70.61	75.27	79.02	80.5	82.98	79.89

The thermal conductivity and mechanical strength measurements carried out according to a protocol

identical to that from Example 1 were carried out and the results are collated in Table 4.

Table 4

	Thermal conductivity (mW/m.K)	Mechanical strength (MPa)	Density in the dry state (kg/m^3)
Composition C1 (reference)	62	0.6	350
Composition C2	55	0.5	250
Composition C3	54	0.36	236
Composition C4	48.6	0.26	210
Composition C5	48.2	0.26	200
Composition C6	43.7	0.3	160
Composition C7	47.2	0.31	195

Composition C1 has to be considered as the reference. If the amount of expanded polystyrene beads increases in the formulation of the mortar, it is observed that the thermal conductivity is improved as it is decreasing, at the expense of the mechanical strength which drops below 0.3 MPa.

Composition C6 is a formulation comprising a large amount of expanded polystyrene beads and also of polymeric admixtures: the thermal conductivity is improved but the mechanical strength does not exceed 0.3 MPa.

In composition C7, the amount of metakaolin represents 7% by weight of the total composition: even though the thermal conductivity is improved relative to composition C5, the mechanical strength remains around 0.3 MPa.

CLAIMS

1. Lightweight insulating mortar having a density of less than 300 kg/m^3 in the dry state comprising:
at least one mineral binder chosen from cement and lime, in a quantity comprised between 50and 95% by weight relative to the total composition of the mortar,
at least 1% by weight of a polymeric admixture relative to the total composition of the mortar,
at least 0.2% by weight of a rheological admixture relative to the total composition of the mortar,and
optionally aggregates,
characterized in that it comprises at least 70% by volume of lightening fillers having a thermal conductivity of less than 55 mW/m.K, chosen from expanded polystyrene, aerogels, hollow glass microspheres, expanded glass beads, cenospheres, vermiculite and perlite and in that at least 10% by weight of said mineral binder is substituted by a pozzolanic agent.

2. Mortar according to Claim 1, characterized in that it comprises at least 75% by volume of expanded polystyrene beads.

3. Mortar according to one of Claims 1 or 2, characterized in that it also comprises a pore-forming agent.

4. Mortar according to one of the claims, characterized in that the cement is chosen from Portland cement, cements of pozzolanic mixtures optionally comprising fly ash, blast-furnace slags, silica fume and/or natural, calcined or ~~synthetic pozzolans, ground industrial residues,~~

high alumina cements, sulphoaluminate cements, belite cements, alone or as a mixture.

5. Mortar according to one of the preceding claims, characterized in that the lime is hydraulic lime or air-slaked lime.

6. Mortar according to one of the preceding claims, characterized in that the pozzolanic binder is chosen from metakaolin, blast-furnace slags, fly ash and silica fumes.

7. Mortar according to one of the preceding claims, characterized in that at least 25% by weight of the mineral binder is substituted by metakaolin.

8. Mortar according to one of Claims 1 to 7, characterized in that at least 15% by weight of the mineral binder is substituted by blast-furnace slags.

9. Mortar according to one of the preceding claims, characterized in that the binder consists of a mixture of from 20% to 70% by weight of cement, from 0 to 50% by weight of lime and from 3% to 50% by weight of pozzolanic binder, relative to the total composition of the mortar.

10. Mortar according to Claim 9, characterized in that the binder consists of a mixture of from 30% to 60% by weight of cement, from 20% to 40% by weight of lime and from 5% to 25% by weight of pozzolanic binder, relative to the total composition of the mortar.

11. Mortar according to one of the preceding claims, ~~characterized in that the polymeric admixture is~~

chosen from redispersible polymer powders and latices.

12. Mortar according to Claim 11, characterized in that the polymeric admixture represents at least 2% by weight, preferably at least 7% by weight, of the total composition of the mortar.

13. Mortar according to one of the preceding claims, characterized in that the rheological admixture is chosen from cellulose ethers, starch ethers and mixtures thereof, such as ethyl cellulose, hydroxyethyl cellulose, hydroxypropyl cellulose, hydroxyethyl methyl cellulose and hydroxypropyl methyl cellulose.

14. Mortar according to one of the preceding claims, characterized in that the rheological admixture represents between 0.3% by weight and 1.5% by weight of the total composition of the mortar.

15. Insulating coating capable of being obtained after mixing with water of the mortar according to one of the preceding claims.

16. Coating according to the preceding claim, characterized in that it has a compressive strength of at least 0.35 MPa and a thermal conductivity of less than or equal to 55 mW/m.K, and preferably a compressive strength of at least 0.40 MPa and a thermal conductivity of less than or equal to 45 mW/m.K.

INSULATING MORTAR COMPOSITION

The present invention relates to a lightened insulating mortar and the use thereof in the construction field for coating and/or treating surfaces or walls of buildings, in particular façades, both for new structures and for the renovation of existing structures. It relates in particular to a mortar that can easily be applied to surfaces by standard application means, such as for example by pneumatic spraying using a mortar pump.

External thermal insulation (ETICS) has major advantages by enabling energy savings, reductions in the emission of carbon dioxide and an improvement in the comfort of the dwelling. ETICs systems conventionally comprise an insulator to which one or more layers of finishing renders are applied. These are generally complex systems that are very thick.

The insulating capacities of these systems are in particular dependent on the choice of the insulating material and the thickness thereof. Expanded polystyrene boards having a thickness that varies between 20 and 500 mm are currently used. The greater the thickness of the board, the better the insulation. However, an excessively large thickness of insulator leads to a loss of ground area and also many additional costs. It is therefore necessary to find a compromise between a material having the best insulation characteristics with the smallest thicknesses.

Current insulating renders or mortars incorporate insulating materials such as expanded polystyrene beads or exfoliated vermiculite. They are generally applied in several layers. Even though they enable an improvement in the insulation of the surface to which they are applied, they do not make it possible to achieve technical performance equivalent to that of

other techniques and ETICS system and do not make it possible to do away with insulation boards. The expanded polystyrene boards used in conventional ETICS systems have a thermal conductivity of around 37 mW/m.K. In order for an insulating mortar to be able to achieve similar thermal performances, it would be necessary for it to contain only lightening insulating aggregates, of perlite or vermiculite type, the thermal conductivity values of which are respectively 50 mW/m.K and 70 mW/m.K. However, such a mortar would not be able to be used as a façade render due to too low a mechanical strength. Moreover, the insulation solutions that envisage installing insulation boards have the drawback of the existence of inevitable thermal bridges at the joints between the boards and around singular points (openings, French windows…).

The present invention has sought to develop a lightened insulating mortar that can be used as a façade coating that makes it possible to obviate the aforementioned drawbacks. The insulating mortar according to the present invention has the advantage of combining good thermal insulation properties, comparable to those of expanded polystyrene boards, and good mechanical strength properties, compatible with the envisaged applications. It also has very good fire resistance, greater than that of the EPS boards alone.

Thus, the present invention provides a lightweight insulating mortar having a density of less than 300 kg/m^3 in the hardened state comprising at least one mineral binder chosen from cement and lime, in a quantity comprised between 50 and 95% by weight relative to the total composition of the mortar,
at least 1% by weight of a polymeric admixture relative to the total composition of the mortar, at least 0.2% by weight of a rheological admixture relative to the

total composition of the mortar, and optionally aggregates, said mortar comprising at least 70% by volume of lightening fillers having a thermal conductivity of less than 55 mW/m.K, relative to the composition of the mortar, chosen from expanded polystyrene, aerogels, hollow glass microspheres, expanded glass beads, cenospheres, vermiculite and perlite and wherein at least 10% by weight of the mineral binder is substituted by a pozzolanic agent.

The percentages of the binder, polymeric or rheological admixtures, lightening fillers or other fillers and/or additives are given by weight or by volume relative to the total composition of the mortar. Only the percentage of the pozzolanic agent is expressed relative to the quantity of the mineral binder, since a part thereof is substituted by this agent.

The mortar is lightened and has a density of less than 300 kg/m^3 in the hardened state. Conventionally, the density measurement is carried out after setting, hardening and drying of the mortar. The expression "lightened mortar" is understood to mean that it is a low-density mortar, comprising a large amount of air. The lightening may be obtained through various means. It is possible to introduce into the composition lightening fillers, for which the bulk density, that is to say the mass of material contained in a given volume, including the volume of interstitial air, is conventionally less than 300 kg/m^3. Another way of lightening the mortar is to use it in foam form, either by introducing into its composition a preformed foam, as described for example in patent application WO 2011/095718, or by introducing into its composition a pore-forming agent that creates pores during its decomposition as for example described in application

EP 0 485 814. The various means of lightening the mortar may be combined together.

The mortar according to the present invention comprises at least 70% by volume of lightening fillers having a thermal conductivity of less than 55 mW/m.K, relative to the composition of the mortar. Said lightening fillers are chosen from expanded polystyrene, aerogels, hollow glass microspheres, expanded glass beads, cenospheres, vermiculite and perlite. For the purposes of the present invention, the expression "lightening fillers" is understood to mean that it is a constituent that makes it possible to lighten the mortar, without acting as a binder.

More preferably, the mortar according to the present invention comprises 75% by volume, relative to the total composition, of expanded polystyrene beads.

The mortar composition has the advantage of being able to be applied manually and sprayed onto the surfaces to be rendered with conventional spraying machines. It has good workability and makes it possible to obtain renders that have good mechanical strengths, in particular good crack resistance. The mortar is both lightened and insulating. The solution provided by the present invention has a great ease of implementation and can be used in particular for already existing constructions, in particular in the domain of renovation.

This mortar composition thus makes it possible to have a low thermal conductivity, without giving rise to a reduction in the mechanical performances. The presence of pozzolanic agent in the large proportions described above makes it possible in particular to obtain this compromise.

The presence of rheological admixture advantageously makes it possible to give the mortar good workability and a thixotropic consistency enabling the vertical use thereof.

The presence of polymeric admixture advantageously makes it possible to give the mortar the desired mechanical strength, and also a good cohesion. This additive makes it possible in particular to improve the crack resistance.

The binder that makes it possible to ensure the cohesion of the various constituents of the mortar and the hardening thereof is a mixture comprising cement and/or lime, and a pozzolanic agent. In order to be able to obtain the properties that are desired from a thermal and mechanical viewpoint, it is essential that the amount of pozzolanic agent is sufficient. At least 10% of the mineral binder chosen from cement and lime is substituted by a pozzolanic agent. Conventionally, the total quantity of binder present in the mortar composition represents between 50 and 95% by weight of the composition of the mortar.

The mortar may comprise a pore-forming agent that makes it possible to release air and therefore to increase the porosity of the mortar during the formation thereof. The decomposition of the pore-forming agent is generally carried out when this agent comes into contact with a decomposition catalyst. The pore-forming agent may be based on peroxides, on aluminium powder or on any other component known for its decomposition capacities. The presence of this pore-forming agent may be the means of lightening the mortar. It is also possible to have a mortar comprising both lightening fillers and pore-forming agent.

The cement used in the mortar according to the present invention is chosen from Portland cement, cements of pozzolanic mixtures optionally comprising fly ash, blast-furnace slags, silica fume and/or natural, calcined or synthetic pozzolans, high alumina cements, sulphoaluminate cements, ground industrial residues, belite cements, alone or as a mixture.

The presence of the pozzolanic agent is necessary whatever the type of mineral binder used in the mortar, so as to obtain the expected performances. Even if the mineral binder comprises a cement of pozzolanic mixtures, at least 10% of this binder is substituted by the pozzolanic agent.

The pozzolanic agent is chosen from metakaolin, blast-furnace slags, fly ash and silica fumes. Preferably, the pozzolanic agent is chosen from metakaolin and blast-furnace slags. These agents have the advantage of being able to react with the free lime generated during the cement hydration reaction in order to form stable hydration products and thus improve the mechanical properties. The minimum amount of pozzolanic agent that makes it possible to achieve the desired mechanical and thermal performances varies depending on the type of agent. According to one embodiment, at least 25% by weight of the mineral binder is substituted by metakaolin. According to another embodiment, at least 15% by weight of the mineral binder is substituted by blast-furnace slags.

The lime may be hydraulic lime or air-slaked lime.

Advantageously, the binder consists of cement, lime and pozzolanic agent in the following proportions: this is a mixture of from 20% to 70% by weight of cement, from

0 to 50% by weight of lime and from 3% to 50% by weight of pozzolanic agent, relative to the total composition of the mortar.

More preferably still, the binder consists of a mixture of from 30% to 60% by weight of cement, from 20% to 40% by weight of lime and from 5% to 25% by weight of pozzolanic agent, relative to the total composition of the mortar.

The polymeric admixture is a redispersible polymer powder and/or a latex. The expression "redispersible polymer powder" is understood to mean a polymer powder which, once mixed with an aqueous medium, divides into particles of small size, forming a stable dispersion in water. Among the polymers that go into the composition of such a powder, mention may be made of vinyl and/or acrylic polymers. The term "latex" denotes in particular latex polymers customarily used in construction materials. The term "latex" is understood to mean an aqueous emulsion or dispersion of one or more natural or synthetic polymer substances. Mention may be made, for example, of elastomer latices, thermoplastic latices and thermosetting latices. By way of example, mention may be made of polyethylene, polyisoprene, polystyrene, polyvinyl chloride, polybutadienes, alkali metal polyacrylates, polyacrylic acid, polymethyl methacrylate, polyvinyl acetate, polyvinyl laurate, a polyvinyl acid such as polyvinyl versatate, an organic terpolymer such as a vinyl acetate/ethylene copolymer, a styrene/acrylic acid copolymer derivative, a styrene/butadiene copolymer, a vinyl acetate/vinyl versatate copolymer, an acrylonitrile/acrylic ester copolymer, a silanized styrene/acrylic acid copolymer or a silanized styrene/acrylic ester copolymer. The polymeric admixture represents at

least 2% by weight, preferably at least 7% by weight of the total composition of the mortar.

The rheological admixture present in the mortar according to the present invention is chosen from cellulose ethers, starch ethers and mixtures thereof, such as ethyl cellulose, hydroxyethyl cellulose, hydroxypropyl cellulose, hydroxyethyl methyl cellulose and hydroxypropyl methyl cellulose. It represents preferably between 0.4% by weight and 1.5% by weight of the total composition of the mortar.

The mortar may comprise aggregates or sands, that act in particular on the rheology, the thickness, the hardness, the final appearance and the permeability of the mortar. They are generally formed of siliceous, calcerous and/or silico-calcerous sands, generally having a particle size between 100 µm and 5 mm. The amount of such aggregates may represent between 0 and 10% by weight relative to the total composition of the mortar.

The mortar may comprise calcerous and/or siliceous inert fillers that are generally in powder form, the particle size of which is less than 120 µm. The content of fillers in the mortar composition represents between 0 and 20% by weight relative to the total composition of the mortar.

The mortar according to the invention may also comprise additives or admixtures that impart particular properties. They are chosen from rheological agents such as plasticizers or superplasticizers, water-retaining agents, thickeners, biocidal protective agents, dispersing agents, pigments, accelerators and/or retarders, hydrophobic agents and from other agents that make it possible to improve the setting,

the hardening and/or the stability of the mortar or concrete after application, to adjust the colour, workability, implementation or impermeability. The total content of additives conventionally varies between 0.1% and 5% by weight.

The mortar according to the present invention is in the form of a dry mix, preferably in a ready-mix form. Once mixed with the mixing water, the mortar thus becomes able to be applied onto the surface to be coated. The application may be carried out manually or by spraying. The mortar according to the present invention has the advantage of being able to be sprayed onto the surface.

Another subject of the present invention is a wall coating or render obtained by application of the mixed mortar described above. The coating is deposited over all or some of a support such as a building wall or façade in the form of one or more layers. The total thickness of the coating may vary between 1 and 12 cm.

The coating has a compressive strength of at least 0.35 MPa and a thermal conductivity of less than or equal to 55 mW/m.K. Preferably, the coating has a compressive strength of at least 0.4 MPa and a thermal conductivity of less than or equal to 45 mW/m.K. The compressive strength measurements and the thermal conductivity measurements are made conventionally after 28 days.

The support onto which the mixed mortar is applied may be made of various materials, such as concrete, brick, board, cement, polystyrene panel, wood, fibro-cement, rock wool or glass wool, blocks, perpend stones, etc. The application may be carried out directly onto the support or after application of an adhesion primer if necessary.

The coating according to the present invention may be integrated into any external thermal insulation process and meets the safety standards in this field. It has the advantage of being a continuous coating, which makes it possible to avoid thermal bridges. It has in particular a durability and an ageing that are compatible with its use as a façade mortar, exhibiting neither degradation nor cracks at the end of ageing cycles described by the EOTA guide used for external thermal insulation processes with mortar and/or at the end of the artificial ageing tests according to the standards NF T 30-049, NF P 84-402 and/or EN1015-21.

The examples below illustrate the invention without limiting the scope thereof.

Examples

Example 1 (according to the invention)

Two formulations of mortars according to the present invention are produced by mixing the various constituents listed in Table 1 in a Hobart-type mixer.
Composition 1 comprises a mineral binder consisting of a mixture of cement, metakaolin (pozzolanic agent) and air-slaked lime.
Composition 2 comprises a mineral binder consisting of a mixture of cement, slag (pozzolanic agent) and hydraulic lime.

Table 1

	Composition A1			Composition A2		
Constituents	% (weight)	Volume (unit)	% (volume)	% (weight)	Volume (unit)	% (volume)
White cement	52.72	58.58	7.73	54.5	60.55	10.35

42.5 (CEMEX)						
Air-slaked lime (Llierca)	10.0	27.78	3.66	---	---	---
Hydraulic lime (Saint Astier)	---	---	---	14.94	16.6	2.84
Metakaolin (Newchem)	13.92	34.80	4.59	---	---	---
Slag (Ecocem)	---	---	---	10.0	11.11	1.90
Expanded polystyrene beads (Manofacturas Pals)	12.3	615.0	81.12	9.5	475	81.16
Yellow pigment	0.94	1.18	0.15	0.94	1.18	0.20
Vinyl acetate/ethylene copolymer type resin (Wacker)	9.0	18.0	2.38	9.0	18.0	3.07
Magnesium stearate (Union Derivan) (hydrophobic agent)	0.56	1.60	0.21	0.56	1.60	0.27
Silipon™ RN7002 (air-entraining agent) (Ashland)	0.036	0.19	0.02	0.036	0.19	0.03
Walocel MK10000 PF30 (cellulose ether) (Dow Chemical)	0.524	1.05	0.14	0.524	1.05	0.18

The mortars are prepared by mixing the various constituents with water. The fresh paste is poured into suitable moulds, then cured for 28 days (at a temperature of 22°C and 55% relative humidity) before undergoing a final drying in an oven at 70°C, for several days, until the mass of the sample becomes

stable (corresponding to the elimination of free water).

The thermal conductivity is then determined on samples of dimensions 25 × 25 × 4 cm, using a TCA 300DT conductivity meter from Taurus Instruments GmbH, according to the EN NF 12664 standard.

The compressive strength is determined before the final drying step at 70°C on samples with dimensions 4 × 4 × 16 cm, according to the EN 196.1 standard, using a Zwick Z020 measuring machine.

The results obtained are given in Table 2:

Table 2

	Thermal conductivity (mW/m.K)	Mechanical strength (MPa)	Density in the hardened state (kg/m^3)
Composition A1	44	0.43	157
Composition A2	42	0.4	153

These two formulations make it possible to obtain good results in terms of thermal insulation, and also as regards their mechanical strength.

Example 2 (comparative)

Formulations of mortar not in accordance with the invention were prepared by the same process as in Example 1, and are described in Table 3 below.

Composition	C1	C2	C3	C4	C5	C6	C7
% White cement 42.5 (CEMEX)	41	38.92	47.24	37.23	36.81	46.71	39.51
% Air-slaked lime	49.19	34	34	32.52	32.15	23.35	29.9

(Llierca)							
% Metakaolin (Newchem)	-	-	-	-	-	-	7.83
% Expanded polystyrene beads (Manofacturas Pals)	5.8	8	10	12	13	14.48	13.03
% Calcium carbonate filler (Omya Clariana)	-	10.32	-	9.86	9.76	-	-
Yellow pigment	1.25	1.26	1.26	1.21	1.19	-	1.11
% Vinyl acetate/ethylene copolymer type resin (Dow)	0.84	6	6	5.74	5.67	14.01	5.28
% Magnesium stearate (hydrophobic agent) (Union Derivan)	0.75	0.75	0.75	0.72	0.71	0.82	0.66
% Silipon™ RN7002 (air entraining agent) (Ashland)	0.05	0.05	0.05	0.05	0.05	0.05	0.04
Admixture (Tylose MH10001P4) (Shinetsu)	1.12	0.7	0.7	0.67	0.66	0.58	0.62
Volume % of binder	62.83	24.3	22.12	17.35	19.66	13.38	22.49
Volume of binder/volume of lightening fillers ratio	60.41	70.61	75.27	79.02	80.5	82.98	79.89

The thermal conductivity and mechanical strength measurements carried out according to a protocol identical to that from Example 1 were carried out and the results are collated in Table 4.

Table 4

	Thermal conductivity (mW/m.K)	Mechanical strength (MPa)	Density in the hardened state (kg/m^3)
Composition C1 (reference)	62	0.6	350
Composition C2	55	0.5	250
Composition C3	54	0.36	236
Composition C4	48.6	0.26	210
Composition C5	48.2	0.26	200
Composition C6	43.7	0.3	160
Composition C7	47.2	0.31	195

Composition C1 is considered as the reference. If the amount of expanded polystyrene beads increases in the formulation of the mortar, it is observed that the thermal conductivity is improved since it is decreasing, at the expense of the mechanical strength which drops below 0.3 MPa.

Composition C6 is a formulation comprising a large amount of expanded polystyrene beads and also of polymeric admixtures: the thermal conductivity is improved but the mechanical strength does not exceed 0.3 MPa.

In composition C7, the amount of metakaolin represents 7% by weight of the total composition: even though the thermal conductivity is improved relative to composition C5, the mechanical strength remains around 0.3 MPa.

CLAIMS

1. Lightweight insulating mortar having a density of less than 300 kg/m^3 in the hardened state comprising:
at least one mineral binder chosen from cement and lime, in a quantity comprised between 50 and 95% by weight relative to the total composition of the mortar,
at least 1% by weight of a polymeric admixture relative to the total composition of the mortar,
at least 0.2% by weight of a rheological admixture relative to the total composition of the mortar, and
optionally aggregates,
characterized in that it comprises at least 70% by volume of lightening fillers having a thermal conductivity of less than 55 mW/m.K, relative to the composition of the mortar, said fillers being chosen from expanded polystyrene, aerogels, hollow glass microspheres, expanded glass beads, cenospheres, vermiculite and perlite and in that at least 10% by weight of said mineral binder is substituted by a pozzolanic agent.

2. Mortar according to Claim 1, characterized in that it comprises at least 75% by volume of expanded polystyrene beads.

3. Mortar according to either of Claims 1 and 2, characterized in that it also comprises a pore-forming agent.

4. Mortar according to one of the claims, characterized in that the cement is chosen from Portland cement, cements of pozzolanic mixtures

optionally comprising fly ash, blast-furnace slags, silica fume and/or natural, calcined or synthetic pozzolans, ground industrial residues, high alumina cements, sulphoaluminate cements, belite cements, alone or as a mixture.

5. Mortar according to one of the preceding claims, characterized in that the lime is hydraulic lime or air-slaked lime.

6. Mortar according to one of the preceding claims, characterized in that the pozzolanic agent is chosen from metakaolin, blast-furnace slags, fly ash and silica fumes.

7. Mortar according to one of the preceding claims, characterized in that at least 25% by weight of the mineral binder is substituted by metakaolin.

8. Mortar according to one of Claims 1 to 6, characterized in that at least 15% by weight of the mineral binder is substituted by blast-furnace slags.

9. Mortar according to one of the preceding claims, characterized in that the binder consists of a mixture of from 20% to 70% by weight of cement, from 0 to 50% by weight of lime and from 3% to 50% by weight of pozzolanic agent, relative to the total composition of the mortar.

10. Mortar according to Claim 9, characterized in that the binder consists of a mixture of from 30% to 60% by weight of cement, from 20% to 40% by weight of lime and from 5% to 25% by weight of pozzolanic agent, relative to the total composition of the mortar.

11. Mortar according to one of the preceding claims, characterized in that the polymeric admixture is chosen from redispersible polymer powders and latices.

12. Mortar according to Claim 11, characterized in that the polymeric admixture represents at least 2% by weight, preferably at least 7% by weight, of the total composition of the mortar.

13. Mortar according to one of the preceding claims, characterized in that the rheological admixture is chosen from cellulose ethers, starch ethers and mixtures thereof, such as ethyl cellulose, hydroxyethyl cellulose, hydroxypropyl cellulose, hydroxyethyl methyl cellulose and hydroxypropyl methyl cellulose.

14. Mortar according to one of the preceding claims, characterized in that the rheological admixture represents between 0.3% by weight and 1.5% by weight of the total composition of the mortar.

15. Insulating coating capable of being obtained after mixing with water of the mortar according to one of the preceding claims.

16. Coating according to the preceding claim, characterized in that it has a compressive strength of at least 0.35 MPa and a thermal conductivity of less than or equal to 55 mW/m.K, and preferably a compressive strength of at least 0.40 MPa and a thermal conductivity of less than or equal to 45 mW/m.K.