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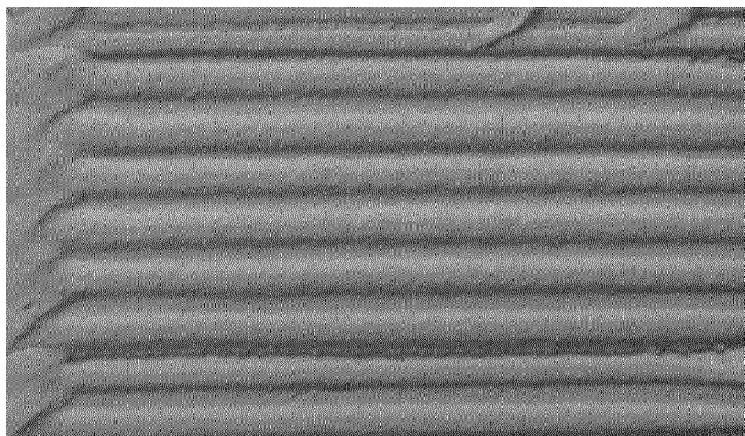


Fig. 2

(57) Abstract: A cementitious adhesive composition, to be used as tile adhesive in automatic tiling systems wherein the method of tiling includes the application of processable composition comprising: (a) producing a processable composition by (a1) mixing a cementitious composition comprising 10 - 70 wt.-% of a hydraulic binder; 20 - 90 wt.-% of aggregates and 0.01 - 5 wt.-% cellulose ether; (a2) adding water, whereby a weight ratio of water to hydraulic binder is chosen between 0.3-0.8; (a3) removing air during intermixing to an air content of 0-5% and (b) subsequently applying the composition on a support element with a pumping system of an automatic tiling system to fix a tile to a floor structure, a wall or a ceiling structure.



## Cementitious adhesive composition

### Technical field

The invention relates to a cementitious adhesive composition, in particular a tile adhesive, especially for use in automatic tiling systems as well as a processable  
5 composition comprising such an adhesive composition. Also, the invention is concerned with a method for producing and application of a processable composition, with a shaped body and with the use of an adhesive composition or a processable composition as an adhesive in an automatic tiling system.

### Background art

10 Nowadays, the covering of floors, walls or ceilings with tiles ("tiling") usually is performed manually by a specialist, i.e. a tiler or paver, respectively. Tiling is a physically hard and very time-consuming work which needs a lot of expertise. If a tiling job is not performed correctly, uneven or irregular tiled surfaces are obtained which for aesthetic reasons often are not accepted by the building owners. In this  
15 case the tiled surfaces have to be repaired or fully replaced. Repairing or replacing a tiled surface is very laborious, generates a lot of dust and is expensive.

It would therefore be highly desirable to automate the tiling process in order to reduce costs, save time, increase reliability of tiling processes and improve quality of tiled surfaces in order to minimize repair works.

20 A robot able to position tiles over a floor or wall surface with high precision ("tiling robot") is an example of a suitable embodiment of an automated tiling system.

However, a tiling robot or any other automated tiling system will have full functionality only if it includes the automatic application of a suitable adhesive composition, typically via high pressure pumping systems.

In this regard, DE 198 21 612 A1 (Fraunhofer-Gesellschaft zur Förderung der  
5 angewandten Forschung e.V.) describes a system for automatic application of an adhesive composition.

However, current adhesive compositions are designed for manual application. They contain a significant amount of dispersed air (up to 30% of the volume) which is necessary to entail sufficient softness so that manual application is possible.

10 Due to its high air content, a classical adhesive composition is highly sensitive to pressure, which when applied with a high pressure pump results in large air voids and leads to overshooting or afterflowing problems, preventing precise dosing and metering.

Simple removal of air by vacuum may eliminate the pressure sensitivity of classical  
15 adhesive compositions but results in a very hard adhesive of high viscosity, which cannot be pumped properly.

There is thus a need to develop new and improved adhesive compositions which can be used in automated tiling systems and which overcome the aforementioned drawbacks.

## 20 **Disclosure of the invention**

It is an object of the present invention to provide an improved cementitious adhesive composition, in particular a tile adhesive, which can be used in automated systems, in particular in automated tiling systems or in tiling robots. Especially, the adhesive composition should be pumpable with high pressure  
25 pumping systems. Thereby, the adhesive composition should be easy to pump and at the same time allow for accurate dosing and metering. Particularly, the adhesive composition should have a reduced tendency of overshooting or afterflowing.

Surprisingly, it has been found that these objects are achieved by the features of claim 1. Thus, the core of the invention is a cementitious adhesive composition, in particular a tile adhesive, especially for use in automatic tiling systems, comprising or consisting of:

- 5 a) 10 – 70 wt.-% of a hydraulic binder, in particular cement;
- b) 20 – 90 wt.-% of aggregates, in particular silica and/or calcium carbonate;
- c) 0.01 – 5 wt.-% cellulose ether.

It has been shown that such adhesive compositions can be reliably pumped and precisely metered. Hence, the inventive cementitious adhesive compositions are highly advantageous for automatic application or for use with automated tiling systems, respectively. The adhesive composition has been proven to be especially advantageous if used as a tile adhesive. Compared to classical adhesive compositions for manual application, the inventive adhesive composition shows a significantly reduced tendency to overshooting or afterflowing when applied with high pressure pumps.

Additional aspects of the invention are subject of further independent claims. Particularly preferred embodiments are outlined throughout the description and the dependent claims.

### **Ways of carrying out the invention**

20 A first aspect of the invention relates to a cementitious adhesive composition, in particular a tile adhesive, especially for use in automatic tiling systems, comprising or consisting of:

- a) 10 – 70 wt.-% of a hydraulic binder, in particular cement;
- b) 20 – 90 wt.-% of aggregates, in particular silica and/or calcium carbonate;
- 25 c) 0.01 – 5 wt.-% cellulose ether.

In particular, all the amounts are with respect to the total weight of the adhesive composition.

Especially preferred, the cementitious adhesive composition is a tile adhesive.

In the present context, a "tile" is in particular a manufactured piece of hard-wearing material such as ceramic, stone, metal, and/or glass. Typically, tiles are used for covering roofs, floors, walls, and/or showers.

In particular, the tile is a ceramic tile, a tile made of natural stone and/or a modular tile. The definition, classification, characteristics and marking of ceramic tiles is provided in European Standard EN 14411. Analogously, the definitions and specifications/requirements for natural stone products and modular tiles are provided in European Standard EN 12057.

In the present context, the expression "hydraulic binder" in particular stands for substances that harden because of hydration chemical reactions producing hydrates. Preferably the hydrates produced are not water-soluble. In particular, the hydration chemical reactions of the hydraulic binder takes essentially place independently of the water content. This means that the hydraulic binder can harden and retain its strength even when exposed to water, e.g. underwater or under high humidity conditions.

"Cellulose ethers" are derivatives of cellulose. Specifically, with cellulose ethers hydrogen atoms of hydroxyl groups are partially or fully substituted, typically with alkyl groups, hydroxyalkyl groups, carboxy groups and/or carboxy alkyl groups. In particular, the alkyl groups comprise methyl, ethyl and/or propyl radicals.

Especially, the cellulose ether is a water-soluble cellulose ether.

Preferably, the cellulose ether is selected from hydroxymethyl cellulose, hydroxyethyl cellulose, hydroxypropyl methylcellulose, hydroxyethyl methylcellulose and/or carboxymethyl cellulose. Especially preferred are hydroxypropyl methylcellulose and/or hydroxyethyl methylcellulose. Such kind of cellulose ether have been proven to be especially suitable in the present invention. However, for special applications, other cellulose ethers may be suitable as well.

According to a preferred embodiment, an amount of cellulose ether is 0.05 – 3 wt.-%, in particular 0.1 – 1 wt.-%, especially 0.2 – 0.6 wt.-%.

Especially, the cementitious adhesive composition is present as a dry mixture. This means that the adhesive composition is essentially free of water or an amount of  
5 water is below 1 wt.-%, in particular below 0.5 wt.-% or below 0.1 wt.-%, with respect to the total weight of the adhesive composition.

According to a preferred embodiment, the cementitious adhesive composition is a one-component mixture. That means that all the individual materials and/or substances are intermixed. One-component compositions are in particular easy to  
10 handle and exclude the risk of a mix up or wrong dosing of individual components by users.

However, it is in principle possible to provide a two-component cementitious adhesive composition or even a multi-component cementitious adhesive composition. A first component may e.g. be present in a first receptacle comprising  
15 the hydraulic binder and the cellulose ether. A second component, present in a second receptacle, may comprise the aggregates and optionally water. Other distributions are possible as well. Two- or multi-component mortar compositions allow e.g. for adjusting the adhesive composition with regard to specific applications.

20 Preferably, the hydraulic binder comprises or consists of cement. Preferably the cement is Portland cement and/or alumina cement and/or sulphoaluminate cement and/or a ternary binder. Mixtures of Portland cement and alumina cement are possible as well. A ternary binder may comprise or consist of alumina cement, calcium sulphate and optionally Portland cement.

25 Preferred Portland cement is according to norm EN 197, in particular of type CEM I. The term "alumina cement" stands in particular for a cement with an aluminum content, measured as  $\text{Al}_2\text{O}_3$ , of at least 30 wt.-%, especially at least 35 wt.-%, in particular 35 – 58 wt.-%. Preferably, the alumina cement is alumina cement according to standard EN 14647.

Moreover, the hydraulic binder can optionally comprise or consist of latent hydraulic and/or pozzolanic binder materials. The term "latent hydraulic and/or pozzolanic binder materials" stands in particular for type II concrete additives with latent hydraulic and/or pozzolanic character according to EN 206-1. In particular, 5 the latent hydraulic or pozzolanic binder material comprises or consists of slag, fly ash, silica fume, metacaolin and/or natural pozzolanes.

According to a further preferred embodiment, the hydraulic binder comprises or consists of 10 – 95 wt.% of hydraulic binder, in particular Portland cement and/or alumina cement, and 90 – 5 wt.% of latent hydraulic and/or pozzolanic binder 10 material. More preferably, the binder composition comprises or consists of 30 – 90 wt.% of hydraulic binder and 70 – 10 wt.% of latent hydraulic and/or pozzolanic binder material.

A preferred amount of hydraulic binder is 20 – 50 wt.-%, in particular 30 – 50 wt.-%, with respect to the total weight of the adhesive composition.

15 Preferred aggregates are selected from sand, quartz, calcium carbonate, natural river sand and/or metallic aggregates. The grain size of the aggregates is preferably at most 4 mm, in particular at most 2 mm, especially at most 1 mm. However, other aggregates may be used as well for specific purposes.

In particular, an amount of the aggregates is 25 – 60 wt.-%, in particular 50 – 60 20 wt.-%, with respect to the total weight of the adhesive composition.

According to an advantageous embodiment, the cementitious adhesive composition further comprises 0.1 – 10 wt.-%, in particular 0.1 – 5 wt.-%, of a polymer. An especially preferred amount of the polymer is 1 – 4 wt.-%, with respect to the total weight of the adhesive composition.

25 Preferably, the polymer is a water soluble or water redispersible polymer, in particular a water redispersible polymer. Such polymers have proven to be beneficial in the present mortar compositions. However, e.g. for specific purposes, other polymers might be suitable as well.

Especially the polymer is a homopolymer or copolymer based on one or more monomers selected from vinyl acetate, vinyl ester, vinyl alcohol, acrylic acid, acrylate, methacrylic acid, methacrylate and ethylene.

Preferably, the polymer is selected from polyvinyl esters, polyvinyl alcohols,  
5 polyacrylates, polymethacrylates, butylacrylates, vinylversatate or mixtures thereof. Especially, the polymer is selected from polyacrylate, poly(vinyl acetate), poly(vinyl alcohol), ethylene-vinyl acetate copolymer, ethylene-vinyl alcohol copolymer or mixtures thereof. However, other water-soluble polymers might be suitable as well.

According to another preferred embodiment, the cementitious adhesive  
10 composition comprises at least one plasticizer. In particular, the plasticizer is chemically different from the above mentioned polymer. The plasticizer is in particular selected from the group of lignosulfonates, gluconates, naphthalenesulfonates, melamine sulfonates, vinyl copolymers, casein, polycarboxylates and/or polycarboxylate ethers. Polycarboxylate ethers are  
15 especially preferred.

It is also possible to use a combination of several different plasticizers.

A preferred amount of plasticizer is chosen within a range 0.001 – 10 wt.-%, in particular 0.01 – 5 wt.-%, preferably, 0.1 – 1 wt.-%, in particular 0.1 – 0.5 wt.-%, with respect to the total weight of the adhesive composition.

20 Advantageously, the cementitious adhesive composition comprises 0.05 – 2.0 wt.-%, especially 0.1 – 0.8 wt.-%, in particular 0.1 – 0.5 wt.-%, of a defoamer.

The defoamer is in particular selected from silicon based defoamers and/or glycol based defoamers and/or ethoxylate fatty alcohol based defoamers and/or a mixture thereof. A suitable glycol based defoamer is a polyalkylene glycol and/or  
25 an ethylenoxide/propylenoxide copolymer. A preferred silicon based defoamer is polysiloxane.

Moreover, suitable defoamers may comprise or consist of (i) mixtures of dodecyl alcohol and propylene glycol, (ii) fatty alcohol ethyloxates, (iii) dibutylphthalates, (iv)

dibutylphosphates, (v) silicone polymers and (vi) aqueous emulsions of silane, siloxane and/or silicone.

According to an especially preferred embodiment, the defoamer comprises a mixture of polyalkylene glycol and hydrocarbons.

- 5 Especially, the defoamer comprises a mixture of an alkoxyated fatty alcohol and a polyetherol fatty acid on an inert carrier material.

In a further preferred embodiment, the cementitious adhesive composition additionally comprises 5 – 40 wt.-%, especially 20 – 40 wt.-%, preferably 25 – 35 wt.-%, of a filler. In particular, the term "filler" stands for rock flour or aggregates,  
10 respectively, which passes a sieve with a mesh size of 0.063 mm. The filler is in particular chosen from silica and/or calcium carbonate. Especially, the filler material is different from the aggregates present in the adhesive composition.

According to a preferred embodiment, the cementitious adhesive composition further comprises a layered material. The term "layered material" stands in  
15 particular for a material with a layered crystal structure. Especially, the layered material is a plate-like material. A plate-like material is in particular a material with a length and width larger than its thickness.

Preferably, the layered material is selected from clay and/or mica. Within the context of this invention, "clay" stands in particular for phyllosilicates and/or sheet  
20 silicates. Especially preferred, the layered material comprises or consists of Bentonite, Hectorite, Attapulgite, Sepiolith and/or Vermiculite.

In particular, a grain size of the layered material is 4 mm at most, preferably 2 mm at most, especially 1 mm at most.

A preferred amount of layered material is 0.001 – 5 wt.-%, in particular 0.01 – 2  
25 wt.-%, especially 0.1 – 1 wt.-%, with respect to the total weight of the adhesive composition.

Additionally the cementitious adhesive composition may comprise 0.001 – 5 wt.-%, in particular 0.01 – 2, especially 0.1 – 1 wt.-% or 0.2 – 0.5 wt.-%, with respect to the total weight of the adhesive composition, of starch. Starch is a polysaccharide.

According to another preferred embodiment, the cementitious adhesive

5 composition comprises fibers. Fibers may be used to strengthen the tensile strength of the adhesive composition after hardening. Preferably, the fibers are selected from cellulose, polypropylene and/or acrylonitrile fibers. In particular, an amount of fibers is 0.001 – 2 wt.-%, especially 0.01 – 1 wt.-%, preferably 0.1 – 0.5 wt.-%, with respect to the total weight of the adhesive composition.

10 Additionally, the cementitious adhesive composition may comprise retarders. Retarders can be used in order to extend the processing time of the adhesive composition and/or to counteract the accelerating effect of high temperatures. Especially, the retarder is chosen from carbohydrates, phosphates, hydroxycarboxylic acids and/or salts thereof. An especially preferred retarder is  
15 gluconate, in particular sodium gluconate. Preferably, an amount of retarder is 0.001 – 2 wt.-%, especially 0.01 – 1 wt.-%, preferably 0.1 – 0.5 wt.-%. with respect to the total weight of the adhesive composition.

In another preferred embodiment, the cementitious adhesive composition comprises a latex or an aqueous polymer dispersion, respectively. In the present  
20 document, a "polymer dispersion" is understood to mean a dispersion of polymer particles in an aqueous phase. Particularly, a dispersion is stable for a long time, i.e. typically at room temperature for at least one week without precipitations.

If the cementitious adhesive composition comprises a latex, the adhesive composition is preferably present as a two-component composition or a multi-  
25 component composition. Thereby, the latex is preferably present in a component separate from a component comprising the hydraulic binder. For example, the hydraulic binder, the aggregates and the cellulose ether and any other of the above mentioned non-aqueous substances and materials are present in a first receptacle or a first component, respectively, whereas the latex is present in a  
30 second receptacle or a second component, respectively.

Especially the latex is an aqueous dispersion of at least one dispersed homopolymer and/or copolymer. In particular, the homopolymer and/or copolymer is composed of at least one monomer, in particular at least two, three or more different monomers, selected from the group consisting of ethylene, propylene, 5 butylene, isoprene, butadiene, styrene, acrylonitrile, acrylic acid, methacrylic acid, alkyl acrylate, alkyl methacrylate, vinyl ester, vinyl acetate and vinyl chloride.

Particularly suitable polymers are butadiene/styrene copolymers, acrylic acid/styrene copolymers, methacrylic acid/styrene copolymers, ethylene/vinyl acetate copolymers, vinyl acetate/alkyl methacrylate copolymers, and styrene/alkyl 10 methacrylate copolymers, and styrene/alkyl methacrylate copolymers.

Most preferred as dispersed copolymers are butadiene/styrene copolymers.

The size of the polymer particles in the latex is preferably between 50 nanometers and 50 micrometers, preferably between 500 nanometers and 30 micrometers. Due to the particle size, the polymer dispersion is more or less opaque and 15 naturally typically has a milky white color.

The polymer content of the latex is preferably 10 – 60 wt.-%, especially 25 – 45 wt.-%, based on the weight of the aqueous polymer dispersion.

In particular, the homopolymer and/or copolymer of the latex is chemically different from the above mentioned polymer and plasticizer.

20 An especially preferred cementitious adhesive composition comprises or consists of:

- a) 20 – 50 wt.-%, of cement, in particular Portland cement,
- b) 25 – 60 wt.-%, of silica sand,
- c) 0.2 – 0.6 wt.-%, of cellulose ether selected from hydroxypropyl 25 methylcellulose and/or hydroxyethyl methylcellulose,
- d) optionally 1 – 6 wt.-%, especially 1 – 4 wt.-%, of a redispersable polymer, selected from polyacrylate, poly(vinyl acetate), poly(vinyl alcohol), vinyl

ester-vinyl acetate copolymer, ethylene-vinyl acetate copolymer and ethylene-vinyl alcohol copolymer or mixtures thereof,

- e) optionally 0.1 – 1 wt.-%, of a plasticizer, in particular a polycarboxylate ether,
- 5 f) optionally 0.1 – 0.8 wt.-% of a defoamer, in particular selected from silicon based defoamers and/or glycol based defoamers.

According to another example, the cementitious adhesive composition comprises or consists of:

- a) 30 – 50 wt.-%, of cement, in particular Portland cement ,
- 10 b) 50 – 60 wt.-%, of silica sand,
- c) 0.2 – 0.6 wt.-%, of cellulose ether selected from hydroxypropyl methylcellulose and/or hydroxyethyl methylcellulose,
- d) 1 – 6 wt.-%, especially 1 – 4 wt.-% of a redispersable polymer, selected from polyacrylate, poly(vinyl acetate), poly(vinyl alcohol), vinyl ester-vinyl  
15 acetate copolymer, ethylene-vinyl acetate copolymer and ethylene-vinyl alcohol copolymer or mixtures thereof,
- e) 0.1 – 0.5 wt.-%, of a plasticizer, in particular a polycarboxylate ether,
- f) 0.1 – 0.5 wt.-% of a defoamer, in particular selected from silicon based defoamers and/or glycol based defoamers.

20 The following four exemplary cementitious adhesive compositions have been proven to be especially beneficial:

- 1) A cementitious adhesive composition comprising or consisting of:
  - a) 15 – 25 wt.-%, of cement, in particular Portland cement,
  - b) 40 – 50 wt.-%, of silica sand,

- c) 0.05 – 0.2 wt.-%, of cellulose ether selected from hydroxypropyl methylcellulose and/or hydroxyethyl methylcellulose.
- d) 30 – 35 wt.-% filler, in particular limestone or calcium carbonate filler.

2) A cementitious adhesive composition comprising or consisting of:

- 5 a) 40 – 50 wt.-%, of cement, in particular Portland cement
- b) 45 – 55 wt.-%, of silica sand,
- c) 0.2 – 0.6 wt.-%, of cellulose ether selected from hydroxypropyl methylcellulose and/or hydroxyethyl methylcellulose,
- 10 d) 2.5 – 3.5 wt.-%, of a redispersable polymer, selected from polyacrylate, poly(vinyl acetate), poly(vinyl alcohol), vinyl ester-vinyl acetate copolymer, ethylene-vinyl acetate copolymer and ethylene-vinyl alcohol copolymer or mixtures thereof.

3) A cementitious adhesive composition comprising or consisting of:

- a) 35 – 45 wt.-%, of cement, in particular Portland cement
- 15 b) 25 – 35 wt.-%, of silica sand,
- c) 0.2 – 0.4 wt.-%, of cellulose ether selected from hydroxypropyl methylcellulose and/or hydroxyethyl methylcellulose,
- d) 0.8 – 2.5 wt.-%, of a redispersable polymer, selected from polyacrylate, poly(vinyl acetate), poly(vinyl alcohol), vinyl ester-vinyl acetate copolymer, ethylene-vinyl acetate copolymer and ethylene-vinyl alcohol copolymer or mixtures thereof,
- 20 e) 20 – 30 wt.-% filler, in particular limestone or calcium carbonate filler,
- f) 0.01 – 0.1 wt.-% of retarder, in particular a sodium gluconate.

- 4) A cementitious adhesive composition comprising or consisting of:
- a) 35 – 45 wt.-%, of cement, in particular Portland cement
  - b) 50 – 60 wt.-%, of silica sand,
  - c) 0.3 – 0.5 wt.-%, of cellulose ether selected from hydroxypropyl methylcellulose and/or hydroxyethyl methylcellulose,
  - d) 2 – 6 wt.-%, especially 1 – 4 wt.-% of a redispersable polymer, selected from polyacrylate, poly(vinyl acetate), poly(vinyl alcohol), vinyl ester-vinyl acetate copolymer, ethylene-vinyl acetate copolymer and ethylene-vinyl alcohol copolymer or mixtures thereof,
  - e) 0.2 – 0.5 wt.-%, of a plasticizer, in particular a polycarboxylate ether,
  - f) 0.2 – 0.5 wt.-% of a defoamer, in particular selected from silicon based defoamers and/or glycol based defoamers.

In another aspect, the present invention relates to a processable composition comprising a cementitious adhesive composition as described above and water.

- 15 Thereby, all of the components of the adhesive composition as well as the water are intermixed. A "processable composition" is meant to be an adhesive composition which is ready to be applied to a support element, e.g. a floor structure, in order to fix a cover element, for example a tile. In particular, the processable composition is at the initial stage of setting of the hydraulic binder.
- 20 Preferably, a weight ratio of water to hydraulic binder in the processable composition is chosen in the range of 0.3 – 0.8, in particular 0.35 – 0.7, especially 0.35 – 0.5.

Especially, an air content of the processable composition is 0 – 5%, in particular 0.1 – 3 %. The air content is measured for example according to DIN EN 1015-7

- 25 As it has been shown, keeping the air content at a rather low level is highly beneficial for obtaining a processable composition which can accurately be dosed and metered in automatic tiling systems.

Also, the present invention relates to a method for producing such a processable composition whereby an adhesive composition as described above is intermixed with water.

According to an especially preferred embodiment, air is actively removed at least  
5 during intermixing of the adhesive composition and water. Also it is possible to remove air from the processable composition after intermixing, e.g. during a storage period. This allows for a further reduction of the air content of the processable composition. Preferably, the air is removed with underpressure, e.g. by subjecting the mixing and/or storage receptacle to underpressure, for example  
10 with the help of an external vacuum pump. Typically, the underpressure applied is about 25 – 400 mbar, in particular about 50 – 200 mbar.

An especially preferred method for producing a processable composition comprises or consists of the following steps:

- 15 i. Mixing a cementitious adhesive composition as described above, in particular comprising 10 – 70 wt.-% of a hydraulic binder, preferably cement, 20 – 90 wt.-% of aggregates, in particular sand and/or calcium carbonate, 0.01 – 5 wt.-% cellulose ether;
- ii. Adding water, preferably with a weight ratio of water to hydraulic binder chosen in the range of 0.3 – 0.8, in particular 0.35 – 0.7, especially 0.35 – 0.5;
- 20 iii. Intermixing of the adhesive composition and water;
- iv. Optionally, removing air, preferably during the intermixing of the adhesive composition and water, especially so that an air content is 0 – 5%, in particular 0.1 – 3 %.

According to another aspect, the present invention is concerned with a method for  
25 the application of a processable composition, comprising the steps of producing a processable composition as described above and subsequently applying the so produced processable composition on a support element and/or on a cover element. Preferably, the processable composition is applied on the support element.

The support element can e.g. be a floor, a wall or a ceiling structure. Preferably, the cover element is a tile.

Preferably, the processable composition is applied with a thickness of 0.5 – 10 mm, in particular 3 – 6 mm.

- 5 Especially, the processable composition is applied with a pumping system, in particular with a pumping system of an automatic tiling system, especially with a tiling robot. The automatic tiling system can e.g. be similar to the one described in DE 198 21 612 A1.

For example, the cementitious adhesive composition or the processable  
10 composition, respectively, is pressurized in the pumping system with a pressure of 0.5 – 30 bar, in particular 1 – 20 bar, especially 5 – 15 bar or 10 – 13 bar.

Especially preferred, a method for the application of a processable composition comprises or consist of the following steps:

- 15 1. Producing a processable composition according to the method for producing a processable composition comprising or consisting of the steps i, ii, iii and iv as described above;
2. Applying the processable composition on a support element and/or on a cover element, especially with a pumping system, in particular with a pumping system of an automatic tiling system, in particular for fixing the cover element, for  
20 example a tile, on the support element.

Furthermore, the present invention relates to a shaped body, in particular a flat layer, comprising a hardened processable composition as described above. Thus, the shaped body is obtainable by hardening the processable composition. In particular, the shaped body is arranged between a support element and a cover  
25 element, and preferably the cover element is a tile. Especially, the shaped body is an adhesive layer between a support element, e.g. a floor, wall or ceiling structure, and a cover element, for example a tile.

In particular, the shaped body is a flat layer, especially with a thickness of 0.5 –10 mm, preferably 3 – 6 mm. Within the present context, a flat layer is in particular a body with a width and a length larger than its thickness.

Also, the present invention relates to a structure, in particular a floor, a wall or a ceiling, comprising the shaped body as described above, whereby the shaped body is arranged between a support element and cover element. In particular, the support element is a floor, a wall or a ceiling structure, and/or the cover element is a tile.

Optionally, it is possible to have additional layers, e.g. primer layers, between the support element and the shaped body. This might further increase the adhesion between the support element and the shaped body.

According to a further aspect, the present invention is related to a method for the production of an above mentioned structure, whereby a processable composition as described above is applied on a support element and/or on a cover element and subsequently the cover element is placed on the support element.

Another aspect of the present invention is directed to the use of a cementitious adhesive composition as describe above or of a processable composition as described above as an adhesive, preferably in an automatic application system, more preferred in an automated tiling system or a tiling robot.

Further advantageous configurations of the invention are evident from the exemplary embodiments.

### **Brief description of the figures**

In the figures used for explaining the embodiments:

Fig. 1 shows a photograph of a cementitious adhesive layer which has been produced by application of a conventional tile adhesive with a high pressure pump system and an application head with a profiled slot nozzle; and

Fig. 2 shows a photograph of a cementitious adhesive layer which has been produced in a similar manner by application of a tile adhesive according to the invention.

## 5 Exemplary embodiments

### 1. Cementitious adhesive compositions

Table 1 shows four inventive adhesive compositions **A1 – A4**. The compositions have been prepared by intermixing all of the commercially available components in dry state. The adhesive composition **A1 – A4** are present as dry powders and can preferably be used as tile adhesives.

Table 1:

Component	A1	A2	A3	A4
Hydraulic binder [wt-%]				
- Portland cement	21.0	45.0	42.0	40.0
Aggregate [wt-%]				
- Sand (0-1 mm)	45.0	51.1	29.33	56.0
Cellulose ether [wt.-%]	0.1	0.4	0.30	0.40
- hydroxyethyl ethylcellulose				
Limestone filler [wt-%]	33.9	-	26.75	-
Polymer [wt-%]				
- Ethylene-vinyl acetate copolymer	-	3.5	1.60	3.0
Plasticizer [wt.-%]				
- Polycarboxylate ether	-	-	-	0.3

Defoamer [wt.-%] - Mixture of alkoxyated fatty alcohol and a polyetherol fatty acid on an inert carrier material (Lumiten®)	-	-	-	0.3
Retarder [wt.-%] - Sodium gluconate	-	-	0.03	-

## 2. Preparation of processable compositions

Processable compositions **C1 – C4** have been obtained by intermixing the dry adhesive compositions **A1 – A4** with water (weight ratio of water to total weight of dry adhesive composition = 0.25 – 0.26).

For comparison, a reference composition **R** has been produced with a commercially available adhesive composition for manual application in a similar manner.

Subsequently, the air content has been determined according to DIN EN 1015-7.

10 All of the so processable compositions **C1 – C4** had an air content of about 1 – 2%. In contrast, the reference composition had an air content of about 20%.

## 3. Application

The processable compositions **C1 – C4** as well as the reference composition **R** have been applied with a pump system and an application head with a profiled slot nozzle (comparable to the one described in DE 198 21 612 A1) with a thickness of 15 3-6 mm on a cleaned flat plate under identical conditions.

Fig. 1 shows a photograph of the so applied reference composition **R** with large air voids which are caused by inhomogeneous flow behavior of the adhesive composition during application. In contrast, with inventive composition **C1** (Fig. 2), 20 a very homogeneous adhesive layer without any voids is produced.

Thus, adhesive compositions according to the present invention are highly beneficial for use as adhesive in automatic tiling systems.

It will be appreciated by those skilled in the art that the present invention can be embodied in other specific forms without departing from the spirit or essential  
5 characteristics thereof. The presently disclosed embodiments are therefore considered in all respects to be illustrative and not restricted.

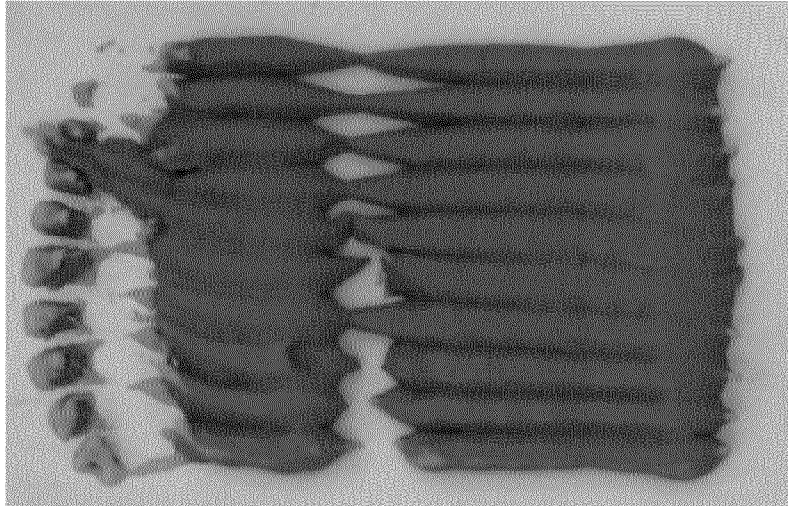
**Claims**

1. Cementitious adhesive composition, in particular a tile adhesive, especially for use in automatic tiling systems, comprising or consisting of:
  - a) 10 – 70 wt.-% of a hydraulic binder, in particular cement;
  - 5 b) 20 – 90 wt.-% of aggregates, in particular sand and/or calcium carbonate;
  - c) 0.01 – 5 wt.-% cellulose ether.
2. Cementitious adhesive composition according to claim 1 further comprising 0.1 – 10 wt.-%, in particular 0.1 – 5 wt.-%, of a polymer, in particular a homopolymer or copolymer based on one or more monomers selected from  
10 vinyl acetate, vinyl ester, vinyl versate, vinyl alcohol, acrylic acid, acrylate, methacrylic acid, methacrylate and ethylene.
3. Cementitious adhesive composition according to any of preceding claims further comprising 0.001 – 10 wt.-% of a plasticizer, in particular selected from lignosulfonates, gluconates, naphthalenesulfonates, melamine  
15 sulfonates, vinyl copolymers, polycarboxylates and/or polycarboxylate ethers.
4. Cementitious adhesive composition according to any of preceding claims further comprising 0.05 – 2.0 wt.-% of a defoamer, in particular selected from silicon based defoamers and/or glycol based defoamers.
5. Cementitious adhesive composition according to according to any of  
20 preceding claims whereby the cellulose ether is selected from hydroxymethyl cellulose, hydroxyethyl cellulose, hydroxypropyl methylcellulose, hydroxyethyl methylcellulose and/or carboxymethyl cellulose, preferably hydroxypropyl methylcellulose and/or hydroxyethyl methylcellulose.
6. Cementitious adhesive composition according to any of preceding claims  
25 comprising or consisting of:
  - a) 20 – 50 wt.-%, of cement, in particular Portland cement,

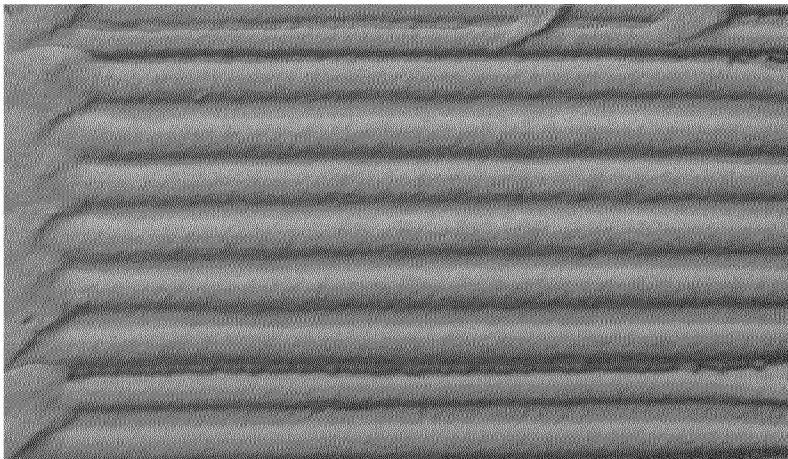
- b) 25 – 60 wt.-%, of silica sand,
  - c) 0.2 – 0.6 wt.-%, of cellulose ether selected from hydroxypropyl methylcellulose and/or hydroxyethyl methylcellulose,
  - d) optionally 1 – 6 wt.-%, of a redispersable polymer, selected from  
5 polyacrylate, poly(vinyl acetate), poly(vinyl alcohol), vinyl ester-vinyl acetate copolymer, ethylene-vinyl acetate copolymer and ethylene-vinyl alcohol copolymer or mixtures thereof,
  - e) optionally 0.1 – 1 wt.-%, of a plasticizer, in particular a polycarboxylate ether,
  - 10 f) optionally 0.1 – 0.8 wt.-% of a defoamer, in particular selected from silicon based defoamers and/or glycol based defoamers.
7. Cementitious adhesive composition according to any of preceding claims comprising or consisting of:
- a) 30 – 50 wt.-%, of cement, in particular Portland cement,
  - 15 b) 50 – 60 wt.-%, of silica sand,
  - c) 0.2 – 0.6 wt.-%, of cellulose ether selected from hydroxypropyl methylcellulose and/or hydroxyethyl methylcellulose,
  - d) 1 – 6 wt.-%, of a redispersable polymer, selected from polyacrylate,  
20 poly(vinyl acetate), poly(vinyl alcohol), vinyl ester-vinyl acetate copolymer, ethylene-vinyl acetate copolymer and ethylene-vinyl alcohol copolymer or mixtures thereof,
  - e) 0.1 – 0.5 wt.-%, of a plasticizer, in particular a polycarboxylate ether,
  - f) 0.1 – 0.5 wt.-% of a defoamer, in particular selected from silicon based defoamers and/or glycol based defoamers.
- 25 8. Processable composition comprising an cementitious adhesive composition according to any of preceding claims and water, whereby a weight ratio of

water to hydraulic binder is chosen in the range of 0.3 – 0.8, in particular 0.35 – 0.5.

9. Processable composition according to claim 8 having an air content of 0 – 5%, in particular 0.1 – 3 %.
- 5 10. Method for producing a processable composition according to any of claims 8 – 9, whereby a cementitious adhesive composition according to any of claims 1 – 7 is intermixed with water.
11. Method according to claim 10 whereby at least during intermixing, air is actively removed, especially with underpressure.
- 10 12. Method for the application of a processable composition, comprising the steps of producing a processable composition according to any of claims 10 – 11 and subsequently applying the so produced processable composition on a support element and/or on a cover element.
13. Method according to claim 12 whereby the processable composition is  
15 applied with a pumping system, in particular with a pumping system of an automatic tiling system.
14. Shaped body, in particular a flat layer, comprising a hardened processable composition according to any of claims 8 – 9, whereby, in particular, the shaped body is arranged between a support element and a cover element,  
20 and preferably the cover element is a tile.
15. Use of a cementitious adhesive composition according to any of claims 1 – 7 or of a processable composition according to any of claims 8 – 9 as an adhesive in an automatic tiling system.



**Fig. 1**



**Fig. 2**

INTERNATIONAL SEARCH REPORT

International application No  
PCT/EP2016/082036

A. CLASSIFICATION OF SUBJECT MATTER  
INV. C04B28/04  
ADD.  
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED  
Minimum documentation searched (classification system followed by classification symbols)  
C04B B05C E04F

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)  
EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	DE 10 2010 062061 A1 (WACKER CHEMIE AG [DE]) 31 May 2012 (2012-05-31)	1-14
A	paragraph [0001] - paragraph [0077] paragraph [0080] - paragraph [0088]; claims 1-11; figure 1; examples 1-4; table 1	15
X	DE 198 12 247 A1 (PCI AUGSBURG GMBH [DE]) 30 September 1999 (1999-09-30)	1-10,12,14
A	page 2, line 3 - page 4, line 49; claims 1-19; examples 1-5	11,13,15
X	EP 2 537 818 A2 (DOW GLOBAL TECHNOLOGIES LLC [US]) 26 December 2012 (2012-12-26)	1,2,5-10,12,14
A	paragraph [0005] - paragraph [0055] paragraph [0060] - paragraph [0062]; claims 1-10; examples A-D; tables 1-4	11,13,15
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Further documents are listed in the continuation of Box C.

See patent family annex.

\* Special categories of cited documents :

<p>"A" document defining the general state of the art which is not considered to be of particular relevance</p> <p>"E" earlier application or patent but published on or after the international filing date</p> <p>"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)</p> <p>"O" document referring to an oral disclosure, use, exhibition or other means</p> <p>"P" document published prior to the international filing date but later than the priority date claimed</p>	<p>"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention</p> <p>"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone</p> <p>"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art</p> <p>"&amp;" document member of the same patent family</p>
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Date of the actual completion of the international search <b>8 February 2017</b>	Date of mailing of the international search report <b>16/02/2017</b>
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Name and mailing address of the ISA/ European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Authorized officer <b>Büscher, Olaf</b>
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## INTERNATIONAL SEARCH REPORT

International application No  
PCT/EP2016/082036

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	DE 198 21 612 A1 (FRAUNHOFER GES FORSCHUNG [DE]) 18 November 1999 (1999-11-18) cited in the application the whole document	1,12,13, 15
A	----- US 3 678 645 A (VALDES JUAN J) 25 July 1972 (1972-07-25) column 1, line 4 - column 6, line 71; claims 1-5; figures 1-10	1,12,13, 15
A	----- US 9 074 381 B1 (DREW GARY LEE [US]) 7 July 2015 (2015-07-07) page 1, line 66 - page 18, line 35; claims 1-20; figures 1-14 -----	1,12,13, 15

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Information on patent family members

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DE 19812247	A1	30-09-1999	NONE
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DE 19821612	A1	18-11-1999	NONE
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US 3678645	A	25-07-1972	NONE
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US 9074381	B1	07-07-2015	US 9074381 B1 WO 2015164449 A1
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