CLAIMS

1. A cementitious cooling paint comprising:

a composite cement;

a structural filler;

a water-absorbing polymer;

a water capture material comprising a deliquescent salt; and

water; wherein

the water to composite cement ratio is from 0.4 to 1.2 by mass;

the composite cement to structural filler ratio is from 0.4 to 0.7 by mass;

the composite cement to water-absorbing polymer ratio is from 0.01 to 0.03 by mass; and

the composite cement to water capture material ratio is from 0.05 to 0.3 by mass; and

wherein the cementitious cooling paint exhibits dual passive cooling mechanisms including radiative cooling and evaporative cooling.

2. The cementitious cooling paint according to claim 1, further comprising:

a dispersant, wherein the composite cement to dispersant ratio is from 20 to 50 by mass.

3. The cementitious cooling paint according to claim 1, wherein the composite cement is at least one selected from the group consisting of various types and grades of Portland cement and geopolymer cement.

4. The cementitious cooling paint according to claim 1, wherein the structural filler is at least one selected from the group consisting of silicon dioxide (SiO_2), barium sulfate ($BaSO_4$), calcium carbonate ($CaCO_3$), zinc oxide (ZnO), aluminum oxide (Al_2O_3), zirconium dioxide

(ZrO_2), titanium dioxide (TiO_2), iron(III) oxide (Fe_2O_3), hydrated goethite (α-FeOOH) and Prussian Blue.

5. The cementitious cooling paint according to claim 1 or 4, wherein the structural filler comprises nanoparticles having an average particle size ranging from 0.3μm to 2μm.

6. The cementitious cooling paint according to claim 1, wherein the water-absorbing polymer is at least one selected from the group consisting of sodium poly(acrylate), sodium carboxymethyl cellulose and sodium alginate, polyvinyl alcohol, hydroxypropyl methylcellulose and carboxymethyl cellulose.

7. The cementitious cooling paint according to claim 1, wherein the deliquescent salt is selected from the group consisting of lithium chloride (LiCl) and calcium chloride ($CaCl_2$).

8. The cementitious cooling paint according to claim 2, wherein the dispersant is at least one selected from the group consisting of sodium polyacrylic and superplasticizer such as sulfonated naphthalene formaldehyde condensate, sulfonated melamine formaldehyde condensate, acetone formaldehyde condensate and polycarboxylates ethers.

9. A cementitious cooling construction material comprising:

a composite cement;

a structural filler;

a water-absorbing polymer;

a water capture material comprising a deliquescent salt;

a dispersant; and

water; wherein

the water to the composite cement ratio is from 0.5 to 1.5 by mass.

the composite cement to structural filler ratio is from 0.4 to 0.7 by mass;

the composite cement to water-absorbing polymer ratio is from 0.01 to 0.03 by mass;

the composite cement to water capture material ratio is from 0.05 to 0.3 by mass; and

the composite cement to dispersant ratio is from 8 to 15 by mass; and

wherein the cementitious cooling construction material exhibits dual passive cooling mechanisms including radiative cooling and evaporative cooling.

10. The cementitious cooling construction material according to claim 9, further comprising alkaline water for hydrating the cementitious cooling construction material and for preventing the cementitious cooling construction material from cracking.

11. The cementitious cooling construction material according to claim 9, wherein the composite cement is at least one selected from the group consisting of various types and grades of Portland cement and geopolymer cement.

12. The cementitious cooling construction material according to claim 9, wherein the structural filler is at least one selected from the group consisting of silicon dioxide (SiO_2), barium sulfate ($BaSO_4$), calcium carbonate ($CaCO_3$), zinc oxide (ZnO), aluminum oxide (Al_2O_3), zirconium dioxide (ZrO_2), titanium dioxide (TiO_2), iron(III) oxide (Fe_2O_3), hydrated goethite (α-FeOOH) and Prussian Blue.

13. The cementitious cooling construction material according to claim 9 or 12, wherein the structural filler comprises nanoparticles having an average particle size ranging from 0.3μm to 2μm.

14. The cementitious cooling construction material according to claim 9, wherein the water-absorbing polymer is at least one selected from the group consisting of sodium poly(acrylate), sodium carboxymethyl cellulose and sodium alginate, polyvinyl alcohol, hydroxypropyl methylcellulose and carboxymethyl cellulose.

15. The cementitious cooling construction material according to claim 9, wherein the deliquescent salt is selected from the group consisting of lithium chloride (LiCl) and calcium chloride ($CaCl_2$).

16. The cementitious cooling construction material according to claim 9, wherein the dispersant is at least one selected from the group consisting of sodium polyacrylic and superplasticizer such as sulfonated naphthalene formaldehyde condensate, sulfonated melamine formaldehyde condensate, acetone formaldehyde condensate and polycarboxylates ethers.

17. The cementitious cooling construction material according to any one of claims 9 to 16, wherein the cementitious cooling construction material has a viscosity suitable for fabricating cement-based building product selected from cooling tile, cooling brick, cooling concrete, cooling concrete block, cooling concrete slab and cooling cement wall.

18. A cement-based building product comprising a cementitious cooling construction material as defined in claim 9, wherein the cement-based building product is one selected from

cooling tile, cooling brick, cooling concrete, cooling concrete block, cooling concrete slab and cooling cement wall.

19. A kit of parts comprising the cementitious cooling paint as defined in claim 1, the kit comprising:

a first portion containing a solid mixture consisting of the composite cement and the structural filler; and

a second portion containing a liquid mixture consisting of the water-absorbing polymer, the water capture material, the water, and a dispersant; wherein

the water to the composite cement ratio is from 0.4 to 1.2 by mass;

the composite cement to structural filler ratio is from 0.4 to 0.7 by mass;

the composite cement to water-absorbing polymer ratio is from 0.01 to 0.03 by mass;

the composite cement to water capture material ratio is from 0.05 to 0.3 by mass; and

the composite cement to dispersant ratio is from 20 to 50 by mass.

20. A method for producing a cement-based building product comprising the cementitious cooling construction material of claim 9, the method comprising:

preparing a solid mixture by mixing the composite cement with the structural filler;

preparing a liquid mixture by mixing the water-absorbing polymer together with the water capture material, the dispersant and the water; mixing the solid mixture and the liquid mixture homogenously to form a cementitious cooling construction material precursor;

hydrating the cementitious cooling construction material precursor using alkaline water to prevent cracks in the cementitious cooling construction material precursor; and

moulding the hydrated cementitious cooling construction material precursor into the desired cement-based building product.

21. The method according to claim 20, wherein the method comprises mixing the composite cement, the structural filler, the water-absorbing polymer, the water capture material, the dispersant and the water in the following weight ratios:

the water to composite cement ratio is from 0.5 to 1.5 by mass;

the composite cement to structural filler ratio is from 0.4 to 0.7 by mass;

the composite cement to water-absorbing polymer ratio is from 0.01 to 0.03 by mass;

the composite cement to water capture material ratio is from 0.05 to 0.3 by mass; and

the composite cement to dispersant ratio is from 8 to 15 by mass.

22. The method according to claim 20 or 21, wherein the composite cement is at least one selected from the group consisting of various types and grades of Portland cement and geopolymer cement.

23. The method according to claim 20 or 21, wherein the structural filler is at least one selected from the group consisting of silicon dioxide (SiO_2), barium sulfate ($BaSO_4$), calcium carbonate ($CaCO_3$), zinc oxide (ZnO), aluminum oxide (Al_2O_3), zirconium dioxide (ZrO_2), titanium dioxide (TiO_2), iron(III) oxide (Fe_2O_3), hydrated goethite (α-FeOOH) and Prussian Blue.

24. The method according to claim 20 or 23, wherein the structural filler comprises nanoparticles having an average particle size ranging from 0.3μm to 2μm.

25. The method according to claim 20, wherein the water-absorbing polymer is at least one selected from the group consisting of sodium poly(acrylate), sodium carboxymethyl cellulose

and sodium alginate, polyvinyl alcohol, hydroxypropyl methylcellulose and carboxymethyl cellulose.

26. The method according to claim 20, wherein the deliquescent salt is selected from the group consisting of lithium chloride (LiCl) and calcium chloride ($CaCl_2$).

27. The method according to claim 20, wherein the dispersant is at least one selected from the group consisting of sodium polyacrylic and superplasticizer such as sulfonated naphthalene formaldehyde condensate, sulfonated melamine formaldehyde condensate, acetone formaldehyde condensate and polycarboxylates ethers.

28. The method according to any one of claims 20 to 27, wherein the cement-based building product is one selected from cooling tile, cooling brick, cooling concrete, cooling concrete block, cooling concrete slab and cooling cement wall.