CLAIMS

1. A cementitious mixture for preparing a ductile self-cleaning cementitious composite, the cementitious mixture comprising:

a hydraulic cement;

water, wherein the ratio of water to the hydraulic cement is a range from 0.2 to 1 by weight;

a plurality of fibers comprising polyvinyl alcohol (PVA) fibers, wherein the average length of each fiber is in a range from 4 to 30 mm, wherein the ratio of the plurality of fibers to the hydraulic cement is in a range from 1.5 to 3 % by volume; and

a self-cleaning agent, wherein the ratio of the self-cleaning agent to the hydraulic cement is in a range from 0.01 to 1 by weight.

2. The cementitious mixture of claim 1, wherein the self-cleaning agent is selected from the group consisting of nanoparticles of titanium dioxide (TiO_2), zinc oxide (ZnO), iron (III) oxide (Fe_2O_3), cadmium sulfide (CdS), zinc sulfide (ZnS), tungsten (VI) oxide (WO_3), copper (I) oxide (Cu_2O), silver phosphate (Ag_3PO_4), strontium titanate ($SrTiO_3$), barium titanate ($BaTiO_3$), calcium titanate ($CaTiO_3$), and a mixture thereof.

~~3. The cementitious mixture of claim 2, wherein the self-cleaning agent is TiO_2 nanoparticles.~~

~~4~~3. The cementitious mixture of claim 1~~any one of claims 1 to 3~~, wherein the ratio of the self-cleaning agent to the hydraulic cement is in a range from 0.05 to 0.1 by weight.

~~5. The cementitious mixture of claim 4, wherein self-cleaning agent is TiO_2 nanoparticles and the ratio of TiO_2 nanoparticles to the hydraulic cement is 0.05 or 0.1 by weight.~~

~~6~~4. The cementitious mixture of claim 1~~any one of claims 1 to 5~~, wherein the hydraulic cement is selected from the group consisting of Portland cement, blended Portland

cement, expansive cement, rapid setting and hardening cement, calcium aluminate cement, magnesium phosphate, and a mixture thereof.

~~7. The cementitious mixture of claim 6, wherein the hydraulic cement comprises Type I white Portland cement.~~

~~8~~5. The cementitious mixture of claim 1~~any one of claims 1 to 7~~, wherein the plurality of fibers further comprise~~are selected from a group consisting of~~ polypropylene (PP) fibers, aromatic polyamide fibers, high modulus polyethylene (PE) fibers, ~~polyvinyl alcohol (PVA) fibers,~~ steel fibers, ~~and~~or a mixture thereof.

~~9. The cementitious mixture of claim 8, wherein the plurality of fibers are PVA fibers.~~

~~10~~6. The cementitious mixture of claim ~~9~~1, wherein the ratio of the ~~plurality of~~ PVA fibers to the hydraulic cement is 2 % by volume.

~~11~~7. The cementitious mixture of claim 1~~any one of claim 1 to 10~~, further comprising a viscosity control agent, wherein the ratio of viscosity control agent to the hydraulic cement is in a range from 0.001 to 0.05 by weight.

~~12. The cementitious mixture of claim 11, wherein the viscosity control agent comprises methylcellulose, polyvinyl alcohol, or starch.~~

~~13~~8. The cementitious mixture of claim 1~~any one of claims 1 to 12~~, further comprising a water reducing agent, wherein the ratio of water reducing agent to the hydraulic cement is in a range from 0.005 to 0.07 by weight.

~~14~~9. The cementitious mixture of claim ~~13~~8, wherein the water reducing agent comprises a polycarboxylate-based superplasticizer and the ratio of the water reducing agent to the hydraulic cement is in a range from 0.01 to 0.05 by weight.

10. The cementitious mixture of claim 1, wherein the self-cleaning agent comprises TiO_2 nanoparticles in an amount ranging from more than 0 wt% and up to 10 wt%

of the cementitious mixture, wherein the TiO_2 nanoparticles comprise at least 70% anatase TiO_2.

~~15~~11. A method of preparing a ductile self-cleaning cementitious composite, the method comprising:

mixing a hydraulic cement, water, wherein the ratio of water to the hydraulic cement is a range from 0.2 to 1 by weight; a plurality of fibers comprising polyvinyl alcohol (PVA) fibers, wherein the average length of each fiber is in a range from 4 to 30 mm, wherein the ratio of the plurality of fibers to the hydraulic cement is in a range from 1.5 to 3 % by volume; and a self-cleaning agent, wherein the ratio of the self-cleaning agent to the hydraulic cement is in a range from 0.01 to 1 by weight; and

curing the mixture.

~~16~~12. The method of claim ~~15~~11, wherein the self-cleaning agent is selected from the group consisting of nanoparticles of titanium dioxide (TiO_2), zinc oxide (ZnO), iron (III) oxide (Fe_2O_3), cadmium sulfide (CdS), zinc sulfide (ZnS), tungsten (VI) oxide (WO_3), copper (I) oxide (Cu_2O), silver phosphate (Ag_3PO_4), strontium titanate ($SrTiO_3$), barium titanate ($BaTiO_3$), calcium titanate ($CaTiO_3$), and a mixture thereof.

~~17. The method of claim 16, wherein the self-cleaning agent is TiO_2 nanoparticles.~~

~~18~~13. The method of claim 11~~any one of claims 15 to 17~~, wherein the ratio of the self-cleaning agent to the hydraulic cement is in a range from 0.05 to 0.1 by weight.

~~19. The method of claim 18, wherein self-cleaning agent is TiO_2 nanoparticles and the ratio of TiO_2 nanoparticles to the hydraulic cement is 0.05 or 0.1 by weight.~~

~~20~~14. The method of claim 11~~any one of claims 15 to 19~~, wherein the hydraulic cement is selected from the group consisting of Portland cement, blended Portland cement, expansive cement, rapid setting and hardening cement, calcium aluminate cement, magnesium phosphate, and a mixture thereof.

~~21. The method of claim 20, wherein the hydraulic cement comprises Type I white Portland cement.~~

~~22~~15. The method of claim 11~~any one of claims 15 to 21~~, wherein the plurality of fibers further comprise~~are selected from a group consisting of~~ polypropylene (PP) fibers, aromatic polyamide fibers, high modulus polyethylene (PE) fibers, ~~polyvinyl alcohol (PVA) fibers,~~ steel fibers, ~~and~~ or a mixture thereof.

~~23. The method of claim 22, wherein the plurality of fibers are PVA fibers.~~

~~24~~16. The method of claim ~~23~~11, wherein the ratio of the ~~plurality of~~ PVA fibers to the hydraulic cement is 2 % by volume.

~~25~~17. The method of claim 11~~any one of claim 15 to 24~~, further comprising a viscosity control agent, wherein the ratio of viscosity control agent to the hydraulic cement is in a range from 0.001 to 0.05 by weight.

~~26. The method of claim 25, wherein the viscosity control agent comprises methylcellulose, polyvinyl alcohol, or starch.~~

~~27~~18. The method of claim 11~~any one of claims 15 to 26~~, further comprising a water reducing agent, wherein the ratio of water reducing agent to the hydraulic cement is in a range from 0.005 to 0.07 by weight.

~~28~~19. The method of claim ~~27~~18, wherein the water reducing agent comprises a polycarboxylate-based superplasticizer and the ratio of the water reducing agent to the hydraulic cement is in a range from 0.01 to 0.05 by weight.

20. The method of claim 11, wherein the self-cleaning agent comprises TiO_2 nanoparticles in an amount ranging from more than 0 wt% and up to 10 wt% of the cementitious mixture, wherein the TiO_2 nanoparticles comprise at least 70% anatase TiO_2.