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 1, wherein the ratio of the self-cleaning agent to the hydraulic cement is in a range from 0.05 to 0.1 by weight.

4. The cementitious mixture of claim 1, 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.

5. The cementitious mixture of claim 1, wherein the plurality of fibers further comprise polypropylene (PP) fibers, aromatic polyamide fibers, high modulus polyethylene (PE) fibers, steel fibers, or a mixture thereof.

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

7. The cementitious mixture of claim 1, 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.

8. The cementitious mixture of claim 1, 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.

9. The cementitious mixture of claim 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.

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.

12. The method of claim 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.

13. The method of claim 11, wherein the ratio of the self-cleaning agent to the hydraulic cement is in a range from 0.05 to 0.1 by weight.

14. The method of claim 11, 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.

15. The method of claim 11, wherein the plurality of fibers further comprise polypropylene (PP) fibers, aromatic polyamide fibers, high modulus polyethylene (PE) fibers, steel fibers, or a mixture thereof.

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

17. The method of claim 11, 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.

18. The method of claim 11, 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.

19. The method of claim 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.