

CLAIMS

WHAT IS CLAIMED IS:

1. A cementitious reagent, comprising:

particles comprising atoms of Si, Al, Fe, Ca, Mg, Na, and K, in which:

$$\frac{Si}{Si + Al + Fe + (Ca + Mg) + (Na + K)} = 0.295 \text{ to about } 0.605$$

$$\frac{Al}{Si + Al + Fe + (Ca + Mg) + (Na + K)} = 0.190 \text{ to about } 0.340$$

$$\frac{Fe}{Si + Al + Fe + (Ca + Mg) + (Na + K)} = 0 \text{ to about } 0.16$$

$$\frac{Ca + Mg}{Si + Al + Fe + (Ca + Mg) + (Na + K)} = 0 \text{ to about } 0.215$$

, and

$$\frac{Na + K}{Si + Al + Fe + (Ca + Mg) + (Na + K)} = 0.04 \text{ to about } 0.24,$$

wherein the particles have a spheroidal morphology having a mean roundness (R)

> 0.8; and

wherein the particles are at least 80% X-ray amorphous.

2. The cementitious reagent of claim 1, wherein the particles are in the form of a non-crystalline solid.
3. The cementitious reagent of claim 1, wherein the particles are in a powder form comprising a particle size distribution with D[3,2] of 20µm or less.
4. The cementitious reagent of claim 1, wherein the particles are solid microspheroidal glassy particles.
5. The cementitious reagent of claim 1, wherein less than 40% of the particles have an angular morphology in which (R) < 0.7.
6. The cementitious reagent of claim 1, wherein the particles comprise a mean roundness (R) of at least 0.9.

7. The cementitious reagent of claim 1, comprising the mean oxide Formula 1:
 $(\text{CaO}, \text{MgO})_a \cdot (\text{Na}_2\text{O}, \text{K}_2\text{O})_b \cdot (\text{Al}_2\text{O}_3, \text{Fe}_2\text{O}_3)_c \cdot (\text{SiO}_2)_d$ [Formula 1]
 wherein a is about 0 to about 4;
 b is about 0.1 to about 1;
 c is 1; and
 d is about 1 to about 20.
8. The cementitious reagent of claim 7, wherein the particles comprises less than about 10 wt % CaO.
9. The cementitious reagent of claim 1, wherein the particles have a size distribution with D[3,2] of about 20 μm or less.
10. The cementitious reagent of claim 1, wherein the particles have a size distribution with D[3,2] of about 10 μm or less.
11. The cementitious reagent of claim 1, wherein the particles are 100% non-crystalline.
12. A supplementary cementitious material comprising a cementitious reagent, the cementitious reagent comprising non-flyash microspheroidal glassy particles containing Si, Al, Fe, Ca, Mg, Na, and K, in which:

$$\frac{\text{Si}}{\text{Si} + \text{Al} + \text{Fe} + (\text{Ca} + \text{Mg}) + (\text{Na} + \text{K})} = 0.295 \text{ to about } 0.605$$

$$\frac{\text{Al}}{\text{Si} + \text{Al} + \text{Fe} + (\text{Ca} + \text{Mg}) + (\text{Na} + \text{K})} = 0.190 \text{ to about } 0.340$$

$$\frac{\text{Fe}}{\text{Si} + \text{Al} + \text{Fe} + (\text{Ca} + \text{Mg}) + (\text{Na} + \text{K})} = 0 \text{ to about } 0.16$$

$$\frac{\text{Ca} + \text{Mg}}{\text{Si} + \text{Al} + \text{Fe} + (\text{Ca} + \text{Mg}) + (\text{Na} + \text{K})} = 0 \text{ to about } 0.215$$

, and

$$\frac{\text{Na} + \text{K}}{\text{Si} + \text{Al} + \text{Fe} + (\text{Ca} + \text{Mg}) + (\text{Na} + \text{K})} = 0.04 \text{ to about } 0.24,$$

wherein the particles have a spheroidal morphology having a mean roundness (R) > 0.8; and

wherein the particles are at least 90% X-ray amorphous.

13. The supplementary cementitious material as in claim 12, wherein the cementitious reagent comprises at least 20 wt % of the supplementary cementitious material.

14. A method for producing a cementitious reagent from aluminosilicate materials, comprising the steps of:

providing a solid aluminosilicate material;

milling the solid aluminosilicate material to have a particle size distribution with $D[3,2]$ of less than $20\mu\text{m}$;

melting, by in-flight melting, of the aluminosilicate material in a kiln; and

quenching, by in-flight quenching, of the aluminosilicate material to produce solid microspheroidal glassy particles.

15. The method of claim 14, wherein the solid microspheroidal glassy particles having a mean roundness (R) of at least 0.8

16. The method of claim 14, wherein the cementitious reagent has a molar composition ratios of $(\text{Ca}, \text{Mg})_{0-12} \cdot (\text{Na}, \text{K})_{0.05-1} \cdot (\text{Al}, \text{Fe}^{3+})_1 \cdot \text{Si}_{1-20}$.

17. The method of claim 14, further comprising controlling an in-flight quenching profile to produce the solid microspheroidal glassy particles that are greater than 80% X-ray amorphous.

18. The method of claim 14, further comprising the step of adjusting composition of a non-ideal solid aluminosilicate material to a desired content of the elements Ca, Na, K, Al, Fe, and Si.

19. The method of claim 14, further comprising the step of locating the kiln at an aggregate quarry.

20. The method of claim 14, further comprising the step of locating the kiln at a concrete batch plant.