CLAIMS

1. An aggregate comprising:

a core-shell structure,

wherein the shell comprises:

a cement comprising ordinary Portland cement, wherein the ordinary Portland cement comprises microfine ordinary Portland cement, wherein the microfine ordinary Portland cement has a specific surface area of 750 m^2/kg or higher; and

a ground granulated blast-furnace slag, wherein the ground granulated blast-furnace slag comprises microfine ground granulated blast-furnace slag, wherein the microfine ground granulated blast-furnace slag has a specific surface area of 750 m^2/kg or higher;

and

wherein the core comprises bottom ash,

wherein the cement is hydrated in the presence of the ground granulated blast-furnace slag to have a calcium silicate hydrate or derivative thereof formed which encapsulates the bottom ash.

2. The aggregate of claim 1, wherein the ordinary Portland cement comprises lime (CaO), silica (SiO_2), alumina (Al_2O_3), iron (III) oxide (Fe_2O_3), and/or magnesia (MgO).

3. The aggregate of claim 1 or 2, wherein the ordinary Portland cement comprises lime and silica present in an amount of at least 50 wt%.

4. The aggregate of any one of claims 1 to 3, wherein the ground granulated blast-furnace slag comprises CaO, SiO_2, and/or MgO.

5. The aggregate of any one of claims 1 to 4, wherein the ground granulated blast-furnace slag comprises:

CaO present in an amount ranging from 30 to 50 wt%;

SiO_2 present in an amount ranging from 28 to 38 wt%; and

MgO present in an amount from 1 to 18 wt%.

6. The aggregate of any one of claims 1 to 5, wherein the bottom ash comprises bottom ash from any power plant and/or any incineration facility.

7. The aggregate of any one of claims 1 to 6, wherein the bottom ash comprises a heavy metal, a halide, and/or a volatile organic compound.

8. The aggregate of any one of claims 1 to 7, wherein the aggregate comprises at least about 40 wt% of the ordinary Portland cement.

9. The aggregate of any one of the claims 1 to 8, wherein the aggregate comprises at least about 10 wt% of the ground granulated blast-furnace slag.

10. The aggregate of any one of claims 1 to 9, wherein the calcium silicate hydrate or derivative thereof encapsulating the bottom ash has an average thickness ranging from 200 μm to 700 μm.

11. The aggregate of any one of claims 1 to 10, wherein the aggregate has an average diameter of 0.8 mm or more.

12. The aggregate of any one of claim 1 to 11, wherein the aggregate further comprises an additive, wherein the additive comprises bentonite, clay, carbon nanofiber, biochar, fly ash, and/or silica fume.

13. A method of producing the aggregate of any one of claims 1 to 12, the method comprising:

mixing the cement and the ground granulated blast-furnace slag with the bottom ash in the presence of water to form pre-coated bottom ash; and

granulating the pre-coated bottom ash.

14. The method of claim 13, further comprising:

contacting a bottom ash with water prior to mixing the cement and the ground granulated blast-furnace slag with the bottom ash; or

contacting a bottom ash with water prior to mixing the cement and the ground granulated blast-furnace slag with the bottom ash, wherein contacting the bottom ash with water comprises spraying the bottom ash with water.

15. The method of claim 13 or 14,

wherein granulating the pre-coated bottom ash is carried out for a duration of at least 3 minutes; or

wherein granulating the pre-coated bottom ash is carried out for a duration of at least 3 minutes, and wherein granulating the pre-coated bottom ash comprises granulating the pre-coated bottom ash in a granulator drum rotating at a speed of at least 100 rpm.

16. The method of claim 13, further comprising mixing the cement and the ground granulated blast-furnace slag with water to form a slurry prior to mixing the cement and the ground granulated blast-furnace slag with the bottom ash.

17. The method of claim 16, wherein granulating the pre-coated bottom ash comprises adding more cement to the pre-coated bottom ash.

18. The method of claim 16 or 17, further comprising pelletizing the pre-coated bottom ash after granulating the pre-coated bottom ash.

19. The method of any one of claims 13 to 18, further comprises curing the aggregate, wherein curing the aggregate comprises:

thermal treating the aggregate in a humidity chamber; and

conditioning the aggregate in water.

20. The method of claim 19, wherein curing the aggregate further comprises steaming the aggregate in the humidity chamber.