

CLAIMS

WHAT IS CLAIMED IS:

1. A composite material, comprising:
a cellulosic material characterized by one or more members selected from the group consisting of (i) at least a portion of the cellulosic material is delignified, (ii) at least a portion of crystal structure of the cellulosic material is maintained, and (iii) the cellulosic material comprises a plurality of pores; and
a binder material comprising lime, wherein the lime comprises calcium oxide or calcium hydroxide.
2. The composite material of claim 1, wherein the lime comprises calcium oxide and calcium hydroxide.
3. The composite material of any one of the preceding claims, wherein the binder material further comprises silica.
4. The composite material of any one of the preceding claims, wherein a weight ratio of the silica (S) and the lime (L) is between about 1:1 and about 1:5 (S:L).
5. The composite material of any one of the preceding claims, wherein a weight ratio of the silica (S) and the lime (L) is about 1:3 (S:L).
6. The composite material of any one of the preceding claims, wherein a weight ratio of the binder material (BM) to the cellulosic material (CM) is between about 1:10 and about 20:10 (BM:CM).
7. The composite material of any one of the preceding claims, wherein a weight ratio of the binder material (BM) to the cellulosic material (CM) is (i) between about 7:10 and about 15:10 (BM:CM) or (ii) between about 1:10 and about 2:10.
8. The composite material of any one of the preceding claims, wherein the binder material further comprises silicate.
9. The composite material of any one of the preceding claims, wherein the cellulosic material comprises one or more members selected from the group consisting of: a bast fiber, leaf, seed, fruit, grass, and wood.
10. The composite material of any one of the preceding claims, wherein the cellulosic material comprises a hemp bast fiber.
11. The composite material of any one of the preceding claims, wherein the cellulosic material characterized by two or more members selected from the group consisting of (i) at least a portion of the cellulosic material is delignified, (ii) at least a portion of crystal structure of the cellulosic material is maintained, and (iii) the cellulosic material comprises a plurality of pores.
12. The composite material of any one of the preceding claims, wherein the cellulosic

material characterized by (i) at least a portion of the cellulosic material is delignified, (ii) at least a portion of crystal structure of the cellulosic material is maintained, and (iii) the cellulosic material comprises a plurality of pores.

13. The composite material of any one of the preceding claims, wherein the composite material is characterized by having a density between about 1 pounds per cubic foot (lb/ft^3) and about 100 lbs/ft^3 .

14. The composite material of any one of the preceding claims, wherein the composite material is characterized by having a density between about 1 lb/ft^3 and about 30 lbs/ft^3 .

15. The composite material of any one of the preceding claims, wherein the composite material has a density between about 5 lb/ft^3 and 25 lb/ft^3 .

16. The composite material of any one of the preceding claims, wherein the composite material is characterized by having a density of at least about 5 lbs/ft^3 .

17. The composite material of any one of the preceding claims, wherein the composite material is usable as a thermal or acoustic insulator for a building.

18. The composite material of any one of the preceding claims, wherein the composite material exhibits a biocidal activity against a microorganism.

19. The composite material of any one of the preceding claims, wherein the cellulosic material exhibits enhanced shelf-life as compared to a cellulosic material that does not exhibit the characterization.

20. A method for generating a composite material, comprising

- (a) providing (1) a cellulosic material characterized by one or more members selected from the group consisting of: (i) at least a portion of the cellulosic material is delignified, (ii) at least a portion of crystal structure of the cellulosic material is maintained, and (iii) the cellulosic material comprises a plurality of pores and (2) a binder material comprising lime, wherein the lime comprises calcium oxide or calcium hydroxide; and
- (b) mixing the cellulosic material and the binder material, to generate the composite material.

21. The method of any one of the preceding claims, wherein the cellulosic material is at least partially dried by an external pressure or heat.

22. The method of claim 21, wherein the cellulosic material is at least partially dried in absence of an external source of heat.

23. The method of any one of the preceding claims, wherein the lime comprises calcium oxide and calcium hydroxide.

24. The method of any one of the preceding claims, wherein the binder material further

comprises silica.

25. The method of any one of the preceding claims, wherein a weight ratio of the silica (S) and the lime (L) is between about 1:1 and about 1:5 (S:L).
26. The method of any one of the preceding claims, wherein a weight ratio of the silica (S) and the lime (L) is about 1:3 (S:L).
27. The method of any one of the preceding claims, wherein a weight ratio of the binder material (BM) to the cellulosic material (CM) is between about 1:10 and about 20:10 (BM:CM).
28. The method of any one of the preceding claims, wherein a weight ratio of the binder material (BM) to the cellulosic material (CM) is (i) between about 7:10 and about 15:10 (BM:CM) or (ii) between about 1:10 and about 2:10.
29. The method of any one of the preceding claims, further comprising exposing the mixture in (b) to an external stimulus to transform the binding material into a cementitious material.
30. The method of claim 29, wherein the external stimulus comprises one or more members selected from the group consisting of: carbonation, hydration, pressure, and heat.
31. The method of claim 29, wherein the external stimulus comprises hydration.
32. The method of claim 29, wherein the cementitious material comprise silicate.
33. The method of any one of the preceding claims, wherein the cellulosic material comprises one or more members selected from the group consisting of: a bast fiber, leaf, seed, fruit, grass, and wood.
34. The method of any one of the preceding claims, wherein the cellulosic material comprises a hemp bast fiber.
35. The method of any one of the preceding claims, wherein the composite material is characterized by having a density between about 1 pounds per cubic foot (lb/ft³) and about 100 lbs/ft³.
36. The method of any one of the preceding claims, wherein the composite material is characterized by having a density between about 1 lb/ft³ and about 30 lbs/ft³.
37. The method of any one of the preceding claims, wherein the composite material has a density between about 5 lb/ft³ and 25 lb/ft³.
38. The method of any one of the preceding claims, wherein the composite material is characterized by having a density of at least about 5 lbs/ft³.
39. The method of any one of the preceding claims, wherein the composite material is usable as a thermal or acoustic insulator for a building.
40. The method of any one of the preceding claims, wherein the composite material exhibits a biocidal activity against a microorganism.

41. The method of any one of the preceding claims, wherein the cellulosic material exhibits enhanced shelf-life as compared to a cellulosic material that does not exhibit the characterization.