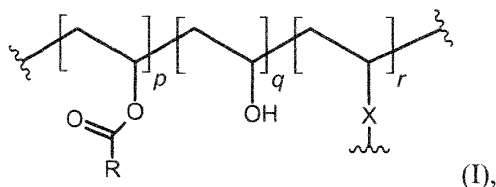


Claims

1. A waterborne sizing composition for treating natural fibers used as reinforcing material in thermoplastic, comprises:

(a) a polymeric material having a structure (I)



wherein,

R represents an alkyl group,

X represents a reversible covalently bonded crosslinkable group,

10 p, q, and r represent order on main polymer chain, wherein the total sum of order greater than 50;

(b) a water-soluble metal complex having an antimicrobial property; and

(c) a redox active water-soluble compound.

2. The composition according to claim 1, wherein R is selected from a linear alkyl group, a branched alkyl group, or a cyclic alkyl group.

15 3. The composition according to claim 2, wherein R is a linear alkyl group selected from methyl group or propyl group.

4. The composition according to claim 1, wherein X is reversible covalently bonded crosslinkable group obtained from a mixture of boric acid and dialdehydes.

20 5. The composition according to claim 4, wherein the ratio of boric acid to dialdehydes is in a range of 1:2 – 1:4 based on the mole basis.

6. The composition according to claim 4 or 5, wherein the dialdehydes are selected from glyoxal, succindialdehyde, glutaraldehyde, or a mixture thereof.

7. The composition according to claim 1, wherein the total sum of p, q, and r orders is more than 100.

25 8. The composition according to claim 1 or 7, wherein the percentage of p order is 70 – 90 %; q order 10 – 30 %, and r order 0.02 – 1.25 % based on 100 % of the total sum of p, q, and r orders.

9. The composition according to claim 1, wherein the water-soluble metal complex is selected from copper complexes, silver complexes, or mixture thereof.

10. The composition according to claim 1 or 9, wherein the water-soluble metal complex comprises ligand selected from polyamines or aminocarboxylates.

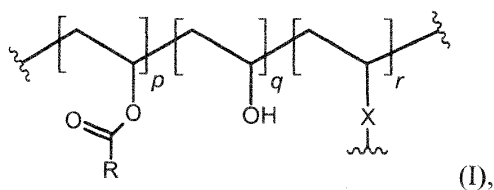
5 11. The composition according to claim 1, wherein the redox active water-soluble compound is selected from aldohexoses, aldopentoses, or mixture thereof.

12. The composition according to claim 1, wherein further comprises the polymeric material from 7 to 15 weight by volume percentage (% w/v), the water-soluble metal complex from 50 – 750 parts per million (ppm), and the redox active water-soluble compound from
10 100 – 1500 parts per million (ppm).

13. A preparation process of natural fibers used as reinforcing material in thermoplastic, comprises the following steps:

(1) coating the natural fibers with the waterborne sizing composition comprising:

(a) the polymeric material having structure (I)



wherein,

R represents an alkyl group,

X represents a reversible covalently bonded crosslinkable group,

20 p, q, and r represent order on main polymer chain, wherein the total sum of order greater than 50;

(b) the water-soluble metal complex having an antimicrobial property; and

(c) the redox active water-soluble compound; and

(2) drying the natural fibers obtained from (1) by heating and cutting into suitable sizes for using.

25 14. The process according to claim 13, wherein R is selected from a linear alkyl group, a branched alkyl group, or a cyclic alkyl group.

15. The process according to claim 14, wherein R is a linear alkyl group selected from methyl group or propyl group.

16. The process according to claim 13, wherein X is a reversible covalently bonded crosslinkable group obtained from mixture of boric acid and dialdehydes.

17. The process according to claim 16, wherein the ratio of boric acid to dialdehydes is in a range of 1:2 – 1:4 on the mole basis.

5 18. The process according to claim 16 or 17, wherein the dialdehydes is selected from glyoxal, succindialdehyde, glutaraldehyde, or mixture thereof.

19. The process according to claim 13, wherein the total sum of p, q, and r orders greater than 100.

10 20. The process according to claim 13 or 19, wherein the percentage of p order is 70 – 90 %; q order 10 – 30 %, and r order 0.02 – 1.25 % based on 100 % of the total sum of p, q, and r orders.

21. The process according to claim 13, wherein the water-soluble metal complex is selected from copper complexes, silver complexes, or mixture thereof.

15 22. The process according to claim 13 or 21, wherein the water-soluble metal complex comprises ligands selected from polyamines or aminocarboxylates.

23. The process according to claim 13, wherein the redox active water-soluble compound is selected from aldohexoses, aldopentoses, or mixture thereof.

20 24. The process according to claim 13, further comprising the polymeric material from 7 to 15 weight by volume percentage (% w/v), the water-soluble metal complex from 50 – 750 parts per million (ppm), and the redox active water-soluble compound from 100 – 1500 parts per million (ppm).

25. The process according to claim 13, wherein the coating of the natural fibers in step (1) is performed by immersing the natural fibers in said waterborne sizing composition at the temperature lower than 50 °C.

25 26. The process according to claim 25, wherein coating of the natural fibers is operated at ambient temperature.

27. The process according to claim 13, wherein drying by heating in step (2) is operated at the temperature equal or higher than 80 °C.

30 28. The process according to claim 27, wherein drying by heating is operated at the temperature in a range of 80 to 140 °C.

29. The process according to any one of claims 13 to 28, wherein the natural fibers are cellulosic fibers from raw fibers or treated fibers.

30. The process according to claim 29, wherein the natural fibers are selected from kenaf, jute, hemp, or mixture thereof.

5 31. The natural fibers obtained from the process according to any one of claims 13 to 30.

32. A composites materials comprises the natural fibers according to claim 31 and polyolefins.

10 33. The composites materials according to claim 32, wherein polyolefin is selected from polyethylene, polypropylene, copolymers thereof, or mixture thereof.