Claims

1. A method of fabricating a silica aerogel blanket, comprising the steps of:

   i) providing incineration bottom ash;

   ii) pre-treating the incineration bottom ash with a pre-treatment acid;

   iii) extracting silica from the incineration bottom ash in the presence of a base to form a water glass;

   iv) diluting the water glass in deionized water at a ratio in the range of 1:2 to 3:4 by volume;

   v) adjusting pH value of the diluted water glass to form a silica gel;

   vi) aging the silica gel;

   vii) crushing the aged silica gel into a powder; and

   viii) contacting the powdered silica gel with a fibre to form the silica aerogel blanket,

   wherein the pre-treatment step ii) comprises irradiating the incineration bottom ash in the presence of the pre-treatment acid with microwaves at a temperature in the range of 160 °C to 200 °C for a duration in the range of 30 minutes to 2 hours; and

   wherein the extraction step iii) comprises irradiating the incineration bottom ash in the presence of the base with microwaves at a temperature in the range of 160 °C to 220 °C for a duration in the range of 30 minutes to 2 hours.

2. The method according to claim 1, further comprising the step of drying the incineration bottom ash at a temperature in the range of 50 °C to 100 °C before step iii) and/or the step of grinding the incineration bottom ash to a particle size of less than 200 µm before step iii).

3. The method according to claim 1 or 2, wherein the base comprises a metal, wherein the base is contacted with Y g of incineration bottom ash having X percent by weight of silicon, wherein Y is the mass of the incineration bottom ash in grams,

   wherein the mass of the base (m_{base}) to be used in the extraction step is described by the following equation (Ia):

   $$m_{base} = \frac{Y \times X}{30 \times a} \times MW_{base} \qquad \text{(Ia)}$$

   wherein MW_{base} is the molecular weight of the base; a is the ionic charge of the metal of the base; and

the volume of the base dissolved in deionised water to form a solution (V_{base}), to be used in the extraction step is described by the following equation (Ib):

$$V_{base} = \frac{Y \times X}{30 \times a \times M_{base}} \qquad \text{(Ib)},$$

wherein M_{base} is the molar concentration of the base and a is the ionic charge of the metal of the base.

4. The method according to any one of the preceding claims, wherein the pH adjustment step further comprises the step of adding a pH-adjusting acid to the diluted water glass until the pH is in the range of 8 to 11, to form the silica gel.

5. The method according to any one of the preceding claims, further comprising the step of purifying the water glass on a strongly acidic ion exchange resin to collect silicic acid.

6. The method according to any one of the preceding claims, further comprising the step of adding a pH-adjusting base to the silicic acid until the pH is in the range of 3 to 6 to form the silica gel.

7. The method according to any one of the preceding claims, further comprising the step of surface modifying the aged silica gel before or after contacting with the fibre.

8. The method according to claim 7, wherein the step of surface modification is performed by reacting the aged silica gel with an organosilicon compound.

9. The method according to claim 7 or 8, wherein:

the step of surface modification is performed after contacting the silica gel with the fibre, and the silica aerogel blanket is immersed in a mixture of organosilicon compound, an alcohol and an alkyl having 6 or more carbon atoms, wherein:

- the molar ratio of organosilicon compound:silica is in the range of 3:1 to 1:1;

- the molar ratio of organosilicon compound:alcohol is in the range of 2:1 to 1:2; and

- the ratio of alkyl having 6 or more carbon atoms: organosilicon compound by volume is in the range of 10:1 to 15:1; or

the step of surface modification is performed before contacting the silica gel with the fibre, and the aged silica gel is immersed in a mixture of organosilicon compound in a surface modification solvent, wherein:

- the ratio of the surface modification solvent:aged silica gel is 1:1 to 6:1 by volume; and

- the molar ratio of silica:organosilicon compound is in the range of 1:10 to 1:2.

10. The method according to any one of claims 7 to 9, wherein the step of surface modification is performed at a temperature in the range of 30 ˚C to 50 ˚C for a duration in the range of 2 hours to 36 hours with or without stirring.

11. The method according to claim 9 or 10, wherein when the surface modification is performed before contacting the silica gel with the fibre, the surface modified silica gel is separated from the surface modification solvent and dispersed in an alcohol or an alkyl having 6 or more carbon atoms before being contacted with the fibre.

12. The method according to any one of the preceding claims, wherein the fibre is selected from the group consisting of glass microfibres, mineral microfibres, ceramic micro and nanofibres, nanotubes, polypropylene microfibres, aramid microfibres, carbon micro and nanofibres, carbon nanotubes and cotton nanofibres.

13. The method according to any one of the preceding claims, wherein the fibre is in the form of separate strands or is woven into a sheet.

14. The method according to any one of the preceding claims, further comprising the step of heating the fibre at a temperature in the range of 350 °C to 500 °C before step viii).

15. The method according to claim 14, further comprising the step of washing and wringing the fibre after the heating step.

16. The method according to claim 15, further comprising the step of placing the fibre into a mould before contacting with the silica gel.