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- (54) Benævnelse: **Varmeisoleringssammensætning til forbedring af varmeisolerings- og lydtæthedsfunktioner, indeholdende aerogel, og fremgangsmåde til fremstilling af varmeisoleringstekstil ved anvendelse af denne**
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Fortsættes ...

DESCRIPTION

Technical Field

[0001] The present invention relates generally to material compositions with improved heat insulation and soundproofing properties, and more specifically to material compositions containing aerogel with improved heat insulation and soundproofing properties, methods for manufacturing such material compositions, and methods for manufacturing fabrics using such material compositions.

Background

[0002] Generally, aerogel, made of silicon oxide (SiO_2), has been recognized as a novel material, which has drawn attention, since its discovery in the 1930s, as an insulation material, an impact absorbing material, and a soundproofing material, etc. as it is resistant to heat, electricity, sound, and impact, etc., and is only three times as heavy as air of the same volume. In addition, aerogel is formed of silicon oxide threads having a diameter of one ten-thousandth of human hair, tangled extremely sparsely, and air molecules occupy the space between threads, and air accounts for 98% of the total volume. Because aerogel has very low heat conductivity, it is highly favored as a heat insulation material.

[0003] However, as described above, aerogel has low mechanical stability due to its high porosity and low density, and it was not easy to include aerogel in a heat insulator.

[0004] Korean Patent No. 0998474 discloses a technique addressing the above. In short, the patent describes aerogel and a polymer coating a part or an entire surface of aerogel.

[0005] However, when the polymer penetrates into the inside of aerogel, porosity is reduced and its heat insulation property is significantly decreased. In addition, other properties of aerogel were also adversely affected. Therefore, there is a demand for a material composition capable of using and/or improving heat insulation properties and other properties of aerogel.

[0006] US2005/100728 A1 discloses a material comprising aerogel particles and a polytetrafluoroethylene (PTFE) binder. The material is formed having a thermal conductivity of less than or equal to 25 mW/m K at atmospheric conditions.

[0007] US5948314 discloses a composition comprising between 30 and 95% by volume of aerogel particles and at least one aqueous binder, where the particle diameter of the aerogel particles is less than 0.5 mm and the aerogel particles preferably have hydrophobic surface groups.

[0008] WO03/064025 A1 discloses a heat resistant aerogel insulation composite comprising an insulation base layer comprising hydrophobic aerogel particles and an aqueous binder, and a thermally reflective top layer comprising a protective binder and an infrared reflecting agent.

[0009] WO03/097227 A1 discloses an aerogel-hollow particle binder composition comprising an aqueous binder, hydrophobic aerogel particles, and hollow, non-porous particles.

[0010] EP1787716 A1 discloses a heat resistant aerogel insulation composite comprising an insulation base layer comprising hydrophobic aerogel particles and an aqueous binder, and a thermally reflective top layer comprising a protective binder and an infrared reflecting agent.

Summary of the Invention

[0011] It is an objective of the present invention to provide a heat insulating material composition containing aerogel with heat insulation and soundproofing properties, the heat insulating material composition prepared by mixing adhesive binder and an additive including carbon black powder with aerogel powder for further improving heat insulation and soundproofing properties, and a method for manufacturing a heat insulation fabric using the same.

[0012] The present invention provides a heat insulating material composition as set out in claim 1.

[0013] The heat insulating material composition includes 80 to 100 parts by weight of the solvent, 3 to 5 parts by weight of the aerogel powder, 1 to 2 parts by weight of the adhesive binder, and 1 to 5 parts by weight of the carbon black.

[0014] The carbon black powder may have a particle with a diameter of 10 μm or less and a density of 0.06 to 0.15 g/cm^3 .

[0015] The adhesive binder may include at least one of celluloses, starches, epoxies, polyvinyl alcohol, urethanes, and carboxymethylcellulose (CMC).

[0016] In some embodiments, the additive includes at least one type of mineral oxides (e.g., inorganic oxides), such as titanium dioxide, silicon carbide, and/or iron hydroxide (e.g., hematite or magnetite), and the mineral oxide has a particle with a diameter of 10 μm or less and is added in a weight ratio of 1 to 5 with respect to the mixture of the solvent, adhesive binder, aerogel powder, and carbon black powder.

[0017] In some embodiments, the additive includes a porous mineral oxide (e.g., inorganic oxide), such as fumed silica or glass bubbles.

[0018] In some embodiments, the additive includes an aqueous acrylic resin in a weight ratio of 3 or less with respect to the mixture of the solvent, adhesive binder, aerogel powder, and carbon black powder.

[0019] In some embodiments, the additive includes ethylene glycol or propylene glycol, which is antifreeze.

[0020] Meanwhile, in accordance with the present invention, a method for manufacturing a heat insulation fabric using the composition, containing aerogel, for improving heat insulation and soundproofing properties of a fabric, includes step 10 of manufacturing the heat insulation composition (S10), wherein in S10 80 to 100 parts by weight of the solvent, 1 to 2 parts by weight of the adhesive binder, 3 to 5 parts by weight of the aerogel powder, and 1 to 5 parts by weight of the carbon black powder are mixed; step 20 of coating the heat insulation composition on the outer surface of the moving fabric (S20); and step 30 of applying pressure to the outer surface of the fabric, for the heat insulation composition to be absorbed into the inside of fabric (S30). Step 10 (S10) includes step 11 of preparing an aqueous binder mixture by mixing solvent and adhesive binder (S11); step 12 of adding a first additive to the aqueous binder mixture and mixing (S12); step 13 of adding aerogel powder to the aqueous binder mixture and dispersing (S13); step 14 of adding a second additive to the dispersion where the aerogel powder and first additive are mixed with the aqueous binder mixture (S14); and step 15 of adding carbon black powder in a state where the second additive is mixed and dispersing (S15).

[0021] In step 10 (S10), 80 to 100 parts by weight of water as the solvent, 1 to 2 parts by weight of CMC as the additive binder, 3 to 5 parts by weight of the aerogel powder, and 1 to 5 parts by weight of the carbon black powder with a particle of 10 μm or less and a density of 0.06 to 0.15g/cm³ are mixed.

[0022] Also, in step 12 (S12), as the first additive, at least one of an aqueous acrylic resin, porous mineral oxide powder (e.g., inorganic oxide powder) including fumed silica and/or glass bubble, and antifreeze including at least one of ethylene glycol and propylene glycol is added in a weight ratio of 1 to 2 with respect to the mixture of the solvent, adhesive binder, aerogel powder, and carbon black powder.

[0023] Also, in step 14 (S14), as the second additive, at least one of mineral oxide (e.g., inorganic oxide) with a particle of 10 μm or less including rutile titanium dioxide, silicon carbide, and hematite and magnetite is added in a weight ratio of 1 to 5 with respect to the mixture of the solvent, adhesive binder, aerogel powder, and carbon black powder.

[0024] Further, in step 30 (S30), a roller is prepared similar or greater than a width of the fabric, and arranged to contact both surfaces or one surface of the fabric, for the heat insulation composition to be absorbed into the fabric with the pressure of the roller, or a blade is prepared similar or greater than a width of the fabric and with an elastic lower part having a sharp-shaped side, wherein the lower part is bent to contact the transferred fabric, and applies

pressure to the fabric, for the heat insulation composition to be absorbed into the fabric.

[0025] As described above, according to the present invention, heat insulation properties are enhanced at an extremely low temperature by adding the carbon black powder to the composition containing aerogel.

[0026] Heat insulation properties at a high temperature are enhanced by adding to the composition one or at least one of titanium dioxide (TiO_2), silicon carbide (SiC), and iron hydroxide, such as hematite (Fe_2O_3) and magnetite (Fe_3O_4).

[0027] In addition, heat insulation and soundproofing properties are enhanced while maintaining pores open after drying the composition, by adding to the composition porous mineral oxide (e.g., inorganic oxide), such as fumed silica and glass bubbles.

[0028] In addition, by adding ethylene glycol or propylene glycol to the composition, surface cracking is prevented or reduced when drying the composition, and the rate of drying the composition can be controlled by adjusting the amount of the additive.

Brief description of drawings

[0029] The accompanying drawings attached to the specification illustrate embodiments of the present invention, which, when viewed in conjunction with the detailed description of the invention, assist better understanding of the technical aspects of the present invention. However, the drawings should not be construed to limit the scope of the present invention.

[0030] Fig. 1 is a flow chart illustrating a method for manufacturing a heat insulation fabric using a heat insulation composition, containing aerogel, with improved heat insulation and soundproofing properties, according to an embodiment of the present invention.

<Composition>

[0031] A heat insulation composition with improved heat insulation and soundproofing properties, containing aerogel, according to the present invention is prepared by mixing aerogel powder, carbon black powder, adhesive binder, and an additive with solvent.

[0032] The heat insulation composition according to the present invention is prepared by mixing 3 to 5 parts by weight of the aerogel powder, 1 to 2 parts by weight of the adhesive binder, 1 to 5 parts by weight of the carbon black powder, and the additive with 80 to 100 parts by weight of the solvent.

[0033] The solvent is water, which is readily available.

[0034] Aerogel, which is highly porous nanospheres, is good at insulating heat, electricity, sound, and impact, and has a low weight. Thus, aerogel has been recognized as a next-generation heat insulation material that can replace the conventional construction insulation material, such as glass fiber. Aerogel is expected to reduce heating and cooling energy by 30 to 50%, and is currently used in various applications ranging from LNG ships, automobiles, airplanes, and pipes for exploring offshores, to thin ski jackets, boots, gloves, flame retardant super insulation materials, spacesuits, spacecraft, special armor against impact, and impact shielding films, etc. However, aerogel is fragile, easily breakable, and can be well absorbed, thereby inappropriate to be used alone. The present invention aims to manufacture a composition with improved soundproofing performance in addition to heat insulation performance, while minimizing its disadvantages, by using the powder of aerogel.

[0035] Also, as the adhesive binder, which is a material providing adhesion to the aerogel powder and carbon black powder, at least one of celluloses, starches, epoxies, polyvinyl alcohol and urethanes is used. Particularly, CMC is preferably used.

[0036] Also, the addition of an aqueous acrylic resin to the adhesive binder inhibits scattering of the powder such as the aerogel powder, carbon black powder, and additive, etc., after drying the fabric coated with the heat insulation composition according to the present invention, and particularly it is excellent in inhibiting scattering of the aerogel powder. Here, the aqueous acrylic resin is added in a weight ratio of 3 or less with respect to the mixture of the solvent, adhesive binder, aerogel powder, and carbon black powder.

[0037] Also, when the heat insulation composition according to the present invention is coated on the fabric and dried, surface cracking can be prevented or reduced by adding antifreeze, such as ethylene glycol and/or propylene glycol, to the adhesive binder, and the rate of drying can be controlled by adjusting the amount of the antifreeze.

[0038] Carbon black, which is a micro carbon powder in black, is typically obtained by partially combusting hydrocarbon in the form of soot. The carbon black powder has the particle size of 1 to 500 μm , which is similar to that of graphite, and is a crystalline material with lower regularity than graphite. Industrially, the carbon black particle is manufactured by collecting soot generated from incomplete combustion of natural gas, tar, etc., or pyrolyzing it. The carbon black powder has porous properties with nanopores and enhances a heat insulation effect in an extremely low-temperature region. In order to maximize the effect, the carbon black powder introduced into the present invention has the particle size of 10 μm or less, and the density of 0.06 to 0.15 g/cm^3 , preferably about 0.1 g/cm^3 .

[0039] Further, as the additive, at least one of mineral oxide (e.g., inorganic oxide) including titanium dioxide (TiO_2), silicon carbide (SiC), and hematite (Fe_2O_3) and magnetite (Fe_3O_4), etc. as the type of iron hydroxide is used. Here, the mineral oxide has the particle size of 10 μm or less, and is added in a weight ratio of 1 to 5 with respect to the mixture of the solvent, adhesive binder, aerogel powder, and carbon black powder. At this time, rutile titanium dioxide is used as

titanium dioxide. The reason of using the mineral oxide as the additive is that the mineral oxide can enhance a heat insulation effect at a high-temperature region.

[0040] In addition, as the additive, porous mineral oxide (e.g., porous inorganic oxide) including fumed silica, glass bubble is further included, and the porous mineral oxide is added in powder form. When the heat insulation composition according to the present invention is coated on the fabric and dried, with the additive, heat insulation and soundproofing effects can be enhanced by maintaining pores of the heat insulation composition coated.

<Manufacturing method>

[0041] Fig. 1 is a flow chart illustrating a method for manufacturing a heat insulation fabric using a heat insulation composition, containing aerogel, with improved heat insulation and soundproofing properties, according to a preferred embodiment of the present invention.

[0042] As illustrated in Fig. 1, the method for manufacturing a heat insulation fabric using the heat insulation composition according to the present invention first includes manufacturing the heat insulation composition (S10). In this step, water as solvent, adhesive binder, aerogel, carbon black powder, and various additives are introduced and stirred at a velocity of about 500 to 700 rpm for manufacturing the composition. This step is described in detail.

[0043] First, an aqueous binder mixture is prepared by mixing the solvent and the adhesive binder (S11). At this time, 1 to 2 parts by weight of the additive binder CMC is mixed with 90 parts by weight of water and stirred.

[0044] Next, a first additive is introduced into the aqueous binder mixture and mixed (S12).

[0045] Here, as the first additive, an aqueous acrylic resin is added to the aqueous binder mixture, and the aqueous acrylic resin is added in a weight ratio of 3 or less, for example in a weight ratio of 1 to 2, with respect to the mixture of the solvent, adhesive binder, aerogel powder, and carbon black powder. The aqueous acrylic resin inhibits scattering of powder materials to be mixed later.

[0046] Further, as the first additive, the antifreeze, such as ethylene glycol and/or propylene glycol, is further added to the aqueous binder mixture. The ethylene glycol or propylene glycol prevents or inhibits surface cracking when the heat insulation composition according to the present invention is coated on the fabric and dried, and the drying velocity is controlled by adjusting an addition amount as needed.

[0047] In addition, as the first additive, porous mineral oxide powder (e.g., porous inorganic oxide powder) including fumed silica, glass bubble, etc. is added to the aqueous binder mixture. The porous powder maintains pores even after the heat insulation composition according to the present invention is coated on the fabric and dried, thereby enhancing heat

insulation and soundproofing effects. As such, the aqueous binder mixture is prepared by mixing the solvent, adhesive binder, and various additives.

[0048] Next, aerogel powder is added to the aqueous binder mixture and dispersed (S13). Here, 3 to 5 parts by weight of the aerogel powder is added to the aqueous binder mixture and stirred. At this time, the scattering of the aerogel powder is inhibited by the aqueous acrylic resin. Further, when the aerogel powder is directly dispersed in the solvent, the dispersion is not performed well, and the aerogel powder is thick on the upper part of the solvent for having no viscosity. In order to prevent this state, aerogel is introduced into the aqueous binder mixture where adhesive binder is mixed with the solvent, and dispersed.

[0049] Next, a second additive is introduced into the dispersion where the aerogel powder and first additive are mixed with the aqueous binder mixture and mixed (S14). As the second additive, mineral oxide, such as one or at least one of titanium dioxide (TiO₂), silicon carbide

[0050] (SiC), and iron hydroxide, such as hematite (Fe₂O₃) and magnetite (Fe₂O₄), is mixed and introduced. At this time, the mineral oxide has a particle of a diameter of 10 μm or less, and is added in a weight ratio of 1 to 5 with respect to the mixture of the solvent, adhesive binder, aerogel powder, and carbon black powder. The mineral oxide with the size of micro particle enhances a heat insulation effect at a high-temperature region.

[0051] Finally, carbon black powder is added and dispersed (S15). Here, 1 to 5 parts by weight of the carbon black powder is added. Further, the scattering of the carbon black powder is inhibited by the aqueous acrylic resin. At this time, the carbon black powder has a particle of about 10 μm or less and a density of about 0.06 to 0.15g/cm³.

[0052] Next, the thus-prepared composition is coated on the outer surface of the transferred fabric (S20).

[0053] Finally, the outer surface of the fabric coated with the composition is pressurized by a roller or blade (S30). Thereby, the composition coated on the outer surface of the fabric is absorbed into the inside of fabric.

[0054] Here, a roller is arranged to contact both surfaces or one surface of the fabric, for the heat insulation composition to be absorbed into the fabric with the pressure of the roller. Of course, the roller has a length similar or greater than that of the fabric.

[0055] As another example, a blade is prepared with an elastic lower part having a sharp-shaped side, and the lower part is bent to contact the transferred fabric in a wide area and applies predetermined pressure to the fabric, for the composition coated on the outer surface of the fabric to be absorbed into the inside of fabric. Of course, the blade has a length similar or greater than the fabric.

REFERENCES CITED IN THE DESCRIPTION

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Patentkrav

- 5 **1.** Sammensætning til forbedring af varmeisolering og lydtæthedsegenskaber hos et tekstil, hvor sammensætningen indeholder aerogel, fremstillet ved at blande opløsningsmiddel, aerogelpulver, klæbende bindemiddel og kønrøgpulver, hvor sammensætningen omfatter 80 til 100 vægtdele af opløsningsmidlet, 3 til 5 vægtdele af aerogelpulveret, 1 til 2 vægtdele af det klæbende bindemiddel og 1 til 5 vægtdele af kønrøgpulveret.
- 10 **2.** Sammensætning ifølge krav 1, hvor opløsningsmidlet er vand, og det klæbende bindemiddel er carboxymethylcellulose.
- 3.** Sammensætning ifølge krav 1, hvor kønrøgpulveret har en partikel med en diameter på 10 μm eller mindre og en massefylde på 0,06 til 0,15 g/cm^3 .
- 15 **4.** Sammensætning ifølge krav 1, hvor det klæbende bindemiddel omfatter mindst en af cellulosemidler, stivelsesmidler, epoxymidler, polyvinylalkohol og urethaner og carboxymethylcellulose.
- 20 **5.** Sammensætning ifølge krav 1, hvor der som et tilsætningsstof tilsættes mindst et mineraloxid udvalgt fra en gruppe af titaniumdioxid, silikonecarbide og jernhydroxid, og mineraloxidet har en partikel med en diameter på 10 μm eller mindre og tilsættes i et vægtforhold på 1 til 5 i forhold til blandingen af opløsningsmidlet, klæbende bindemiddel, aerogelpulver og kønrøgpulver.
- 25 **6.** Sammensætning ifølge krav 1, hvor der som et tilsætningsstof tilsættes porøst mineraloxid.
- 7.** Sammensætning ifølge krav 1, hvor der tilsættes en vandig acrylresin som et tilsætningsstof i et vægtforhold på 3 eller mindre i forhold til blandingen af opløsningsmidlet, klæbende bindemiddel, aerogelpulver og kønrøgpulver.
- 30 **8.** Sammensætning ifølge krav 1, hvor der som et tilsætningsstof yderligere tilsættes ethylenglycol eller propylenglycol.
- 35

9. Fremgangsmåde til fremstilling af et varmeisoleringsstekstil under anvendelse af sammensætningen ifølge krav 1, omfattende:

trin 10 med fremstilling af varmeisolerings sammensætningen (S10), hvor der i trin 10 (S10) blandes 80 til 100 vægtdele af opløsningsmidlet, 1 til 2 vægtdele af det klæbende bindemiddel, 3 til 5 vægtdele af aerogelpulveret og 1 til 5 vægtdele af kønrøgpulveret;

trin 20 med coating af varmeisolerings sammensætningen på den udvendige overflade af tekstilet, mens tekstilet bevæger sig (S20); og

trin 30 med påføring af et tryk på en udvendig overflade af tekstilet, for at varmeisolerings sammensætningen kan blive absorberet i en inderside af tekstilet (S30),

hvor trin 10 (S10) omfatter:

trin 11 med fremstilling af en vandig bindemiddelblanding ved at blande opløsningsmiddel og klæbende bindemiddel (S11);

trin 12 med tilsætning af et første tilsætningsstof til den vandige bindemiddelblanding og blanding (S12);

trin 13 med tilsætning af aerogelpulver til den vandige bindemiddelblanding og dispergering (S13);

trin 14 med tilsætning af et andet tilsætningsstof til dispersionen, hvor aerogelpulveret og det første tilsætningsstof blandes med den vandige bindemiddelblanding (S14); og

trin 15 med tilsætning af kønrøgpulver i en tilstand, hvor det andet tilsætningsstof blandes og dispergeres (S15).

10. Fremgangsmåde ifølge krav 9, hvor opløsningsmidlet er vand, det klæbende bindemiddel er carboxymethylcellulose, og kønrøgpulveret har en diameter på 10 μm eller mindre og en massefylde på 0,06 til 0,15 g/cm^3 .

11. Fremgangsmåde ifølge krav 9 eller 10, hvor der i trin 12 (S12), som det første tilsætningsstof, tilsættes mindst en af vandig acrylresin, porøs mineraloxidpulver omfattende røget silica og/eller glashulkugler, og antifrostmiddel af ethylenglycol og/eller propylenglycol i et vægtforhold på 1 til 2 i forhold til blandingen af opløsningsmidlet, klæbende bindemiddel, aerogelpulver og kønrøgpulver.

5 **12.** Fremgangsmåde ifølge krav 9 eller 10, hvor der i trin 14 (S14), som det andet tilsætningsstof, tilsættes mindst et mineraloxid udvalgt fra en gruppe omfattende rutiltitaniumdioxid, silikonecarbide og hematit og magnetit, med en partikel med en diameter på 10 μm eller mindre, i et vægtforhold på 1 til 5 i forhold til blandingen af opløsningsmidlet, klæbende bindemiddel, aerogelpulver og kønrøgpulver.

10 **13.** Fremgangsmåde ifølge krav 9, hvor i trin 30 (S30), en rulle har en bredde, som ligner eller er større end en bredde af tekstilet, og er indrettet til at berøre begge overflader eller en overflade, for at varmeisolerings sammensætningen kan blive absorberet i tekstilet ved hjælp af trykket fra rullen, og en klinge tilvejebringes, så den ligner eller er større end en bredde af tekstilet og med en elastisk nedre del, som har en skarpt formet side, hvor den nedre del bøjes for at berøre det overførte tekstil, og påfører tryk på tekstilet, for at varmeisolerings sammensætningen kan blive absorberet i tekstilet.
15

DRAWINGS

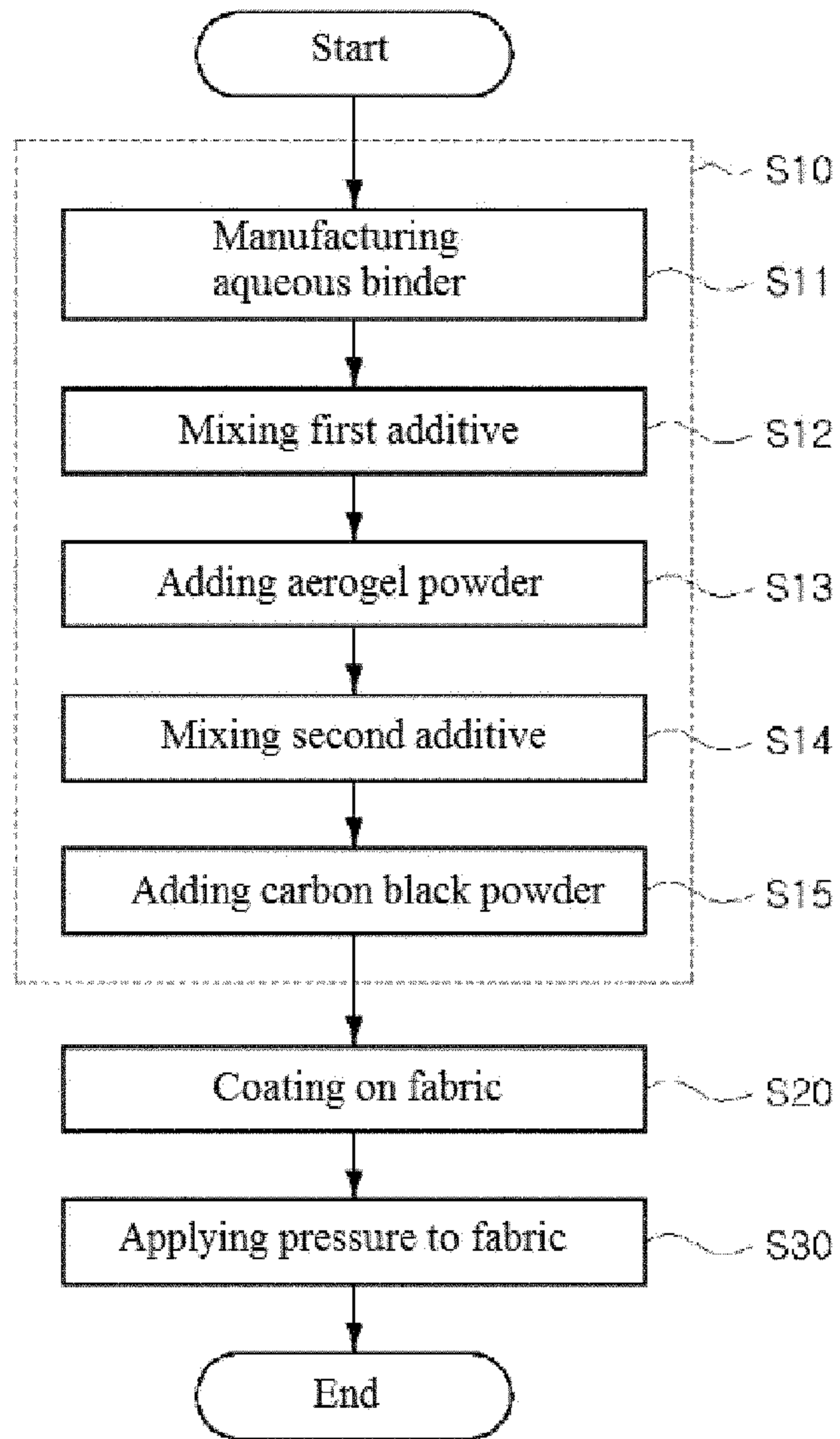


Figure 1