



(86) Date de dépôt PCT/PCT Filing Date: 1999/05/27
(87) Date publication PCT/PCT Publication Date: 1999/12/09
(45) Date de délivrance/Issue Date: 2011/07/19
(85) Entrée phase nationale/National Entry: 2000/11/29
(86) N° demande PCT/PCT Application No.: GB 1999/001676
(87) N° publication PCT/PCT Publication No.: 1999/062834
(30) Priorité/Priority: 1998/06/01 (GB9811663.5)

(51) Cl.Int./Int.Cl. *C03C 3/16* (2006.01),
C03C 13/00 (2006.01), *C03C 3/19* (2006.01),
C03C 3/247 (2006.01), *C03C 4/00* (2006.01)
(72) Inventeur/Inventor:
HEALY, DAVID MICHAEL, GB
(73) Propriétaire/Owner:
TYCO HEALTHCARE GROUP LP, US
(74) Agent: FETHERSTONHAUGH & CO.

(54) Titre : COMPOSITIONS POUR LA FORMATION DE VERRE HYDROSOLUBLE
(54) Title: WATER SOLUBLE GLASS COMPOSITION

(57) **Abrégé/Abstract:**

A composition for a water soluble glass is described. The composition is unusual in that it contains no or very small quantities (up to 5 mole %) of alkali earth metal compounds. The composition typically comprises P_2O_5 : 40 to 60 mole %; B_2O_3 : 0 to 10 mole %; Na_2O : 30 to 40 mole %; K_2O : 5 to 10 mole %; Ag_2O : 0 to 5 mole %; and up to a total of 5 mole % of other compounds such as CaO , MgO etc. The composition is especially suitable for processing into water soluble glass fibres or wool since the melting point is very low, usually less than 350 °C.



**PCT**WORLD INTELLECTUAL PROPERTY ORGANIZATION
International Bureau

INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification ⁶ : C03C 3/16, 3/19, 3/247, 4/00, 13/00	A1	(11) International Publication Number: WO 99/62834 (43) International Publication Date: 9 December 1999 (09.12.99)
(21) International Application Number: PCT/GB99/01676 (22) International Filing Date: 27 May 1999 (27.05.99) (30) Priority Data: 9811663.5 1 June 1998 (01.06.98) GB (71) Applicant (for all designated States except US): GILTECH LIMITED [GB/GB]; 9/12 North Harbour Estate, Ayr KA8 8AA (GB). (72) Inventor; and (75) Inventor/Applicant (for US only): HEALY, David, Michael [IE/GB]; Midton House, By Alloway, Ayr KA7 4EG (GB). (74) Agent: MURGITROYD & COMPANY; 373 Scotland Street, Glasgow G5 8QA (GB).		(81) Designated States: AE, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CU, CZ, DE, DK, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, UA, UG, US, UZ, VN, YU, ZA, ZW, ARIPO patent (GH, GM, KE, LS, MW, SD, SL, SZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG). Published <i>With international search report.</i> <i>Before the expiration of the time limit for amending the claims and to be republished in the event of the receipt of amendments.</i>
(54) Title: WATER SOLUBLE GLASS COMPOSITION (57) Abstract A composition for a water soluble glass is described. The composition is unusual in that it contains no or very small quantities (up to 5 mole %) of alkali earth metal compounds. The composition typically comprises P₂O₅: 40 to 60 mole %; B₂O₃: 0 to 10 mole %; Na₂O: 30 to 40 mole %; K₂O: 5 to 10 mole %; Ag₂O: 0 to 5 mole %; and up to a total of 5 mole % of other compounds such as CaO, MgO etc. The composition is especially suitable for processing into water soluble glass fibres or wool since the melting point is very low, usually less than 350 °C.		

1 **WATER SOLUBLE GLASS COMPOSITION**

2

3 The present invention relates to a composition for a
4 water-soluble glass, especially for a glass adapted for
5 fibre production.

6

7 It is known that certain glasses in which the usual
8 glass former, silicon dioxide, is replaced with
9 phosphorous pentoxide are soluble in water and body
10 fluids. The rate of dissolution is controlled largely
11 by the addition of glass modifiers such as calcium
12 oxide. In simple terms, the greater the concentration
13 of the modifier the slower the rate of dissolution.
14 The rate of dissolution may range from minutes through
15 to several years.

16

17 Soluble phosphate based glasses which have demonstrated
18 good biocompatibility can incorporate inorganic metals
19 such that a sustained release of the metals can be
20 provided at the wound site. Such materials can also
21 find use in mechanical applications where, for example,
22 slow release of an anti-corrosion agent may be
23 beneficial.

24

25 Certain applications require that the glass is in the

1 form of wool or fibres for mechanical applications such
2 as insulation wool and packaging. Thus, for example,
3 Mohr et al in "Fibre Glass" (Van Norstrand, Reinhold
4 Company, New York 1978) and Jaray in "A New Method of
5 Spinning Glass Fibres" (28th Annual SPI RP/C Institute
6 proceedings 1973, Section 3-A) describe the production
7 of wool and fibres, respectively, from molten glass.
8 The glass fibres can be used for insulation,
9 construction or even communication purposes. Glass
10 wool also finds uses in packaging and insulation
11 applications.

12

13 Normally, glass fibres are produced from molten glass
14 using traditional fibre pulling techniques; whereby
15 filaments of high temperature molten glass (850°-
16 1300°C) are formed into strands and stretched over pull
17 rolls before being collected onto a reel.

18

19 Glass wool formation is similar in that the glass is
20 initially melted in a crucible. The crucible has
21 suitable apertures to allow filaments of glass to flow
22 downwards, which are then "blown" into wool using jets
23 of either steam or compressed air. Alternatively,
24 glass wool can be formed using a flame attenuation
25 process, developed by Owens-Corning Fibreglass
26 Corporation circa 1940. In this process molten glass
27 passes through a bushing stage where primary filaments
28 approximately 1 mm wide are formed. The fibres are
29 then aligned into an exact uniformly juxtaposed array,
30 using a fibre guide, into a jet flame issuing from an
31 internal combustion burner. The jet flame causes
32 thinning and lengthening of the fibres before they are
33 collected on a steel mesh belt.

34

35 In both cases, the glass is either supplied in molten
36 form direct from a crucible or from a temperature-

1 gradient furnace.

2

3 Generally, water soluble glasses do not lend themselves
4 to these traditional fibre and wool forming techniques.

5 As an example, US Patent 4,604,097 of Graves et al.

6 discloses a water soluble drawn fibre, composed

7 primarily of calcium oxide and phosphorous pentoxide.

8 The fibre produced has a very low tensile strength,

9 compared to fibres spun from non-soluble glass

10 compositions.

11

12 Further, water soluble glasses can also be chemically

13 aggressive when molten, unlike traditional glasses

14 where silicon dioxide is used as the glass former.

15 Additionally, the fibres produced are prone to thermal

16 shock and can suffer from devitrification or

17 crystallisation.

18

19 To combat problems of devitrification and

20 crystallisation, water soluble glass fibres have been

21 previously produced in exacting conditions. Thus, for

22 example, Zimmer et al. in WO-A-92/07801 discloses

23 drawing fibres from a water soluble glass composed

24 primarily of phosphorus pentoxide, calcium oxide and

25 iron oxide. In order to keep the viscosity of the

26 glass suitable for drawing, the fibres were drawn at

27 1200°C. Also as a result of the chemically aggressive

28 nature of the glass at that temperature the glass was

29 pulled in an oxygen rich atmosphere (as high as 80%

30 oxygen by volume). Obviously the commercial production

31 of glass fibres under these high temperature controlled

32 atmospheric conditions is expensive.

33

34 The problems of working with water soluble glass are

35 compounded by the very nature of the glass. Metal

36 oxides of elements such as lead and tellurium have

- 4 -

1 previously been used in glass as additives to affect
2 qualities of the glass; crystallisation temperature,
3 viscosity and density, for example. As a result of
4 environmental concerns and particularly when the glasses
5 are to be used in a biological application these additives
6 must be avoided and replaced by more acceptable
7 alternatives.

8

9 SUMMARY OF THE INVENTION

10 Our copending Application, WO-A-98/54104, describes a
11 method of producing water soluble glass fibres. We have
12 now found a particular type of composition which is
13 especially suited to this method. In the prior art
14 compositions described therein a mixture of Group I and
15 Group II compounds are present, and a typical phosphorus
16 pentoxide based glass composition comprises approximately
17 30 mole % Na_2O and approximately 15 mole % CaO .

18

19 In one aspect, there is provided a water-soluble glass
20 fibre consisting essentially of the following
21 constituents: P_2O_5 : 30 to 60 mole %; Na_2O : 30 to 60
22 mole %; K_2O : 5 to 15 mole %; B_2O_3 : greater than 0 to 15
23 mole %; Ag_2O : 0 to 5 mole %; NaF : 0 to 5 mole % and
24 alkaline earth metal compounds: 0 to 5 mole %.

25

26 In another aspect, there is provided a water-soluble glass
27 fibre consisting essentially of the following
28 constituents: P_2O_5 : 30 to 60 mole %; Na_2O : 30 to 60
29 mole %; K_2O : 5 to 15 mole %; B_2O_3 : 5 to 15 mole %; Ag_2O : 0
30 to 5 mole %; NaF : 0 to 5 mole % and alkaline earth metal
31 compounds: 0 to 5 mole %.

- 4a -

1 DETAILED DESCRIPTION

2 The composition of the present invention comprises a glass
3 former (which is typically phosphorus pentoxide) and an
4 alkali metal compound. Preferably no alkali earth metal
5 (Group II) elements or compounds containing such elements
6 are present, although very low quantities (eg 1-2 mole %,
7 and not more than 5 mole %) may be useful to adjust the
8 rate of dissolution of the glass. This low level or
9 absence of alkali earth metal compounds forms a
10 distinction over the water soluble glass compositions
11 currently available. The reference to alkali metal
12 compounds herein refers to compounds of Group Ia (Li, Na,
13 K, Rb, Cs and Fr) and the reference to alkali earth metal
14 compounds herein refers to compounds of Group IIa (Be, Mg,
15 Ca, Sr, Ba, Ra).

16

17 The present invention thus provides a water soluble glass
18 composition formed from a glass former and at least one
19 alkali metal compound, characterised in that

1 said glass composition contains a maximum amount of
2 alkali earth metal compounds of 5 mole %.

3
4 Phosphorous pentoxide (P_2O_5) is preferably used as a
5 glass former and desirably the glass former will
6 preferably be mainly P_2O_5 . Solution rate control and
7 stability can be affected by the addition of other
8 glass formers such as boron, silica, alumina, sulphur,
9 germanium, arsenic etc. Generally the mole percentage
10 of phosphorous pentoxide in the glass composition is
11 less than 85 mole %, preferably less than 60 mole % and
12 especially between 30-60 mole %.

13
14 Alkali metals and lanthanide oxides or carbonates are
15 preferably used as glass modifiers. Generally, the
16 mole percentage of alkali metals and lanthanide oxides
17 or carbonates is less than 60 mole %, preferably
18 between 40-60 mole %.

19
20 Boron containing compounds (eg B_2O_3) are preferably used
21 as glass additives. Generally, the mole percentage of
22 boron containing compounds is 15 mole % or less,
23 preferably 10 mole % or less, especially 5 mole % or
24 less.

25
26 As indicated above, other compounds may also be added
27 to the glass to modify its properties, for example SiO_2 ,
28 Al_2O_3 , SO_3 , MgO , CaO , ZnO , sulphate ions (SO_4^{2-}) or
29 transition metal compounds (eg. first row transition
30 metal compounds), but these will be present only in
31 very low quantities, for example up to a total amount
32 of 5 mole % or less of the glass composition.

33
34 Typically the soluble glasses used in this invention
35 comprise phosphorus pentoxide (P_2O_5) as the principal
36 glass-former, together with any one or more

1 glass-modifying non-toxic materials such as sodium
2 oxide (Na_2O) and potassium oxide (K_2O). The rate at
3 which the glass dissolves in fluids is determined by
4 the glass composition, generally by the ratio of
5 glass-modifier to glass-former and by the relative
6 proportions of the glass-modifiers in the glass. By
7 suitable adjustment of the glass composition, the
8 dissolution rates in water at 38°C ranging from
9 substantially zero to $25\text{mg}/\text{cm}^2/\text{hour}$ or more can be
10 designed. However, the most desirable dissolution rate
11 R of the glass is between 0.01 and $2.0\text{mg}/\text{cm}^2/\text{hour}$.
12

13 The water-soluble glass is thus preferably a phosphate
14 glass, and preferably comprises a source of silver ions
15 which may advantageously be introduced during
16 manufacture as silver orthophosphate (Ag_3PO_4). The
17 glass preferably enables controlled release of silver
18 and other constituents in the glass and the content of
19 these additives can vary in accordance with conditions
20 of use and desired rates of release, the content of
21 silver generally being up to 5 mole %. While we are
22 following convention in describing the composition of
23 the glass in terms of the mole % of oxides, of halides
24 and of sulphate ions, this is not intended to imply
25 that such chemical species are present in the glass nor
26 that they are used for the batch for the preparation of
27 the glass.
28

29 The optimum rate of release of silver ions into an
30 aqueous environment may be selected by circumstances
31 and particularly by the specific function of the
32 released silver. The invention provides a means of
33 delivering silver ions to an aqueous medium at a rate
34 which will maintain a concentration of silver ions in
35 said aqueous medium of not less than 0.01 parts per
36 million and not greater than 10 parts per million. In

1 some cases, the required rate of release may be such
2 that all of the silver added to the system is released
3 in a short period of hours or days and in other
4 applications it may be that the total silver be
5 released slowly at a substantially uniform rate over a
6 period extending to months or even years. In
7 particular cases there may be additional requirements,
8 for example it may be desirable that no residue remains
9 after the source of the silver ions is exhausted or, in
10 other cases, where the silver is made available it will
11 be desirable that any materials, other than the silver
12 itself, which are simultaneously released should be
13 physiologically harmless. In yet other cases, it may
14 be necessary to ensure that the pH of the resulting
15 solution does not fall outside defined limits.

16

17 An exemplary composition contains:

18 P_2O_5 : 30 to 60 mole %;19 Na_2O : 30 to 60 mole %; and20 K_2O : 5 to 15 mole %;

21 and optionally may contain:

22 B_2O_3 : 0 to 15 mole %; and/or23 Ag_2O : 0 to 5 mole %; and/or24 NaF : 0 to 5 mole %; and/or

25 total alkali earth metal compounds: 0 to 5 mole %.

26

27 A preferred composition contains:

28 P_2O_5 : 40 to 60 mole %;29 B_2O_3 : 0 to 10 mole %;30 Na_2O : 30 to 40 mole %;31 K_2O : 5 to 10 mole %;32 Ag_2O : 0 to 5 mole %; and

33 up to 5 mole % of other additive compounds such as

34 CaO , MgO , ZnO , etc.

35

36 These glasses are characterised by having a very low

1 melting point (for example less than 350°C, usually
2 less than 300°C).

3

4 According to a further aspect of the present invention
5 the composition described above is processed into glass
6 fibres and/or wool.

7

8 In the method described in our copending Application
9 WO-A-98/54104 a composition for water-soluble glass is
10 heated above its melting point and then cooled to a
11 working temperature at which fibre formation occurs.

12

13 Generally, the glass is initially heated to a high
14 temperature (800°C to 1200 °C) to clarify the glass and
15 then taken to a melting temperature of 500°-800°C. The
16 temperature is then slowly lowered to the working
17 temperature at which fibre formation occurs.

18

19 Generally, the working temperature of the glass will be
20 at least 200°C lower than the temperature at which the
21 glass is initially heated. Suitable working
22 temperatures may fall within the following ranges 400°-
23 600°C (preferably 400°-500°C, more preferably
24 approximately 450°C). The working temperature selected
25 will depend upon the glass composition, but an
26 approximate indication of a suitable working
27 temperature can be established as hereinafter
28 described. Depending upon the glass composition used,
29 the working temperature may be a range of suitable
30 temperatures. The range of working temperatures may be
31 narrow, for example of only 10°C, so that fibre
32 formation may occur only between the temperature of N°C
33 to (N+10)°C. Other glass compositions may have a wider
34 temperature range for the working temperature in which
35 glass formation is possible.

36

1 Alternatively, the working temperature of the glass may
2 be defined as 50-100°C above the T_g of the glass.

3
4 In order to obtain an approximate indication of the
5 working temperature for any particular glass
6 composition, the glass composition should be slowly
7 heated to its melting point. As soon as the glass is
8 molten, frequent attempts to pull the composition
9 upwardly to form a fibre should be made, with the
10 temperature of the composition being very gradually
11 increased between attempts. The temperature range of
12 the composition during which fibre formation is
13 possible should be noted and used as a preliminary
14 working temperature in the process of the invention.

15
16 It will be clear to those skilled in the art that the
17 pulling speed at which the fibre is drawn off can
18 affect the choice of working temperature and the
19 diameter of the fibre required. Where a fibre of
20 relatively large diameter is required, the fibre tends
21 to be pulled more slowly and the working temperature
22 may need to be decreased slightly. Where a fibre of
23 relatively small diameter is required (eg a glass
24 wool), the fibres may be drawn at the much higher
25 pulling speed and the working temperature may need to
26 be increased (thus lowering the viscosity of the
27 composition to accommodate the increased pulling
28 speed). Selection of the exact working temperature in
29 respect of any particular fibre size and composition
30 will be a simple matter of routine evaluation of
31 optimal process conditions.

32
33 With reference to the "working temperature" of the
34 glass, the skilled person will appreciate that the
35 furnace temperature may differ considerably from the
36 temperature of the glass itself and indeed there may be

1 a significant temperature gradient in the glass.
2 Ideally the "working temperature" will be the
3 temperature of the glass as fibre formation (ie.
4 pulling) takes place. In many compositions however, it
5 may not be practical to measure the temperature at the
6 surface of the glass where pulling occurs by insertion
7 of a temperature probe as the introduction of the probe
8 may precipitate crystallisation of the glass. One
9 alternative is to place a temperature probe into the
10 bushing and to monitor the bushing temperature which
11 will be a good indicator of the glass temperature at
12 the moment of fibre formation. Alternatively an Infra
13 Red pyrometer may be focused onto the appropriate area
14 of the glass and used to monitor the temperature.
15

16 The glass to be formed into fibres will generally be
17 heated until molten, optionally clarified, and then
18 cooled slowly and controllably until the appropriate
19 working temperature is reached and fibre formation can
20 commence. The initial heating of the glass above its
21 melting point and the subsequent fibre formation may be
22 carried out in a single vessel or, alternatively, the
23 molten glass may be transferred to a vessel designed
24 specifically for fibre formation. One way of holding
25 the molten glass in a vessel having a bushing within
26 its lower surface until the temperature drops to the
27 required working temperature is to coat or fill the
28 holes of the bushing with a material that gradually
29 melts over the period of time taken for the glass to
30 reach the temperature required.
31

32 The most important aspect of the present invention is
33 the manner in which the working temperature is reached.
34 We have found that the molten glass, which may
35 preferably be heated significantly above its melting
36 point, should be allowed to cool in a highly controlled

1 manner, the temperature being only gradually reduced
2 until the working temperature is reached. A stirrer
3 may be present to ensure that the temperature of the
4 whole of the molten glass is kept as uniform as
5 possible.

6
7 The glass is cooled to a temperature at which the glass
8 will not crystallise for at least the period of time
9 needed to convert the melt to fibre. This temperature
10 is termed a "holding temperature". The rate of cooling
11 from this holding temperature is determined by the rate
12 at which the melt is consumed at the bushing and the
13 difference in temperature between the bushing
14 temperature (the working temperature) and the melt
15 holding temperature.

16
17 Due to low viscosity and narrow temperature band for
18 many of these compositions, control of the balance
19 between melt temperature, bushing temperature and glass
20 throughput rate is critical.

21
22 The glass composition produces good stable strong
23 consistent fibres.

24
25 The present invention will now be further described by
26 reference to the following, non-limiting, examples:
27

WO 99/62834

12

PCT/GB99/01676

1 **Example 1**

2	Na ₂ O	31.19 mole %
3	K ₂ O	9.63 mole %
4	Ag ₂ O	2.9 mole %
5	B ₂ O ₃	2.74 mole %
6	2NaF	0.66 mole %
7	P ₂ O ₅	52.88 mole %

8

9 Furnace at 710°C - 800°C.

10 Bushing at 450°C - 460°C.

11 4.5mm bushing holes.

12 50km per hour pull rate.

13 Good fibres.

14 Solution rate = 1.68 not annealed 2.28 annealed

15 (mg.cm⁻³.hr⁻¹).

16

17 **Example 2**

18	Na ₂ O	32 mole %
19	K ₂ O	10 mole %
20	Ag ₂ O	3 mole %
21	P ₂ O ₅	55 mole %

22

23 Furnace at 850°C.

24 Bushing at 530°C.

25 5mm bushing holes.

26 55kmph.

27 Good strong fibres.

28

29 **Example 3**

30	Na ₂ O	32 mole %
31	K ₂ O	10 mole %
32	(MgO	4 mole % - added as an anti-microbial)
33	B ₂ O ₃	5 mole %
34	Ag ₂ O	3 mole %
35	P ₂ O ₅	46 mole %

36

1 Furnace temperature 650°C - 730°C.
2 Bushing temperature 410°C - 420°C.
3 Bushing 5.5mm diameter.
4 Speed up to 100kmph.
5 Solution rate 0.7 annealed 1.0 non annealed (mg.cm⁻³.hr⁻¹).
6 Very good strong reliable fibre. Very stable.
7

8 Example 3 can be modified by replacing the MgO with
9 ZnO.

10

11 **Example 4**

12	Na ₂ O	36.68 mole %
13	K ₂ O	8.63 mole %
14	P ₂ O ₅	45.09 mole %
15	B ₂ O ₃	5.29 mole %
16	Ag ₂ O	2.59 mole %
17	(CaO	1.73 mole % to attenuate solution rate)

18

19 Furnace temperature 550°C.
20 Bushing 62 x 5.0mm holes.
21 Bushing temperature 400°C.
22 Speed 80kmph.
23 Very good fibres.
24 Solution rate 3.11 annealed, 3.8 non annealed (mg.cm⁻².hr⁻¹).
25

26 The fibres show excellent tensile strength, flexibility
27 and shock resistance.

28

29 The fibres are especially suitable for industrial and
30 plastics reinforcement controlled release (anti-
31 microbial, anti-corrosion etc) and rapidly
32 biodegradable applications.

1 CLAIMS

2

3 1. A water-soluble glass fibre consisting essentially of
4 the following constituents:

5 P_2O_5 : 30 to 60 mole %;

6 Na_2O : 30 to 60 mole %;

7 K_2O : 5 to 15 mole %;

8 B_2O_3 : greater than 0 to 15 mole %;

9 Ag_2O : 0 to 5 mole %;

10 NaF : 0 to 5 mole % and

11 alkaline earth metal compounds: 0 to 5 mole %.

12

13 2. The water soluble glass fibre as claimed in claim 1
14 wherein a maximum of 2 mole % of alkaline earth metal
15 compounds are present.

16

17 3. The water soluble glass fibre as claimed in claim 1
18 wherein the ranges of the following compounds are:

19 P_2O_5 : 40 to 60 mole %;

20 B_2O_3 : greater than 0 to 10 mole %;

21 Na_2O : 30 to 40 mole %;

22 K_2O : 5 to 10 mole %; and

23 Ag_2O : 0 to 5 mole %;

24 wherein the compounds constitute at least 95 mole %
25 of the water soluble glass fibre.

26

27 4. The water soluble glass fibre as claimed in claim 1
28 wherein 4 mole % or less of the alkaline earth metal
29 compound(s) are present, and the only alkaline earth metal
30 compound(s) are selected from the group consisting of MgO
31 and CaO .

32

33 5. The water soluble glass fibre as claimed in claim 4

1 wherein 2 mole % or less of the alkaline earth metal
2 compound(s) are present.

3

4 6. The water soluble glass fibre as claimed in claim 1,
5 which contains no alkaline earth metal compounds.

6

7 7. The water soluble glass fibres as claimed in claim 1
8 wherein up to 5 mole % of silver is present.

9

10 8. The water soluble glass fibre as claimed in claim 1
11 which has a melting point of 350°C. or less.

12

13 9. The water soluble glass fibre as claimed in claim 8
14 which has a melting point of 300°C. or less.

15

16 10. A glass wool comprising the water soluble glass fibre
17 as claimed in claim 1.

18

19 11. A water-soluble glass fibre consisting essentially of
20 the following constituents:

21 P₂O₅: 30 to 60 mole %;

22 Na₂O: 30 to 60 mole %;

23 K₂O: 5 to 15 mole %;

24 B₂O₃: 5 to 15 mole %;

25 Ag₂O: 0 to 5 mole %;

26 NaF: 0 to 5 mole % and

27 alkaline earth metal compounds: 0 to 5 mole %.