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(54) Title: COMPOSITION FOR HIGH PERFORMANCE GLASS FIBERS AND FIBERS FORMED THEREWITH

(57) **Abrégé/Abstract:**

A composition for the manufacture of high strength glass fibers suitable for manufacture in a refractory lined glass melter is disclosed. The glass composition of the present invention includes 64-75 weight % SiO_2, 16-24 weight % Al_2O_3, 8-11 weight % MgO and 0.25 to 3.0 weight % R_2O where R_2O is the sum of Li_2O and Na_2O. A preferred composition of the present invention includes 64-75 weight % SiO_2, 16-24 weight % Al_2O_3, 8-11 weight % MgO and 0.25 to 3.0 weight % Li_2O. Another preferred composition includes 68-69 weight percent SiO_2, 20-22 weight percent Al_2O_3, 9-10 weight percent MgO and 1-3 weight percent Li_2O. By using oxide based refractory lined furnaces the cost of production of glass fibers is substantially reduced in comparison with the cost of fibers using a platinum lined melting furnace. Fibers formed by the present invention are also disclosed. The fibers have a fiberizing temperature of less than 2650° F (1454 °C), a ΔT of at least 80° F (44.44 °C). Further, the glass fibers have a strength in excess of 680 KPSI, preferably a strength in excess of about 700 KPSI, and most preferably a strength in excess of about 730 KPSI. The glass fibers will desirably have a modulus greater than 12.0 MPSI, preferably greater than about 12.18 MPSI, and most preferably greater than about 12.7 MPSI.

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(54) Title: COMPOSITION FOR HIGH PERFORMANCE GLASS FIBERS AND FIBERS FORMED THEREWITH

(57) Abstract: A composition for the manufacture of high strength glass fibers suitable for manufacture in a refractory lined glass melter is disclosed. The glass composition of the present invention includes 64-75 weight % SiO_2, 16-24 weight % Al_2O_3, 8-11 weight % MgO and 0.25 to 3.0 weight % R_2O where R_2O is the sum of Li_2O and Na_2O. A preferred composition of the present invention includes 64-75 weight % SiO_2, 16-24 weight % Al_2O_3, 8-11 weight % MgO and 0.25 to 3.0 weight % Li_2O. Another preferred composition includes 68-69 weight percent SiO_2, 20-22 weight percent Al_2O_3, 9-10 weight percent MgO and 1-3 weight percent Li_2O. By using oxide based refractory lined furnaces the cost of production of glass fibers is substantially reduced in comparison with the cost of fibers using a platinum lined melting furnace. Fibers formed by the present invention are also disclosed. The fibers have a fiberizing temperature of less than 2650° F (1454 °C), a ΔT of at least 80° F (44.44 °C). Further, the glass fibers have a strength in excess of 680 KPSI, preferably a strength in excess of about 700 KPSI, and most preferably a strength in excess of about 730 KPSI. The glass fibers will desirably have a modulus greater than 12.0 MPSI, preferably greater than about 12.18 MPSI, and most preferably greater than about 12.7 MPSI.

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COMPOSITION FOR HIGH PERFORMANCE GLASS FIBERS AND FIBERS FORMED THEREWITH

TECHNICAL FIELD AND INDUSTRIAL APPLICABILITY OF THE INVENTION

The present invention is generally directed to a composition for use in manufacturing continuous high strength glass fibers and fibers formed from the composition.

BACKGROUND OF THE INVENTION

A common glass composition for making continuous high-strength glass fiber strands is "S-Glass." The term S-Glass defines a family of glasses composed primarily of the oxides of magnesium, aluminum, and silicon with a chemical composition that produces glass fibers having a higher mechanical strength than E-Glass fibers. The chemical composition of the S-glass family produces high strength glass fiber and enables these glasses to be used in high strength applications such as ballistic armor. ASTM International defines S-Glass as family of glasses composed primarily of the oxides of magnesium, aluminum, and silicon with a certified chemical composition which conforms to an applicable material specification and which produces high mechanical strength (D578-05). The Deutsches Institut für Normung (DIN) defines S-Glass as an aluminosilicate glass without added CaO and having a partial mass of MgO where MgO is about 10% by weight (An alumino-silicate glass is defined as a glass which consists largely of aluminum trioxide and silicon dioxide and other oxides) (DIN 1259-1).

R-Glass is another family of high strength, high modulus glasses that is typically formed into fibers for use in aerospace composite applications. The R-Glass family is primarily composed of silicon oxide, aluminum oxide, magnesium oxide, and calcium oxide with a chemical composition that produces glass fibers with a higher mechanical strength than S-Glass fibers. R-Glass generally contains less silica and greater calcium oxide (CaO) than S-Glass which requires higher melting and processing temperatures during fiber forming.

Tables IA- IE set forth the compositions for a number of conventional high strength glass compositions.

TABLE I-A

Constituent	Chinese High Strength glass	RUSSIAN CONTINUOUS ROVING MAGNESIUM ALUMINOSILICATE	NITTOBO "T" Glass Fabric "B"	NITTOBO "T" Glass Fabric (Yarn) "C"
SiO_2	55.08	55.81	64.58	64.64
CaO	0.33	0.38	0.44	0.40
Al_2O_3	25.22	23.78	24.44	24.57
B_2O_3	1.85		0.03	0.03
MgO	15.96	15.08	9.95	9.92
Na_2O	0.12	0.063	0.08	0.09
Fluorine	0.03		0.034	0.037
TiO_2	0.023	2.33	0.019	0.018
Fe_2O_3	1.1	0.388	0.187	0.180
K_2O	0.039	0.56	0.007	0.010
ZrO_2	0.007	0.15		
Cr_2O_3		0.011	0.003	0.003
Li_2O		1.63		
CeO_2				

TABLE I-B

Constituent	Nitto Boseki A&P Yarn	Nitto Boseki NT6030 Yarn	Nitto Boseki TE Glass RST-220PA-535CS	Vetrotex Saint Gobain SR Glass Stratifils SR CG 250 P109	Polotsk STEKLOVOLOKNO High Strength Glass
SiO_2	65.51	64.60	64.20	63.90	58.64
CaO	0.44	0.58	0.63	0.26	0.61
Al_2O_3	24.06	24.60	25.10	24.40	25.41
B_2O_3					0.04
MgO	9.73	9.90	9.90	10.00	14.18
Na_2O	0.04	0.06	0.020	0.039	0.05
Fluorine	0.07				0.02
TiO_2	0.016	0.000	0.000	0.210	0.624
Fe_2O_3	0.067	0.079	0.083	0.520	0.253
K_2O	0.020	0.020	0.020	0.540	0.35
ZrO_2	0.079				
Cr_2O_3	0.0010			0.001	0.023
Li_2O					
CeO_2					

TABLE I-C

Constituent	Chinese High Strength Yarn (8 micron)	Chinese High Strength Glass Roving	Advanced Glass Yarns Zentron S-2 Glass Roving	SOLAIS Glass Sample
SiO_2	55.22	55.49	64.74	64.81
CaO	0.73	0.29	0.14	0.55
Al_2O_3	24.42	24.88	24.70	24.51
B_2O_3	3.46	3.52		0.02
MgO	12.46	12.28	10.24	9.35
Na_2O	0.104	0.06	0.17	0.16
Fluorine	0.07			0.02
TiO_2	0.32	0.36	0.015	0.04
Fe_2O_3	0.980	0.930	0.045	0.238
K_2O	0.240	0.150	0.005	0.03
ZrO_2				
Cr_2O_3	0.0050			0.007
Li_2O	0.59	0.63		
CeO_2	1.23	1.25		

TABLE I-D

Constituent	Advanced Glass Yarns S Glass	Culimeta Roving	IVG Vertex B96 675 Yarn	IVG Vertex Glass Roving	IVG Vertex Outside #1 Glass Roving
SiO_2	64.61	59.37	58.34	58.58	58.12
CaO	0.17	0.27	0.31	0.30	0.31
Al_2O_3	24.84	25.49	23.81	24.26	24.09
B_2O_3	0.04	0.05			
MgO	10.11	13.47	14.99	15.02	15.36
Na_2O	0.118	0.024	0.05	0.02	0.03
Fluorine	0.03		0.04	0.04	0.04
TiO_2	0.011	0.530	1.380	0.67	0.91
Fe_2O_3	0.042	0.374	0.333	0.336	0.303
K_2O		0.48	0.42	0.28	0.29
ZrO_2		0.152	0.129	0.165	0.157
Cr_2O_3	0.0050	0.0120	0.0100	0.0120	0.0120
Li_2O					
CeO_2					

TABLE I-E

Constituent	IVG Vertex Outside #2 Glass Roving	RH CG250 P109 Glass Fiber Strand
SiO_2	58.69	58.54
CaO	0.29	9.35
Al_2O_3	24.3	25.39
B_2O_3		
MgO	15.06	6.15
Na_2O	0.03	0.10
Fluorine	0.04	0.16
TiO_2	0.64	0.008
Fe_2O_3	0.331	0.069
K_2O	0.36	0.14
ZrO_2	0.187	0.006
Cr_2O_3	0.0130	
Li_2O		
CeO_2		

Typical R-Glass and S-Glass are generally produced by melting the constituents of the compositions in a platinum lined melting container. The costs of forming R-Glass and S-Glass fibers are dramatically higher than E-Glass fibers due to the cost of producing the fibers in such melters. Thus, there is a need in the art for methods of forming glass compositions useful in the formation of high performance glass fibers from a direct-melt process.

SUMMARY OF THE INVENTION

The present invention is a glass composition for the formation of continuous glass fibers suitable for use in high strength applications. The composition may be inexpensively formed into glass fibers using low-cost, direct melting in refractory-lined furnaces due to the relatively low fiberizing temperature of the composition. Once formed into fibers, the glass composition provides the strength characteristics of S-Glass. One composition of the present invention includes 64-75 weight % SiO_2, 16-24 weight % Al_2O_3, 8-11 weight % MgO and 0.25 to 3.0 weight % R_2O where R_2O is the sum of Li_2O and Na_2O. The composition of the present invention includes 64-75 weight % SiO_2, 16-24 weight % Al_2O_3, 8-11 weight % MgO and 0.25 to 3.0 weight % Li_2O. In a preferred embodiment, the glass composition is composed of 64-70 weight % SiO_2, 17-22 weight % Al_2O_3, 9-11 weight % MgO and 1.75-3.0 weight % R_2O where R_2O is the sum of Li_2O and Na_2O. In another preferred embodiment, the glass composition is composed of 64-70 weight % SiO_2, 17-22 weight % Al_2O_3, 9-11 weight % MgO and 1.75-3.0 weight % LiO_2. The composition preferably does not contain more than about 5.0 weight % of oxides or compounds selected from the group consisting of CaO, P_2O_5, ZnO, ZrO_2, SrO, BaO, SO_3, F_2, B_2O_3, TiO_2 and Fe_2O_3.

The desired properties of the high performance composite fibers manufactured by the present invention include a fiberizing temperature of less than about 2650 ° F (1454 °C), preferably less than about 2625° F (1441 °C), more preferably less than about 2600° F (1427 °C)and most preferably less than about 2575° F (1413 °C)and a liquidus temperature that is preferably below the fiberizing temperature by at least 80° F (44.44 °C), more preferably by at least about 120° F (66.67 °C), and most preferably by at least about 150° F (83.33 °C). The present invention also includes fibers formed from such a composition.

In one aspect, there is provided a composition for high strength glass fibers, formable from a direct melt process, comprising:

64-74 weight percent SiO_2;

16-24 weight percent Al_2O_3;

8-12 weight percent MgO;

1.75 – 3.0 weight percent R_2O, where R_2O equals the sum of Li_2O and Na_2O; and

no more than 2 weight percent CaO,

the composition having a fiberizing temperature of less than 2650 °F (1399 °C) and the high strength glass fibers formed from said composition have a density no greater than 2.486 g/cc and a strength of greater than 700 KPsi (4.83 GPa).

In another aspect, there is provided a high strength glass fiber formed by melting a glass batch in a refractory lined glass melter, comprising:

64-74 weight percent SiO_2;

16-24 weight percent Al_2O_3;

8-12 weight percent MgO; and

1.75 – 3.0 weight percent R_2O, where R_2O equals the sum of Li_2O and Na_2O; and no more than 2 weight percent CaO, wherein the batch has a fiberizing temperature of less than 2650 °F (1399 °C) and wherein the glass fiber has a density no greater than 2.486 g/cc and a strength of greater than about 700 KPsi (4.83 GPa).

DETAILED DESCRIPTION AND PREFERRED EMBODIMENTS OF THE INVENTION

The fiberizing properties of the glass batch composition of the present invention include the fiberizing temperature, the liquidus, and delta-T (ΔT). The fiberizing temperature is defined as the temperature that corresponds to a viscosity of 1000 Poise. As discussed in more detail below, a lowered fiberizing temperature reduces the production cost of the fibers, allows for a longer bushing life, increases throughput, permits the glass to be melted in a refractory-lined melter, and reduces energy consumption. For example, at a lower fiberizing temperature, a bushing operates at a cooler temperature and does not "sag" as quickly. Sag is a phenomenon that occurs in bushings that are held at an elevated temperature for extended periods of time. By lowering the fiberizing temperature, the sag rate of the bushing may be reduced and the bushing life can be increased. In addition, a lower fiberizing temperature allows for a higher throughput since more glass can be melted in a given period at a given energy input. As a result, production cost is reduced. In addition, a lower fiberizing temperature will also permit glass formed with the inventive composition to be melted in a refractory-lined melter since both its melting and fiberizing temperatures are below the upper use temperatures of many commercially available refractories.

The liquidus of a glass is defined as the highest temperature at which equilibrium exists between liquid glass and its primary crystalline phase. At all temperatures above the liquidus, the glass is free from crystals in its primary phase. At temperatures below the liquidus, crystals may form. Crystals in the melt will cause blockages in the bushing and weakness in the fibers.

Another fiberizing property is delta-T (ΔT), which is defined as the difference between the fiberizing temperature and the liquidus. A larger ΔT offers a greater degree of flexibility during the formation of the glass fibers and helps to inhibit devitrification of the glass (that is, the formation of crystals within the melt) during melting and fiberizing. Increasing the ΔT also reduces the production cost of the glass fibers by allowing for a greater bushing life and by providing a wider process window for forming fibers.

The glasses of the present invention are suitable for melting in traditional commercially available refractory-lined glass melters that are widely used in the manufacture of glass reinforcement fibers. Starting batch components typically include SiO_2 (ground silica sand), and Al_2O_3 (calcined alumina) or pyrophyllite, as well as chain modifiers from source materials such as talc, magnesite or dolomite. The carbon included in materials such as magnesite is off gassed as oxides of carbon such as CO_2.

A fiber formed in accordance with the present invention will preferably include 64-75 weight % SiO_2, 16-24 weight % Al_2O_3, 8-11 weight % MgO and 0.25 to 3.0 weight % R_2O where R_2O is the sum of Li_2O and Na_2O. More preferably, the composition will include 0.25 to 3.0 weight % Li_2O rather than a combination of Li_2O and Na_2O. In another preferred embodiment, the glass composition is composed of 64-70 weight % SiO_2, 17-22 weight % Al_2O_3, 9-11 weight % MgO and 1.75 to 3.0 weight % R_2O where R_2O is the sum of Li_2O and Na_2O. More preferably, the composition will include 1.75 to 3.0 weight % LiO_2. A fiber formed in accordance with the present invention will typically include small amounts of CaO, P_2O_5, ZnO, ZrO_2, SrO, BaO, SO_3, F_2, B_2O_3, TiO_2 and Fe_2O_3, preferably in a total amount of less than 5 weight percent, and more preferably less than about 4 weight percent. In addition, a fiber formed in accordance with the method and composition of the present invention will have a fiberizing temperature of less than 2650° F (1454 °C), preferably less than about 2625° F (1441 °C), more preferably less than about 2600° F (1427 °C) and most preferably less than about 2575° F (1413 °C) and a liquidus temperature that is preferably below the fiberizing temperature by at least 80° F, more preferably by at least about 120° F (66.67 °C), and most preferably by at least about 150° F (83.33 °C). Further, the glass of the present invention preferably will have a pristine fiber strength in excess of 680 KPSI, more preferably a strength in excess of about 700 KPSI, and most preferably a strength in excess of about 730 KPSI. Further, the glass fibers will desirably have a modulus greater than 12.0 MPSI, preferably greater than about 12.18 MPSI, and most preferably greater than about 12.6 MPSI.

The glass batch of the present invention is preferably melted using the glass melting furnace made from appropriate refractory materials such as alumina, chromic oxide, silica, alumina-silica, zircon, zirconia-alumina-silica, or similar oxide-based refractory materials. Often, such glass melting furnaces include one more bubblers and/or electrical boost electrodes (one suitable glass melting furnace is disclosed in U.S. Application Number 20070105701 entitled "Method of Manufacturing High Performance Glass Fibers in a Refractory Lined Melter and Fiber Formed Thereby"). The bubblers and/or electrical boost electrodes increase the temperature of the bulk glass and increase the molten glass circulation under the batch cover.

The melted glass is delivered to a bushing assembly from a forehearth. The bushing includes a tip plate with a plurality of nozzles, each nozzle discharges a stream of molten glass, which are mechanically drawn to form continuous filaments. Typically, the filaments are coated with a protective sizing, gathered into a single continuous strand and wound onto a rotating collet of a winder device to form a package. The filaments may also be processed into other forms including, without limitation, wet used chopped strand fibers, dry use chopped strand fibers, continuous filament mats, chopped strand mats, wet formed mats or air laid mats.

Having generally described this invention, a further understanding can be obtained by reference to certain specific examples illustrated below which are provided for purposes of illustration only and are not intended to be all inclusive or limiting unless otherwise specified.

EXAMPLES

The glasses in the examples listed in Tables IIA IID were melted in platinum crucibles or in a continuous platinum-lined metier for determining the mechanical and physical properties of the glass and fibers produced therefrom. The units of measurement for the physical properties are: Viscosity (°F), Liquidus temperature (°F) and ΔT (°F). In some examples the glasses were fiberized and Strength (KPsi), Density (g/cc), Modulus (MPsi) were measured.

The fiberizing temperature was measured using a rotating spindle viscometer. The fiberizing viscosity is defined as 1000 Poise. The liquidus was measured by placing a platinum container filled with glass in a thermal gradient furnace for 16 hours. The greatest temperature at which crystals were present was considered the liquidus temperature. The modulus was measured using the sonic technique on a single fiber of glass. The tensile strength was measured on a pristine single fiber.

Table IIA

Glass	Ex. 1	Ex. 2	Ex. 3	Ex. 4	Ex. 5	Ex. 6
SiO_2	67.2	69	67	70	70	65
Al_2O_3	20	22	22	17	17	21
MgO	9.8	9	11	11	10	11
Li_2O	3	0	0	2	3	3
Measured Viscosity ° F (°C)	2531 (1388)	2761 (1516)	2648 (1453)	2557 (1403)	2558 (1403)	2461 (1349)
1st Measured Liquidus ° F (°C)	2313 (1267)	2619 (1437)	2597 (1425)	2332 (1278)	2302 (1261)	2296 (1258)
2nd Measured Liquidus ° F (°C)	2302 (1261)	2620 (1438)	2614 (1434)	2346 (1286)	2308 (1264)	2318 (1270)
ΔT ° F (°C)	218 (121.1)	142 (78.89)	51 (28.33)	225 (125)	256 (142.2)	165 (91.67)
Measured Density (g/cc)	2.459	2.452	2.481	2.450	2.441	2.482

Table II-B

Glass	Ex. 7	Ex. 8	Ex. 9	Ex. 10	Ex. 11	Ex. 12
SiO_2	70	69	70	65	66	65
Al_2O_3	18	17	21	22	22	22
MgO	9	11	9	11	9	10
Li_2O	3	3	0	2	3	3
Measured Viscosity ° F (°C)	2544 (1396)	2496 (1369)	2752 (1511)	2525 (1385)	2523 (1384)	2486 (1363)
1st Measured Liquidus ° F (°C)	2311 (1266)	2234 (1223)	2597 (1425)	2468 (1353)	2391 (1311)	2361 (1294)
2nd Measured Liquidus ° F (°C)	2324 (1273)	2343 (1284)	2603 (1428)	2462 (1350)	2394 (1312)	2382 (1306)
ΔT ° F (°C)	233 (129.44)	262 (145.55)	155 (86.11)	57 (31.67)	132 (73.33)	125 (69.44)
Measured Density (g/cc)	2.434	2.455	2.443	2.486	2.460	2.474

Table II-C

Glass	Ex. 13	Ex. 14	Ex. 15	Ex. 16	Ex. 17	Ex. 18
SiO_2	70	67.32	67.57	68.27	68.02	67.76
Al_2O_3	19	20.49	20.49	20.10	20.10	20.10
MgO	11	10.00	10.00	9.69	9.69	9.69
Li_2O	0	2.00	1.75	1.75	2.00	2.25
Measured Viscosity ° F (°C)	2679 (1471)	2563 (1406)	2584 (1418)	2598 (1426)	2578 (1414)	2547 (1397)
1st Measured Liquidus ° F (°C)	2596 (1424)	2456 (1347)	2486 (1363)	2446 (1341)	2431 (1333)	2399 (1315)
2nd Measured Liquidus ° F (°C)	2582 (1417)	2447 (1342)	2469 (1354)	2469 (1354)	2437 (1336)	2406 (1319)
ΔT ° F (°C)	83 (59.17)	111.5 (78.05)	106.5 (59.17)	140.5 (78.05)	144 (80)	144.5 (80.28)
Measured Density (g/cc)	2.453		2.461		2.452	

The composition of the present invention may also include chain modifiers such as Na_2O, CaO and B_2O_3. Such compositions are shown in Table II-D (below).

Table II-D

Glass	Ex. 19	Ex. 21	Ex. 22	Ex. 22	Ex. 23	Ex. 24
SiO_2	75	66	65	65	66	74
Al_2O_3	15	20	20	24	19	15
MgO	8	9	8	8	9	8
Li_2O	1	1	2	0	0	0
Na_2O	1	2	1	1	2	3
CaO		2	4			
B_2O_3				2	4	
Measured Viscosity ° F (°C)	2765 (1518)	2607 (1431)	2469 (1354)	2669 (1465)		2809 (1542.78)
1st Measured Liquidus ° F (°C)	2422 (1328)	2729 (1498)		2614 (1435)	2630 (1443)	2680 (1471)
ΔT ° F (°C)	343 (190.55)	-122 (-67.78)		55 (30.56)		129 (71.67)

The fibers of the present invention have superior modulus and strength characteristics. The fibers of Example 1 have a Measured Modulus of 12.71 MPsi and a Measured Strength of 688 KPsi. The fibers of Example 3 have a Measured Modulus of 12.96 MPsi and a Measured Strength of 737 KPsi. The fibers of Example 17 have a Measured Modulus of 12.75 MPsi and a Measured Strength of 734 KPsi.

As is understood in the art, the above exemplary inventive compositions do not always total 100% of the listed components due to statistical conventions (such as, rounding and averaging) and the fact that some compositions may include impurities that are not listed. Of course, the actual amounts of all components, including any impurities, in a composition always total 100%. Furthermore, it should be understood that where small quantities of components are specified in the compositions, for example, quantities on the order of about 0.05 weight percent or less, those components may be present in the form of trace impurities present in the raw materials, rather than intentionally added.

Additionally, components may be added to the batch composition, for example, to facilitate processing, that are later eliminated, thereby forming a glass composition that is essentially free of such components. Thus, for instance, minute quantities of components such as fluorine and sulfate may be present as trace impurities in the raw materials providing the silica, calcia, alumina, and magnesia components in commercial practice of the invention or they may be processing aids that are essentially removed during manufacture.

As apparent from the above examples, glass fiber compositions of the invention have advantageous properties, such as low fiberizing temperatures and wide differences between the liquidus temperatures and the fiberizing temperatures (high ΔT values). Other advantages and obvious modifications of the invention will be apparent to the artisan from the above description and further through practice of the invention). The high-performance glass of the present invention melts and refines at relatively low temperatures, has a workable viscosity over a wide range of relatively low temperatures, and a low liquidus temperature range.

The invention of this application has been described above both generically and with regard to specific embodiments. Although the invention has been set forth in what is believed to be the preferred embodiments, a wide variety of alternatives known to those of skill in the art can be selected within the generic disclosure. Other advantages and obvious modifications of the invention will be apparent to the artisan from the above description and further through practice of the invention. The invention is not otherwise limited, except for the recitation of the claims set forth below.

CLAIMS

1. A composition for high strength glass fibers, formable from a direct melt process, comprising:

64-74 weight percent SiO_2;

16-24 weight percent Al_2O_3;

8-12 weight percent MgO;

1.75 – 3.0 weight percent R_2O, where R_2O equals the sum of Li_2O and Na_2O; and

no more than 2 weight percent CaO,

the composition having a fiberizing temperature of less than 2650 °F (1399 °C) and the high strength glass fibers formed from said composition have a density no greater than 2.486 g/cc and a strength of greater than 700 KPsi (4.83 GPa).

2. The composition for high strength glass fibers of claim 1, wherein the glass batch comprises less than 5 weight percent total of compounds selected from the group consisting of P_2O_5, ZnO, ZrO_2, SrO, BaO, SO_3, F_2, B_2O_3, TiO_2 and Fe_2O_3.

3. The composition for high strength glass fibers of claim 1, wherein glass produced from said batch has a ΔT of at least 80° F (44.44 °C).

4. The composition for high strength glass fibers of claim 3 wherein glass produced from said batch has a ΔT of at least 120° F (66.67 °C).

5. The composition for high strength glass fibers of claim 1, wherein glass produced from said batch has a fiberizing temperature of less than 2600° F (1427 °C), and a ΔT of at least 140° F (77.78 °C).

6. The composition for high strength glass fibers of claim 1, wherein the glass batch further comprises 0 to 3 weight percent alkali metal oxides.

7. The composition for high strength glass fibers of claim 1, wherein the composition comprises:

68-69 weight percent SiO_2;

20-22 weight percent Al_2O_3;

9-10 weight percent MgO; and

0.25-3 weight percent Li_2O.

8. A high strength glass fiber formed by melting a glass batch in a refractory lined glass melter, comprising:

64-74 weight percent SiO_2;

16-24 weight percent Al_2O_3;

8-12 weight percent MgO; and

1.75 – 3.0 weight percent R_2O, where R_2O equals the sum of Li_2O and Na_2O; and

no more than 2 weight percent CaO,

wherein the batch has a fiberizing temperature of less than 2650 °F (1399 °C) and wherein said glass fiber has a density no greater than 2.486 g/cc and a strength of greater than 700 KPsi (4.83 GPa).

9. The high strength glass fiber of claim 8, wherein the fiber has a modulus greater than 12.0 MPSI (82.74 GPa).

10. The high strength glass fiber of claim 8, wherein the fiber has a modulus greater than 12.7 MPSI (87.57 GPa).

11. The high strength glass fiber of claim 8, comprising:

68-69 weight percent SiO_2;

20-22 weight percent Al_2O_3;

9-10 weight percent MgO; and

1.75 – 3.0 weight percent Li_2O.

12. The composition of claim 1, wherein Li_2O is present in said composition in an amount from 1.75 to 3.0 weight percent.

13. The high strength glass fiber of claim 8, wherein:

said Al_2O_3 is present in said fiber in an amount from 17 to 22 weight percent;

said MgO is present in said fiber in an amount from 9 to 11 weight percent; and

said Li_2O is present in said fiber in an amount from 1.75 to 3.0 weight percent.

14. The composition of claim 1, wherein the components of said composition are meltable in a refractory-lined melter.