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3.Dec.91 11:18 No.006 P.01

ARUP

Ove Arup & Partners
Building Engineering

Fax To: GOURGOUES

Fax No:

Attn: HUMBERT

cc:

From: ANDY SEDGWICK

Subject: SIV GLASS

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Date 2.12.91

Ref/Job no

Total Pages.
(Including this page) 5

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Message

HUMBERT,

PLEASE FIND ATTACHED INFORMATION RECEIVED
FROM SIV REGARDING THEIR CHEMICALLY
TREATED GLASS.

BEST WISHES,

Andy



NOUVELLE ADRESSE
A PARTIR DU 14 MARS 1991

2, Rue Louis Armand - Tour Objectif 1 - 92600 ASNIERES
Tél. (1) 40 86 96 08 - Télécopie (1) 40 86 90 22

V/r

N/r

Paris, le

TO: ANDREW SEDWICK
FR: ROBERT VISCHI
DATE: 22 NOV 91
Subject: CHEACOR
glass

Here is a brochure chemical
glass (chemical tempering glass)

Different thicknesses are available
from 1 mm to 6.35 mm.

The standard size is 1000 x 850 mm.

If any problem, please contact me.

Regards

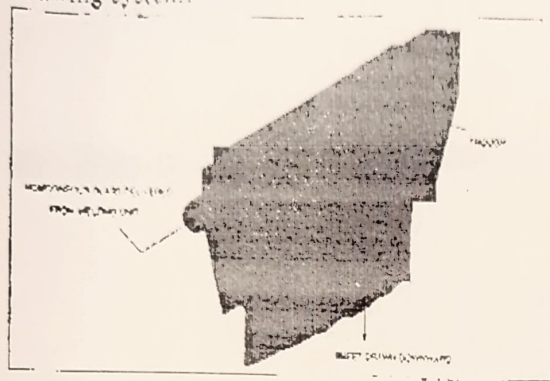
A handwritten signature in dark ink, appearing to be "R. Vischi", written over a horizontal line.

3/5

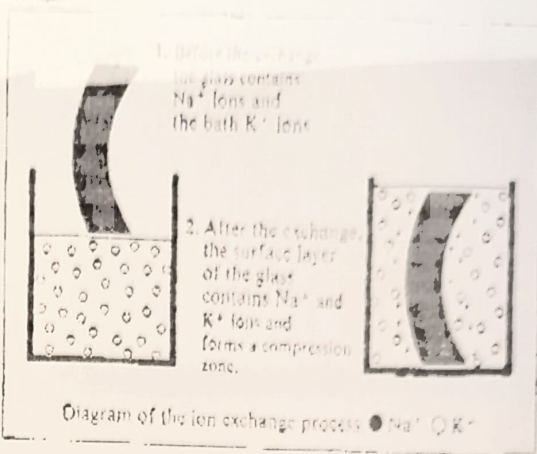
The glass is continuously melted, refined and delivered to a unit called the "Fusion Draw" machine which contains a ceramic part known as an "isopipe".

The glass is fed into a trough, then ~~is drawn~~ flows at a constant rate over each side of the "isopipe". The external surfaces of the sheet are never in contact with the structure.

The two halves of the sheet fuse together at the root of the isopipe, the sheet is pulled downwards then annealed in a mechanical drawing system.



With the largest K^+ ion replacing the smallest Na^+ ion in the glass structure, a "packing effect" is produced which consequently produces a compression zone on the surface.



ADVANTAGES OF CHEMICAL TEMPERING

- Possibility of producing a wide range of thicknesses (0.8mm - 7.0mm.) with a large flexibility
- Very good surface quality on each side of the sheet
- Outstanding flatness
- Improved control of thickness (down to $\pm 20\mu m$)
- Excellent optical qualities.

- Possibility of tempering very thin glass
- Possibility of uniformly tempering all shapes (flat, sagged...)
- Zero deformation
- Flexibility of the process, which allows wide variations in mechanical resistance and dicing
- Modulus of rupture is 3 times that of thermally tempered glass
- Modulus of rupture is 6 times that of untempered glass
- Optical properties are not modified.

Chemical Tempering

The aim of chemical tempering, as with thermal tempering, is to compress the glass's external surfaces.

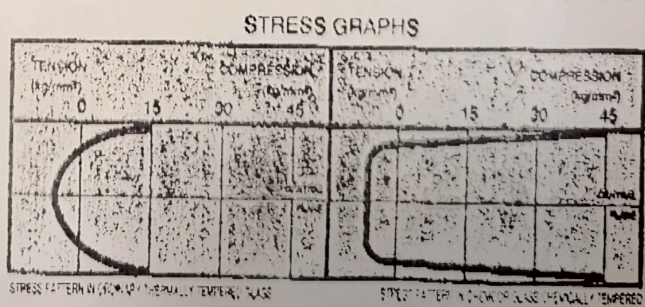
Chemical tempering consists of dipping the glass in a bath of molten salts. Above a certain temperature (about $400^\circ C - 752^\circ F$) an ion exchange takes place between glass and salts: mixture of potassium nitrate (KNO_3) and sodium nitrate ($NaNO_3$).

Chemical tempering allows a significant improvement in the mechanical properties of thin glass, without altering its dimensional or optical properties.

COMPARISON OF CHEMICAL TEMPERING AND THERMAL TEMPERING

While the tensile stress within the two glasses are almost the same, the chemically tempered glass has a surface compressive stress three times greater than a thermally tempered glass.

The result is that CHEMCOR glass can give you the strength you need at one-third the thickness of thermally tempered glass.



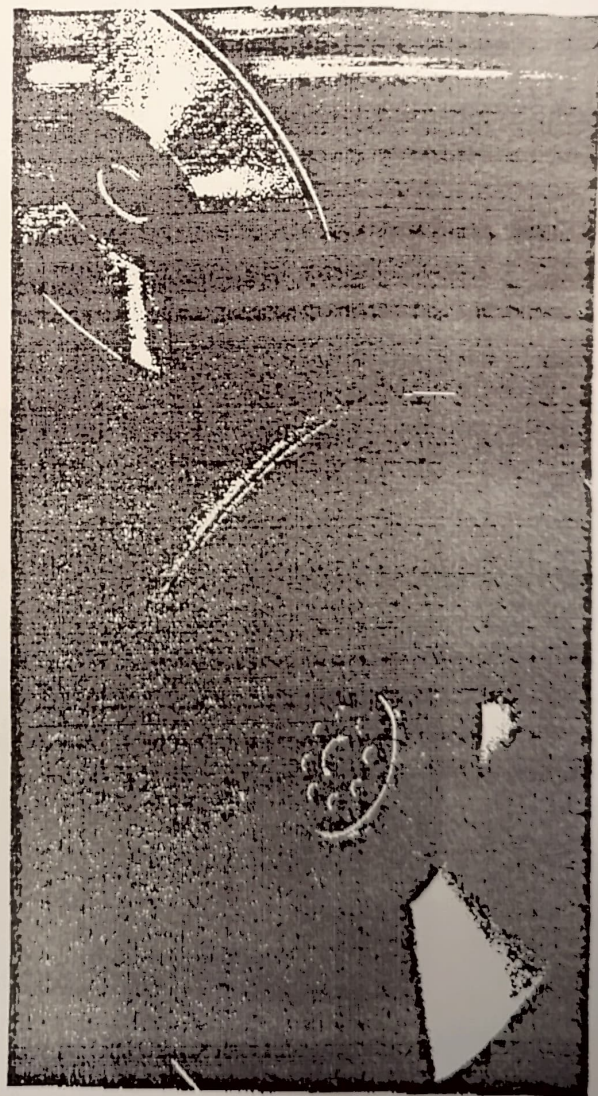
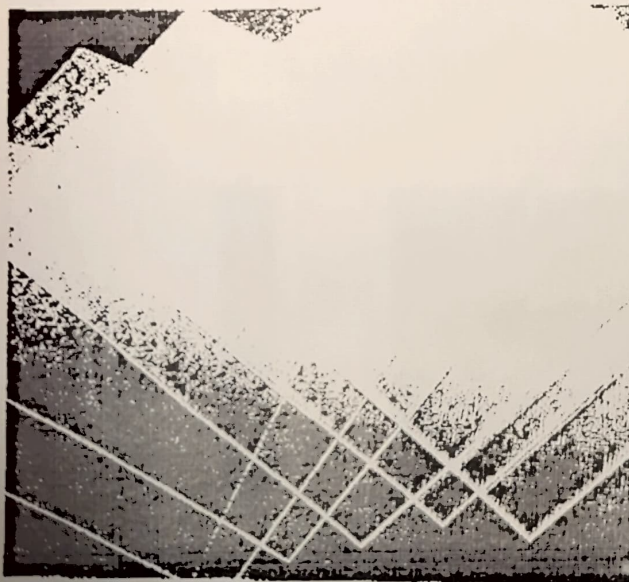
Bringing together "Fusion Draw" and "Chemical tempering" technologies with a specific composition of glass gives CHEMCOR:

- exceptional dimensional qualities (flatness, surface quality, improved control of thickness, etc)
- above standard specific mechanical properties (lightness, hardness, high mechanical resistance, etc)
- exceptional optical properties (transparence, transmittance, etc)

these properties allow the customer greater processing flexibility:

- a reduction in the length of operations (polishing, tempering time, etc)
- possibility of using lighter technologies (sticking, etc)
- more freedom in the shapes possible (design, etc)
- possibility of using CHEMCOR at high temperature, up to 550°C - 1022°F (coating, etc)

- Transportation (automotive, aeronautics, etc)
- Safety glass (building, optics, etc)
- Memory Products (Optical memory discs, etc)
- Electronics (substrates, etc)
- Lighting (projectors, etc)
- Miscellaneous (watch glass, etc)



thickness (mm)	maximum width (mm)	maximum length (mm)
0,8 - 1,2	900	1 500
1,3 - 7,0	1 000	2 000

± 50µm over the whole width of the sheet
 ± 20µm over 90% of the width of the sheet

On request: ± 20µm over the whole width of the sheet

± 0.5mm for dimensions greater than 100×100 mm

± 0.2mm for dimensions smaller than 100×100 mm

Standard sizes: 1,000×850 mm

Packaging: in crates of 200 kg to 1,500 kg with paper interleaving.

SICOVER offers a complete range of services including:

- cutting, grinding, drilling, chemical tempering

This allows us to offer the customer a whole range of products from plain sheet glass to finished parts (cut, bevelled, chemically tempered).

MECHANICAL PROPERTIES OF CHEMCOR

Mechanical properties

Young's Modulus	: 10.4 × 10 ⁴ psi	7000 kg/mm ²
Poisson's ratio	: 0.21	0.21
Modulus of rupture of CHEMCOR before chemical tempering	: 5.7 × 10 ⁴ psi	4 kg/mm ²
Modulus of rupture of CHEMCOR after chemical tempering	: 64.1 × 10 ⁴ psi	45 kg/mm ²
Knoop hardness (0.22 lb - 100 g) before chemical tempering	: 8.25 × 10 ⁴ psi	550 kg/mm ²
Knoop hardness (0.22 lb - 100 g) after chemical tempering	: 9.95 × 10 ⁴ psi	700 kg/mm ²

Thermal properties

Thermal expansion (68-572°F - 20-300°C)	: 48.9 × 10 ⁻⁷ /°F	88 × 10 ⁻⁷ /°C
Thermal conductivity (77°F - 25°C)	: 0.595 BTU/ft.h.°F	1.03 W/m °C
Specific heat	: 0.192 BTU/lb.°F	803 J/kg °C

Thermo mechanical properties

Extreme temperature of service of CHEMCOR untempered	: 1,022°F	550°C
Maximum temperature of service of CHEMCOR chemically tempered	: 527°F	275°C

Physical properties

Density	: 153.32 lb./ft. ³	2,456 g./cm. ³
Softening point (10 ⁴ poises)	: 1598°F	870°C
Annealing point (10 ³ poises)	: 1152°F	622°C
Strain point (10 ² poises)	: 1062°F	574°C

Optical properties

Refractive index at 68°F 20°C	: N _D = 1.5129	N _F = 1.5129
	: N _D = 1.5068	N _D = 1.5068
	: N _C = 1.5043	N _D = 1.5043
Transmittance (visible) - 2mm thickness	: 91.6%	91.6%

Electrical properties

Power factor (68°F - 20°C, 1 MHz)	: 0.012%	0.012%
Dielectric constant (68°F - 20°C, 1 MHz)	: 7.38	7.38
Loss factor (68°F - 20°C, 1 MHz)	: 0.088%	0.088%
Log10 of Volume Resistivity		

(77°F-25°C)	: 14.55 Ω.cm	14.55 Ω.cm
(482°F-250°C)	: 8.2 Ω.cm	8.2 Ω.cm
(662°F-350°C)	: 5.5 Ω.cm	5.5 Ω.cm

Corrosion resistance

Weathering corrosion (1)	: 1	1
Acid corrosion (2)	: 3	3

(1) In weathering corrosion, glasses are classified from 1 to 3. Class 1 means that CHEMCOR is not affected by weathering corrosion.

(2) In acid corrosion, glasses are classified from 1 to 4. Class 3 means that CHEMCOR glass will lose between 1 × 10⁻⁴ in. and 1 × 10⁻³ in. in thickness from any one surface in one day when exposed to 5N hydrochloric acid at 203°F.

Spectral transmittance (2mm)

