5TH JULY 1999

LUTING GLASS-IONOMER CEMENT

I. EXECUTIVE SUMMARY

A superior luting glass-ionomer cement has been developed from a strontium-based aluminosilicate glass of low cross-link density. The luting glass-ionomer cements on the market varying very widely in quality. The poorest quality luting cements are radiolucent and possess low compressive strengths and long working times. The cement developed belongs to the highest end of the scale in terms of properties.

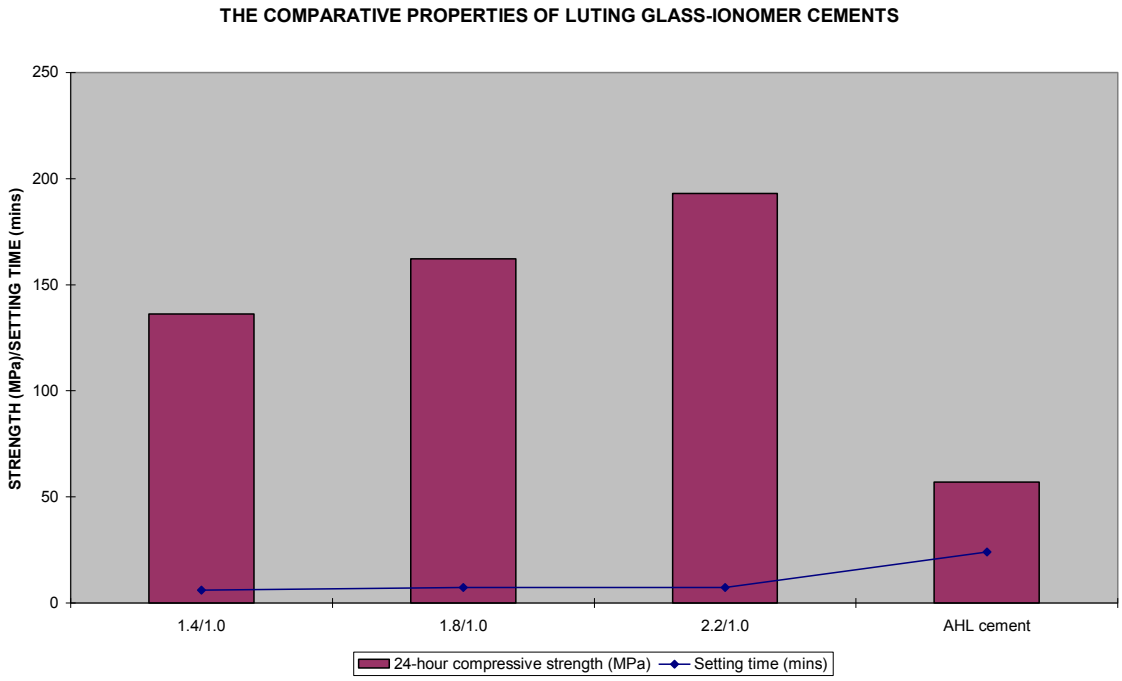
- ***High radiopacity*** of the cement is due to the substitution of the Ca of the glass by Sr. The glass contains the highest level of Sr possible in glass-ionomer cement glasses (29-weight %). The radiopacity has also been enhanced by the composition of the cement; optimised for glass content rather than poly(acrylic acid) content. Only a few commercially available luitng cements are radiopaque. Fuji I lining (27 weight % Sr) is and Ionoglass is not.
- ***High strength*** has been obtained due to the composition of the glass. With such low cross-link density, the glass decomposes very rapidly to form glass-ionomer cements. The very early strength (<10 minutes), as evidenced from the Wilson rheometer traces, is particularly useful in the bonding of orthodontic and endodontic appliances
- ***Sharp set*** of the cement has been achieved by: i) using very fine glass particles, mean particle size < 4 microns; ii) the inclusion of optimum level of tartaric acid; and iii) post-firing processing of the glass. The difference in the sharpness of the set of this cement (and Fuji I Lining) compared to Ionoglass (see Wilson rheometer traces) will be obvious and appreciated by dentists.
- ***Similarity to Fuji I Lining*** has been further enhanced by the light yellow shade of the cement, its mixing powder/liquid regime and Users instruction.

II. CEMENT DETAILS

The details of the cement in comparison to Fuji I Lining and Ionoglass cements are presented in the appended Wilson rheometer traces and in the Table and Figure below.

THE HANDLING PROPERTIES OF LUTING CEMENTS

Powder/liquid ratio	Properties on Wilson rheometer (Time to x % amplitude)		
	95 % (mins)	5 % (mins)	1 % (mins)
(1.4/1.0)	3.2	6.7	9.2
(1.8/1.0)	2.3	4.8	6.0
(2.2/1.0)	2.3	5.0	7.3
(2.6/1.0)	3.2	5.1	7.3
Fuji (1.4/1.0)	3.3	6.4	8.3
Fuji (1.8/1.0)	3.3	5.7	7.5
Fuji (2.2/1.0)	2.6	4.5	5.6
AHL cement	3.3	11	24



The details contained in the Table and Figures shows the similarity and superiority of the BJM cement and Fuji I Lining cement in contrast to AHL cement. The ideal combination of properties for a luting cement, sharp set (short setting time) and high strength, are possessed by the BJM luting cements, in contrast to Ionomer glass.

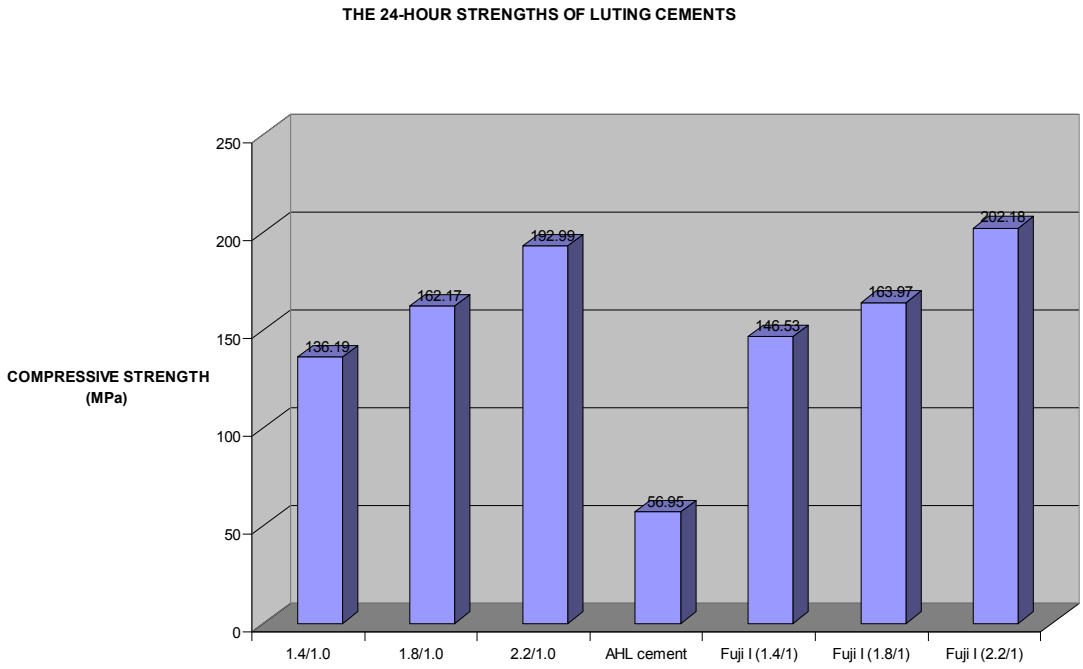


TABLE 1. THE CONSTITUENTS OF THE LINING CEMENT POWDERS

CONSTITUENTS	WEIGHT PERCENT	
	FUJI I LINING	FSL LINING
Silica, SiO_2	29.41	26.85
Titania, TiO_2	0.21	<0.01
Alumina, Al_2O_3	29.80	21.45
Ferric oxide, Fe_2O_3	0.08	0.02
Lime, CaO	0.07	0.32
Magnesia, MgO	0.03	0.06
Potash, K_2O	0.03	0.05
Soda, Na_2O	0.85	2.05
Phosphorus pentoxide, P_2O_5	1.48	5.44
Chromium sesquioxide, Cr_2O_3	<0.01	<0.01
Manganic oxide, Mn_3O_4	<0.01	<0.01
Zirconia, ZrO_2	<0.01	0.05
Hafnia, HfO_2	<0.01	<0.01
Lead monoxide, PbO	<0.02	<0.01
Zinc oxide, ZnO	<0.01	<0.01
Barium oxide, BaO	0.39	0.40
Strontia, SrO_2	24.61	25.66
Stannic oxide, SnO_2	<0.01	<0.01
Cupric oxide, CuO	<0.01	<0.01
Fluorine, F (By ISE)	11.20	13.00
Oxygen equivalent Fluorine (OEF)	-4.71	-5.49
Loss on ignition at 500°C	7.04	10.18
Total	**100.48**	**100.04**

The "loss on ignition" values relate to the organic matter, tartaric acid and poly(acrylic acid), blended into the strontium aluminosilicate glass.

TABLE 2. THE CONSTITUENTS OF THE LINING GLASS (0NLY)

CONSTITUENTS	WEIGHT PERCENT	
	FUJI I LINING	FSL LINING
Silica, SiO_2	31.62	29.83
Titania, TiO_2	0.23	<0.01
Alumina, Al_2O_3	32.04	23.83
Ferric oxide, Fe_2O_3	0.09	0.02
Lime, CaO	0.08	0.36
Magnesia, MgO	0.03	0.07
Potash, K_2O	0.03	0.05
Soda, Na_2O	0.91	2.28
Phosphorus pentoxide, P_2O_5	1.59	6.04
Chromium sesquioxide, Cr_2O_3	<0.01	<0.01
Manganic oxide, Mn_3O_4	<0.01	<0.01
Zirconia, ZrO_2	<0.01	0.05
Hafnia, HfO_2	<0.01	<0.01
Lead monoxide, PbO	<0.02	<0.01
Zinc oxide, ZnO	<0.01	<0.01
Barium oxide, BaO	0.42	0.44
Strontia, SrO_2	26.46	28.51
Stannic oxide, SnO_2	<0.01	<0.01
Cupric oxide, CuO	<0.01	<0.01
Fluorine, F (By ISE)	12.04	14.44
Oxygen equivalent Fluorine (OEF)	-4.72	-6.10
Total	**100.82**	**99.84**

TABLE 3. THE COMPOSITION OF THE FSL LINING CEMENT POWDER

POWDER

CONSTITUENT	WEIGHT %
Strontium aluminosilicate glass powder (d_{50}=2.42 μm, d_{90} <10μm)	90.00
Dextro-tartaric acid dry powder "Analar" grade	5.23
Dry poly(acrylic acid) powder (<38 μm)	4.77
17268 "food" grade yellow iron oxide powder	0.008
TOTAL	**100.00**

LIQUID

CONSTITUENT	WEIGHT %
Poly(acrylic acid)	40.0
Distilled water	60.0
TOTAL	**100.0**