Vivaglass CEM PL

Scientific Documentation

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1 Introduction

Glass ionomers were first described by Alan Wilson and Brian Kent in the late 1960s [1]. The first commercially manufactured dental cements that were based on their findings appeared on the market as early as in 1975 [2]. However, the technology employed was not as advanced as that of the glass ionomers used for conventional cementation in dentistry today.

Originally, glass ionomer cements were composed of an aqueous solution of polyacrylic acid, which reacted with calcium aluminium fluorosilicate glass powder. These first cements were very opaque, demonstrated a long setting time and were very sensitive to moisture. Due to their biocompatibility, these cements were also employed in non-dental fields, eg as components of bone or cartilage replacement material [3].

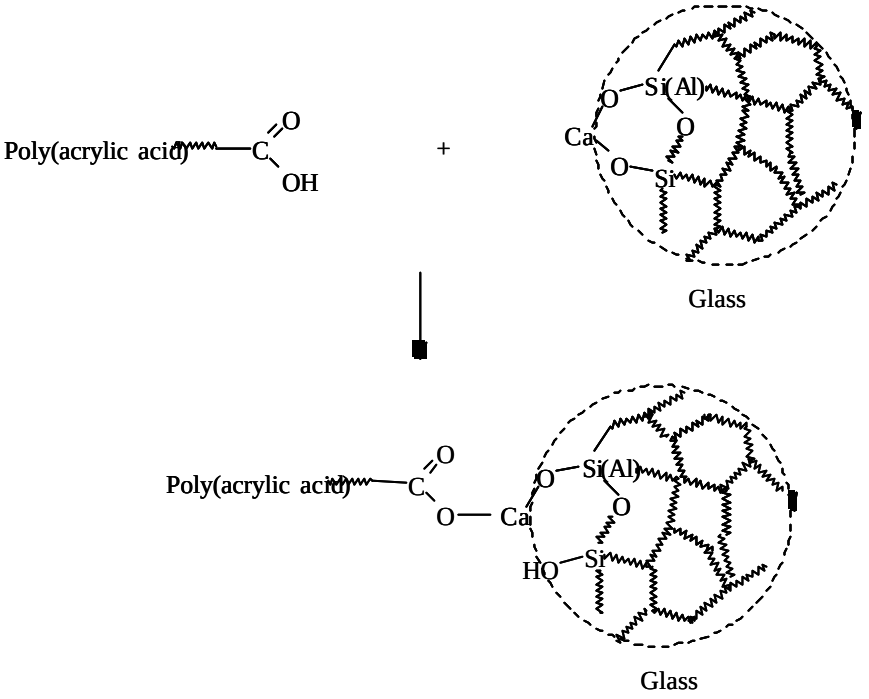

Figure 1: First step of the neutralization reaction

The properties of the various glass ionomers, such as handling properties and compressive strength, can be modified via the following parameters [4]:

- Molar weight of the employed polymer
- Concentration of the acid solution
- Powder/liquid ratio
- Use of complexing agents (e.g. tartaric acid)

When mixing the powder and liquid, the dissolved polymer acid reacts with the alkaline surface of the glass. This reaction is called a “neutralization reaction“, which is the reaction between an acid and a base that produces water and a salt. The acid first reacts with the calcium ions of the glass (see fig 1). The formation of salt with the aluminum ions takes place slightly more slowly. However, the bond that forms is much stronger and the resulting aluminum carboxylates are not soluble in water. Gradually, a thoroughly cross-linked inorganic structure forms. In the process, the density and viscosity of the cement progressively increases (see fig 2).

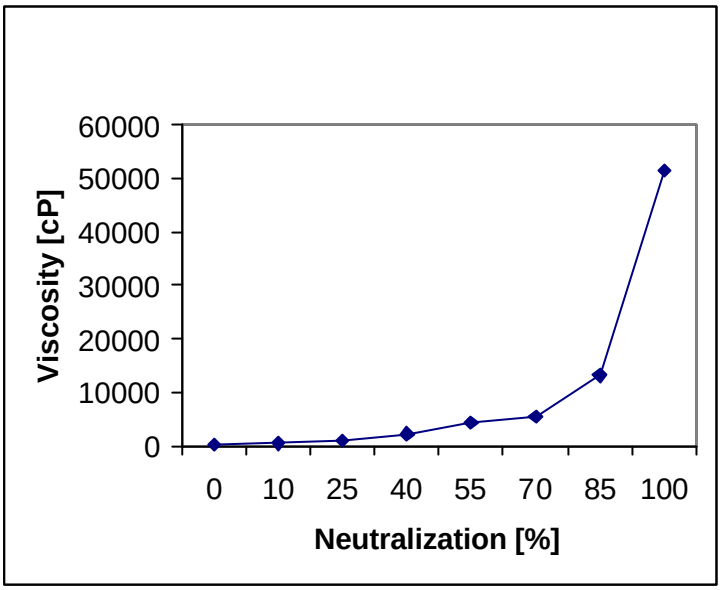

Figure 2: Increase of viscosity in the course of neutralization (according to [5])

For glass ionomer cements, aluminosilicate-type glasses are used exclusively. They are obtained by sintering the components at temperatures between 1200 °C and 1550 °C (2192 °F - 2822 °F). By cooling them down suddenly very porous structures form, which are milled into fine particles with a size smaller than 45 µm or even smaller than 15 µm. The following typical compositions are used: SiO_2 – Al_2O_3 – CaO or SiO_2 – Al_2O_3 – CaF_2. Glass ionomers which contain the latter ingredients are capable of releasing fluoride and thus demonstrate a caries-inhibiting effect.

2 Technical Data Sheet

Standard – Composition (in weight %)

Powder	Ionomer glass	72.0
	Polyacrylic acid	28.0
	Pigments	< 0.1
Liquid	Water	85.0
	Tartaric acid	15.0
	Parabene	< 0.3

Physical properties

In accordance to ISO/FDIS 9917:2002 – Water-based cements

Mixing ratio: Powder/Liquid 3:1

Film thickness	15 ± 5	µm
Setting time (at 37 °C, 100 % rel. humidity)	6.0 – 7.0	Min.
Compressive strength	110 ± 5	MPa
Acidic solubility	0.16 ± 0.1	mm
Lead content	< 10	ppm

3 Physical properties

Vivaglass CEM PL stands out from among conventional glass ionomer cements because of its good radiopacity and aesthetic appearance (see fig 3). Its solubility in water and acid meets the requirements of valid standards. With a shear bond strength of 6 MPa, Vivaglass CEM PL exhibits an exceptionally high dentin bonding ability when compared to other glass ionomers.

Vivaglass Cem PL (7.2 %)

Ketac Cem (5.3 %)

CX Plus (4.5 %)

Figure 3: Comparison of the transparency of several conventional cements

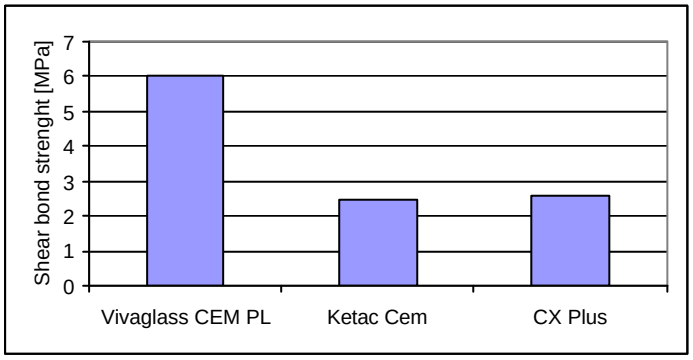

Figure 4:

Shear bond strength on dentin after 24-h immersion in H_2O

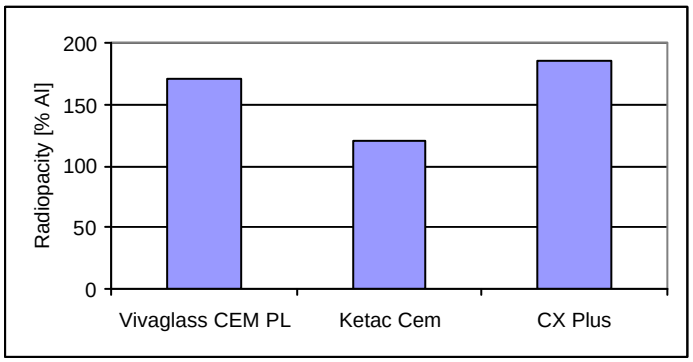

Figure 5:

Radiopacity of different glass ionomer cements

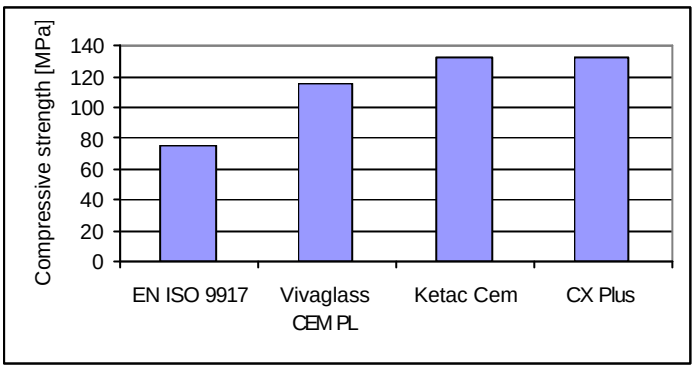

Figure 6: Compressive strength

A compressive strength of 115 MPa clearly surpasses the 75 MPa prescribed by EN ISO 9917.

This feature as well as the comparatively high dentin bonding value ensure reliable adhesion between the restoration and the dental hard tissues.

During the reaction of the carboxylic acid with calcium aluminofluorosilicate glass, fluoride anions are continuously released from the glass (Figure 7).

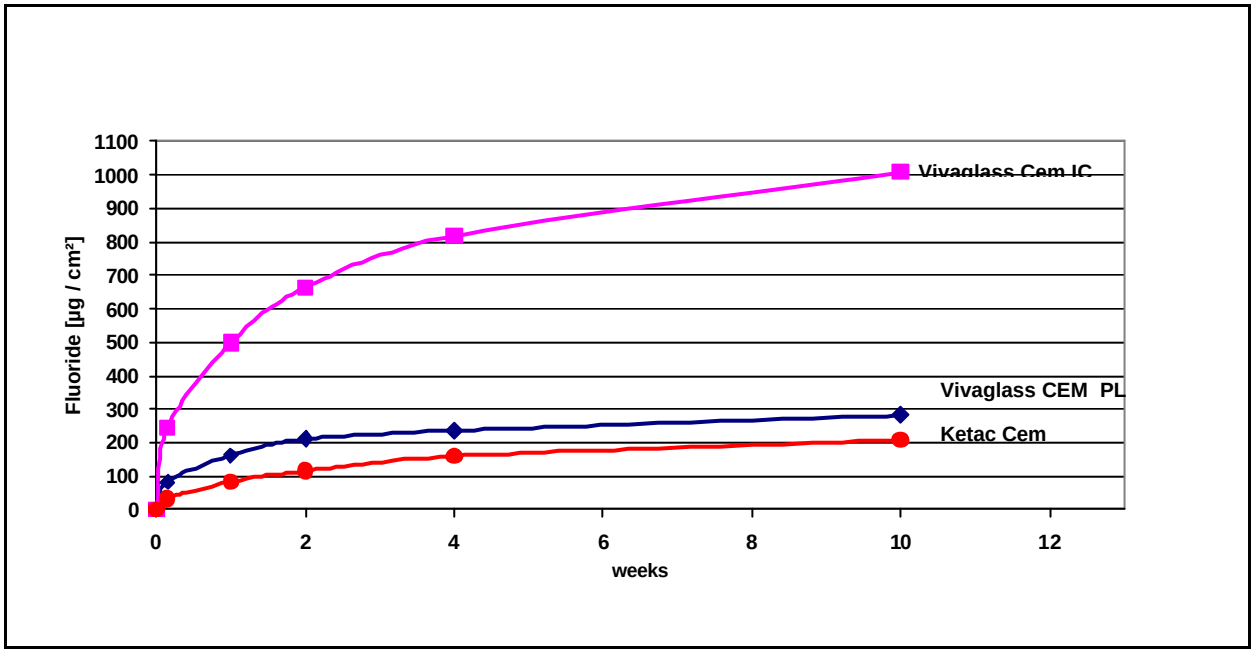

Figure 7: Measurement of the fluoride release in water of different cements

Summary

Vivaglass Cem PL is a traditional glass ionomer cement. Comparable products have been marketed for 30 years with excellent clinical success rates [6]. The properties of Vivaglass Cem compare favourably with those of standard products, and the product meets the standard requirements in all the important parameters (or shows even better values than those prescribed by ISO 9917).

Even though no extensive clinical studies have been carried out so far, a good clinical performance of the product is expected, judging from the data available and the initial clinical experiences gathered.

4 Biocompatibility

The biocompatibility of glass ionomer cements has been confirmed in scientific studies [6].

All substances used are typical components of glass ionomer cements that have been employed in dentistry for years. Carcinogenic, mutagenic or teratogenic effects are not known to date [7].

Compared with standard products, no increased toxicological risk is to be expected with Vivaglass Cem PL based on the present state of knowledge.

5 Literature

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