Experimental report

09/03/2016

Proposal: 9-12-407 **Council:** 4/2015

Title: Dental Cements and Quasielastic Neutron Scattering: Meeting the Challenges of Today's Health Concerns

Research area: Other...

This proposal is a continuation of 6-04-271

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Samples: Polymeric modified commercial dental cement mixed with water
Commercial dental cement mixed with commercial dental acidic aqueous solution mixed with a polymeric chain
Commercial dental acidic aqueous solution mixed with a polymeric chain

Instrument	Requested days	Allocated days	From	To
IN16B	4	3	20/10/2015	23/10/2015

Abstract:

In typical odontological studies water sorption in the restoration material is determined by weighting a freshly mixed cement at regular intervals. In the case of resin-modified cement, such process was proven to be rapid; and over the first 8 h, absorption was shown to follow Ficks law. These findings were attributed to conformational changes in hydrophilic segments of the polymer on absorption of aqueous sodium chloride. It is considered that in this scenario the molecules form more compact coils than in the presence of pure water. To improve such evaluation process, to compare different dental cements and, at the same time, to develop new materials to be used in dental treatment, insight on parameters such as consistency, working and setting times, as well as the chemical reaction dynamics are important. Such factors are usually hard to determine accurately and non-destructively. Two techniques, however, NMR and QENS have the potential to be successfully used for such studies. Here we propose to use QENS to understand how the dynamics of the liquid used in the hydration process in dental cement is modified when confined and relate the results get to durability properties.

EXPERIMENTAL REPORT

EXPERIMENT N° : 9-12-407 INSTRUMENT: IN16B

DATES OF EXPERIMENT : 20-23 Oct. 2015

TITLE: Dental cement and Quasielastic Neutron scattering: Meeting the Challenges of Todays Health Concerns

EXPERIMENTAL TEAM (names and affiliation)

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Date of report: 9 of March 2016

This work aims to obtain the diffusion coefficient of the confined liquid in dental cements, and relate these values to the durability of selected glass ionomer cements (GIC). The data collected using IN16B (ΔE=1μeV) will be used as part of a bigger investigation and will be combined with previously collected quasielastic neutron scattering (QENS) data obtained at the IRIS spectrometer at ISIS (ΔE=20μeV) and data to be collectd on April 2016 using PELICAN at ANSTO (ΔE=50 μeV).

For the measurements using IN16B selected GICs cured for 7 and 28 days were used. During the experiment we investigated the temperature dependence for two samples and based on these results, the remaining time was used to measure the quasielastic (QE) signal for different materials at body temperature only. In total 5 different GICs were investigated either with a doppler speed of 4.6 m/s or 4.4 m/s, corresponding to a energy range of -30 μeV to 30μeV. Example of the data collected is shown in Figure 1.

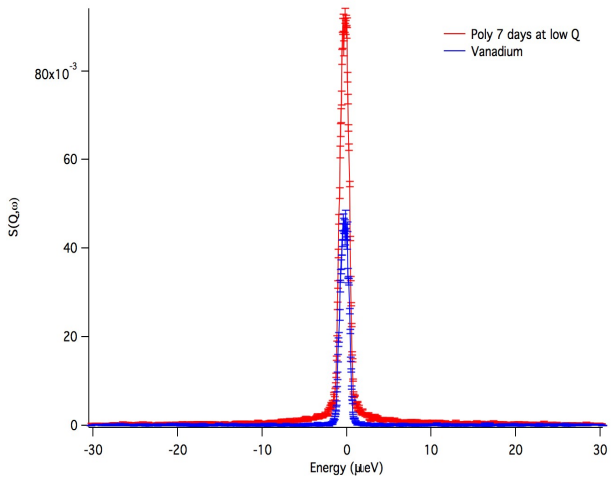

Figure1: Data reduced using MANTID for a GIC cured for 7 days (red) and the resolution of the instrument (blue) at Q = 0.69 Å^{-1}.

Data reduction software for 'mirror sense' was not yet sufficient stable and user friendly which led during the experimenters to unnecessary doubts about the origin of observed intensity fluctuations (sample or instrumental). Moreover the instability of the doppler caused 12 hours of beam time loss, implying that the users were not able to collect data on 2 samples.