

# Optical Transmission of Soaked Acrylic.

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## Introduction:

Acrylic coupons have been soaked for various periods of time and at several temperatures in several solutions. In most cases a slight deterioration in optical transmission has been observed but the magnitude is not considered large enough to cause SNOI to reject any of the D<sub>2</sub>O additives being considered.

## Measurements:

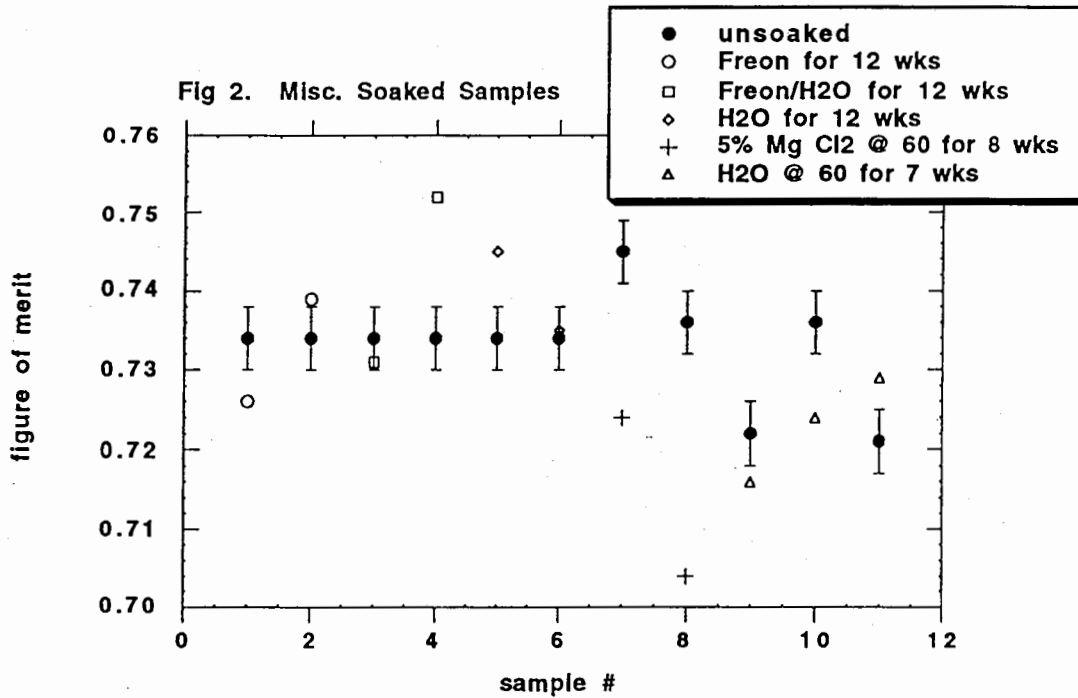
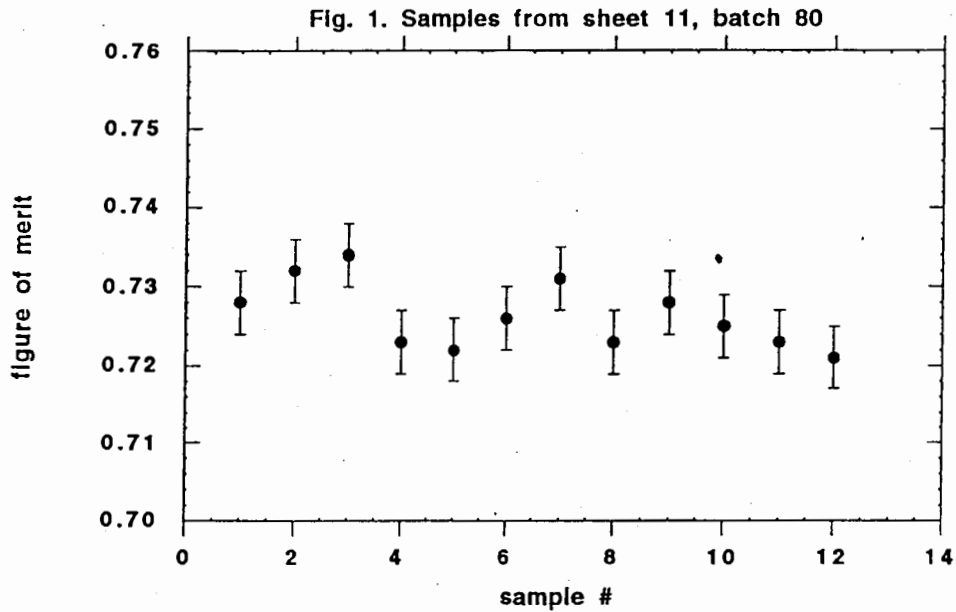
Optical transmission measurements have been made at CRL by placing acrylic coupons in a water bath<sup>1)</sup>. The results have been analyzed to produce a figure of merit (F) for each measurement. This figure of merit represents the fraction of Cerenkov light getting through the acrylic vessel.

Coupons have been soaked in DDD H<sub>2</sub>O, in freon, in freon solution, in 5%, 1% & 0.2% MgCl<sub>2</sub> solution, in 1% NaCl solution and in a 0.1% boric solution. The solution temperatures were either 20 or 60 degs C. The coupons soaked at 60 degs were measured after 2, 4 and 6 weeks and the coupons at room temperature after 2, 4 and 6 months. It is assumed that forty days at 60 degs C corresponds to an aging of 10 years at 10 degs<sup>2)</sup>.

The experimental uncertainty associated with each F is assumed to be 0.5%. This error was determined by examining the spread in values from repeated measurements of the same coupon and from the spread of a family of coupons from the same sheet. Fig. 1 which is taken from the QC document on Polycast Acrylic Sheets<sup>3)</sup> shows the F for twelve different coupons from sheet 11 of batch 80. The error bars shown in this figure are 0.5%.

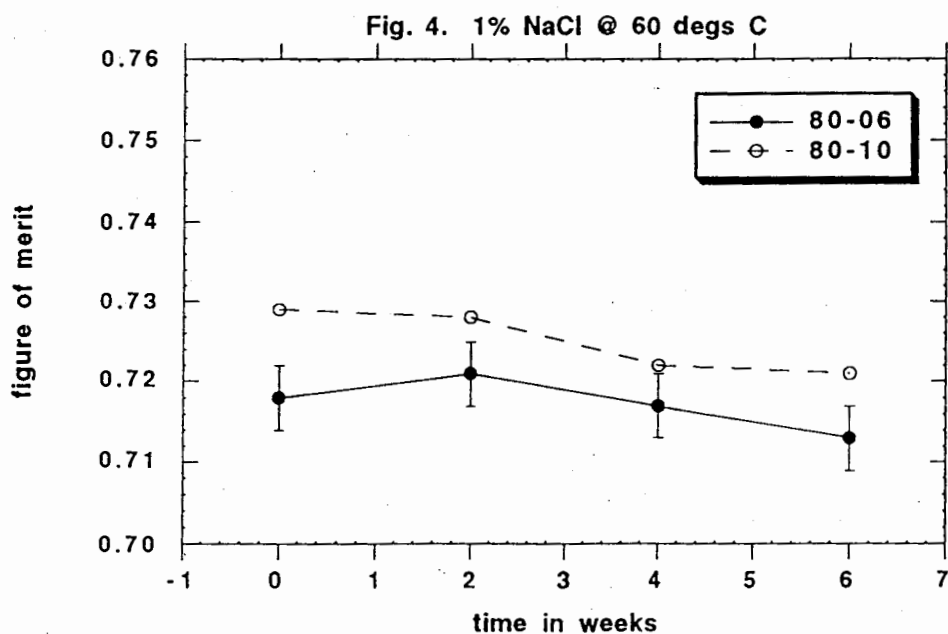
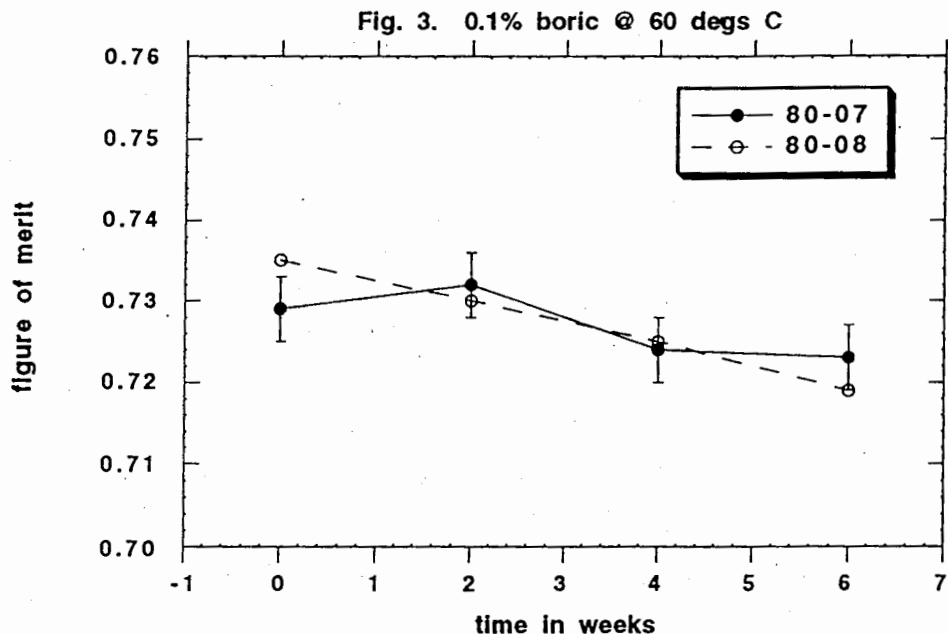
## Results:

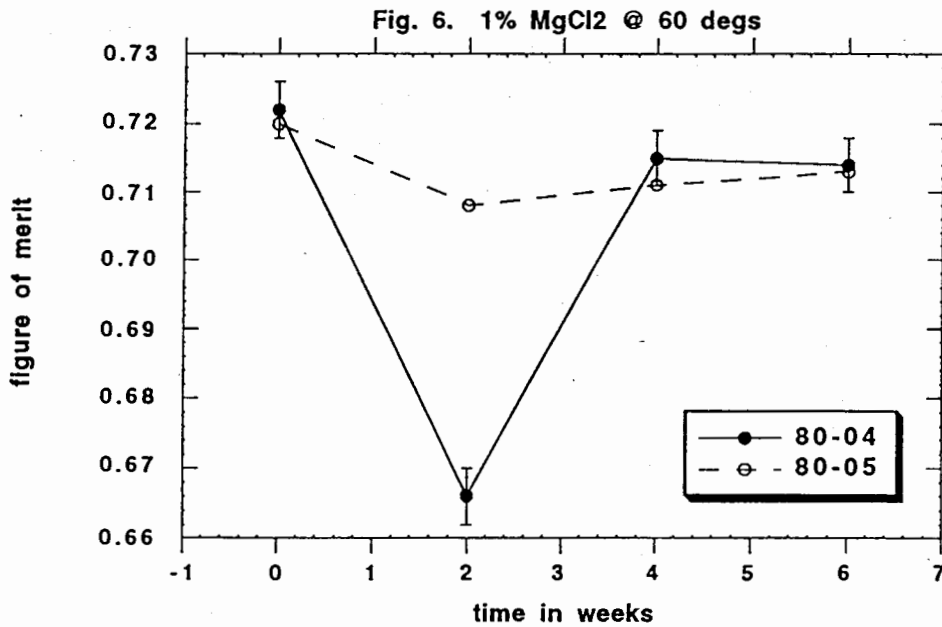
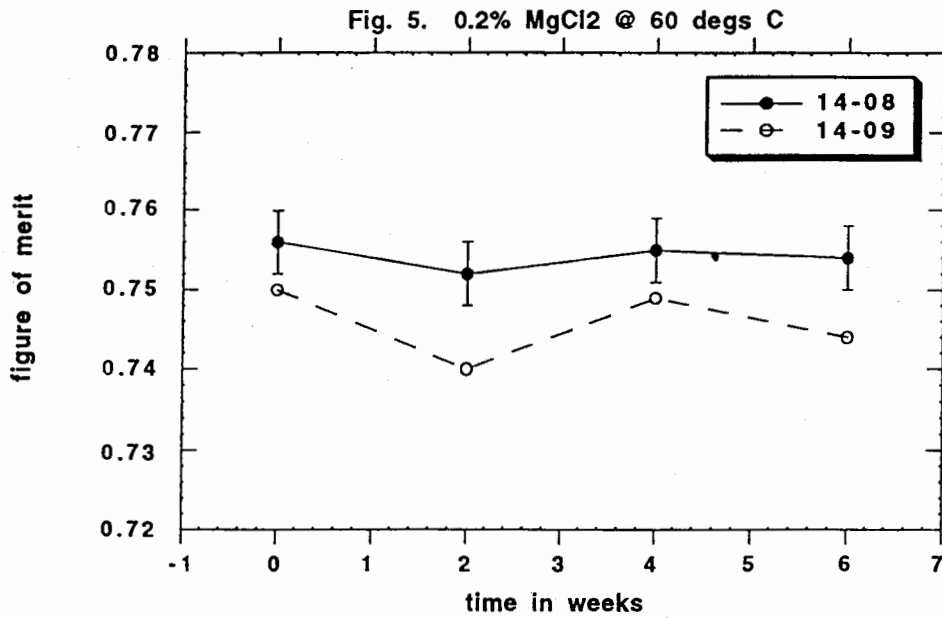
Fig. 2 shows F for coupons soaked in freon, freon solution and H<sub>2</sub>O for 3 months and for coupons soaked in 5% MgCl<sub>2</sub> and H<sub>2</sub>O at 60 degs C for 2 months. The figure compares the F values after the



soaking (open symbols) with the F values before the soaking (closed circles with error bars). The transmission of the coupons soaked in  $MgCl_2$  have deteriorated by about 3%. There is no evidence that soaking in water or freon causes any deterioration.

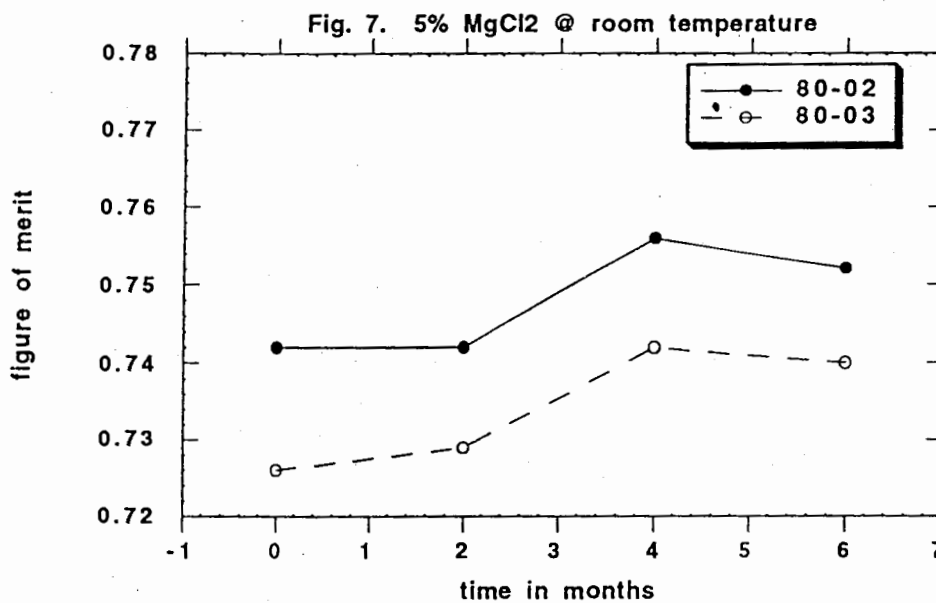
Figs 3, 4, 5 & 6 each show the change in F of two coupons soaked at 60 degs C for 2, 4 and 6 weeks in 0.1% boric acid, in 1% NaCl solution, in 0.2% MgCl<sub>2</sub> solution and in 1% MgCl<sub>2</sub> solution. The reading, in Fig 6, of F=0.665 for one of the coupons after 2 weeks in 1% MgCl<sub>2</sub> may be an experimental error in view of the results on the same coupon after 4 and 6 weeks. This conclusion is supported by





the results, in the same figure, on the other coupon handled similarly. This set of data indicates that any deterioration of transmission following soaking in these various solution is small and not more than about 1%.

Fig 7 shows the F for coupons soaked in 5% MgCl<sub>2</sub> at room temperature for 2, 4 and 6 months. No deterioration is observed, in fact there appears to be an improvement after 4 months.



## Conclusions:

The optical transmission of the acrylic may deteriorated by up to 1% during the lifetime of the SNO experiment due to the various additives currently being considered for the D<sub>2</sub>O. The change in transmission of coupons soaked in high concentrations of MgCl<sub>2</sub> is greater than the experimental uncertainty but the sign of the change is inconsistent. Additional tests are required before conclusions could be drawn. The effect of 0.2% NaCl or MgCl<sub>2</sub> on the optical transmission of the acrylic will be negligible and there is no experimental evidence to favour one compound before the other.

## References:

- 1) Evaluation of Optical Properties of Acrylic Coupons from Different Suppliers. E. Bonvin & E.D. Earle, SNO-STR-92-068
- 2) P. Doe et al. UCI-Neutrino-89-10
- 3) Polycast Acrylic Sheet. E.D. Earle, R. Deal & E. Gaudette, SNO-STR-93-042 (revised)