COMPARISON OF ENVIRONMENTAL TLD RESULTS OBTAINED USING GLOW CURVE DECONVOLUTION AND REGION OF INTEREST ANALYSIS

SAND--87-2814C

DE88 002410

INTRODUCTION

Earlier this year we had the opportunity to test a Harshaw Model 4000 TLD Reader in the Sandia Environmental TLD Program. An extra set of LiF TLD-700 chips were prepared for each field location and calibration level. At the end of quarter one, half of the TLDs were read on the Model 4000 and the other half were read on our standard Harshaw Model 2000. The purpose of this presentation is to compare the results of the two systems. The Model 4000 results are reported for two regions of interest and for background subtraction using Harshaw Glow Curve Deconvolution Software.

INSTRUMENT BACKGROUND

In most dosimetry applications a control dosimeter is used to subtract background. In doing this a user subtracts not only an unwanted radiation background but also the inherent instrument background that results from the PMT dark current, heater IR and the

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heating of an unexposed TLD chip and the surrounding gas. In environmental dosimetry it is not possible to use a control in the conventional sense, in that it is measuring the same background as the field dosimeter. Therefore some other method to account for the inherent instrument background must be used.

A standard method is to use the reread of the TLD chip as the measure of the instrument background. The reread value is then subtracted from the first read value to yield the net response due to the environmental radiation background. This method is used in the Sandia program and in the evaluation of the current data where a region of interest is used in the analysis.

The new method of background subtraction using Glow Curve Deconvolution also looks promising and results using this method are included for comparison.

REGIONS OF INTEREST

Using a region of interest in the readout of TLDs has two related benefits:

1. It can eliminate the integration of light from shallow traps and thereby reduce the effect of TL fading and,

2. It can increase the signal-to-noise ratio by eliminating the integration of light from regions outside the main glow peak.

The regions-of-interest used in this study are as follows:

Instrument	ROI
Harshaw 2000	175-250°C
Harshaw 4000	Channels 110-180 (165-270°C)
	Channels 110-160 (165-240°C)

DATA ANALYSIS

Data analysis for each method was performed using personal computer software designed for the Sandia environmental TLD program. The software allows the systematic and uniform processing of calibration, field and control data. The software consists of BASIC programs and screens.

COMPARISON OF RESULTS

The results for the four methods are summarized in the following table.

The first comparison is a measure of the quality of the precision for each method. To find this we pooled the S by taking the RMS of values for each location.

VIEWGRAPH

The pooled estimates of variability show that precision or variability for the Model 4000 using an ROI of 110-160 channels is quite large. This demonstrates that one must be careful in selecting an ROI. The ROI of 110-160 channels was too narrow to accommodate my variability in TLD chip heating rate and therefore any change in the position of the glow curve.

Also note the large variability resulting from the background subtract method. This large variation is primarily due to difficulty with the CGCD program to subtract the proper background from glow curves obtained at two locations. These glow curves have a very large tail following the main peak that is not integrated when using the ROI methods. If we exclude the data from these two locations the variability is cut almost in half.

I don't know what caused the large tail on the glow curves at two locations but if the deconvolution program could be modified to handle such unusual situations the method does appear to produce improved precision for environmental measurements.

The final comparison shows the average differences of the exposures for the 4 methods.

The first table uses the results obtained on the Model 2000 as the reference.

VIEWGRAPH

The second table compares the results taken on the Harshaw 4000 using the two methods: BKG Subtract and ROI 110-180 channels.

VIEWGRAPH

This comparison shows that there is a significant difference in the measured exposure values depending on which instrument and which method of integration is used. A T-test indicates that the differences are statistically significant at the 95% level with the exception of the value for the ROI 110-160 channel method.

CONCLUSION

Additional field measurements and laboratory exposures must be made to resolve the differences in response found between the different instruments and integration methods. Also additional improvements in glow curve deconvolution may make it a very useful tool in improving the precision of environmental TLD measurements.