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It appears that the filter described by Jensen and Barbetti (1979) is the best compromise when regarding the response of the human eye, short wavelength bleaching and use with bialkali type photo multipliers.

Jensen, H. and Barbetti, M., Ancient TL #7, p. 10, 1979
Sutton, S. and Zimmerman, Ancient TL #5, p. 58, 1978

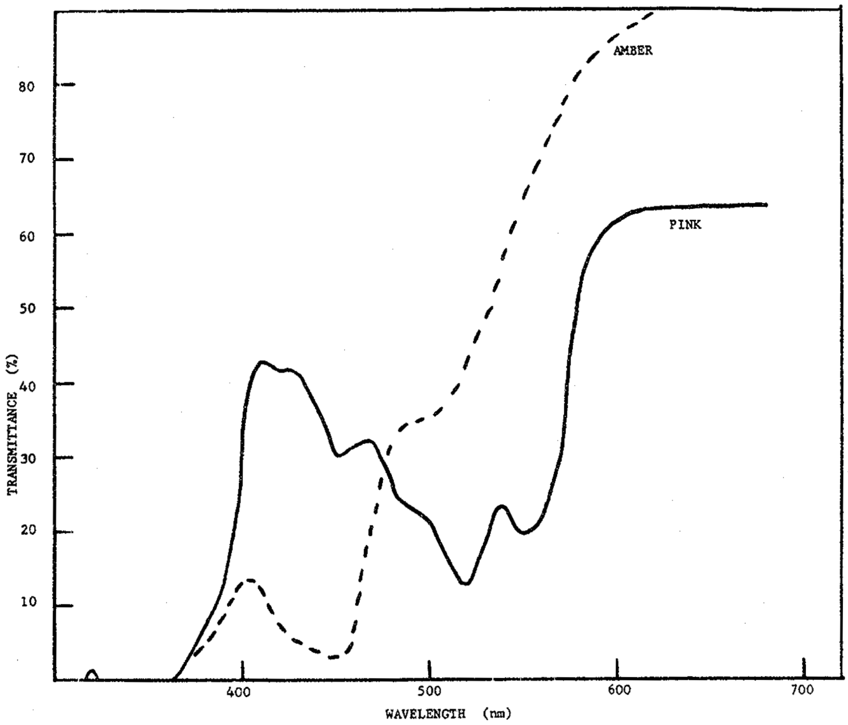

Figure 1: Light transmission through a single thickness of Solar Screen "Pink" (solid line) and "Amber" (broken line, afte Sutton and Zimmerman, 1979). Measured with a Cary recording spectrophotometer model 14, Chemistry Department, Brookhaven National Laboratory.

A CONVENIENT DOSIMETER FOR MEASURING THE ENVIRONMENTAL RADIATION DOSE RATE AS IT APPLIES TO THERMOLUMINESCENCE DATING

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Knowledge of the environmental radiation dose rate, R_e, is generally essential to an application of the usual methods of thermoluminescence dating. While it is possible to eliminate it from the calculations using the subtraction technique, which requires the application of both the fine grain and inclusion methods to the same sample, this is time consuming and subject to substantial errors unless great care is exercised.

Measurement of R_e may be made using samples of the burial soil or, in the field, using sensitive phosphors. The former does not take account of possible additional radiation due to nearby rocks and the latter commonly requires placement periods in the field of many months. Also there is a problem of read-out of the phosphors. If it is not done in the field there are problems with in-flight radiation pick-up and border customs inspectors.

A small self-contained radiation dosimeter has recently become available which gives promise of measuring the environmental radiation dose in the field in as little as two weeks. Furthermore zeroing and read-out can be made in the field, doing away with the particular problems just described.

The dosimeter is a pocket-sized halogen quenched GM counter device known as RAD-21 manufactured by Wallac Control Instruments, PL10 20101 Turku 10 Finland (supplied in Australia by ANAC Pty. Ltd., P.O. Box 515, Hurstville, N.S.W. 2220, for around $Aust 300). It features an exposure range from 0.1 mR to 999.9 mR and has a button activated digital display reading down to 0.1 mR. Here mR stands for milli Röentgen. Normally supplied with three rechargeable 1.25 V NiCd dry cells the unit can also be operated from non-rechargeable 1.5 V cells.

The energy dependence of the filtered GM tube is stated to be ±20% from 50 keV to 3 MeV. The accuracy of the dose measurement is stated to be ±15% of indicated dose excluding energy dependence. The energies of the decay produced gamma rays in the field situation lie in this range.

The dosimeter is zeroed in the field and then sealed in two polythene bags, the outer bag with some desiccant present to prevent condensing moisture affecting the unit. The loaded bags are then placed in the burial situation where the background gamma and cosmic radiation level needs to be known. After about two weeks (the batteries have a life-time of three weeks) it is extracted and read out on the spot. In an actual case where the environmental dose rate in a small museum was being measured the corrected total exposure (a correction based on exposure to a calibrated ^{137}Cs source is supplied by the manufacturers with each unit) was 7.8 mR after 17 days, corresponding to an annual dose rate of 0.15 rad/yr. This was much as expected. The dose rate just quoted is to air.

Of great practical significance is the small physical size of the dosimeter. This means it may be easily and discreetly inserted totally into the same burial situation from which the test potsherds (say) have been removed. By being back covered with earth it is then out of the sight of any curious local natives. Also, by accumulating over a period of two weeks there is an averaging effect which is not present in a single background reading with a dose-rate meter of sufficient sensitivity. Admittedly averaging over a longer period can take account of any seasonal variations, but this particular effect could be judged to be small in appropriate cases, e.g. low rainfall areas.

Strictly, to be used in calculating the absorbed dose to quartz it would first be necessary to expose both the dosimeter and some quartz to the same uniform gamma radiation field. This field should be of the same quality as that met in typical field situations. The quartz should then be glowed out in a TL apparatus and the apparent absorbed dose calculated in the usual way using a calibrated laboratory radioactive source. This is then compared to the dosimeter reading. An additional correction factor, which may be close to unity, can then be calculated and applied to the dosimeter reading. For this test the quartz can of course be appropriately replaced by a more sensitive phosphor such as $CaSO_4$:Dy.

In a series of four two-week long runs with one of these dosimeters in a constant background situation the maximum individual deviation from the calculated mean annual dose rate was approximately 2%. In a separate similar series in a different location, the maximum individual deviation from the mean was approximately 3%. These figures indicate the variation to be expected in a single run of this duration.

Another series of in-ground tests showed that the dosimeter was able to sense the presence of nearby rocks by an increased reading, presumably due to the radioactivity of these rocks being greater than that of the surrounding soil.

The help of Mrs. Glenys Gardner and Mr. David Price in carrying out the test measurements is gratefully acknowledged.

The Wallac RAD-21 Radiation Dosimeter

(the digital display is in the window on the front edge)