



A METHOD FOR THE EVALUATION OF THE "ZERO SIGNAL" FOR PERSONAL THERMOLUMINESCENT DOSEMETERS

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INTRODUCTION

The individual monitoring service (IMS) of the Greek Atomic Energy Commission (GAEC) assures the individual monitoring of almost 10,000 occupationally exposed workers all over the country. The monitoring system is based on thermoluminescent dosimeters (TLD). Three automatic TLD readers and one TLD irradiator are being used for the needs of the IMS. In each dosimeter there are 2 LiF:Mg,Ti pellets, individually calibrated, which are inserted in a chamber with hot nitrogen for measurement after heating. The signal of each pellet is transferred to an in built database and the calculation of the dose is performed according to the calibration protocol of the commercially compatible software.

The usual shape of a glow curve of the LiF:Mg,Ti material in a constant temperature hot gas reader is distorted sometimes, giving an increase at the background signal at the last channels. In order to evaluate the doses properly, the glow curves have to be modified; the person responsible for the measurements has to chose the proper region of interest. The problem becomes more complex when the pellet is not irradiated or irradiated to very low dose (figures 1 and 2).

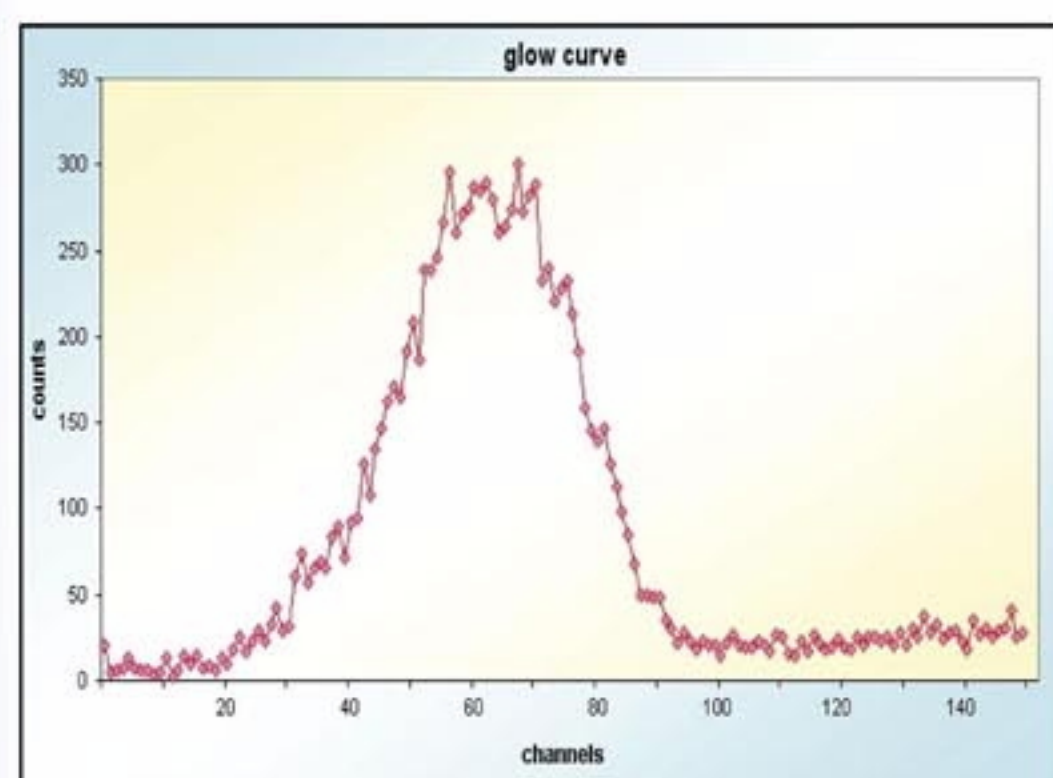


Figure 1: Glow curve of an irradiated (at about 0.1 mSv) LiF:Mg,Ti pellet

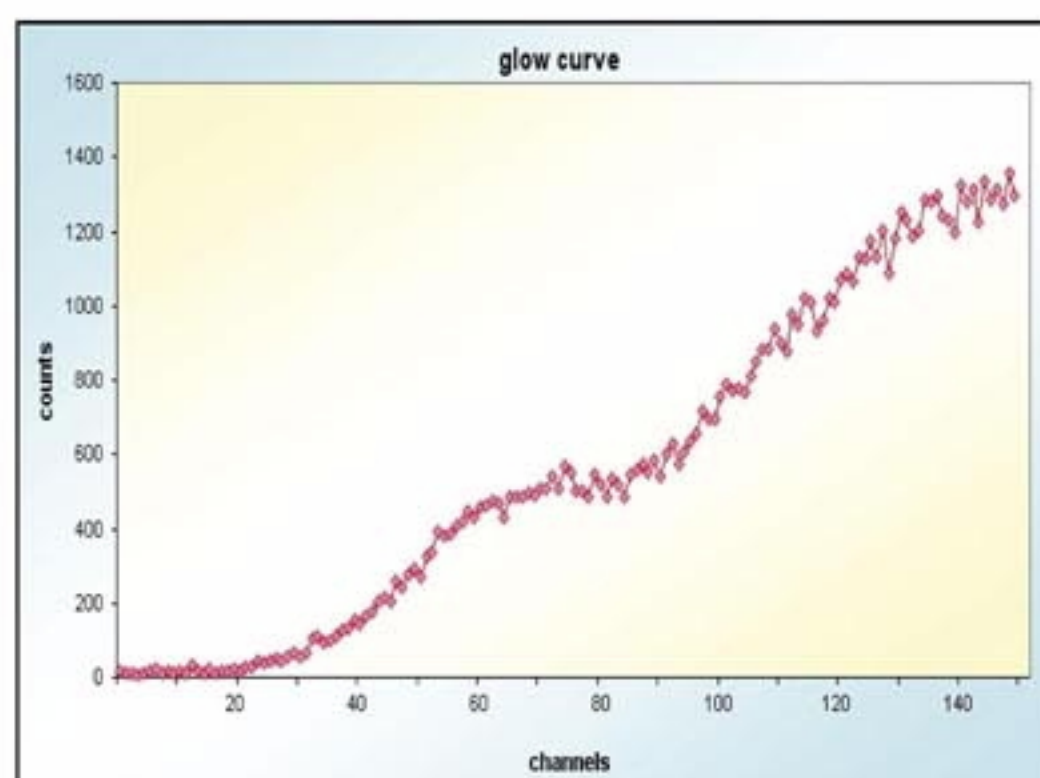


Figure 2: Glow curve of an irradiated (at about 0.1 mSv) LiF:Mg,Ti pellet with a high signal at the last channels

METHODOLOGY

In this study a correction method for the proper calculation of the zero signal of the glow curve has been developed. The method is based on the heating profile of the TL pellet in a non linear heating system.

The number of counts per channel can be given by the equation:

$$\Phi(t) = n + [(N-n) - (N-n) \exp(-\alpha t^x)]$$

- n is the average counts of the first 10 channels of the measurements
- N is the average counts of the last 30 channels of the measurements

The parameter α is calculated using the non linear least square fit after the calculation of the parameter x. The exponential factor x is calculated experimentally after analysis of 20000 glow curves.

Values from 3 to 7 have been used and the results are shown in figure 3. As it is seen from the figure the values 3 and 4 resulted in an overestimation of the zero signal, where the value of 7 underestimates the zero signal. The most proper choice for the parameter x can be the value of 6.

References

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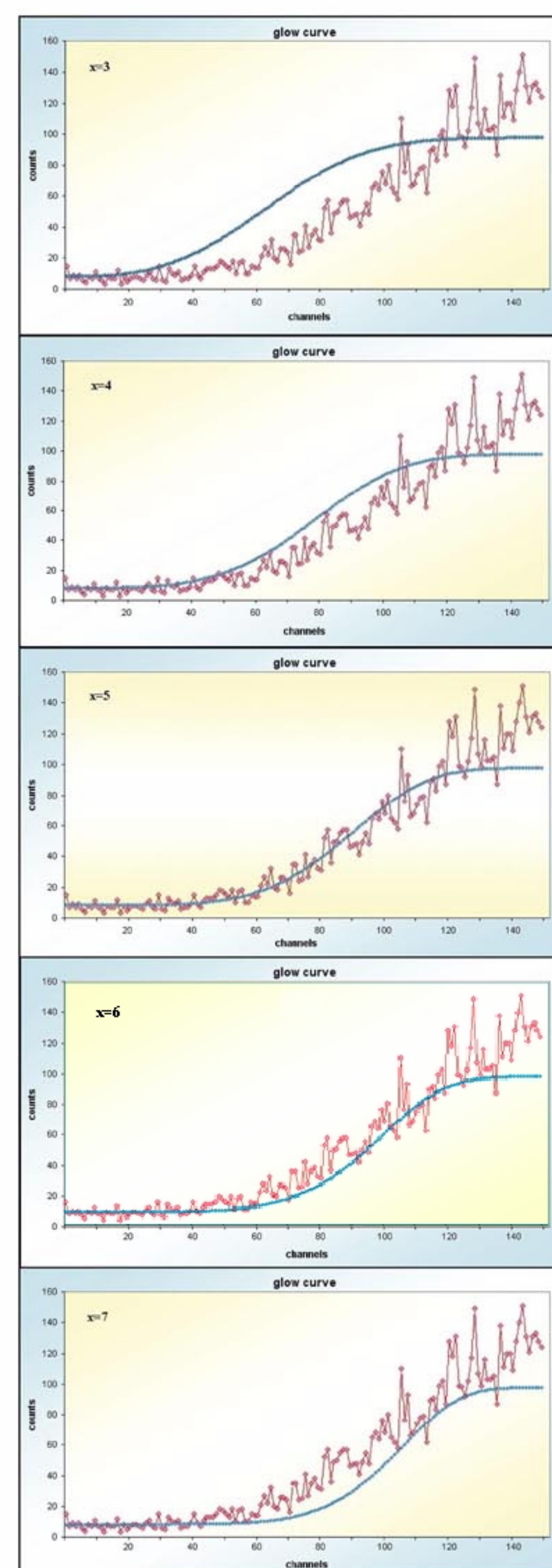


Figure 3: x- choice

RESULTS

The model has been implemented at the TL signal outputs of the dosimeters of the occupational exposed workers monitored by the IMS for verification.

The evaluation of the doses of the monitored workers is performed with the subtraction of the integral of the zero signal from the TL signal output of each pellet as shown in the following figure 4.

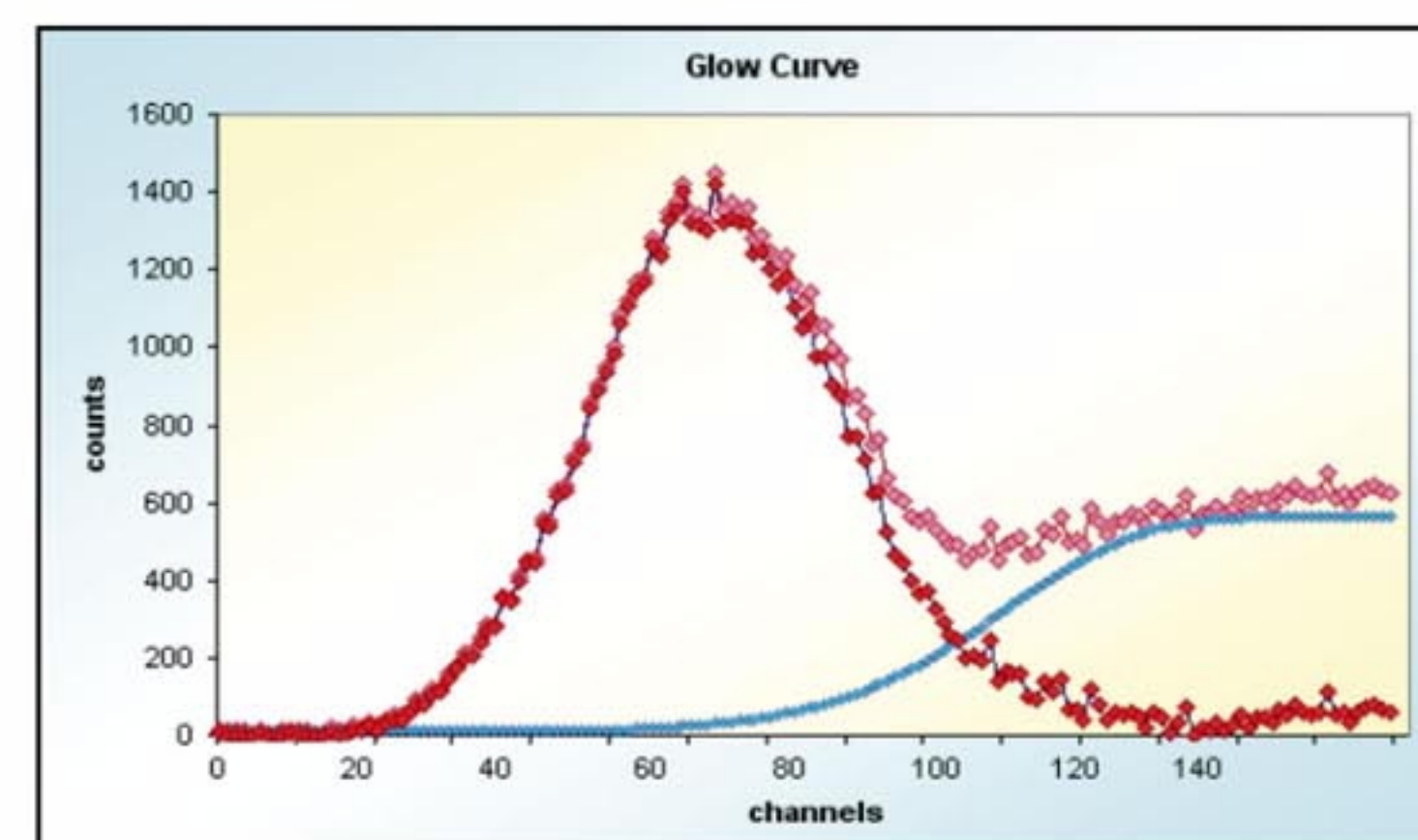


Figure 4: subtraction of the "zero signal"

CONCLUSIONS

The methodology described can be used as a simple and automatic routine in the evaluation of the zero signal of the pellets measured in our system. The advantages of the calculation of the zero signal are the better evaluation of the zero or low doses without spending time and effort by the personnel responsible for the evaluation of the doses.