

# STUDY OF GRAPHITE-MIXED $\text{CaSO}_4:\text{Dy}$ FOR SKIN DOSE ASSESSMENT

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## Abstract.

Sintered pellets of  $\text{CaSO}_4:\text{Dy}$  of thicknesses between 0.2 and 0.8 mm with graphite content from 0 to 10% were investigated for application in beta dosimetry. Results on beta energy response are given.

## 1. Introduction.

A personnel dosimeter for application in mixed beta/gamma fields requires a thin detector with an adequate sensitivity and a mechanical strength suited for handling. By adding graphite in TL dosimeters the TL emission can be reduced to the surface layer and an energy response similar to that of a thin detector can be obtained<sup>(1)</sup>. The presence of graphite in the dosimeter has no effect on the TL characteristics of the phosphor, and the dosimeters have the same mechanical strength as dosimeters without graphite. In the past four years thin pellets of  $\text{CaSO}_4:\text{Dy}+\text{Teflon}$  (0.20 mm) have been produced by the Dosimetric Materials Production Laboratory of IPEN for beta radiation dosimetry<sup>(2)</sup>. The addition of various amounts of graphite powder into 0.20 mm thick  $\text{CaSO}_4:\text{Dy}+\text{Teflon}$  pellets was investigated<sup>(3)</sup>. Pellets of different thickness and graphite contents has now been investigated. The TL characteristics of the dosimeters prepared from graphite mixed sintered  $\text{CaSO}_4:\text{Dy}$  are described.

## 2. Materials and Methods.

Sintered TLD pellets of different thickness were obtained from a homogeneous mixture of  $\text{CaSO}_4:\text{Dy}$

(35% by weight) Teflon powder and graphite (0, 0.5, 1, 2, 3, 5 and 10% by weight). Pellets of this mixture, with a diameter of 6.0 mm and thickness between 0.20 and 0.80 mm were first cold pressed and then sintered.

The TL response was determined using the Harshaw TL Reader model 2000(AB). Prior to irradiation, the samples were subjected to an annealing at 300°C for 3 h. They were irradiated under the same conditions. Each reported value corresponds to the average of five measurements.

The beta irradiations were carried out using a beta Secondary Standard System with  $^{90}\text{Sr}-^{90}\text{Y}$ ,  $^{204}\text{Tl}$  and  $^{147}\text{Pm}$  sources. The gamma irradiations were carried out using a  $^{60}\text{Co}$  source. The samples were always irradiated sealed in Hostaphan foil 15  $\mu\text{m}$  thick and under electronic equilibrium conditions.

## 3. Results.

### Photon Response

The  $\text{CaSO}_4:\text{Dy}$  Teflon pellets with different graphite contents and thickness were firstly calibrated with gamma radiation from a  $^{60}\text{Co}$  source all pellets were exposed to  $2.58 \times 10^5 \text{ C.kg}^{-1}$  (100 mR). It was

observed the decrease of the TL sensitivity with increasing graphite content and the increase of the TL sensitivity with increasing thickness.

### Beta Response

The TL response of all type of  $\text{CaSO}_4:\text{Dy}$  dosimeters was measured for  $^{90}\text{Sr}-^{90}\text{Y}$ ,  $^{204}\text{Tl}$  and  $^{147}\text{Pm}$  beta sources and normalised to  $^{90}\text{Sr}-^{90}\text{Y}$  radiation, as shown in table 1.

The energy dependence of the TL response was analysed. The energy response of 0.20 mm and 0.40 mm thick pellets are shown in fig. 1 and 2 respectively for 0, 0.5, 3.0 and 5.0% graphite content.

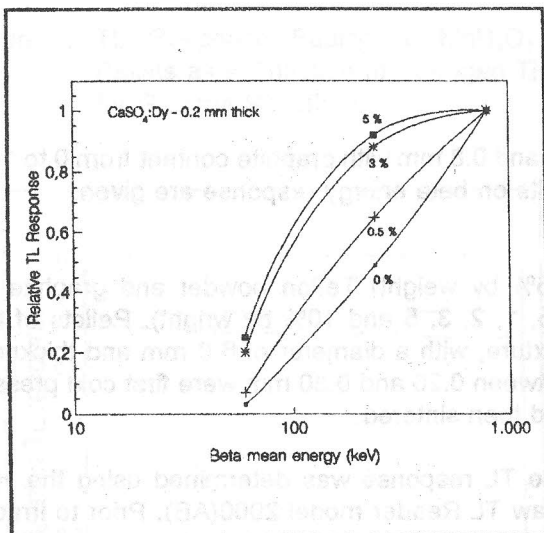


Figure 1 - Energy response of the 0.20 mm thick pellets.

It can be seen that the dosimeters 0.4 mm thick with a graphite content of 3% gives a better response curve than that of pellets without graphite. This result shows that the optimal TL response is obtained with 0.4 mm thick pellets with 3% of graphite content and not 0.20 mm thick pellets with 10% of graphite content that we have proposed previously<sup>(3)</sup>.

### 4. Conclusions.

The graphite mixed  $\text{CaSO}_4:\text{Dy}$  Teflon pellets produced at IPEN appear attractive for beta as well as mixed beta-gamma dose measurements. The reduced energy dependence to beta rays with average energy between 100 and 800 keV makes them useful in personnel monitoring.

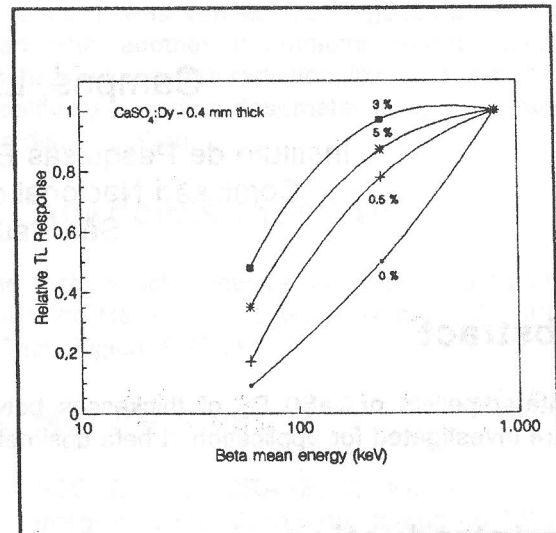


Figure 2 - Energy response of the 0.40 mm thick pellets.

### 5. References.

1. Horowitz, Y.S.. TL and TL Dosimetry. V.II (Cleveland, OH:CRC Press) ch. 2, pp. 62-64 (1984).
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TABLE 1

Effect of graphite content on the TL response of CaSO<sub>4</sub>:Dy Teflon pellets.

Beta Source	Graphite Content %	Relative TL Response			
		Pellet Thickness (mm) 0.2	Pellet Thickness (mm) 0.4	Pellet Thickness (mm) 0.6	Pellet Thickness (mm) 0.8
<sup>204</sup> Tl	0	0.49	0.50	0.40	0.34
	0.5	0.65	0.78	0.60	0.57
	1.0	0.78	0.98	0.69	0.64
	3.0	0.88	0.97	0.81	0.90
	5.0	0.92	0.87	0.83	0.85
	10.0	0.80	0.66	0.97	0.87
<sup>147</sup> Pm	0	0.03	0.09	-	-
	0.5	0.07	0.17	-	-
	1.0	0.10	0.25	-	-
	3.0	0.20	0.48	-	-
	5.0	0.25	0.35	-	-
	10.0	-	-	-	-