13 - 18 May 2012 ■ SECC ■ Glasgow ■ Scotland

13th International Congress of the International Radiation Protection

Results of a Dosimetric System for Personal Dose Equivalent Assessment

Felícia D.G. Rocha[1, 2] and Letícia L.Campos[2]

[1]Anhanguera Educacional

Rua Maria Cândida, 1813, 02071-013 - São Paulo - Brazil

[2] Instituto de Pesquisas Energéticas e Nucleares - CNEN/SP

Av. Prof. Lineu Prestes, 2242, 05508-000 - São Paulo - Brazil

fgrocha@ipen.br; lcrodri@ipen.br

1. INTRODUCTION

Since the introduction of thermoluminescence (TL) for dosimetric purposes, a lot of efforts have been made to explain and also to improve its application for personal, clinical and environmental dosimetry. The use of thermoluminescent dosemeter is attractive because of its small size, low cost and they also can assess the radiation doses to demonstrate compliance with regulations on dose limits. $CaSO_4$: Dy is one of the most useful and sensitive thermoluminescence material for radiation dosimetry. Because of its high sensitivity to gamma radiation and stability of response, it is often used to assess the radiation dose to the general public from nuclear or radiological facilities [1,2,3] and also for personal dosimetry. The Individual Monitoring Service of the Instituto de Pesquisas Energéticas e Nucleares (IPEN/CNEN-SP) monitors approximately 1500 workers on a monthly basis, from 14 facilities spread all over the country, using thermoluminesce dosemeters (TLD). This paper summarises the obtained results with the intercomparison that was done with two different dosimetric systems for evaluate the personal dose equivalent .

2. OBJECTIVES

-To analyse the results of the dosimetric system as a part of a radiation monitoring programme of occupationally exposed workers;

-To compare the assessment of personal dose equivalent Hp(10) according to national and international recommendations [4].

3. MATERIALS AND METHODS

TL Radiation Detectors and Badge

- $CaSO_4$: Dy sintered discs: Thickness = 0.8 mm; Diameter = 6.0 mm from IPEN
- Plastic badges - with different metal filters - Figures 1 (Type 1) and 2 (Type 2)

Readout Equipment

- Harshaw 3500 Automatic TLD Reader

Irradiation Set-up

- ^{137}Cs gamma source: STS OB85/1 - Irradiator - 128 GBq - (09/2011)
- X Radiation Quality N-60:Pantak-Seifert, Model ISOVOLT 160 HS
- ISO Water Filled Phamton (30 x 30 x 15) cm

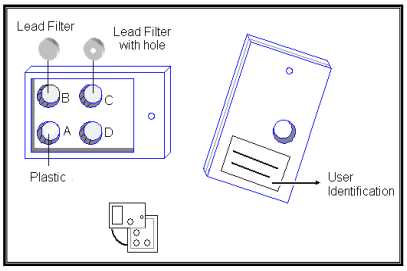

Figure 1. Dosimeter used for personal monitoring at Ipen (Type 1).

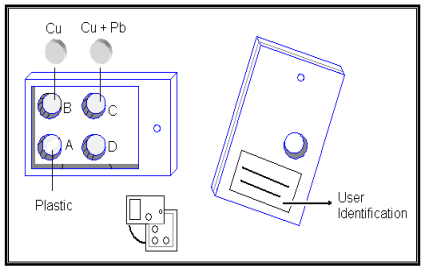

Figure 2. Dosimeter developed at IPEN using copper and lead filters (Type 2).

4. RESULTS

Reproducibility

- Dosimeters: $CaSO_4$:Dy TLD (Types 1 and 2)
- Reading cycles: 10
- Standard annealing:300°C/1h for $CaSO_4$:Dy;
- Absorbed dose: 5mGy
- Reproducibility: better than 4.5% for both dosemeters type

Dose Response Curves

- Absorbed dose range: 0.2 to 10 mSv
- Radiation quality: ^{137}Cs and N60 X rays beams
- Irradiation conditions: ISO Water Filled Phantom
- Calibration curves for gamma radiation: $CaSO_4$:Dy TLD Type 1 - Figure 3 and $CaSO_4$:Dy TLD Type 1 - Figure 4

Table 1 - Personal dose equivalent results of the intercomparison.

Radiation Quality	Conventional True $H_p(10)_T$ (mSv)	$CaSO_4$:Dy(Type 1)		$CaSO_4$:Dy (Type 2)	
		Mean Evaluated $H_p(10)_E$ (mSv)	Deviation $\frac{H_p(10)_E}{H_p(10)_T}$	Mean Evaluated $H_p(10)_E$ (mSv)	Deviation $\frac{H_p(10)_E}{H_p(10)_T}$
N60	0.3	0.31±0.01	1.03	0.31±0.02	1.03
	2.0	2.17±0.26	1.09	2.19±0.15	1.10
	10.0	10.09±0.06	1.01	10.00±0.13	1.00
^{137}Cs	0.2	0.21±0.01	1.05	0.23±0.04	1.15
	2.0	2.12±0.24	1.06	2.25±0.18	1.13
	10.0	10.22±0.26	1.02	10.06±0.40	1.01

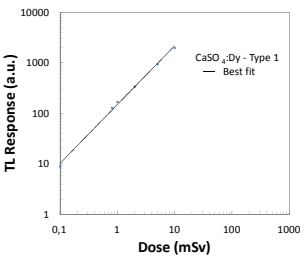

Figure 3- Calibration Curve: $CaSO_4$:Dy type 1

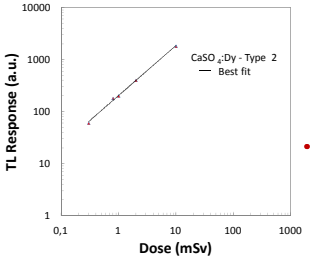

Figure 4 - Calibration Curve: $CaSO_4$:Dy type 2

- **$CaSO_4$:Dy dosimeters:** the deviation between evaluated dose and conventional true dose were less than 10% for X radiation. For ^{137}Cs gamma rays, the deviation had larger values for $CaSO_4$:Dy type 2 dosimeters. In this case, probably there was a difference in the irradiation positioning.

5. CONCLUSIONS

- The dosimetric systems studied are able to measure the operational quantity personal dose equivalent Hp(10) according to ICRU for normal incidence.
- The differences between evaluated and conventional true dose were in the range of 1% to 15%, that are inside national requirements.
- To improve the personal dose equivalent evaluation technique, periodic intercomparison is needed.

REFERENCES

1. Campos, L.L and Lima, M.F. Dosimetric properties of $CaSO_4$:Dy teflon pellets produced at IPEN. *Radiat. Prot. Dosim.*, 14(4), 333-335, 1986.
2. Van Dijk, J.W.E. On the assessment of the performance of personal dosemeters and individual monitoring services. *Radiat.Prot.Dosim.*, 120(1-4), 250-258, 2006.
3. Kortov, V. Materials for thermoluminescent dosimetry: current status and future trends. Radiat. Meas., 42(1-4), 576-581, 2007.
4. International Commission on Radiation Units and Measurement. *Determination of Dose Equivalents Resulting from External Radiation Sources - Part 2.* Report 43 (Bethesda, MD: ICRU Publications), 1988.

The authors are grateful to Conselho Nacional de Desenvolvimento Científico e Tecnológico (CNPq), and Fundação de Amparo à Pesquisa do Estado de São Paulo (FAPESP), Brazil, for the partial financial support of this work.