----Raf. Jour. Sci., Vol.17, No. 2 Physics, Special Issue, pp.1-5, 2006----

X-ray Hazard from Colour Television Sets and Video Display Terminals

Mazin F. Mahrok **Qusay KH. AL – Dulamey**

Department of Physics
College of Science
Mosul University

(Received 20/9/2004 , Accepted 20/2/2005)

ABSTRACT

Measurement and assessment of dangerosity of X- ray leakage from coloured television (TV) and video display terminals (VDT) are attempted. Three different techniques have been used (X-ray film, scintillation counter and Geiger counter). A comparison of the X-ray film result with literature value is made. Another comparison of the three techniques with published values is also made.

Although big differences are noticed between most of the readings cited in the literature and those found in the present work, it can be seen that all reading are less than the maximum limit of the natural background radiation dose (2 m Sv/y).

خطورة الأشعة السينية من أجهزة التلفزيون الملون وأجهزة العرض

الملخص

أجريت محاولة لقياس وتقدير خطورة تسرب الأشعة السينية من التلفزيون الملون وأجهزة العرض. تم استخدام ثلاث تقنيات (فلم الأشعة السينية والعداد الوميض وعداد كايكر). وقد تم مقارنة نتائج الفلم الشعاعي مع القيم المنشورة. ومقارنة أخرى للتقنيات الثلاث مع القيم المنشورة قد أنجزت.

وبالرغم من الاختلافات الكبيرة الملاحظة بين معظم القراءات المنشورة من جهة وتلك التي وجدت في العمل الحالي من جهة أخرى ،يمكن رؤية أن جميع القراءات أقل من الحد الأعلى لجرعة الأشعة الخلفية الطبيعية وهي (2) ملي سيفرت في السنة.

INTRODUCTION

The study of the effects of X-radiation on man are important .To avoid accidental effect of X-ray radiations, laboratory experiments should be carried out to give primary measures of X-ray dose emitted from equipments which are expected to have some dangerous effects. Among these equipments are (TV) and (VDT). In fact, any electrical equipment operated over (10 kV) in a vacuum may produce X-rays.

The operation principle in most (VDT) is similar to (TV) sets (Tell, 1990) and both contain evacuated glass tube called cathode ray tube (CRT) where electrons are emitted from the cathode and accelerated by the high voltage (10-25 kV) towards a second electrode covered by a phosphor layer. This material emits visible light when fast electrons incident on it. Other emissions are ultraviolet and infrared radiation. But the highest energetic radiation emitted from (CRT) is X-rays. These X-rays are produced when electrons are rapidly decelerated as they strike the phosphor at the front of the screen (ILO, 1994).

As there is no threshold for the damage that X-ray may produce, add to that, nowdays, there is a big interest in the effect of low dose radiations over a long period of time; for these reasons measurements and analysis of small dose of X-ray emitted from (TV) sets and (VDT) were performed.

EXPERIMENTAL

Three different measurement techniques have been employed to detect low energy X-rays emitted from colour (TV) sets and (VDT). Kodak Dental double emulsion films (3.1cm x 4.1cm) are used to monitor X-rays (Martin and Harbison, 1982). Two films were used successively at (5 cm) distance from the screen of National (TV) set which is over (15) years old. The first film exposed to X-rays from (TV) for (17h) to reduce systematic errors and to make the exposure fall on the straight line portion of the sensitometric curve shwon in Figure (1). The second film was positioned in the same place as the first film for the same peried of time when the (TV) set is not working. However, X-ray from LG, Sony, EiC and Vestel (TV) sets were also measured and their results are very close to the first (TV) set result. The two films were processed chemically in the usual manner to make the exposure visible. The optical density (or degree of blackness) on films were measured by DT 1105 densitometer. This apparatus comprises two units; Type 305 base unit, and Type 205 photometer. The intensity of the light transmitted through the X-ray film is measured by a photodiode. The function of the photodiode is to convert the photolight into electrical pulses, to be magnified by an amplifier. Then these pulses will be transferred in Digital panel meter into numbers expressing the optical density. The optical density (D) of a point on the X-ray film is expressed by the equation:

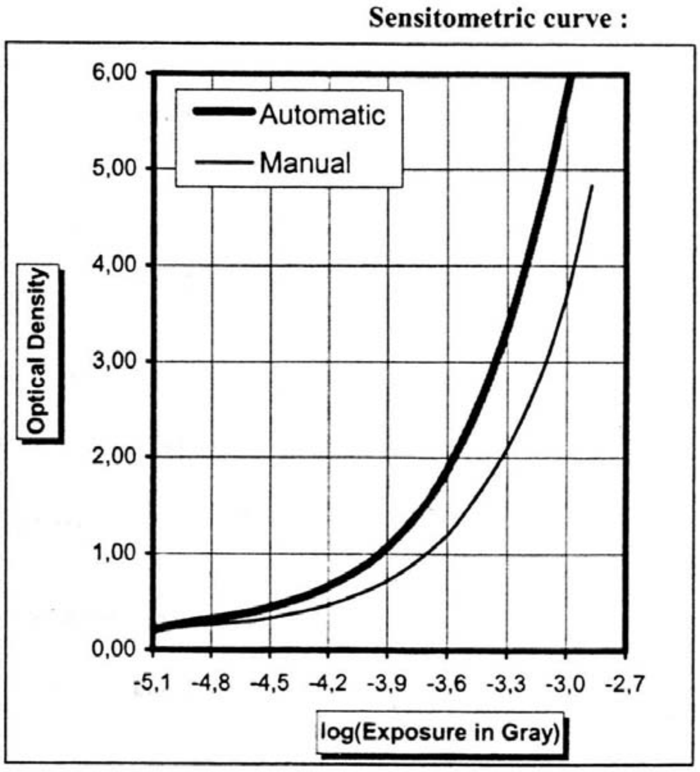
$$D = \mathrm{Log}\,\frac{I_o}{I_t}$$

Where (Io) is the intensity of the visible light incident on small area of the film, and (It) is the intensity of the light transmitted by that area of the film.

The optical density of the X-ray film at a point is the measurement of the blackness in that point.

The optical density on the X-ray film exposed to X-ray from (TV) for (17h) equals (1.88) and was obtained after subtracting the background of the second film (mentioned above) from it.

By reference to the graph relating optical density with log (absorbed dose in Gray) supplied from [Kodak Dental film –Technical data sheet, 2002] and shown in Figure (1), absorbed dose in Gray may be obtained and transferred to Roentgen (R) and then to dose in sievert (Sv).



Log (Absorbed dose in Gray)

Figure 1: Optical density versus log (absorbed dose in Gray).

Table (1) compares the dose equivalent rate of X-ray in (nSv/h) measured by the researchers at (5 cm) distance from (TV) set screen with present work.

Table 1 : Comparison between published values and present work values of dose equivalent rate at (5 cm) distance from (TV) screen.

Researcher	**Dose equivalent rate nSv/h**	**Detector**
Doerfel and Graffunder (1985)	1-5 max.10	Proportional counter with Xe gas
Tuyn and Roger (1985)	5.3	Proportional counter with Xe gas
Marriott and Stuchly (1986)	869	Not mentioned
Doerfel et al (1986)	max. 10	Proportional counter with Xe gas
Present work (2004)	$26x\ 10^3$	Kodak Dental X-ray Film

Further to the X-ray film technique, the scintillation counter NaI (Tl) and Geiger counter were also used to measure X-rays emitted from (VDT) screen. Table (2), compares the dose equivalent rate of X-rays in (nSv/h) cited in the literature at (5 cm) distance from (VDT) screen with the present work.

Table 2 Comparison between literature values and present work values of dose equivalent rate at (5 cm) distance from (VDT).

Researcher	Dose Equivalent rate nSv/h	Detector
Doerfel and Graffunder (1985)	0.2	Phoswich
Marriott and Stuchly (1986)	869	Not mentioned
Doerfel et al (1986)	25	Proportional Counter with Xe gas
ILO (1994)	4340	Geiger tube
Pantinakis and Skamnakis (2003)	196	Geiger tube
Present work (2004)	6700	Kodak Dental X – ray film
	6.51	Scintillation Counter
	737.8	Geiger Counter

DISCUSSION

The dose equivalent rate for X-ray emission at (5 cm) distance from (TV) screen measured by Doerfel and Graffunder (1985), equals less than 10 nSv/h as stated in Table (1) and agrees well with the value 5.3 nSv/h given by Tuyn and Roger (1985). However, Marriott and Stuchly (1986), reported the value 869 nSv/h for similar measuring conditions but without mentioning the type of detector they used. It can be seen that their result is about (164) times the value of Tuyn and Roger (1986). The present work result with X-ray film is much higher than the rest of values in Table (1).

Table (2) for X-ray emission from (VDT) screen shows large differences among the results of the measurement. The highest value in the literature cited is that reported by ILO(1994) and equals 4340 nSv/h. This value is about (21700), (5), (174) and (22) times that of Doerfel and Graffunder (1985), Marriott and Stuchly (1986), Doerfel et al. (1986) and Pantinakis and Skamnakis (2003), respectively. However, the present work value using Kodak Dental X-ray film is (1.5) times that reported by ILO (1994).

The large variation in the dose equivalent rate in Table (1) and Table (2) even with the authers who used same measuring technique, means that this subject needs further investigation with more sensitive devices. Since Dental X-ray film value is only (1.5) times that reported by ILO (1994), therefore X-ray film, as a measuring device, can not be totally rejected. Finally, all values of dose equivalent rate in Table (1) and Table (2) are less than the maximum limit of the natural background radiation dose which is (2 mSv/y).

REFERENCES

Doerfel, H. and Graffunder, H., 1985. Investigation of X-Ray Emitted by CRT Devices. Kernforschungszentrum Karlsruhe GmbH ISSN pp.0303-4003 kfk 3923

Doerfel, H., Graffunder, H. and Piesch, E., 1986. Radiation Protection Dosimetry Vol. 14, No. 10, pp.123-126.

International Labour Office (ILO), 1994. Visual Display Units: Radiation Protection Guidance, Occupational Safety and Health series, No.70, Geneva.

Marriot, I.A. and Stuchly, M.A., 1986. Health Aspects of Work with Video Display Terminals. Journal of Occupational Medicine. Vol. 28, pp.833-848

Martin, A. and Harbison, S.A., 1982. Radiation Protection, 2nd ed. London: Chapman and Hall.

Pantinakis, A. and Skamnakis, N., 2003. Measurement of the Level of Radiation from a VDT. Technical University of Crete, pp.211-214.

Tell, A., 1990. Skin Problem from Visual Display Units, Acta Dermato-Venerobgico, Vol. 69, pp.45-51.

Tuyn and Roger, 1985. Some Radiation Measurements in Vicity TV and VDU Screen. Geneva Suitzerland.