A STATISTICAL STUDY OF FILTRES USED AS SHIELDING FOR PC MONITORS

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ABSTRACT

In this paper it was aimed to obtain a radiological study about the attenuation of radiation of PC filters which are produced by different companies. For this purpose different radiation sources were used for UV (ultraviolet) IR (infrared), visible light and X-ray radiation. For every type of radiation measurements, the most proper detector was selected. The radiation measurements were made with and without filters and the measurements were taken for different distances. Measurements have bee observed for white & black and coloured monitors radiation levels for X-ray emission. All results were compared according to related regulations. Furthermore all data evaluated statistically in the point of view of public safety.

INTRODUCTION

Human-made sources proliferated and added their contribution to human exposure after Roentgen's discovery of X-ray ionizing radiation in 1895. Such ionizing radiation exposures arise from a variety of sources including radiopharmaceuticles and diagnostic X-rays in medicine and consumer products containing radioactive materials.

A large number of consumer products and industrial devices are a source of radiation due usually to the high potential differences needed to operate the circuits. Typical examples include colour television (TV) receivers, personal computer (PC), video display terminals, cold cathode discharge tubes, electron microscopes, airport baggage inspection system and shoe fitting fluoroscopes. X-rays are released at low exposure rates from television sets as a result of components being bombarded by electrons [1].

Non-ionising electromagnetic radiation varies in frequency from low-frequency radiowaves, through microwaves and infrared radiation to visible light and finally to the ultraviolet (UV) part of the spectrum. Only radiation with shorter wavelengths affect living organisms. While the all electromagnetic radiations with even shorter wavelengths affect living organisms, some are only harmful if used to excess. The higher the frequency, the greater is the energy in each photon of radiation, which means that only UV radiation has enough energy to cause photochemical reactions, the lower frequencies merely heating the tissues where they are absorbed. These frequencies are not sufficiently energetic to cause ionization, in contrast to X-rays and gamma rays. All the UV radiation in the environment comes from the Sun, most of whose energy is in the visible band of the electromagnetic spectrum. Six per cent (6%) is radiated in the UV part of the spectrum at wavelengths shorter than 400 nm. Radiation from 290 to 320 nm is biologically active and it is this UVB (Sunburn range) radiation that causes Sunburn and skin cancer [2].

An important property all the electromagnetic waves have in common is that they travel with the same speed in free space. The frequency (ν) of the vibration is the number of vibrations occurring in one second. Therefore, the velocity, c, is given by:

$$C=\nu\lambda$$

Physically the electromagnetic waves do not have identical effects for all wavelengths, for example, some are visible while the majority are not; others affect photographic film while most do not [3]. A photon interacts with matter in three mechanisms. These three mechanisms are Photoelectric Effect, Compton Scattering and Pair Production. The first of the three major mechanisms by which photons interact with matter is the Photoelectric Effect. Photoelectric Effect is the predominant mechanism only for low energy photon [1,3].

The control of radiation dose to public or occupational workers is one of the basic principles of radiation protection. ALARA is the acronym for "as low as reasonable achievable." It means making every reasonable effort to maintain radiation exposures as far below the regulatory limits or standards as is practical consistent with the purpose for which the activity is undertaken ALARA is every radiation worker's responsibility. This includes the individual worker, healthy physics personnel, and plant supervision and management. [4].

The basic three ALARA principles are time, distance, and shielding. The *time* refers to the principle that the working time while being exposed to the radiation from the source should be no longer than necessary. If the time spent in a given radiation field is doubled, the workers dose is doubled. *Distance* refers to the desirability of keeping as much distance as possible between the source and the worker. The radiation dose received is inversely proportional to the square of the distance of separation [1,4].

Radiation intensity can be reduced to any desired level by specifying the appropriate *Shielding* material. The fact that radiation protection can be achieved by shielding is the most obvious of the available methods. Essentially this method involves interposing a barrier between the source and the point of interest.

The using of PC and TV can increase the risk factor of human health. It is known that the PC and TV monitors can generate harmful radiation and effect the man negatively. In order to reduce the harmful radiation effects, special designed filters are used widely. In this paper it was aimed to obtain a radiological study about the attenuation of radiation of PC filters which are produced by different companies. For this purpose different radiation sources were used for UV (ultraviolet) IR (infrared), visible light and X-ray radiation.

EXPERIMENT

In this work the attenuation of radiation of PC filters produced by various companies were determined. For this purpose, different sources of UV (ultraviolet), IR (infrared), visible light and X-ray were used. For every type of radiation measurements, the most proper detector was selected. The electromagnetic radiation source and the detection devices used in this study were shown in Table 1. The filters were inserted between the source and the detection system as seen in Figure 1. The measurements were taken form 5, 60 and 80 cm away from the sources. In the second step the filters were removed and the measurements were taken for the same distances. The results for with and without filters were interpreted to each other in order to observe the attenuation effects of the filters. All results were compared according to related regulations. Furthermore all data were evaluated statistically in the point of view of public safety.

Table 1 The Electromagnetic Radiation Source and the Detection Systems Used in This Study

Electromagnetic Radiation Source	Detection System
Ultraviolet (UV) (Interflux)	Spectoline DSE-100 X Digital Radiometer DIX-365 UV-A Sensor (365 nm)
Visible Light 75 W	Extech, Model-407025 Heavy Duty Light Meter
Infrared (IR) (Infrarubn IR 2, 250 V 0.6 W)	Extech, Model-407428 Heavy Duty Infrared Thermometer
X-ray (Baltau 300 kV)	XRF-Nuclear Chicago Model-9253

RESULTS AND DISCUSSION

Fourteen different type filters that are used for PC and TV monitors are examined in Istanbul Technical University – Institute For Nuclear Energy in the last ten years. Dimensions of them could be change, but the examining techniques in the same. Examining of the filters observed for X-rays, ultraviolet (UV), Infrared (IR) and visible light. All the filters examined for two different X-ray energies, which represent white and black monitor at 18 keV, and coloured monitor at 30 keV. Results of the experiments are given in Table 2.

Table 2 Results of Examining of Filters Used As TV and PC Monitors.

Filters	X-Ray Absorption (%)		UV Absorption (%)	IR Absorption (%)	Visible Light Absorption (%)
	18 kV	30 kV			
1	87.0 ± 0.3	70.0 ± 0.2	80.0	-	-
2	97.5 ± 0.2	79.7 ± 0.2	99.7	-	31.0 ± 3
3	97.6 ± 0.2	80.2 ± 0.2	99.6		29.0 ± 1
4	98.0 ± 0.2	82.0 ± 0.5	98.0		50.0 ± 5
5	95.3 ± 1.9	80.2 ± 1.0	100	75.9 ± 0.5	35.5 ± 8
6	95.5 ± 1.9	81.9 ± 1.0	100	76.5 ± 0.5	44.7 ± 8
7	91.7 ± 1.9	79.9 ± 1.0	100	75.5 ± 0.5	54.1 ± 8
8	96.3 ± 1.5	80.0 ± 0.7	100	85.1 ± 0.5	58.81 ± 1
9	98.5 ± 1.6	79.2 ± 0.6	100	84.4 ± 0.5	59.9 ± 1
10	93.9 ± 0.3	79.5 ± 1.0	100	85.5 ± 1.2	62.9 ± 3
11	94.2 ± 0.3	79.9 ± 1.0	100	87.1 ± 1.2	59.1 ± 3
12	98.4 ± 4.3	81.9 ± 2.5	100	86.1 ± 0.9	37.4 ± 5
13	97.9 ± 4.3	77.1 ± 2.5	100	84.4 ± 0.9	34.2 ± 5
14	90.7 ± 4.3	80.4 ± 2.5	100	85.5 ± 0.9	43.5 ± 5

For the evaluation of the filters used as TV and PC monitors, graphs are drawn for the different type electromagnetic radiation. In Fig. 2 X-rays absorption curves are drawn for the different energy levels that are represent black & white monitor and coloured monitors. UV and IR absorption levels are given in Fig. 3 and Fig. 4 respectively. Lastly visible light absorption in Fig. 5. All the absorption curves can be seen in Fig. 6 comparatively.

CONCLUSION

Statistical results can be concluded that;

- Filters absorb the X-ray for black & white monitors 87 to 98.5 percent and average value is 95 percent for the studied filters
- Filters absorb the X-ray for coloured monitors 70 to 82 percent and average value is 79 percent for the studied filters
- Filters absorb the ultraviolet (UV) 80 to 100 percent and average value is 98 percent for the studied filters
- Filters absorb the infrared (IR) 75.5 to 87.1 percent and average value is 83 percent for the studied filters
- Filters absorb the visible light 29 to 62.9 percent and average value is 46 percent for the studied filters

For the comparatively evaluation of average absorption for the filters as used as shielding for TV and PC monitors can be given as a bar graph in Fig. 7. So, it can be said that the filter usage can be preferable for TV and PC monitors.

REFERENCES

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3. D. J. Rees, Health Physics, 1967, Butterworths Corporation.
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Fig. 1 Schematic view of measurement system

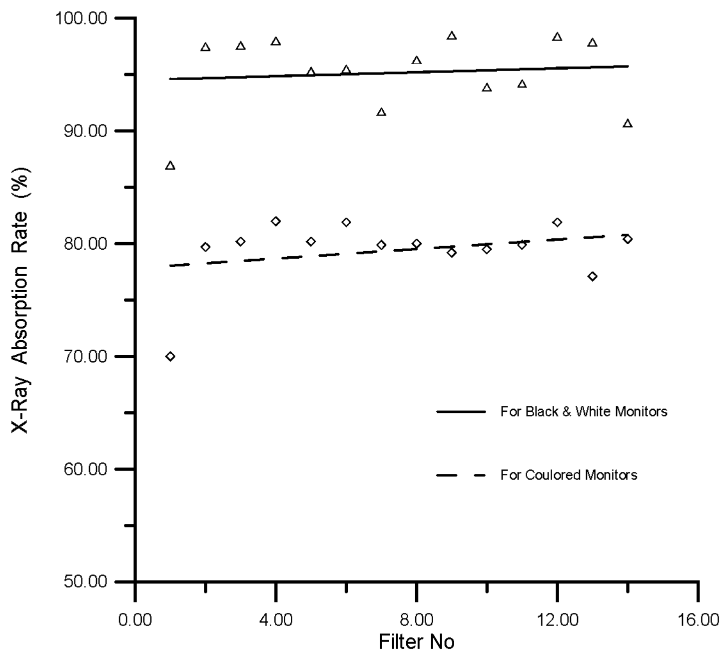

Fig. 2 X-Rays Absorption Rates of Filters For TV and PC Monitors

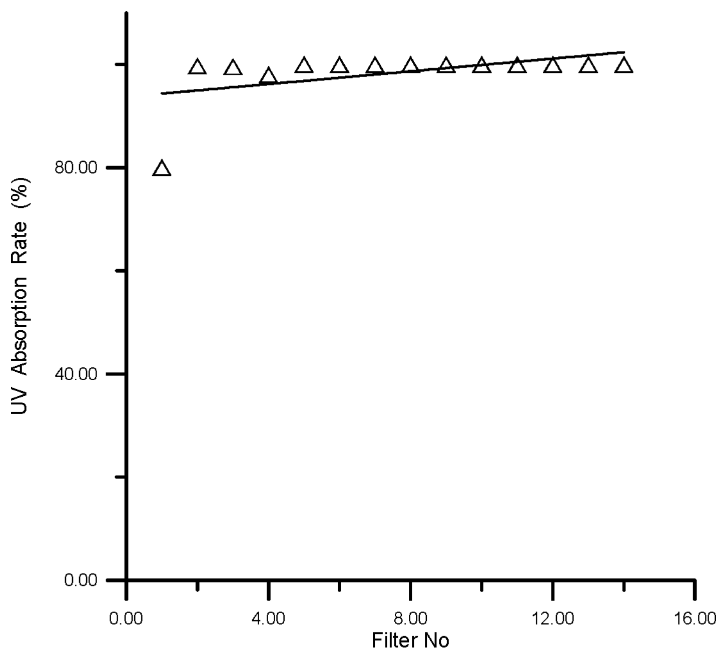

Fig. 3 UV Absorption Rate of Filters For TV and PC Monitors

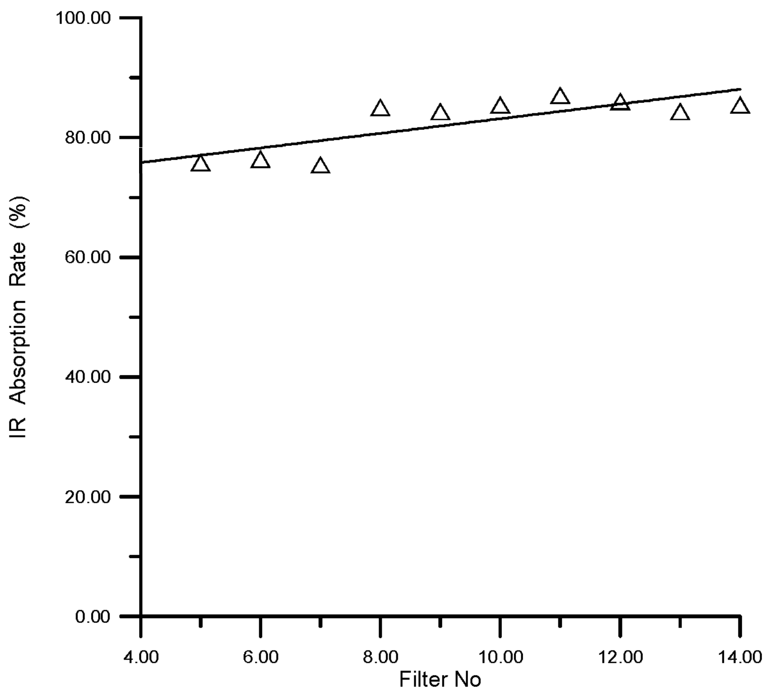

Fig. 4 IR Absorption Rate of Filters For TV and PC Monitors

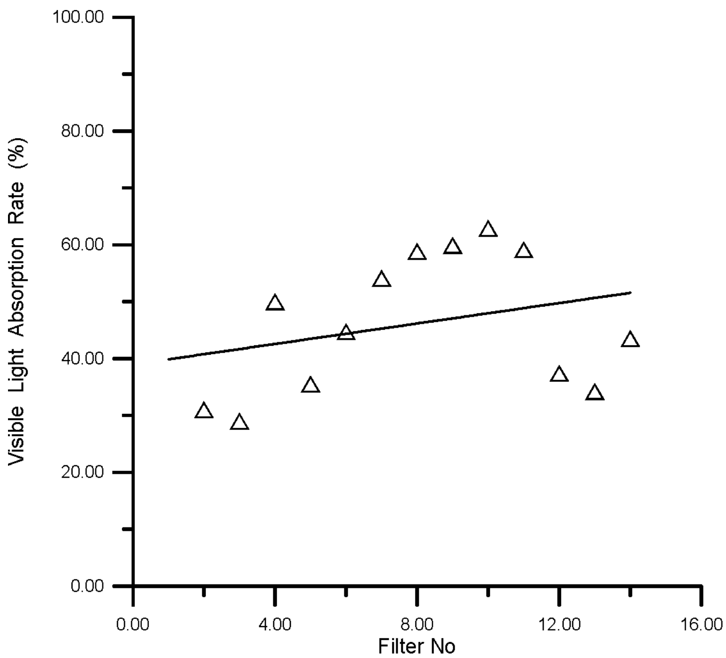

Fig. 5 Visible Light Absorption Rate of Filters For TV and PC Monitors

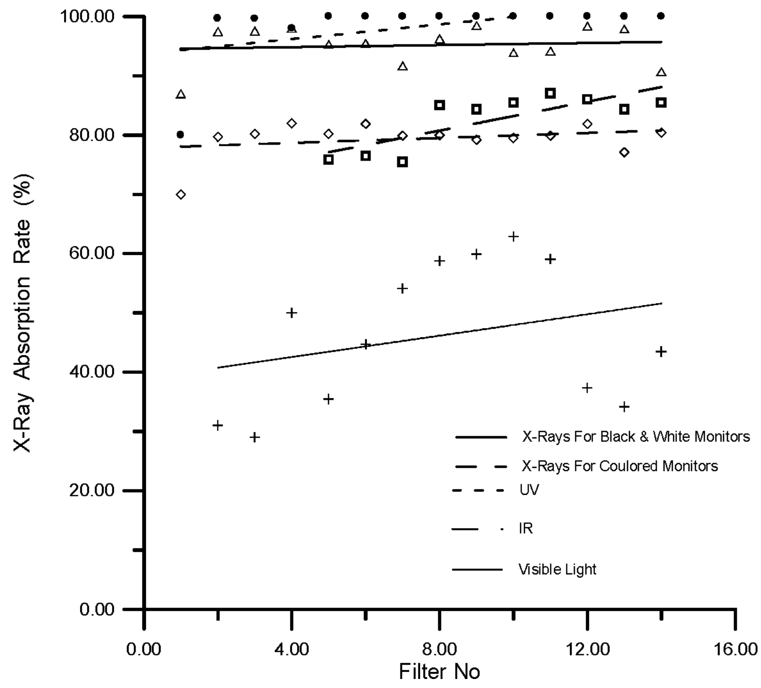

Fig. 6 Comparision of Absorption Rates of Filters For TV and PC Monitors

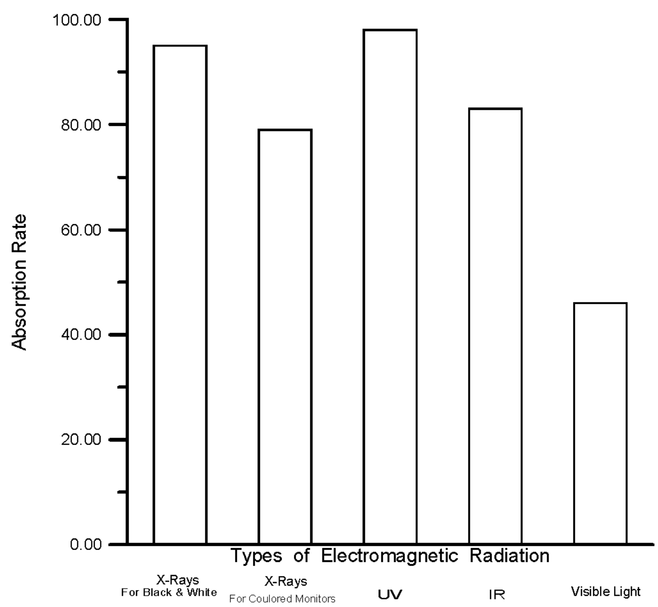

Fig. 7 Comparision of Average Absorption Rates of Filters For TV and PC Monitors