International Journal of Scientific Research and Engineering Development-– Volume 4 Issue 1, Jan-Feb 2021

Available at www.ijsred.com

OPEN ACCESS RESEARCH ARTICLE

Determination the Efficiency of Geiger Muller Counter by Using Cs137 and Co60

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Abstract

Geiger Mullerdetector is applied to study the effect of change in the distance between the detector and the radioactive isotope, and the determination the efficiency of the detector in various distances. Cs 137 and Co 60 with 1500 Bq and 2200 Bq were used in the present study.

According to the obtained results, it is found thatthe increasing in the distance between the detector and the source accompanied to lower detection counts per second. Also, the calculation of the efficiency of the detector for various distances from the source indicates that, the increasing the distance led to decreasing in the efficiency of the detector. In addition, the sensitivity of the detector was estimated from the calculated dose rate in nSv/h for Co 60.

***Keywords:*Geiger Muller, Ionizing radiation, Efficiency, Detector, Cs 137, Co 60**

I. INTRODUCTION

The Geiger–Muller tube is the sensitive component of the Geiger counter device for the detection of ionizing radiation. It was named after Hans Geiger, who designed the basic in 1908 and Walther Muller, who cooperated with Geiger in creating the technique further in 1928 to produce anexperimental tube that could detect a number of various radiation types. Geiger Muller Tube is a portable radiation detection and measuring deviceutilized to detect presence of radiation in the nearness environment. This radiation may be due to alpha particles, beta particles, gamma rays, or x-rays. It also provides us the measurementof intensity of radiation [1].

The Geiger Müller detector is the simplest ionizing radiation detectors and is very frequently used radiation detector in various industrial applications such as level and thickness gauging [2].

Geiger–Müller counters are various applications in a lot of industrial radiation instruments. However, it is of experimental interest to further raise the utilization fields of these detectors to join many industrial applications. This may be attributed to, these counters exhibit a high degree of robustness in an environments which are demanding, their relatively low price cost and they particularize easy electronicsreading [3].

The sensitivity of the Geiger–Muller tube is such that any particle capable of ionizing a single atom of the filling gas of the tube will initiate an electrons and ions in the tube. The collection of the charge thus produced results in the creation of a pulse of voltage at the output of the tube. The amplitude of this pulse, on the order of a volt or so, is an enough sufficiency to operate the

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scalar circuit with little, or no high amplification. The pulse amplitude is mostly independent of the characteristics of the detected particle, and provides therefore little data as to the nature of the particle. Geiger–Muller Counter instrument may be utilized for counting alpha particles, beta particles, and gamma rays, with different levels of efficiency [4].

II. METHODOLOGY

The current study was applied to detect of radioactive radiation with Geiger Muller detector, it was carried out with varying the distance between radioactive sources (Cs 137 – Co 60) and Geiger Muller detector 2,4 ,6 ,8 and 10 cm.

The Geiger-Müller counter with end-window made of mica (mica, d = 12-15 μm), and the applied radioactive isotopes Cs 137 (1500 Bq) and Co 60 (2200Bq).

Geiger-Müller counter should to be assess for the effectiveness of its calibration and standardization. The assessment method was conducted by experimental measurements. The used sourceswere placed in the slits and the counts by the used detector were measured. Then counts per seconds were calculated. With taking into consideration, the counts of background wererated and the mean of the counts wasrecorded as the background counts.

The efficiency of the Geiger-Müller counter instrument was calculated by using two different isotopes, where the measured count rate was compared to the (comparing activity of the source) disintegration rate.

Then with the known activity (dps) and the counts observed per second (cps) were used to determination of the efficiency[3,5] as the following equation.

$$Effeciency = \frac{\text{cps x } 100}{\text{dps}}$$

III. RESULTS AND DISCUSSION

The collected data of counts amount per minutes in various distances (2, 4, 6, 8, 10 cm) are arranged in Table 1 and 2, by using the radioactive isotopes (Cs 137) and (Co 60) respectively.

TABLE 1

Counts per minutes & counts per second and efficiency in different distances for Cs 137

CPM	Distance (cm)				
	2	4	6	8	10
Run1	10416	9871	6892	4115	2122
Run2	10317	9884	6899	4184	2245
Run3	10273	9891	6911	4115	2261
Run4	10265	9894	6932	4245	2315
Run5	10241	9947	6943	4261	2345
Average	10302	9897	6915	4184	2258
CPS	172	165	115	70	38
Efficiency	11.47	11.0	7.67	4.67	2.53

TABLE 2

Counts per minutes & counts per second and efficiency in different distances for Co 60

CPM	Distance (cm)				
	2	4	6	8	10
Run1	15156	13691	9495	6754	3725
Run2	15125	13653	9474	6689	3678
Run3	14894	13689	9387	6711	3714
Run4	15211	13598	9411	6781	3548
Run5	14789	13587	9397	6681	3698
Average	15035	113644	9433	6723	3673
CPS	251	227	157	112	61
Efficiency	11.41	10.32	7.14	5.1	2.77

The counts per minutes were recordedfor five runs in different distances (2, 4, 6, 8 and 10 cm) between the Giger detector and the radioactive isotope, and the average of the counts per minutes were calculated.Also, the counts per seconds were calculated per each distance and the efficiency could be estimated.

Table 1 displays that, the smaller the elemental distance of the Geiger Muller detector the greater the counts per minutes (CPM) of the radioactive source (Cs 137).Similar results are also shown in the Table 2 of the relation between the distance

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and the counts per minutes (CPM) of the radioactive source (Co 60).

The calculated efficiencyGeiger-Müller counter instrumentby using (Cs 137), recorded 2.53 at 10 cm distance and continuously increased to reach 11.47 at 2 cm distance. For (Co 60), calculated efficiency rated 2.77 at 10 cm distance and continuously increased to reach 11.41 at 2 cm distance. The relation between the efficiency and the distance for Cs 137 and Co 60 is shown in Figure 1.

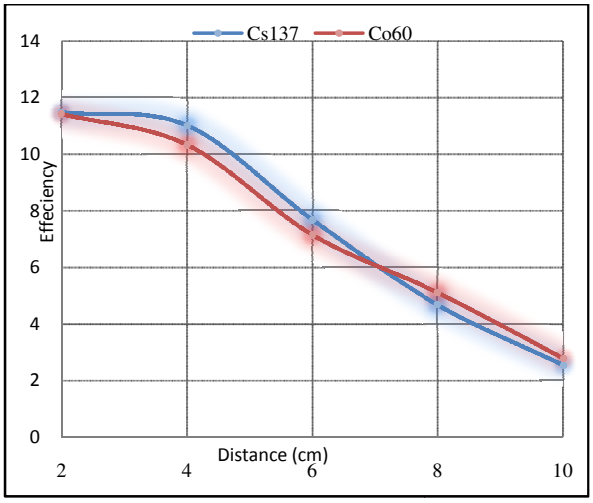

Fig.1: Relation between the efficiency and the distance for Cs 137 and Co 60

It is shown from Figure (1), continuous decreasingwas observed with increasing the distance in the calculated efficiency Geiger-Müller counter instrument for both (Cs 137 and Co 60).

These results may be attributed that, when the distance increases, the diffusion of particles get spread area, then the flux of counting decreases. This result is consistent with the previous studies [5-6-7-8].The dose rate in (nSv/h) was calculated against the source to detector distance in (cm) and tabulated with CPS per various distance for Cs 137 and Co 60 in Table (3).

TABLE 3

Calculated dose rate (nSv/h) and the rated CPS against the source to detector distance (cm) for Co 60

Source to detector distance (cm)	Co 60	
	Dose rate (nSv/h)	(CPS)
2	1690.717	251
4	422.6503	227
6	187.8317	157
8	105.648	112
10	67.6101	61

It is clear from Table 3, the higher distance between the detector and the sourse, the lower value of CPS and the dose rate (nSv/h).

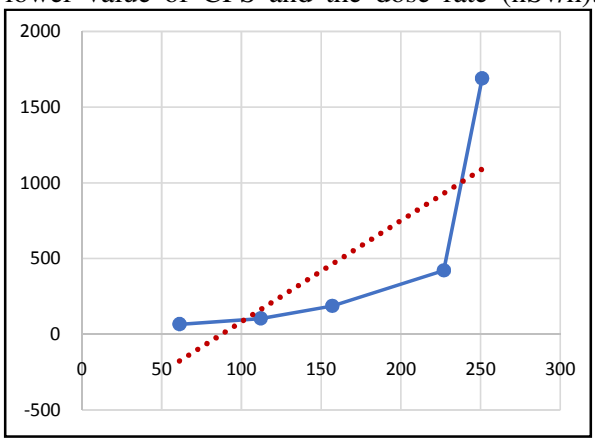

Fig. 4: Relation between calculated dose rate nSv/h and counts per second CPS for Co 60

Fig. (2) shows that the relation between calculated dose rate nSv/h and counts per second CPS for Co 60. The results indicate two stages for both radoactive sourses, first stage between the distances 10-6 cm and the second stage between the distances 4-2 cm. And the senistivity of the detector is estimatedto be = 0.089 CPS/nSv/h) for Co 60.

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IV. CONCLUSION

The present study aim todetermine the efficiency of the counting system by using two radioactive isotopes Cs 137 and Co 60. The higher distance between the detector and the soure, the lower counts per second.

The calculation of the efficiency of the detector for various distances from the sourse indicates that, the increasing the distance lead to decreasing in the effeciency of the detector. These results are aligned with the previous studies [5-8].

The findings from this study are based on a comparison between the observed data of CPS of the radioactive sourse and its calculated dose rate in nSv/h, where the senistivity of the detector had value of (0.089 CPS/nSv/h) for Co 60.

ETHICAL APPROAL

After approval of the research proposal by the deanship of scientific research, it was reviewed by Najran University ethical review panel. A formal approval to carry out the study was obtained from the Dean of Applied Medical Sciences College to conduct the study after an explanation of its objectives. Informed consent was taken from each student. All data was confidential and used for the research purpose only.

ACKNOWLEDGMENT

The authors would like to express their gratitude to the Ministry of Education and the Deanship of Scientific Research, Najran University, Kingdom of Saudi Arabia for their financial and technical support.

REFERENCES

[1] N.N.Ghuge et al, GEIGER MULLER: A THIN END WINDOW TUBE RADIATION, International Journal of Research in Engineering and Technology, Volume: 04 Issue: 05, p: 190-196, 2015

[2] G.A. Johansen, P. Jackson, Radioisotope Gauges for Industrial Process Measurements, John Wiley & Sons Ltd, Wiltshire, UK, 2004.

[3] Meric I., Johansen G.A., Holstad M.B., Calderon A.F., Gardner R.P., 2012. Enhancement of the intrinsic gamma-ray stopping efficiency of Geiger–Müller counters, Nuclear Instruments and Methods in Physics Research A 696, p. 46.

[4] Koviljka Stankovic and Predrag Osmokrovic, "The Model For Calculating The Type A Measurement Uncertainty Of GM Counter From The Aspect Of Device Miniturization," IEEE 3 rd June 2014.

[5] Sivasailanathan et al. International Journal of Physical Sciences, Calibration and estimation of efficiency of Geiger Muller counter using a standard radioactive source, Vol. 12(1), pp. 8-12, 16 January, 2017

[6] G. J. Maulany et al, Radiation detection of alfa, beta, and gamma rays with Geiger Müller detector, International Journal of Mechanical Engineering and Technology, Volume 9, Issue 11, November 2018, pp. 21–27.

[7] M.R. Calin et al, The calculation of the detection efficiency in the calibration of gross alpha–beta systems, Journal of Radioanalytical and Nuclear Chemistry · January 2012

[8] G. Prasanna et al, An embedded read-out for GM counter, Int. J. Instrumentation Technology, Vol. 1, No. 3, 2014

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