

Assessment of Level of Radiation Leakage at Certain Scientific Stores

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Abstract

Background: Radiation is a radiation dose rate at a specified location which is generated by any combination of natural and artificial (man-made) ionizing radiation sources. Background radiation varies with location and time. The global average exposure of humans to ionizing radiation is about 2.4 – 3mSv (0.0024-0.003Sv) per year.

Objective: To detect, and calculate the total cumulative dose of radiation exposure in the center of the store and outside by moving the detector "portable PalmRAD" away from a source.

Patients and Methods: By using portable PalmRAD 907 Nuclear Radiation Meter to detect, and calculate the total cumulative dose of radiation exposure in the center of the store and outside by moving the detector "portable PalmRAD" away from a source. the study was conducted in 2015, the first of March up until June.

Results: The findings indicate that approximately 100% of students, academic staff or public in general are exposed to radiation near the store's window (3.5 m from the store center), and the estimated total cumulative dose of radiation exposure exceeded (13 μ Sv / day) and compare this finding with the standards level of radioactive substances, "Cs137" is (8.333 μ Sv / day) or (3000 μ Sv / year) [5, 18]. It is concluded that there is a risk to any low level radionuclide exposure.

Conclusion: Low-level radiation can cause many health problems; even any level of radiation can be dangerous. There is always a bad effect of natural background radiation on DNA as well as several measures of health.

Key words: Radioactive, Detector, Gamma ray, Ionizing radiation.

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Introduction

Background radiation is defined by the International Atomic Energy Agency as "Dose or dose rate (or an observed measure related to the dose or dose rate) attributable to all sources other than the one(s) specified.[1] So a distinction is made between sources of dose which are incidentally in a location, which is defined as

"background", and the dose due to a certain source. This is important to determine where radiation measurements are taken of a certain radiation source, and natural background may affect this measurement. An example would be detection of radioactive contamination in a gamma ray background, which could

increase the total reading above that expected from the contamination alone.

Effective Dose of radiation Equivalent

Total body exposures are uniform. Dose equivalents for different tissues may differ markedly. And tissues differ in sensitivity to radiation. (HT is the mean dose equivalent received by tissue T), is the sum of the

weighted dose equivalents for irradiated tissues or organs [1, 2].

Mathematically

$$H E = \sum W T H T$$

Where WT is the weighting factor of tissue T and HT is the mean dose equivalent received by tissue T.

Table (1): Effect of background radiation on different organs in our body . The total effective dose equivalent for a member of the population approximately 3.0 mSv/year (300 mrem/year) [3].

Tissue (T)	Risk Coefficient	W_T
Gonads	$40 \times 10^{-4} \text{ Sv}^{-1}$ ($40 \times 10^{-6} \text{ rem}^{-1}$)	0.25
Breast	$25 \times 10^{-4} \text{ Sv}^{-1}$ ($25 \times 10^{-6} \text{ rem}^{-1}$)	0.15
Bone marrow	$20 \times 10^{-4} \text{ Sv}^{-1}$ ($20 \times 10^{-6} \text{ rem}^{-1}$)	0.12
Lungs	$20 \times 10^{-4} \text{ Sv}^{-1}$ ($20 \times 10^{-6} \text{ rem}^{-1}$)	0.12
Thyroid	$5 \times 10^{-4} \text{ Sv}^{-1}$ ($5 \times 10^{-6} \text{ rem}^{-1}$)	0.03
Bone surface	$5 \times 10^{-4} \text{ Sv}^{-1}$ ($5 \times 10^{-6} \text{ rem}^{-1}$)	0.03
others	$50 \times 10^{-4} \text{ Sv}^{-1}$ ($50 \times 10^{-6} \text{ rem}^{-1}$)	0.30
Total	$165 \times 10^{-4} \text{ Sv}^{-1}$ ($165 \times 10^{-6} \text{ rem}^{-1}$)	1.00

The amount of exposure will depend on the time that the organism is exposed; the distance from the radiation source and that reduces the strength of exposure. Indeed there is a relation between the level of dose received and the induce of cancer, which is to be dependent on dose of radiation [3,4].

The exposure of living organisms to radioactive isotopes has been led to result in the accumulation of the radiation source in the body for many years, causing unstable chemical and thus biological reactions. This is because the effect of radiation, especially exposure to radiation for periods of time result causes free radical damage, mutational, or damage to DNA, and cellular dysfunction, inducing several problems processes. Temporary or permanent effects of radiation

toxicity in humans are fatigue, migraines, infertility, allergic reactions, hypertension, disorders of the central nervous system, memory loss, rheumatic pains, decrease in RBC and WBC counts, in addition to induces cancers [5].

Natural sources of radiation include

Background radiation from space, Cosmic radiation from cosmic rays, terrestrial radiation from minerals in the earth's crust, Radiation from inhaling radon gas, radiation from ingesting food and drinking water that may contain radioactive potassium-40.

Man-Made Synthetic Sources

For use in Diagnostic and Therapeutic Purposes.

For Nuclear Industry • For Military Purposes.

For Consumer and Other Purposes.

It is not possible to avoid exposure to radiation in medical therapy. In this case the biological effect have to be taken into account. The biological effects could be divided into: 1. Somatic Effects (e.g. cancer, or burns, skin loss, cataract); 2. Genetic Effects (e.g. chromosomal damage). The type of disease outcome depends generally on sensitivity of tissue to radiation damage. The living cell or organism slowly dividing being the most resistant to radiation and that and rapidly dividing cells are more resistant to radiation [7,8,9].

Units of Radiation Dose

Gray (Gy) is absorbed dose. Or equal= Joule/kilogram = (100 rads).

Rad is small unit of absorbed dose. One rad is equal to = 100 ergs/gram = 0.01 joule/kilogram =0.01 gray.

Rem is dose equivalent. The dose equivalent in rems (1 rem= 0.01 sievert).

The Sievert is the effects of ionizing radiation on living tissue . At = Gy doses, the effects of radioactivity on living cell

depends on the type and energy level of the radiation on the tissue and on the period of exposure. The Sv is a large unit:

$$1 \text{ mSv} = 0.001 \text{ Sv}$$

$$1 \text{ uSv} = 0.000001 \text{ Sv} [8,9,10]$$

This study aims to calculate the total cumulative dose of radiation exposure, and detect the type of radiation leak from unknown source of radiation in a certain scientific store in college of science-chemistry department – at Salahaddin University in Kurdistan region, and then insulating and transferring unknown radiation source to safe place which is far from the students and public in general.

Patients and Methods

The Beta and gamma rays were measured by a detector called "PalmRAD 907 Nuclear Radiation Meter", as well as were calculated the total cumulative dose of radiation exposure during a day.

The Beta particles are easily shielded, but gamma rays are attenuated exponentially through a shield.



Figure (1) :The detector used.

The source of radiation leakage is unknown, but it can be determined from a type of radioactive material inside the store.

By sending an email to the manufacturer company of Liquid Scintillation device, asking them about the type of radioactivity

that is in this device. The company replied that this device was initially sold in the 1970s. It has a 40 microCurie Cs-137. The source is housed in a lead container below the sample changer bed.

Measured the radiation emit from Cs-137. The detector showed the type of radiation that was exposed to the environment. We therefore could conclude that it is gamma ray that emitted near Liquid Scintillation System device, which is completely damaged and is located inside the store (Center of the Store about (0-1) m from the source of radiation).

The first step is to determine if there is a real hazard.

1-Obtain a radiation survey meter and check for radioactivity.

2-Look for a cylinder with a radioactive tag– this is where the Cs-137 source was kept.

3-If there is no measureable radiation, then the rest of the LS counter can be disposed of as electronic waste per local regulations.

4-If radiation is detected, the contamination will have to be removed by qualified individuals – usually the facility radiation safety and environmental health personee.



Figure (2): Inside the store.



Figure (3): Exposure of the company name on worn - out devices.

We moved the detector away from the source of radiation out the store and calculated the total cumulative dose of radiation exposure during 10 minutes.

1-At the stores door which is exposed on my right side in the picture below. (3 m away from the store's center).

2-At the store's window about 3.5 m from the store's center.

3-At 10 m away from a the store (around the store).

Repeating the same processing with another device named Radiation Alert, exposed the same results.

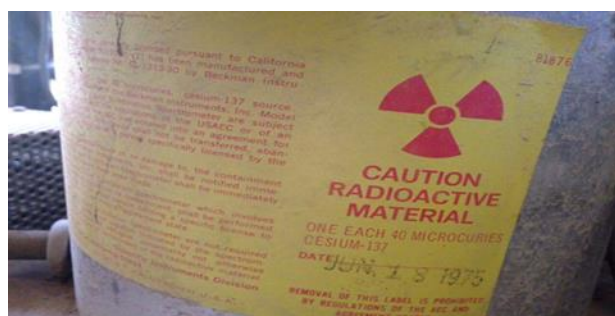


Figure (4): This worn – out container was supposed to hold the Cs – 137 kept for a long time ever since 1975.

Cs-137 is used in small amounts for calibration of radiation-detection equipment, such as Geiger-Mueller counters. In larger amounts, Cs-137 is used in medical radiation therapy devices for treating cancer; in industrial gauges that detect the flow of liquid through pipes; and in other industrial devices to measure the thickness of materials, such as paper, photographic film, or sheets of metal [10,11,12,13].

Its half-life of about 30 years and the contaminated region by large amount of cesium-137 "release doses of radiation" is dangerous to our and for next generation or more, but the contaminated region by small amount of cesium-137 "release doses of radiation" is also dangerous . [16,17,18].

Statistical Analysis

The t-test's statistical significance was used to study the significant compare the means in this study.

Results

The average of radiation emit from Cs-137 that is located inside the store was measured that it was 20.5 μ Sv/ day.

The detector was carried away from the source of radiation and the average of the total cumulative dose of radiation exposure per day was calculated as shown below:

1-At the window about 3 .5 m from the store's center was 13 μ Sv/ day.

2-At the door (3 m away from the store's center) was 8 μ Sv/ day .

3-At 10 m away from a the store was 3.6 μ Sv/ day .

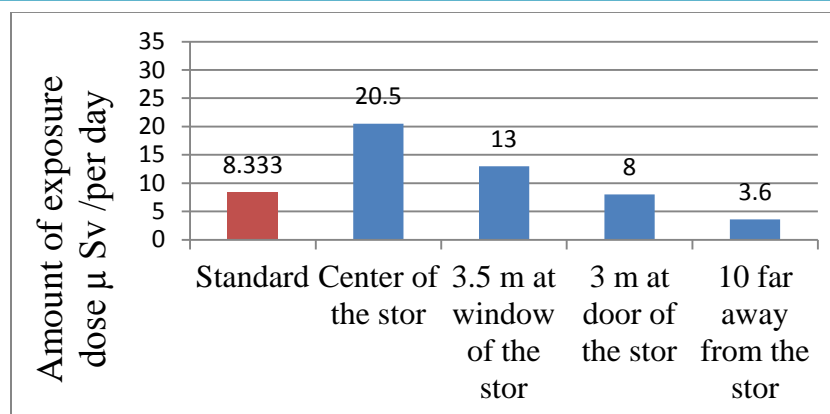


Figure (5): The relationship between the total cumulative dose and distance, the total cumulative dose exponentially decreased with distance.

Discussion

When the detector was placed in the center of the store and calculated the total cumulative dose of radiation exposure per day inside the store and outside, an observation showed that the counts dropped inversely with distance and decrease exponentially. The thickness of wall, and window of store has an impact on radiation exposure, and they will led to decrease counts of radiation. The findings indicate that approximately 100% of students, academic staff or public in general that takes a break in the surrounding of the store that includes the radioactive "Cs137", were exposed to radiation near the store's window (3.5 m from the store center), and the estimated total cumulative dose of radiation exposure exceeded (13μ Sv / day).

The total duration of radiation exposure near the store window (3.5m from the store center) during a year" was 112320μ Sv / year. When it compared with the standards level of radioactive substances, "Cs137" is (8.333μ Sv / day) or (3000μ Sv / year)

[5,18]. It is concluded that there is a risk to any low level radionuclide exposure.

Conclusion

Several factors contributed to the non-control of radioactive material in the devices for laboratory purposes such as: Salahuddin University transferred from Sulaymaniyah governorate to Erbil governorate. The war resulted in mass migration of Kurdish people to the neighbor countries such as Iran and Turkey. As it further lead to the damage of the Salahuddin University and people were not aware of the radioactive material and the Liquid Scintillation System device. In 1991, as the situation calmed down, ruined devices and trash were put in stores in diverse collages with different departments.

Hence the unknown radioactive material that was stored in these stores caused a huge health issue for students that went there. On August 12th 2015, a meeting was held issue and I presented a presentation about the issue to the dean and the head of all departments in

the college. Finally, These recommendations were the results of that meeting:

1-State the danger of the existent radioactive material in the store and then build a concrete wall around the store in which is 50cm thickness of the wall.

2.Contact with a group of experts that can remove the radioactivity away from the place for the safety of everyone.

The outcome of this meeting was that the college decided to take action and the matter into their hands. Therefore they brought a group of people that exposed the radioactivity and removed it to a much safer place.

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