Estimate the Radon Concentration for Water in Samtah– Jazan (Saudi Arabia)

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Abstract—Method for measurement the radon concentration and the calculated annual effective dose received by Samtah-Jazan people (Saudi Arabia) in tap water, water from wells Sterilized by ozone called gallon water, mineral water and distilled water by sensitive plastic track detector (CR-39). It is observed that our results are less than the maximum contaminant level for the US Environmental Protection Agency.

Keywords—Annual effect dose, CR-39 detector, Radon concentration, Water samples.

I. INTRODUCTION

THE radon is a radioactive nuclide, a chemically inert gas and highly soluble in water. Radon in water enters the human body by two different paths, Firstly escape from household water and become a source for indoor radon, secondly from drinking water enters directly through the gastro-intestinal (GI) [1]. Most water sources have very low levels of radioactive contaminants enough to not be considered a public health concern. Radio-nuclides emit ''ionizing radiation'' when they naturally decay [2]. In 1991, the United States Environmental Protection Agency (EPA) proposed a National Primary Drinking Water Regulation (NPDWR) for ^{222}Rn with a maximum contaminant level (MCL) of 11 Bq L^{-1} (300 pCi L^{-1}) [3, 4].

This study aims to estimate the concentration of radon in different types of water by sensitive plastic track detector (CR-39) and determination the annual effective dose which Samtah-Jazan peoples (Saudi Arabia) have received.

II. EXPERIMENTAL METHOD

Samples of different types of water, the primary source for this water is the red sea, (tap water, gallon water, mineral water and distilled water) from Samtah-Jazan (Saudi Arabia), were used in this work. Fig.1.a. Showing location of jazan city in Saudi Arabia and Fig.1.b. Showing location of the study area (Samtah) in jazan city. For gallon water, prior arrangements with the shopkeepers to measure the samples without delay. Taking 200 ml from each type of water put in a plastic cup then fixed the plastic detector (CR-39) in the bottom of the cover 5 cm

above the surface of the sample as shown in figure 2.Two samples for each type of water were used, and taking the average. When alpha particles strike the CR-39 cause damage tracks. After 45 day all detectors are collected then making it etching process by 6.25 N NaOH at 70°C for 7 hours using water-bath then scanned by an optical microscope at a magnification of 400 x for recording the α−track intensity. The radon concentration calculated using equation given by [2]:

$$C_{Rn} = \frac{N}{TC_f}$$

Where, C_{Rn} is the radon concentration [Bq/m^3], N is the track intensity [Track/cm^2], C_F is the calibration factor of α− tracks equal 0.163 ± 0.002 [cm^{-2} d^{-1} per Bqm^{-3}] obtained from [5] and T is the exposure time [hours].

The annual effective dose is given by the following equation:

$$D[mSvy^{-1}] = \frac{C_{Rn} \times n \times f \times 8760h}{170h \times 3700Bqm^{-3}}$$

where, C_{Rn} is the radon concentration, f is the equilibrium factor equal 3.88, n is the fraction of time spent indoors equal 0.4, 170 is the number of hours per working month and 8760 is the number of hours per years. [6].

III. RESULTS AND DISCUSSION

The radon concentrations in mineral water, distilled water, gallon water and tap water are shown in table 1. It is shown that the radon concentration in each type of water are less than the maximum contaminant level for the US Environmental Protection Agency which equal 11 Bql^{-1} [7] except the local mineral water is highest as shown in figure 3 because it is with a short storage time contained, a similar results was also presented in [1,8].

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Fig.1.a. Showing location of jazan city in Saudi Arabia
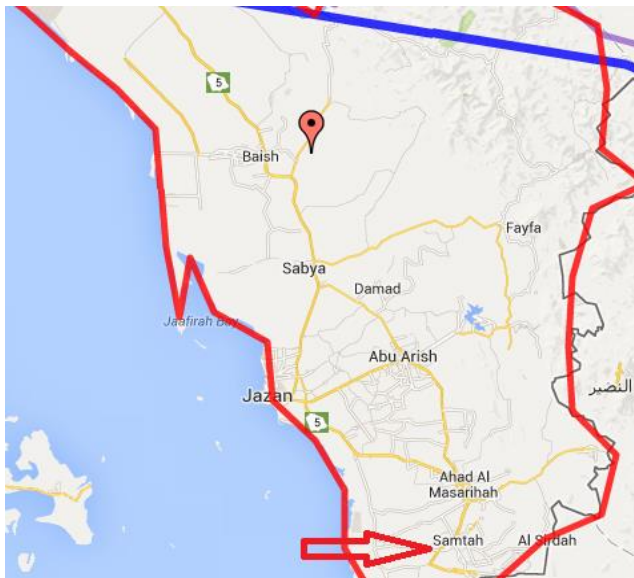

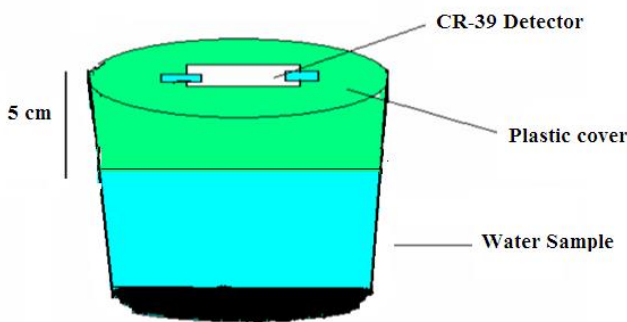Fig.1.b. Showing location of the study area (Samtah) in jazan city.

Fig. 2. Technique to determine the alpha intensity in water by CR-39 detector

TABLE I
THE RADON CONCENTRATION IN WATER OF SAMTAH-JAZAN (SAUDI ARABIA) BY CR-39

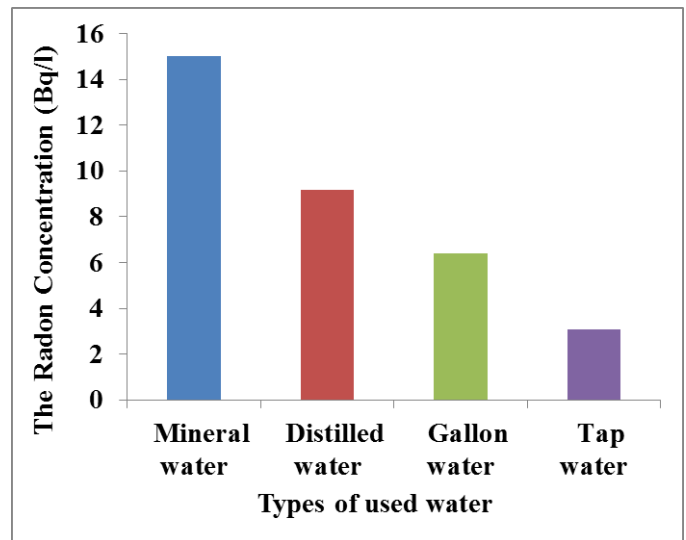| The Samples	Radon concentration $(Bq\ l^{-1})$
Mineral water	15.02
Distilled water	9.18
Gallon water	6.40
Tap water	3.06

'Five measurements of each sample are taken.

Fig.3 The relation between the radon concentration and type of water

The calculated annual effective dose received by Samtah-Jazan people from corresponding radon concentration in mineral water, distilled water, gallon water and tap water are shown in table 2, it is shown that the calculated annual effective dose received by Samtah-Jazan people in each type of water is blow than the recommended limit of the public of 1.1 m Sv year^{-1}, as shown in figure 4.

TABLE II
THE CALCULATED ANNUAL EFFECTIVE DOSE (m Sv year^{-1}) RECEIVED BY SAMTAH-JAZAN PEOPLE

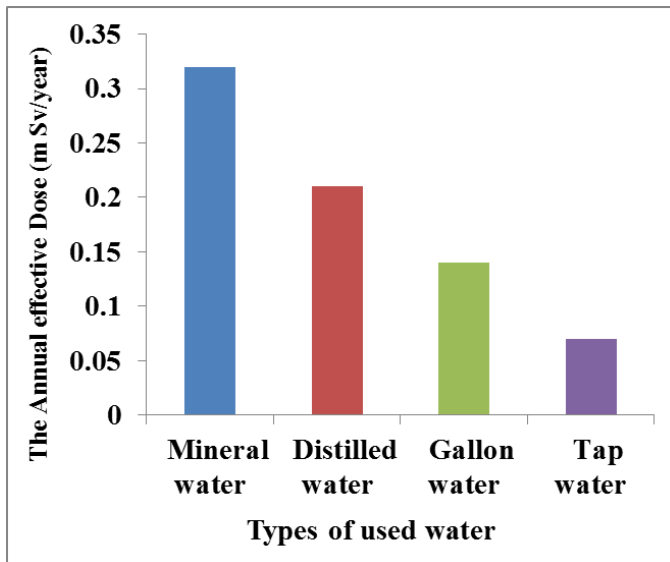| The Samples	Annual effective dose (m Sv year^{-1})
Mineral water	0.32
Distilled water	0.21
Gallon water	0.14
Tap water	0.07

'Five measurements of each sample are taken.

Fig.4. The relation between the annual effective dose and type of water

IV. CONCLUSION

The radon concentration in mineral water, distilled water, gallon water and tap water and the calculated annual effective dose received by Samtah-Jazan people in each type of water have been estimated using a plastic track detector (CR-39). We observed that our results are less than the maximum contaminant level for the US Environmental Protection Agency and the local mineral water is highest, so we prove that the used water in Samtah-Jazan (Saudi Arabia) are clear from radiation and safe to used.

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