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INVESTIGATION AND COMPARISON OF GAMMA BACKROUND AROUND TOMSK POLYTECHNIC UNIVERSITY (TPU) BUILDING

Abstract

There is now due consideration of the effect of buildings on the comfort and health of the population but not on radiation exposure. Buildings can raise the background radiation close to its position as sources of radiation and a significant increase in gamma history is expected. Gamma background can be predicted to increase significantly. Such issues are still not included in publications. A gamma background analysis around TPU buildings has been undertaken in this regard. Gamma levels were measured and analyzed using gamma-ray detector. Around the building, the measurements were made from the center of the building 10 cm and 1 m from the wall with 2-5 m variable pitch. A total of 9-10 different points were chosen for each measurement location. Comparison between the measuring locations were made. The study revealed a number of correlations, which indicated that the background radiation behind the TPU buildings increases significantly.

Introduction

Individuals are exposed to ionizing radiation spontaneously emitted by natural radionuclides such as U238 chain, Th232 chain and K-40 with moment of existence on Earth. However, the main the contribution to the average background radiation arises from natural sources. Gamma background radiation from natural sources is due to cosmic rays, radioactive nuclides present in the crust, atmosphere and in construction, internal exposure to radionuclides entering the body through ingestion of food materials, etc., indoor inhalation exposure due to radon (222Rn), thoron (220Rn) and their daughters [1,2].

Changes in the environment and climate in many regions of the planet, including the territory of Siberia, remain insufficiently studied for both forecast vector of observed changes, and for a reasonable estimate the role of natural and man-made factors [3,4].

A study of gamma background around TPU building will help assess the impact of building to the total gamma background. Furthermore, the estimation of the gamma dose on the population will help to establish the degree of comfort of individual areas of prolonged exposure to ionizing radiation.

The object of study is the changes in ambient equivalent doses around TPU building. The results of the work will help to reveal the existence of areas with increased gamma background, undesirable for a long stay.

Description and Methodology of Research

Areas around TPU buildings as a source of radiation exposure, measurements were carried out using scintillated gamma detector BDKG-03. This device was manufactured in the Republic of Belarus.

The BDKG-03 is a highly sensitive scintillation intelligent gamma-ray detection unit designed to search, quickly detect and locate ionizing-radiations. It consists of Cs137 source with sensitivity of 350 impulses per second (imp/sec) and has a unit of measurement μSv/ hr. It is as well used to measure ambient power equivalent dose and dose of gamma radiation in the energy range of 50 keV – 3 MeV. The range of measurement of the exposure dose rate of gamma radiation is 3 μR / h or 30 mR / h. The measurement range of the exposure dose of gamma radiation is 3 μR - 100 mR. It has an operating temperature range of -30 - + 50 ° C. The main measurement error is not more than ± 20%.

The BDKG-03 intelligent gamma radiation detecting unit works autonomously in real time by connecting through a cable to a Personal computer with a software program (ATexch) installed on it which help in recording the effective dose rates.

Two (2) areas were chosen for investigation. Measurements were taken at the front and backside of TPU building.

The first measurement point was induced at a distance of 10 centimeters at 1meter height from the building. The step between the measurement points was at a variable pitch of 2 to 5 meters for 5 minutes each at 9 to10 different points. At each point, the ambient dose equivalent rate was measured.

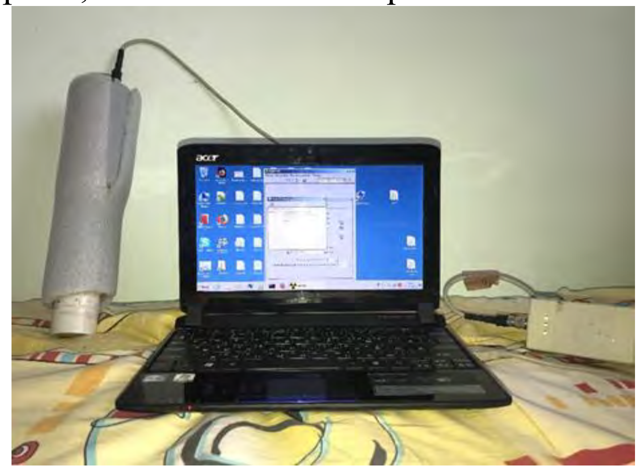

Fig 1: BDKG-03 (Highly sensitive scintillation intelligent gamma detection unit)

Fig 2: Map showing the front and back view of TPU-10th building

Experiment

Measurements was conducted from October to November, 2019. The monitoring period for ambient dose equivalent was done taking into account the impact of weather conditions. The address for this experiment was chosen proceeding from the materials from which the buildings were made, whether it is in the vicinity of industrial facilities since production waste affects the gamma background, and location in the city. Based on these factors, two areas around TPU building were selected. These included the front and back view or areas of TPU-10th building (Prospect Lenina 2).

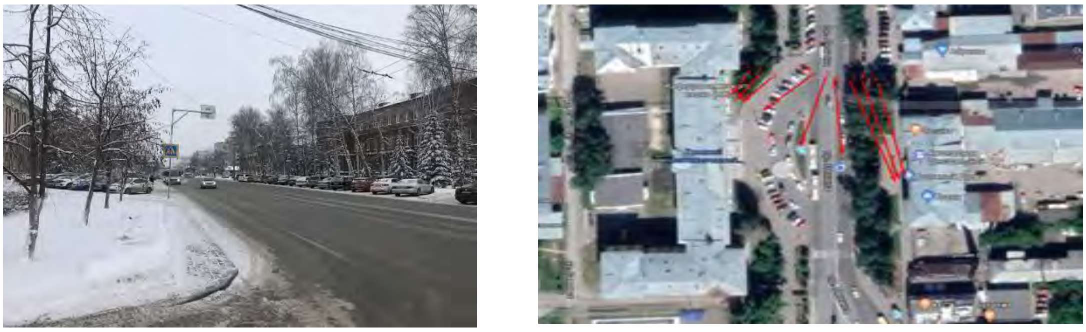

Fig 3: Location 1-Front view of TPU-10th building

Fig 4: Location 2-Back view of TPU-10th building

Results and Discussions

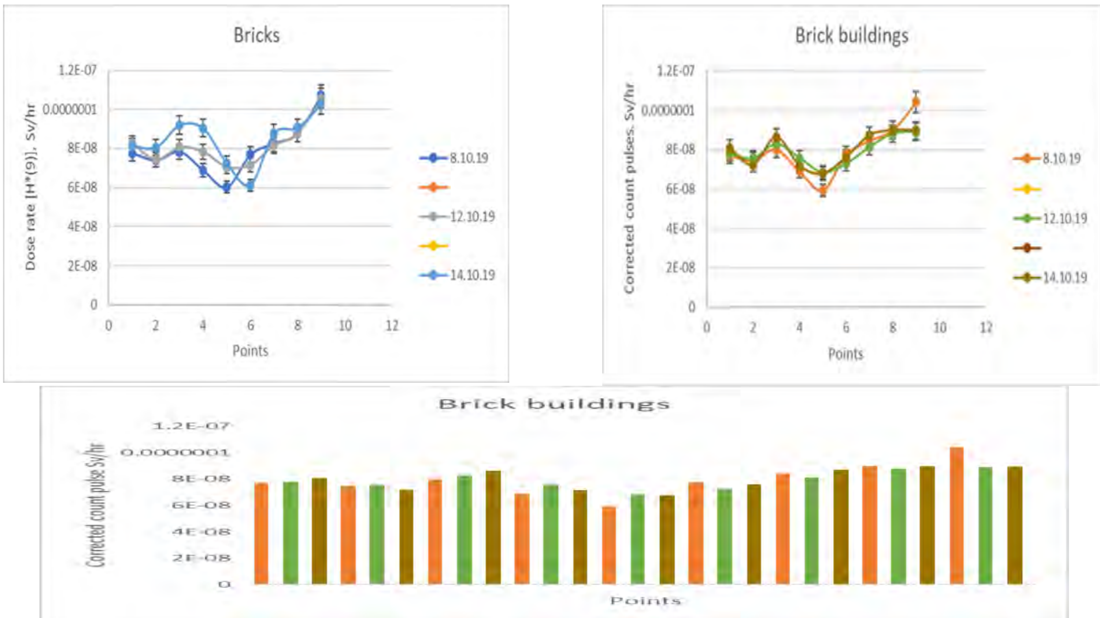

Fig 5: Levels of ambient dose rates as a result of Gamma background changes at the front view of TPU-10th building

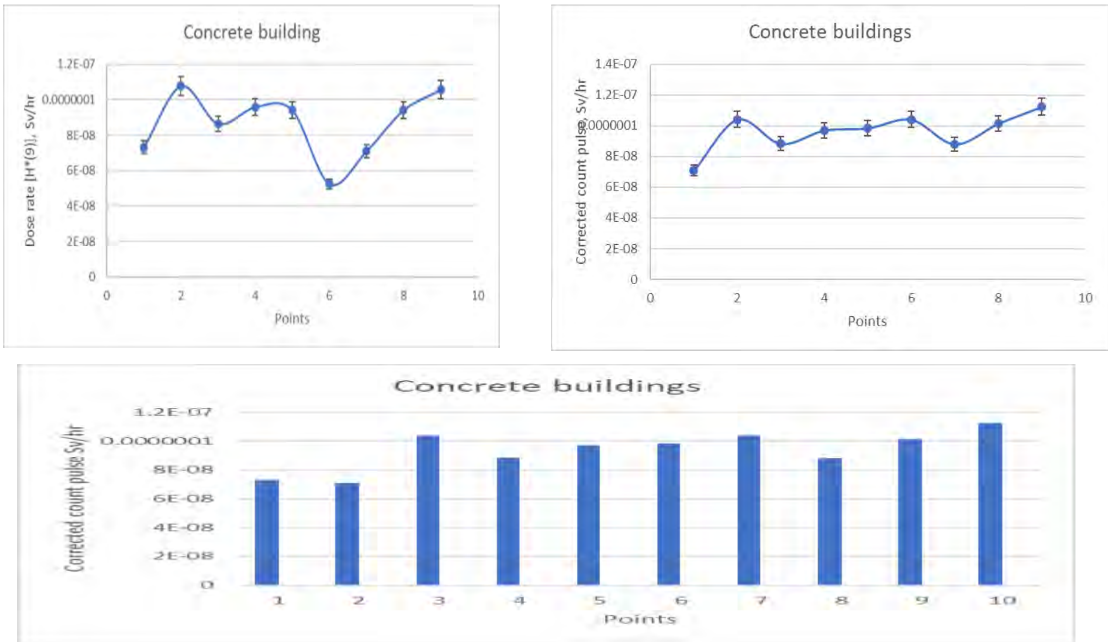

Fig 6: Levels of ambient dose rates as a result of Gamma background changes at the back view of TPU-10th building

From the graph (fig 5 - top left) in location 1 (front view of TPU-10th building), It can be seen that the measured ambient dose rates obtained near the ends of the buildings as a result of the gamma background were very high due to the output of radionuclides specifically radon gas from these buildings which increased the background radiations. This shows that the closer the distance to the buildings, the higher the amount of radiations (radon) released and vice versa. Furthermore, since the buildings are located close to a major street, fumes from exhaust of vehicles containing radioactive gases adds up to the total gamma background. At the middle belt, the background radiations obtained were very low due to the presence of surface covers (street and snow) which prevented the outflow of radioactive gases from the ground into the atmosphere.

During the process of measurement, an anomaly was detected. A sudden decrease in temperature led to a mistake in the algorithm of pulse to dose conversion which resulted in a change of pattern of the ambient dose rates obtained. This problem prompted a wrong pattern in the graph that was plotted. As a result, a corrected count pulse of the dose rates was recalculated and a new graph (fig 5 - top right) was obtained as shown above. The recalculation was done by multiplying all the dose rates obtained by a constant (K) known as the correction factor. The correction factor was found using the equation:

$$impulse * k = dose\ rate \qquad (1)$$

Also, from the graph (fig 6 - top left) in location 2 (back view of TPU-10th building), the ambient dose rates recorded were very high as a result of radionuclides (radon gas) emanating from the buildings into the atmosphere. In addition, the gamma radiations from radionuclides such radon and thoron released from the open soil surrounding the buildings into the atmosphere also led to an increase in the total gamma background hence the higher levels of dose rates obtained. This shows that the larger the size of open ground, the higher the quantity of radionuclides released into the atmosphere.

Similarly, a corrected count pulse of the dose rates was recalculated and a new graph was obtained as shown in the graph above (fig 6 – top right).

A bar chart was therefore drawn to compare the levels of ambient dose rates as a result of the gamma background changes at the front and back view of TPU-10th building. The graphs plotted are shown at the bottoms (fig 5 and fig 6) of each location as seen above.

From these graphs, it is seen that the ambient dose rate levels at the various measurement points are much higher at the back view than at the front side.

Conclusion

In this study, ambient dose rates of gamma background around TPU building, Tomsk have been investigated. The result of the study is the graphs built.

Furthermore, the following dependences and an important anomaly was found:

Dependence on dose rate of distance to buildings as radon sources.

Dependence on the size of open ground.

Revealed mistake in algorithm of pulse to dose conversion.

Also, it was found that most of the gamma background changes measured at different points was higher at the back view than at the front view of TPU-10th building.

Hence it can be concluded that, people should spend much of their time at the front view than at the back side.

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PERFORMANCE OF A DIESEL ENGINE IN DUAL FUEL MODE WITH HHO GAS AS FUELS

1. INTRODUCTION

Due to its energy efficiency and the wide availability of fuel, diesel technology is the main source of energy that is used for land transportation of bulk, freight and containerized cargo. Therefore, the surface network of the global logistics system is powered largely by diesel technology. It also powers most industrial construction, agricultural and mining equipment.

HHO gas injection is a largely undeveloped technology that could very well be used to increase the efficiency of diesel technology, leading to billions of dollars in fuel costs [2].

In 1972, the Royal Navy considered how to refuel the fleet when current fossil fuels become too rare, say, in 2030 [4]. They concluded that the fuel of the future was hydrogen, but since gas was usually not available in a usable form, it would have to be extracted either by electrolysis of water, or by nuclear fusion, or by a dry cell. The impact of the current HHO and water phenomena on diesel engine exhaust emissions and fuel consumption will be discussed. There was a lot of publicity in the public domain regarding the effects on demand of hydrogen systems on demand designed for internal combustion engines, as can be seen from a simple Internet search. The hybrid water vehicle uses an HHO generator (Oxy Hydrogen) to supply hydrogen upon request through electrolysis [3-5]. The electrolysis process is carried out in HHO Dry Cell, when current begins to flow through stainless steel plates; an electrolysis process is conducted between the two terminals of the plate, through which water molecules are separated as HHO gas. Integrating this gives excellent results. The IC Engine of hybrid vehicle during operations simultaneously charges the battery-using alternator which run through gener-