Министерство науки и высшего образования Российской Федерации
федеральное государственное автономное образовательное учреждение
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**«НАЦИОНАЛЬНЫЙ ИССЛЕДОВАТЕЛЬСКИЙ
ТОМСКИЙ ПОЛИТЕХНИЧЕСКИЙ УНИВЕРСИТЕТ»**

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Школа: Инженерная школа ядерных технологий
Отделение: Отделение ядерно-топливного цикла

Научный доклад об основных результатах подготовленной научно-квалификационной работы

Тема научного доклада
ИССЛЕДОВАНИЕ РАДИАЦИОННОЙ БЕЗОПАСНОСТИ В ШАХТАХ ГАНЫ

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ТОМСКИЙ ПОЛИТЕХНИЧЕСКИЙ УНИВЕРСИТЕТ

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School: Nuclear Science & Engineering
Division: Nuclear Fuel Cycle

Scientific report
on main outcomes obtained upon completion of a scientific qualification work

Topic
INVESTIGATION OF RADIATION SITUATION IN GHANA MINES

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Summary

Workers exposed to radon and its short-lived decay products has long been recognized as one of the occupational dangers associated with underground mining activities [12]. Radon and its daughter are especially common in underground uranium mines, where the radon source, uranium, is abundant. Radon is also emitted into the atmosphere of underground non-uranium mines, but at a slower pace due to trace uranium concentrations in the parent rock or penetration of radium containing groundwater. If the ventilation conditions in an underground non-uranium mine are poor, radon progeny may accumulate to levels that are unacceptable for continuous exposure. Miners are exposed to radon, thoron, and their airborne short-lived degradation products, ore dust, and, in some mines (especially uranium and thorium mines), external gamma and beta radiations.

Darko et al (2005, 2010) [51] reported that in Ghana there are more than 200 mining companies embarking on small, medium to large scale operation and that there is limited data on the levels of environmental radioactivity concentrations and public exposure due to mining and mineral processing activities. Tongo is no exception; little research on radon and thoron in mines has been conducted. As a result, there is insufficient information on potential NORM/TENORM health hazards to workers and the general public in the surrounding areas (particularly radon and thoron). Therefore, there is need to conduct more research work on NORMs to cover all gold mines in Ghana. This is very vital because currently Ghana is in the process of developing guidelines on standards pertaining to the regulation of NORMs in the mining sector.

The main objective of this research is to Investigate the radiation situation in the mines of Ghana and:

1. Modeling the transfer of radioactive gases and aerosols in the atmosphere with different turbulence using the Mathematica software

2. To investigate the concentrations of radionuclides and their progeny from the soil of underground goldmines in Ghana

3. A series of measurements of the alpha-radiation with an experimental chamber was made, this design was connected to two pumps that work synchronological and subsequent identification of radionuclides are established.

4. Developing a methodology for calculating the flux density of thoron in the accumulation chamber.

As part of the preparation of the course project, a review of general information about radon and its danger to humans, as well as the general principles of organizing radiation monitoring in uranium mines, was carried out.

As a result of completing the task of the course project, modeling of the radiation situation in the mine was carried out using the example of section No. 4 of the Inkai deposit (South Kazakhstan).

For the calculations, the initial data were taken from the literature sources due to the impossibility of determining some of the necessary characteristics (soil porosity, density of solid soil particles, emanation coefficient, etc.).

The mathematical model used makes it possible to predict the expected levels of radon and its decay products in the mine premises, according to the known properties of soils/ores/enclosing rocks, the design characteristics of the ventilation system and the dimensions of the underground room. Also, this model allows you to calculate the minimum value of the air exchange rate required to ensure safe levels of radon in the mine. While working on this project, the skills of calculating radiation parameters for organizing radiation monitoring at a uranium mining enterprise were acquired.

From this research it has been noted that there will be a strong positive correlation between the soil gas radon and Ra-226. Literature has shown that about 2% of Rn-222 in the soil emanates into the atmosphere. Therefore it is recommendable to:

1. Conduct direct indoor radon measurement in the mines in order to know the contribution ratio of the Rn-222 in the soil, mines to that indoor air
2. Use indoor radon concentration values to estimate the AED to the public due to inhalation of radon emanating from both the soil and mine walls into the indoor air
3. In addition, there is need: For an intensive research work to find out whether there exists the relationship between the radon concentration and the physico-chemical properties of soil in the sampling area
4. To conduct research at Tongo to measure heavy metals by Atomic Absorption Spectrometry (AAS), Inductively Coupled Plasma-Mass Spectrometry (ICP-MS) or Neutron Activation Analysis (NAA) Techniques, pesticides residues and other Persistent Organic Pollutants (POPs) by Gas Chromatography-Mass Spectrometry (GC-MS)