**NATURAL RADIONUCLIDES IN THE SOIL AND VEGETATION COVER IN THE ZHAMBYL DISTRICT OF ALMATY REGION**

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There is a global trend towards transitioning to clean energy sources by increasing the share of energy production with minimal or zero greenhouse gas emissions. Nuclear power generation is considered one of the most promising low-carbon energy sources. According to forecasts by the International Energy Agency, the global share of nuclear energy production will rise to 18% by 2040. Likewise, Kazakhstan views nuclear energy as a stable, low-carbon, environmentally friendly source of power. The decision to construct the country’s first nuclear power plant (NPP) was made following a nationwide referendum, with the Zhambyl District of Almaty Region selected as the designated construction site. The aim of this study was to determine the background levels of the specific activity of natural radionuclides 40K, 232Th, 226Ra, and 238U in the soil and vegetation cover of the Zhambyl District of Almaty Region and assess their potential impact on the health of the local population prior to the construction of the NPP.

Fifteen sampling points were established while considering existing information about local soil types to assess the content of natural radionuclides in key components of terrestrial ecosystems. Composite samples of the aerial parts of herbaceous vegetation and soil samples were collected from approximately 1–2 m2 at each point for analysis of accumulation parameters. Soil samples were collected to a depth of 5 cm using the envelope method. Each sample weighed between 200 and 300 g. Radiation parameters were measured at each sampling point in accordance with standard methodologies, specifically β-particle flux density and ambient dose equivalent rate (ADER) to conduct a preliminary assessment of radioactive contamination. The specific activity of natural radionuclides in soil and plant samples was measured using calibrated equipment following standardised procedural guidelines. The radionuclides 40K, 232Th, 226Ra, and 238U were measured using a Canberra GX-2020 gamma spectrometer. In plants, radionuclide concentrations were determined in ash, followed by recalculation on a dry matter basis. Measurement uncertainty did not exceed 10–20%.

This study constitutes the first comprehensive investigation into the presence of natural radionuclides in the soil and vegetation cover of the Zhambyl District of Almaty Region. The findings indicate that the concentration of 40K in soils in the Ulken settlement ranged from 580 to 740 Bq/kg, 232Th ranged from 22 to 50 Bq/kg, 226Ra ranged from below the limit of detection (<2.1 Bq/kg) to 84 Bq/kg, and 238U ranged from 15 to 40 Bq/kg. The specific activity of 40K in plants ranged from 240 to 900 Bq/kg, 232Th ranged from below the limit of detection (<1.1 Bq/kg) to 4.2 Bq/kg, 226Ra were below the limit of detection (<3.9 Bq/kg), and 238U ranged from below the limit of detection (<1.3 Bq/kg) to 3.2 Bq/kg. Overall, these concentrations corresponded to typical background levels of these radionuclides found in soils globally and in the Republic of Kazakhstan. Radiological hazard parameters were assessed based on the specific activity of natural radionuclides in soils within the study area. All calculated values of radium equivalent activity (Raeq) were below the recommended safety threshold of 370 Bq/kg. Both external (Hex) and internal (Hin) hazard indices remained within the safe recommended limit of 1 for all samples analysed. The representative gamma radiation index (Iɣ), based on mean soil radionuclide content, also remained at or below the recommended value. The calculated mean annual effective dose from external gamma exposure did not exceed 0.11 mSv. However, in several instances, the absorbed dose rate in outdoor air exceeded the global mean of 59 nGy/h.This research was undertaken as part of special-purpose funding by the Ministry of Science and Higher Education RK (BR21882185).