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PRELIMINARY RESULTS OF STUDIES ON RADIOISOTOPES ACTIVITY CONCENTRATIONS IN VICINITY OF CEMENT WORKS

WSTĘPNE WYNIKI BADAŃ AKTYWNOŚCI RADIOIZOTOPÓW W SĄSIEDZTWIE CEMENTOWNI

Abstract: In many cities the abandoned industrial estates can be found. Even if such area has been recultivated and prepared the regions located further from the historical source of pollution could not have been restored. In such areas some unwanted substances, originated from former industry, still remain in soil. Among others, the radioactive isotopes in significant concentrations could appear in processing of mineral materials as well as in branches of production where coal combustion is utilized. Soil samples were collected in the area of the former cement plant "Piast", situated within Opole city borders and in the area of nearby allotment gardens. A number of naturally occurring radioisotopes were found as well as artificial ^{137}Cs. The biggest radioactivity concentration was produced by ^{40}K and ^{137}Cs. Concentration of activities of the remaining radioisotopes was lower and similar to each other. No significant differences in activities of radionuclides in soil samples collected in former industrial estate and in allotment gardens were found.

Keywords: industrial pollution, radioisotopes, contamination

Within urban area limits different production plants can be found. They usually emit different pollutants, characteristic for factory and production type. First of all, activity of a plant as local and long distance pollution source is related to technologies used in production. Contemporary, emissions of pollution by a production plant is usually meticulously controlled and continuously monitored. In past such inspections were often not rigorous or were absent at all. As a result a number of harmful or burdensome substances appeared in surrounding of a plant.

In many cities the abandoned industrial estates can be found. Even if such area has been recultivated and prepared *eg* for human inhabitance or for recreation purposes, the regions located further from the historical source of pollution could not have been restored. It could be expected that some unwanted substances, originated from former industry, still remain in soil of the areas located in vicinity of production plants. Among others, the radioactive isotopes in significant concentrations could appear in processing of mineral materials as well as in branches of production where coal combustion is utilized.

Investigations of radioactive isotopes activity concentrations in soil are very important part of monitoring of population exposure to ionizing radiation. The absorbed dose is substantially affected by the natural radioactive isotopes contained in the soil. Also burning coal can release into the atmosphere large amounts of dust containing naturally occurring radionuclides such as uranium, radium, thorium and their decay products [1-3]. As a result contamination level of the environment depends on the content of radionuclide in

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combusted fuel [2-6]. Therefore, it is reasonable to conduct measurements of gamma radioactive isotopes near industrial plants, both the active and inactive ones.

Materials and methods

Soil samples were collected in the area of the former cement plant "Piast", situated in southeastern part of Opole. After over 70 years of cement production this plant was closed in 1978. In the distance of few hundred meters in south direction from industrial area, the allotment gardens are situated. In Figure 1 position of former "Piast" cement works (marked by letter A) and allotment gardens (marked by letter B) are shown. From these areas soil samples were collected, six from each place. Activity concentrations of radioisotopes were determined by means of a gamma-spectrometer with a germanium detector HPGe (Canberra) of high resolution. Geometry of samples container was Marinelli, and measuring process and analysis of spectra were computer controlled with use of the software GENIE 2000. The radiation spectrum was recorded day and night.

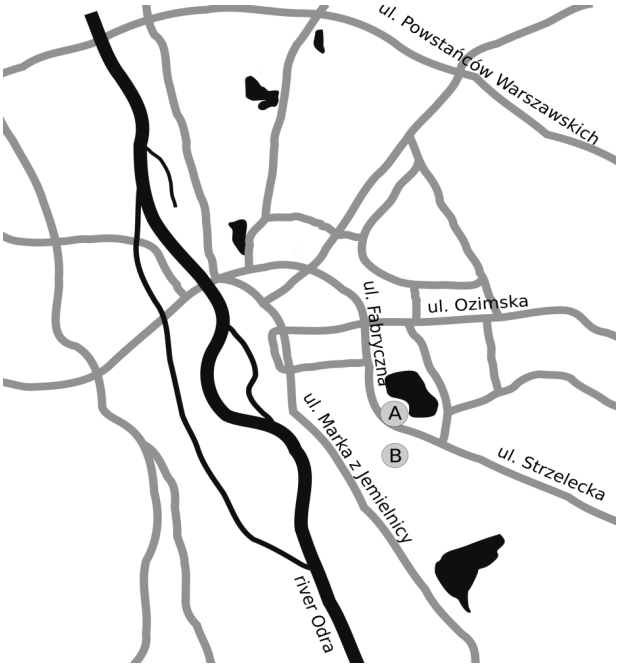

Fig. 1. Plan of Opole shown as scheme of main streets (gray color) in the city. Water reservoirs, river and channels are shown in black. Localization of former "Piast" cement works is marked with letter A, while letter B shows position of allotment gardens

Results

Distributions of radionuclides concentrations of activities are shown in Figure 2. The biggest activities were observed for naturally occurring ^{40}K and for the artificial isotope ^{137}Cs.

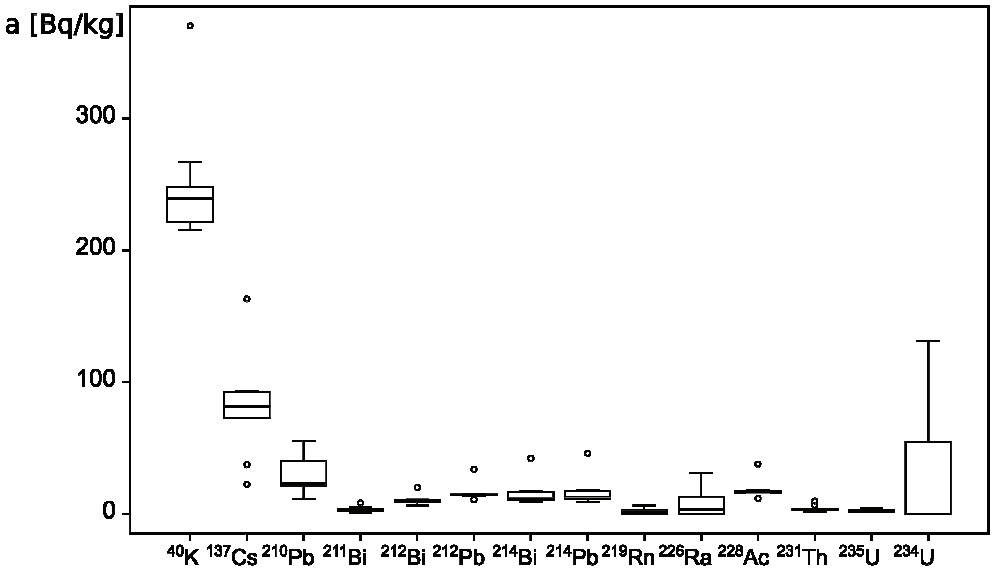

Fig. 2. Distributions of concentrations activities of radionuclides

Activity concentrations of the remaining isotopes were lower, and they were similar to each other.

In Figure 3 distributions of concentration activities in different places are compared. Distribution of isotope activities in samples collected in allotment gardens are marked by AG and distribution of the same parameter measured in samples from industrial estate are marked by P.

It can be noticed that medians of data are similar for all radionuclides. To compare concentration activities of radionuclides in soil in regions AG and P the Mann-Whitney-Wilcoxon test was used. This test enables assessing whether one of two samples of independent observations tends to have larger values than the other. It was found that on the p-level = 0.05 the measurement results obtained from AG and P can be regarded as originating from the same population.

Conclusions

Soil samples collected in the investigated areas contained a number of radionuclides. Most of them were of natural origin, only ^{137}Cs was artificial. Main sources of gamma radiation in soil were ^{40}K and ^{137}Cs. It was found that radioisotope composition of soils in industrial and non-industrial areas were similar. Some explanations can be supposed:

- activity of cement plant did not change composition of soil in both areas,
- range of pollution displacement was big enough to uniformly cover both areas,
- equalization of compositions is due to a long time of cement works inactivity.

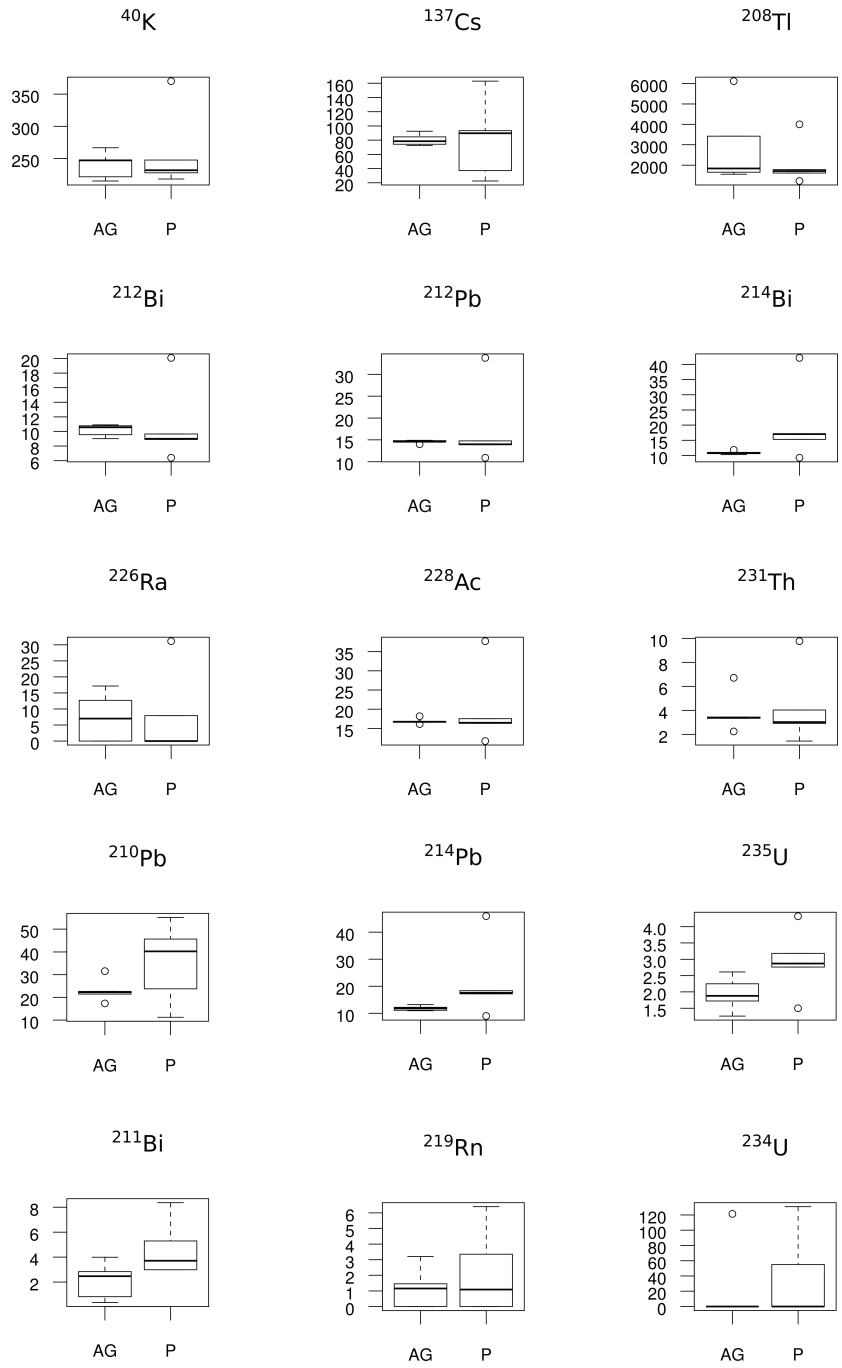

Fig. 3. Distributions of concentration activities in different places

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Abstrakt: W wielu miejscowościach znajdują się pozostałości po zakładach przemysłowych. Nawet jeśli taki teren został zrekultywowany, często obszary położone nieco dalej nie zostały przywrócone do pierwotnego stanu. Na takich terenach można spodziewać się istnienia podwyższonych stężeń różnych pierwiastków, w tym izotopów promieniotwórczych. Do badań pobrano próbki gleby na obszarze byłej cementowni „Piast", znajdującej się w granicach miasta Opola oraz na obszarze pobliskich ogródków działkowych. W badanych próbkach stwierdzono obecność naturalnych izotopów promieniotwórczych oraz ^{137}Cs. Największe aktywności wykazywały ^{40}K oraz ^{137}Cs. Aktywności naturalnych izotopów promieniotwórczych były znacznie niższe i porównywalne względem siebie. Nie stwierdzono istotnych różnic aktywności radionuklidów w próbkach gleby zebranych na obszarze byłych terenów przemysłowych oraz tych, które zebrano w ogrodach działkowych.

Słowa kluczowe: zanieczyszczenia przemysłowe, radioizotopy, skażenie gleby