Monitoring of radiological parameters of drinking water in large polish cities and evaluation of doses received by its consumption

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The water we drink should meet certain quality standards. Intake water supplied by water supply systems may contain radioactive isotopes.
In 2019, monitoring programme included determination of activity concentration of tritium, gross alpha, gross beta, ^{137}Cs and ^{90}Sr in water intended for human consumption in larger urban agglomerations. We tested water from Warsaw and Kielce.
Tap water was collected into polyethylene containers with a volume of 10 dm^3. Twenty liters of water were collected from each point. The water delivered to the laboratory was distributed for testing as follows:
- 15 dm^3 of water was allocated to the ^{137}Cs and ^{90}Sr content tests.
The samples were pre-evaporated to approx. 0.5 dm^3. First, ^{137}Cs content was determined, followed by ^{90}Sr.
- 4 dm^3 of water was dedicated to the study of total alpha and beta radioactivity.
- the remaining 1 dm^3 of water was allocated to the tritium content tests.

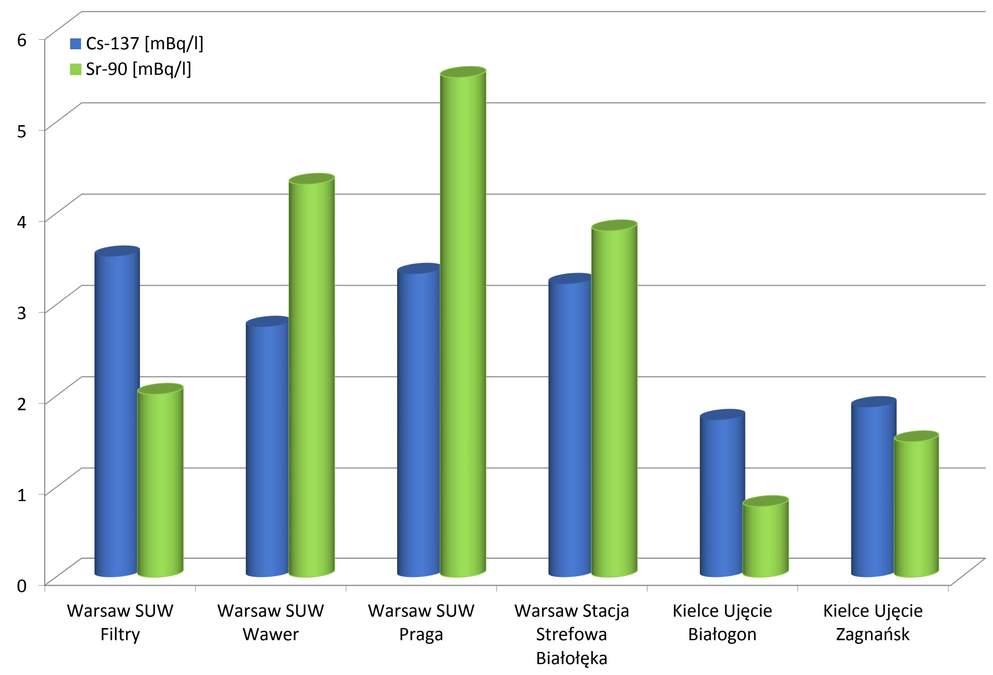

Fig. 1 Activity concentration of ^{90}Sr and ^{137}Cs in water samples

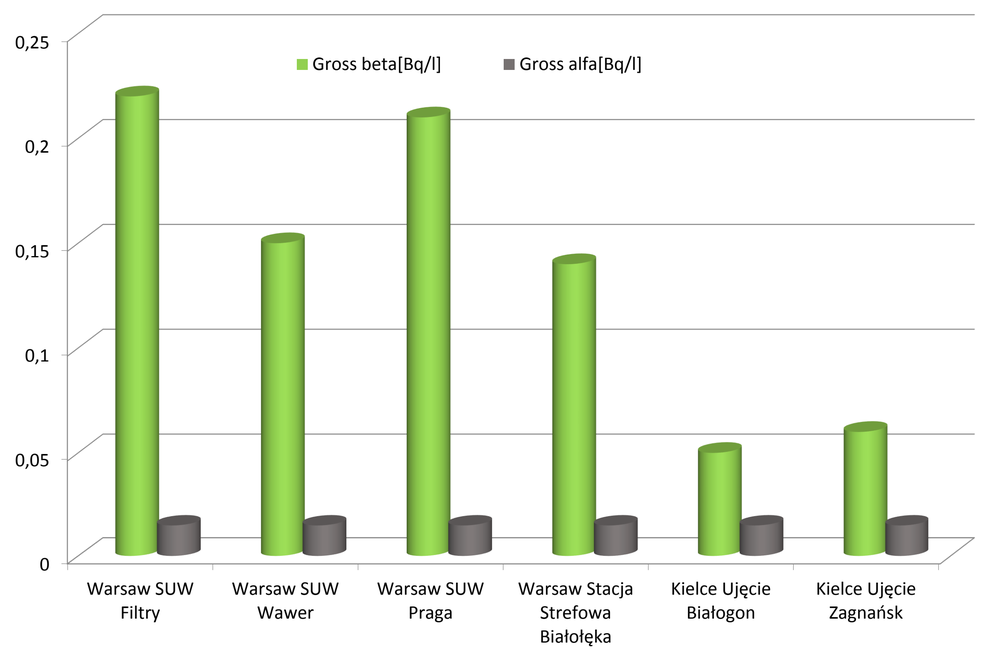

Fig. 2 Total alpha and total beta in water samples

The tritium concentration in drinking water ranged from <0.5 to 1.9 $Bq \cdot l^{-1}$.

Based on the concentrations of ^{137}Cs and ^{90}Sr, the annual absorption of these isotopes with water in age groups was calculated: up to 1 year of age (water intake of 250 l · $year^{-1}$), 1 -10 years (intake of 350 l · $year^{-1}$), 11 up to 17 years (intake 540 1 · $year^{-1}$) and adults (consumption 730 l · $year^{-1}$).
On the basis of these data, the average annual absorption was calculated. These absorptions were 0.23±0.67 $Bq \cdot year^{-1}$; 0.32±0.49 $Bq \cdot year^{-1}$; 0.49±0.75 $Bq \cdot year^{-1}$ and 0.67±1.02 $Bq \cdot year^{-1}$ for ^{137}Cs. The ^{90}Sr absorption in appropriate age groups was: 0.23±0.39 $Bq \cdot year^{-1}$; 0.33±0.55 $Bq \cdot year^{-1}$; 0.50±0.85 $Bq \cdot year^{-1}$ and 0.68± 1.14 $Bq \cdot year^{-1}$. Based on the annual absorption and appropriate conversion factors expressed in Sv · Bq^{-1}, given in Table 4 (Regulation of the Council of Ministers of January 18, 2005 on the ionizing radiation limit doses, Journal of Laws No. 20, item 168), calculated weighing effective doses.

Age group	<1 rok	1-10 lat	11-17 lat	Adult
^{137}Cs				
Conversion faktor, [µSv/Bq]	$2{,}1 \times 10^{-2}$	$1{,}05 \times 10^{-2}$	$1{,}3 \times 10^{-2}$	$1{,}3 \times 10^{-2}$
Annual water consumption, [l]	250	350	540	730
Annual absorption, [Bq]	0,23±0,35[a)]	0,32±0,49	0,49±0,75	0,67±1,02
Dose, [µSv/rok]	0,005±0,007	0,003±0,005	0,006±0,010	0,009±0,013
^{90}Sr				
Conversion faktor, [µSv/Bq]	$2{,}3 \times 10^{-1}$	$6{,}0 \times 10^{-2}$	$8{,}0 \times 10^{-2}$	$2{,}8 \times 10^{-2}$
Annual absorption, [Bq]	0,25±0,44[a)]	0,35±0,61	0,54±0,95	0,73±1,28
Dose, [µSv/rok]	0, 057±0,101	0,021±0,037	0,043±0,076	0,020±0,036

Fig. 3 Average doses from the annual absorption of **^{137}Cs** and ^{90}Sr with drinking water

Doses from absorption of ^{137}Cs range from 0.003 to 0.009 µSv·$year^{-1}$, which is a small percentage (0.0003-0.0009%) of the annual border dose for people from the general population specified in the Regulation of the Council of Ministers dated January 18, 2005 on the radiation dose limits of ionizing radiation Dz. U. No. 20, item 168 (1mSv · $year^{-1}$). From ^{90}Sr absorption, the doses range from 0.019 to 0.054 µSv·$year^{-1}$, which is 0.0019% - 0.0054% of the limit dose. The results obtained indicate that these doses are negligibly small and the tap water in all examined cities meet the requirements set out in the Regulation of the Minister of Health of 7 December 2017.

This work has been performed for National Atomic Energy Agency