Radioactivity in the gas pipeline network in Poland

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The radiological risk in natural gas industry is mostly connected with radon (Rn-222) and its progeny: Po-218, Pb-214, Bi-214, Po-214 and Pb-210. The radon activity concentration in natural gas transported by gas pipelines varies in a wide range from dozens of $\text{Bq/m}^3$ to several thousand $\text{Bq/m}^3$ and mainly depends on the proximity of mines and geological structure of the deposit from which natural gas is extracted and transported. The radon progeny are ion metals, which are easily adsorbed on aerosols and deposited on the inner surfaces of gas pipe and other gas processing equipment such as scrubbers, compressors, reflux pumps, control valves and product lines creating thin radioactive films. Additionally, radon progeny together with aerosols (in contrast to radon) are retained on filters. In the aftermath of successive radioactive decay of short-lived radon progeny, long-lived Pb-210 is accumulated on filters.

The paper presents the study of the Rn-222, Pb-210 connected with the transport of natural gas by the gas pipeline network in Poland. In the scope of the study the measurements of activity concentration of radon (Rn-222) in the gas samples (with alpha scintillation cells), radiolead Pb-210 in spent filter cartridges and dust samples collected from the gas pipeline network (with gamma-ray spectrometry) were performed.

The results show that the Rn-222 activity concentration in natural gas varies from the detection limit of the applied method (30 Bq/m$^3$) to around 1400 Bq/m$^3$. Generally, the Rn-222 concentration in natural gas samples fluctuate around the mean radon concentration in the air of dwellings in Poland. The elevated radon activity concentrations in natural gas of several hundreds of Bq/m$^3$ and more are observed at locations where the gas directly comes from local gas mines or where there is a blend of the national gas with imported one. Relatively low radon concentration in imported natural gas is connected with the fact that this gas was imported from abroad. Therefore, the time elapsed from the gas extraction to the collection of samples was relatively long. In consequence, the concentration of Rn-222 in the gas significantly decreased due to radon decay (3.4 days). Additionally, the temporal variability (daily and weekly) of the radon activity concentration in the natural gas were assessed. The results show radon concentrations does not statistically change in daily or weekly time scale.

The Pb-210 activity concentration in dust (“black-powder”) from gas filters and spent filter
cartridges is high and varies from 500 to 17000 Bq/kg and from 200 to 2900 Bq/kg respectively.