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RADIONUCLIDE CONCENTRATION VARIATIONS IN RESIDUES FROM POTENTIAL NORM INDUSTRIES IN ESTONIA: THE EXAMPLE OF OIL SHALE-FIRED POWER PLANTS

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The new and revised Council Directive 2013/59/EURATOM (adopted in 2013) foresees the integration of protection against natural radiation sources to the overall requirements instead of addressing it separately as in the previous Directive. This in turn obliges the member states to determine the exposure to workers and to the public in industries also processing naturally occurring radioactive material (NORM). A nationwide survey has been started in Estonia in order to determine the activity concentration levels of naturally occurring radionuclides in the ore, products and residues of the following industries: Oil shale industry (oil shale-fired power plants (PPs) as well as oil industry); water industry (drinking water purification); rare earth metal processing industry; mining activities; production of cement and building materials; maintenance of large combustion boilers; clinker ovens. Thorough information on the technological parameters of these industries is being gathered and combined with the data on the input (raw material, energy etc.) and output (products, waste). By analysing the activity concentration of natural radionuclides and their variability in the residues during different time periods, better assessments and recommendations can be made on the need for further monitoring in a longer time scale. The activity concentrations of natural radionuclides have been determined over multiple years in the ashes of oil shale-fired power plants. Oil shale, bottom and fly ash samples were collected from pulverized fuel (PF) boiler equipped with a novel integrated desulphurization (NID) system and bag filters. Secular equilibrium can be observed between ^{238}U , ^{226}Ra and ^{210}Pb in the oil shale samples and between ^{238}U and ^{226}Ra in the bottom ashes as well as in the fly ashes (with few exceptions). ^{210}Pb activity concentrations show clear depletion in the bottom ashes, but highest enrichment factors (the activity concentration ratio between the corresponding ash fraction and the value in oil shale) in the fly ash samples. ^{210}Pb activity concentrations reach up to 89 Bq kg^{-1} . For ^{226}Ra and ^{238}U , the values are up to 69 Bq kg^{-1} and 66 Bq kg^{-1} , respectively. The highest ^{40}K concentration values reach 1186 Bq kg^{-1} . Variations in the enrichment factor values were observable between the samples collected during different days. However, in most cases these variations were not statistically significant. The results indicate that even during complex combustion conditions, the radionuclide enrichment factors in various ashes do not fluctuate significantly. The results can be used to estimate radionuclide enrichment trends in the bottom and fly ashes of the combustion boilers during a certain operating regime and evaluating the PP's impact on producing residues that contain natural radionuclides in a longer time scale. Also this data can be used to estimate the radiological content of certain building materials (e.g. ash blocks) where the filter ash is used as an additional component.