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## BEHAVIOUR OF RADIUM ISOTOPES RELEASED WITH BRINES AND SEDIMENTS FROM COAL MINES IN POLAND

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Saline waters occurring in underground coal mines in Poland often contain natural radioactive isotopes, mainly  $^{226}\text{Ra}$  from uranium series and  $^{228}\text{Ra}$  from thorium series. Approximately 40% of total amount of radium remains underground in a form of radioactive deposits, but 225 MBq of  $^{226}\text{Ra}$  and 380 MBq of  $^{228}\text{Ra}$  are released daily to the rivers with mine effluents. Technical measures as spontaneous precipitation of radium in gobs, decreasing of amounts of water inflowing into underground working etc. have been undertaken in several coal mines and in the result total amount of radium released to the surface waters diminished of about 60% during last 5-6 years.

Mine waters can cause a severe impact on the natural environment. The enhancement of radium concentration in river waters, bottom sediments and vegetation is observed. Sometimes radium concentration in rivers exceeds  $0.7 \text{ kBq/m}^3$ , which is due to Polish law a permissible level for liquid radioactive waste. It was necessary to undertake investigations for development the methods of the purification of mine waters from radium. The radium balance in effluents has been calculated and a map of radioactive contamination of river waters have been prepared.

Solid wastes with enhanced natural radioactivity have been produced in huge amounts in energy and coal industries in Poland. There are two main sources of these waste products. As a result of combustion of coal in power plants low radioactive waste materials are produced, with  $^{226}\text{Ra}$  concentration seldom exceeding few hundreds of Bq/kg. Different situation is observed in coal mines, where as a result of precipitation of radium from radium-bearing waters radioactive deposits are formed. Sometimes natural radioactivity of such materials is very high, in case of scaling from coal mines radium concentration may reach 400 000 Bq/kg - similar activity as for 3% uranium ore. Therefore maintenance of solid waste with technologically enhanced natural radioactivity (TENR) is also a very important subject.