

**REMEDICATION OF THE LOW-LEVEL RADIOACTIVE WASTE TAILING POND  
IN KOWARY**

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**Abstract**

The town of Kowary was the centre of uranium mining activities in Poland. The headquarters of the uranium mining company ZPR-1 (Zakłady Przemysłowe R-1) were located there, as it was the only uranium processing plant in Poland. Mining in Uranium in Poland ceased in 1963, but processing of low-grade dumps was continued in Kowary until 1972. As a result of these processing activities, a significant volume of wastes was produced and the tailings pond in Kowary was constructed to accommodate these wastes. The tailings pond covers an area of 1,3 ha. It is a hydrotechnical construction closed on three sides by a dam, which has been modified a number of times over the years. It is now 300 m long (the sum of the three sides) m with a maximum height of 12 m, and is at the limits of the geotechnical stability. As a result of the uranium processing activities, the tailings pond was filled with about  $2,5 \times 10^5$  t of disposed fine-grained gneisses and schists containing about 4,5 t of uranium and about 440 GBq of radium (from processing of uranium ores).

A prompt remedial action in this case is particularly necessary because the tailings pond is located in a steep mountainous vally where the local climate involves rapid summer rains with heavy erosion. The nearest buildings in the town of Kowary are located literally at the foot of the 12 m high dam and private gardens extend onto the dam slope. The urgency has recently been demonstrated during the flood of summer 1997 when the base of the dam eroded.

In the early seventies, Wrocław University of Technology (WUT) received, by a governmental decision, ownership of both the area and the facilities of the former uranium mining company ZPR-1. Subsequently, the company Hydromet, Ltd., owned by WUT, has continued to use the existing chemical plant for the various experimental processes of rare (radioactive) metals, chemical production and galvanic processes. As a result, 30 t of mixed heavy metals and 300 t of the remnants from the processing of rare metal concentrates have also been disposed in the pond.

The remediation programme of the tailings pond, prepared in 1997 by the WUT, is still being carried out.

**Introduction**

In Poland in the Lower Silesia region extensive exploration and mining activities were carried out under direction of the Soviet Union experts. Prospecting for uranium in Poland was initiated in 1947 when a bilateral agreement between the Poland and USSR governments was concluded. According to that agreement all uranium produced in Poland was transported to the Soviet Union. A systematic exploration programme, including geological, geophysical and geochemical surveys and related research, was carried out until 1966.

Extensive uranium exploration was undertaken in number of localities in the Lower Silesia. Uranium mining took place in Kowary Podgórze, Radoniów and Kletno. Kowary town was a centre of uranium mining activities in Poland. The headquarters of the uranium mining company Zakłady Przemysłowe R-1 (ZPR-1) were located there. Uranium ores from the underground mines were transported directly to the Soviet Union. Chemical treatment of the low-grade ores was opened in Kowary in 1969, being the only uranium processing plant in Poland.

The uranium mining in Poland terminated in 1963, but processing of low-grade dumps was continued at Kowary until 1972. As a result of those processing activities, a significant volume of wastes was produced and a tailing pond in Kowary was constructed to accommodate them.

### **Laws and Policies**

All mining and processing activities in Poland ceased more than 25 years ago, and since then companies responsible for the associated environmental problems have no longer existed. However, a real need to remediate the environment still exists. The Geological and Mining Law stipulates that the State Treasury is liable for the liabilities from the uranium production in Poland which terminated in 1972. Therefore, the government is responsible for the funding of the remediation, either from the national or the district Environmental Protection Fund.

The regional Voivodship authority and its special inspectorates or offices are responsible for the different aspects of the remediation. Finally, the local authority has to approve remediation plans and to supervise their execution and effects. The Inspectorates of Environmental Protection of the Voivodships are responsible for environmental monitoring. The President of the National Atomic Energy Agency is responsible for the radiological monitoring which is considered a part of the environmental monitoring.

According to the Polish regulations, there are no specific maximum admissible concentrations defined for natural radioisotopes, with few exceptions, and limits for chemotoxic contaminants are partially available from several regulations.

The admissible exposure for members of a critical group is derived by calculation from the general limit for the additional effective dose equivalent: 1.0 mSv/a.

### **Construction and development of the tailing pond**

A tailing pond covers an area of 1,3 ha. It is a hydrotechnical construction closed about three sides by a dam which has been modified a number of times over years and is now 300 m long (the sum of three sides), with a maximum height of 12 m; the whole being at the limits of geotechnical stability.

The current status of the dam is shown in the cross-section in Fig.1. There have been three stages of development:

**Stage I:** Construction of the tailing pond by barricading off part of the Jedlica river valley with a dam made from local materials, i.e. mixture of slope clays and detritus (sandy clay plus rock wastes). This source material provides a shallow base for the dam. The bowl of the settling pond was lined. With a layer of a loamy soil it creates a screen against infiltration of water

from the pond to the ground water. Altitude of the top of the dam at this stage was about 570 m above sea level. From the old maps of mine workings it appears that the portion of dam at the south side of settling was constructed over an adit connected to the shaft of the old Wolnoœ uranium mine. This adit is situated about 4 m below the base of the dam, and the mouth, which can be seen in the scarp of the Jedlica river-bed, was sealed with a 30 m concrete plug. In spite of this sealing, continuous water drainage is observed at the adit mouth. This water comes from the underground works of the old Wolnoœ uranium mine.

Stage II: Raising of the dam by hydraulic silting up method to an altitude of about 572 m above sea level. Waste material used was produced from iron-ore mine dumps. Both the dam lifting and pond filling was done with material of granulation corresponding to medium to fine sands, with some additives of chippings and fine-clay soils. This layer of sediments is water-permeable, therefore the silted-up dam at stage II is not leak-proof and allows for wastewater seepage.

Stage III: It involved the construction of a settler for galvanic waste waters. The dam was lifted by another 1.5 to 2.0 m by placing an embankment atop of the existing dam from the same slope clays as used in stage I. Eventually, the top of the dam reached an altitude of 576 m above sea level.

As a result of the uranium processing activities, the tailing pond has been filled with about  $2,5 \times 10^5$  t of disposed fine – grained gneisses and schists of average uranium content of 30 ppm. In the early seventies, the Wrocław University of Technology (WUT) received, by the governmental decision, the ownership of both the area and facilities of the former uranium mining company ZPR-1. Subsequently, the company owned by WUT has continued to use the existing chemical plant for various experimental processes on rare metals, chemical production and galvanic processes. As a result, about 300 t of remnants of rare metals processing and  $5 \times 10^3$  m<sup>3</sup> of post – galvanic fluids with up to 30 t of solids with high content of Al, Ni, Zn and Na sulfates, were also disposed of in the pond.

### **Remediation program**

Poland is one of the co-beneficiary countries of the Phare programmes:

- *Preparing remediation at uranium milling and mining sites in the Phare Countries; provisions of means to assess radiological risk* (completed in 1998). The special equipment to conduct the radiological monitoring has been given to Polish side thanks to this programme. From the beginning of 1999 the radiological monitoring of the historic uranium liabilities in the Lower Silesia Region is provided by the Office of the NAEA located in Jelenia Góra town.
- *Multi-Country Environmental Sector Programme “Remediation Concepts for the Uranium Mining Operations in CEEC*. The objectives of this Programme are to make inventory of the existing situation and to implement a pilot projects. Two projects implementing in the framework of this Programme have a direct relevance to the situation at Kowary:
  - *Technical planning of the long-term stabilisation of tailing ponds*
  - *Concepts and design of reshaping and covering the Sillamae radioactive tailing pond, particularly in relation to dam stability problems.*

The information available from the Phare pilot projects should also be relevant to the established Kowary project.

The remediation programme of the tailing pond prepared in 1997 by the Wroclaw University of Technology is still carried out. The different steps of the overall remediation project, with approximate dates, can be summarised in the following way:

- preliminary investigation;
- construction of water purification plant (completed summer 1999);
- pumping the pond waters through the water purification plant and discharge into the river (to be completed late summer 1999);
- detailed site investigation involving gathering geotechnical, geological, hydrogeological, hydrological, seismic, chemical and radiometric data, with creation of database (works started in June 1999 and will continue until June 2000);
- formulation of general remediation plan based on above data (by the end of June 2000);
- approval of general plan by a local authority (summer 2000),
- detailed technical design of:
  - drainage system to eliminate inflow of water resulting from precipitation and from surface of groundwaters (late summer/autumn 2000),
  - cover of the dried out tailing pond to ensure long-term stability (late summer/autumn 2000);
- submission and approval of above technical designs (end of 2000);
- corresponding construction work: drainage system, pond cover and general reclaiming of the land (end of 2000 to the end June 2001 at the latest); and
- post reclamation continuous monitoring of all the water; radiological and geotechnical monitoring (to be continued during c.30 months).

A number of bodies have contributed and are contributing to the project:

- Wroclaw University of Technology,
- Regional Environmental Protection Fund,
- National Environmental Protection Fund,
- State Committee for Scientific Research, and
- European Commission, DGXI.

The remediation programme for the historic uranium liabilities in the Lower Silesia region is under preparation by the local authorities.

## References

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