GEOPHYSICAL SEEPAGE DETECTION AND MAPPING AT DRAU RIVER DAMS, CARINTHIA, AUSTRIA

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The hydropower plant Annabrücke on the river Drau has dams with a maximum height of 20 metres, with a base width of up to 70 metres. These dams are constructed of a gravel body with a bituminous liner covering the water side. The base of the liner is connected to a sealing wall reaching down to the lacustrine clays in 30 to 50 metres depth forming the base of the reservoir body. The dams are being hydraulically and statically supervised with a network of gauges.

Since 1995 a geophysical control system is being developed and tested. This is intended to complement the existing surveillance system. First operational experiences with this system show a significant improvement in the early detection of damage to dams and in the precision of locating these damages.

A preliminary study showed that conventional — „state of the art" — techniques (self potential, resistivity, geothermal and electromagnetic measurements) will give unequivocal results only in the minority of cases. Often ambiguous or uninterpretable results are encountered, due mainly to the following reasons:

- Due to the large width of the dam, the leakages often lie up to 40 metres offshore, so that the measurable effect of the anomaly may already have been attenuated enough as to be virtually undetectable.
- Gauges, metal inserts and lithological influences cause a complex disturbing field for SP measurements, which is strong enough to mask the significantly weaker amplitudes of streaming potentials. Experiments have shown, however, that these influences are drastically reduced when measurements are taken on the open water surface.
- Due to strong lithological inhomogeneities of the gravels used in the construction of the dam, the specific resistivities vary between 150 and 2500 Ohm.m, so that pelitic and water saturated gravels can be unequivocally distinguished only in a few cases.

To solve these problems, two measuring methods were added to the program which had hitherto not been used in the examination of dams.

To solve the locating problem, the dependency of induced polarisation from lithological composition of the sediment on the one hand and water saturation on the other hand — which is well known from literature — is being used. Chargeability is the parameter of choice for locating seepage, as the high degree of water saturation over a seepage results in a characteristic minimum anomaly across this zone.

The second method employed to solve the locating problem is a measurement of self potential on the open water directly above the areas of seepage. The system currently in use consists of a fixed reference electrode close to the shore that is connected via a cable to the measuring electrode onboard a GPS-controlled boat. With anomalies of ± 5mV, a stable resolution of ± 0,1 mV can be achieved.

The current state of research allows the conclusion that the general problem of locating seepage zones can be satisfactorily solved using IP and resistivity mapping along land side profiles on the dam. For detailed mapping, water based SP measurements are best suited. The further development of geophysical methods with regard to systematic surveillance of dams and the control of repair efforts are future goals of the project.