Application of the Ground Penetrating Radar (GPR) Technique for Characterizing the Internal Structure of Tailings Impoundments

Javier Rey[1], Julián Martínez[2], Mª. Carmen Hidalgo[1], Unai Cortada[1]

[1]*University of Jaen, Department of Geology, Higher Polytechnic School of Linares, Avenida de la Universidad s/n, 23700 Linares, Spain, jrey@ujaen.es, chidalgo@ujaen.es, ucortada@ujaen.es*
[2]*University of Jaen, Department of Mechanical and Mining Engineering, Higher Polytechnic School of Linares, Avenida de la Universidad s/n, 23700 Linares, Spain, jmartine@ujaen.es*

Abstract

Tailings impoundments generated in the old mining district of Linares (Spain) constitute at present a severe environmental problem. Especially alarming is the case of those abandoned ponds located on the banks of the main stream of the area, the Guadiel River. Concerned by this situation, the regional government has proceeded during the last five years to restore some of the biggest impoundments to ensure both their geotechnical stability as to reduce the pollution processes affecting the surface waters.

We report the efficiency of the ground penetrating radar (GPR) as a geophysical tool to analyze the effectiveness of the process of isolation in restored tailings impoundments, and to characterize the internal structure of abandoned tailings ponds.

In the first case, the nature of the sludge and the level of sealing causes a rapid attenuation of the GPR signal, so the depth of research is scarce (less than 10 m) with any of the frequency antennas used (30, 100 and 250 MHz). Despite this, the technique presents a great utility since it allowed to obtain a great detail in the surface zone. Using the 250 MHz antenna, it has been possible to differentiate the continuity and thickness of insulation levels in the restored impoundment.

In the second case, in an unrestored dam, the GPR technique gave equivalent results for the penetration capacity, reaching no more than 10-12 m in depth with the three frequency antennas. Results obtained with the 250 MHz antenna provide detail of the internal structures of the tailings up to 2.5 m deep. In addition, relationship between moisture content and variations in the wave amplitude or signal attenuation can be used to detect the water table and areas with relatively high saturation.

In summary, application of GPR to tailings can be used to identify discontinuities in the top seal layers and analyze the internal structure of these tailings ponds.

Key words Tailings pond, restoration, ground penetrating radar