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Monitoring and assessment of acid mine drainage pollution: the critical future of a reservoir in the southwest of Spain

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Due to the severe drought affecting both socio-economic development and ecosystems quality, the construction of the Alcolea Reservoir in the Odiel River basin (Huelva, Spain) has been planned to improve water management. However, several studies have raised concerns regarding the water quality to be stored, due to the widespread acid mine drainage (AMD) pollution throughout the basin [1]. This study compiles research findings to provide technical recommendations for basin restoration and contamination risk mitigation.

The extent of AMD contamination and the pollutant loads carried by the watercourses have been characterized. Under typical-average streamflows, . Geochemical modeling was then conducted to simulate remediation strategies at pollution sources and predict their effects on water quality. The results indicate a significant improvement (8.75 mg/L eq. of $CaCO_3$ and 0.51 tons/day of metals) if the major sources (Riotinto, Tharsis, and San Telmo mines) were completely eliminated.

To refine predictions, high-frequency sampling is being conducted to monitor water quality throughout a hydrological year, evaluating seasonal variations that commonly influence water conditions. Current data from the two main rivers that would supply the reservoir (Odiel and Oraque) show persistently low pH values (mean values of 3.78 and 3.42, respectively) and high metal concentrations (mean conductivities of 1.43 and 1.29 mS/cm, respectively), indicating sustained acidic conditions. Even during discharge peaks, meaning strong neutralization and dilution effects, potentially toxic elements behave conservatively, possibly reaching the reservoir. Given these trends, there is a significant risk of water acidification in the Alcolea Reservoir, similar to what occurred in a nearby reservoir within the basin [2]. These findings highlight the importance of implementing effective remediation measures before the reservoir is completed to prevent long-term water quality deterioration.

[1] Sarmiento, Nieto, Olías, & Cánovas (2009), *Applied Geochemistry*, *24*(4), 697-714.

[2] Cánovas, Olías, Macias, Torres, San Miguel, Galván, Ayora & Nieto (2016), *Science of the Total Environment*, 541, 400-411.

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