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Permeable reactive barriers for the remediation of groundwater in a mining area: results for a pilot-scale project

Maria Jose Martinez-Sanchez (1), Carmen Perez-Sirvent (1), Maria Luz Garcia- Lorenzo (2), Salvadora Martinez-Lopez (1), Victor Perez-Espinosa (1), Eva Gonzalez-Ciudad (1), Lucia Belen Martinez-Martinez (1), Carmen Hernandez (1), and Jose Molina-Ruiz (3)

(1) Department of Agricultural Chemistry, Geology and Pedology, Regional Campus of International Excellence "Campus Mare Nostrum", University of Murcia, Faculty of Chemistry, Murcia, Spain, (2) Department of Petrology and Geochemistry. Faculty of Geological Sciences. Complutense University of Madrid. Madrid. Spain., (3) Department of Geography, Regional Campus of International Excellence "Campus Mare Nostrum", University of Murcia, Murcia, Spain

The Sierra Minera of Cartagena-La Union is located in the Region of Murcia, Southeast of Spain. This zone presents high levels of heavy metals due to natural, geogenic reasons. In addition, the prolonged mining activity, and subsequent abandonment of farms, has had consequences on the environment, including severe affectation of the groundwater in the area. To remediate this situation, the Permeable Reactive Barrier (PRB) technology was assayed, which required in addition to the hydro-geological study of the zone, a careful optimization study for the design and construction of PRBs. For such a purpose a pilot-scale project was developed, and this communication reports some of the most relevant findings obtained after a four-years monitorization period.
The selected reactive material for the PRBs was limestone filler. The filler is a waste material produced in many factories in the zone. These residues have good adsorption properties, high alkalinity, low cost and high availability, which make them suitable for use in remediation. The PRB was constituted by a 50% limestone filler and 50% sand, a proportion optimized by means of independent batch experiments. A layer of gravel was placed at the top, and on it a layer of natural soil. The barrier was designed in the form of a continuous trench, because the level of the contaminated groundwater was not very deep. In this way, the barrier could be prepared with standard excavation equipment. Parallel to the barrier, 6 wells where arranged downstream for sample collection. The pH and conductivity of the samples was measured directly in situ, and the content of Zn, Cd, Cu, Fe, and Pb were analyzed in the laboratory.
All the samples collected after the PRB was constructed had basic pH values between 7.5 and 8. The conductivity was between 5 and 11 mS / cm except for the well 4, which had a value of 3.70 mS / cm. The concentration values of trace elements were below the detection limit (atomic absorption measurement) in most of cases, or showed values below normal levels of the area. Our results prove that limestone filler is suitable as the active component of PRBs barriers for sites polluted by trace elements. Following this relatively simple technology, there is no risk for human health or ecosystem, and a big cost-saving can be obtained in projects focused to the remediation of areas affected by mining activities.