Microbial transformations by sulfur bacteria can recover value from Phosphogypsum : Sulfate bio-reduction from phosphogypsum leachates and sulfur biorecovery.

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Biotransformation of industrial wastes has recently gained interest in the scientific community as an alternative eco-friendly recycling strategy. Phosphoypsum (PG), the most common by-product in the phosphate industry, is concentrated in sulfates (SO_4^{2-}), making it an excellent substrate for sulfate-reducing bacteria (SRB) to reduce SO_4^{2-} and produce sulfides (S^{2-}), followed by biological recovery of elemental sulfur (S_0) from S^{2-} using sulfur-oxidizing bacteria (SOB) (Bounaga et al., 2022). In this work, 5 SRB consortia were enriched from different environments: IS (Industrial sludges), MS (Marine sediments), WC (Winogradsky column), SNV (petroleum industry sediments) and PG (stored Phosphogypsum). The highest SO_4^{2-} reduction rate was registered with lactate compared to acetate and glucose, IS consortium recorded the maximum reduction rate (81.5%) followed by MS and PG consortia scoring 79% and 71% respectively. IS consortium was chosen to be used as inoculum source for acidic PG-water leachate in a bench top steering bioreactor, the biological reduction rate remained the same reducing about 78% of the initial SO_4^{2-} concentration after four weeks of running the system, The pH of the solution in the bioreactor increased during the experiment, from 5 to 7.5, favoring the production of dissolved HS^-/S^{2-} instead of gaseous H_2S. The nutritional requirements of the consortium while reducing SO_4^{2-} from PG-water leachate was also monitored including Fe, P, and Mg. The dynamic of the bacterial structure during the experiment was evaluated and was correlated with changed the SO_4^{2-} daily reduction rates with other parameters such as Redox potential, Dissolved Oxygen and Agitation. Moreover, the dissolved biogenic sulfide from SRB activity using PG leachate as source of SO_4^{2-}, is considered a good source of sulfide for Sulfur

Oxidizing Bacteria targeting the elemental sulfur recovery using membrane Biotechnologies such as O_2 based MBfR technology.

Keywords: Sulfates reducing bacteria, Sulfide oxidizing bacteria, Phosphogypsum, alkaline leaching, Elemental sulfur.

Bounaga, A., Alsanea, A., Lyamlouli, K., Zhou, C., Zeroual, Y., Boulif, R., & Rittmann, B. E. (2022). Microbial transformations by sulfur bacteria can recover value from phosphogypsum: A global problem and a possible solution. *Biotechnology Advances*, *57*. https://doi.org/10.1016/j.biotechadv.2022.107949