Comparison of characteristics in bioleaching of heavy metals from contaminated soil using sulfur-oxidizing and iron-oxidizing bacteria

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Bioleaching is based on the metabolic activity of various chemoautotrophic bacteria (e.g., *Acidithiobacillus thiooxidans* and *A. ferrooxidans*). To investigate the bioleaching characteristics of *A. ferrooxidans* and *A. thiooxidans*, bioleaching of Pb, Cu, and As from contaminated soil near a refinery was conducted using a sulfur-oxidizing bacterium, *A. thiooxidans*, and an iron-oxidizing bacterium, *A. ferrooxidans*.

Table 1: The experimental sets for bioleaching using *A. thiooxidans* and *A. ferrooxidans*

Set	Soil	Energy source	Inoculum	Removal (%)		
				Pb	Cu	As
A	15 g	Sulfur 3 g	*A. thiooxidans*	33	53	52
B			Deionized water	21	29	40
C	15 g	Fe^{2+} 3 g	*A. ferrooxidans*	35	61	64
D		Fe^{2+} 0 g	*A. ferrooxidans*	11	29	14
E		Fe^{2+} 3 g	Deionized water	33	56	53
F		Fe^{2+} 0 g	Deionized water	2	4	18

Both bacteria supplied with their respective energy sources, S and Fe^{2+}, resulted in decrease in slurry pH from 2.3 to 1.3~1.5. The sulfur oxidizer led to the high concentration of dissolved Pb and As in the slurry; however, the highest removal of the elements from the soil was observed in the presence of the iron oxidizer. The result was due to adsorption of Pb and As onto Fe(III) colloidal suspensions which formed after Fe^{2+} oxidation by the iron oxidizer. After 3-week microbial leaching process, Pb concentration was still higher than the soil pollution criteria regulated by Korean government, which was due to formation of insoluble $PbSO_{4(s)}$ or adsorption onto Fe(III) precipitates. After the bioleaching process, the readily exchangeable fraction of Pb and Cu appeared to increase in the treated soil, thus bioleaching period was required to be extended for safe reuse of the soil.