Biological Sulfate Reduction for Remediation of Gypsiferous Soils and Wastes

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Construction and demolition debris (CDD) are generated during construction, renovation or demolition of buildings or roads. CDD can cause odor problems and possible health impacts to landfill employees and surrounding residents. Although these wastes can be reused as soil amendment or to make building materials, a concern has been raised by regulators regarding the chemical characteristics of the material and the potential risks to human health and the environment due to CDD containing heavy metal and high sulfate (Jang and Townsend, 2001). Under extremely wet conditions (high water table), gypsum waste can contribute to the growth of anaerobic bacteria (Gypsum Association, 1992a). When wet landfill conditions occur, it is suggested that this waste has to be separated from other wastes, especially organic waste, and placed in a specific area of the landfill. This results in the rapid rise of the disposal costs of gypsum waste (Gypsum Association, 1992b).

In addition, soils containing solid sulfate (gypsum), namely gypsiferous soils, have several problems during agricultural development. The presence of gypsum in gypsiferous soils creates several problems for their agricultural development, including low water retention capacity, shallow depth to a hardpan and vertical crusting (Khresat et al., 2004). Reduction of the sulfate content of these solid wastes and soils by biological sulfate reduction is an option to overcome the above mentioned problems. This study aimed to develop a biological sulfate removal system to reduce the sulfate content of gypsum contaminated wastes (CDD) and gypsiferous soils in order to decrease the amount of solid wastes as well as to improve the quality of wastes and soils for recycling purposes and agricultural applications.

Figure 1 shows the treatment concepts for gypsiferous materials. For CDD, the treatment concept leaches the gypsum contained in the CDD by water in a leaching column. The sulfate containing leachate is further treated in a biological sulfate reduction system including: Upflow Anaerobic Sludge Blanket (UASB) reactor, Inverse Fluidized Bed (IFB) Reactor and Gas Lift Anaerobic Membrane Bioreactor (GL-AnMBR). The highest sulfate removal efficiency achieved from these three systems ranges from 75 to 95%. The treated water from the bioreactor can then be reused in the leaching column.

For gypsiferous soils, the *in situ* treatment concept was applied in this part of the experiment. In this concept, both soluble and solid sulfate in gypsiferous soils will be used as electron acceptor for biological sulfate reduction. The gypsum mine soil (overburden) was mixed with organic material in different amount including 10, 20, 30 and 40 % of soil. Rice husk, coconut husk chip and pig farm wastewater treatment sludge was used as organic material (electron donor). The highest sulfate removal

efficiency (60%) was achieved in the soil mixture which contained 40% organic material.

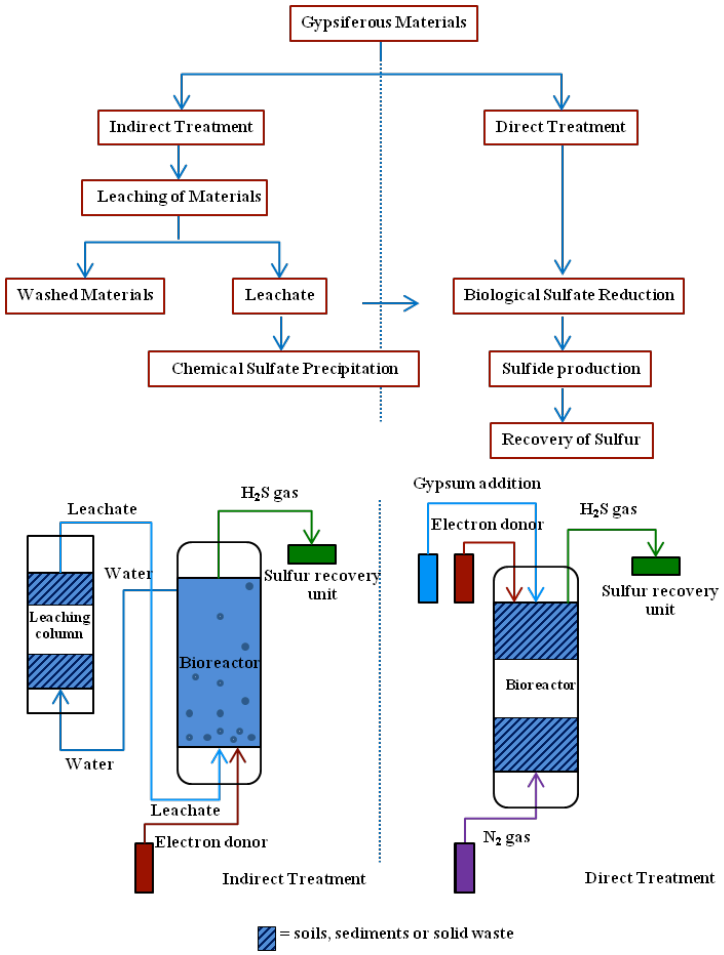

Figure 1. Treatment concepts for gypsiferous materials

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