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Constructed wetlands for treatment of mine tailings at Tara Mines, Ireland

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Abstract

Natural and constructed wetlands can filter pollutants from water. Recently this property has been exploited in utilising wetlands for passive water treatment. Using relatively concentrated waste, wetlands have been shown to be effective in retaining in excess of 90% metals (MAY et al. 1993) and over 70% sulphate (WINTER & KICKUTH 1989). This approach to water quality improvement is more favourable than traditional treatment methods requiring intensive chemical and labour inputs. Experimental wetlands have been constructed on site at Tara Mines, County Meath, Ireland to facilitate a research project investigating the capacity of filter systems in retaining sulphate and metals from mine tailings water. It is expected that such systems, based on natural processes, will be efficient yet require little maintenance and will, therefore, be economically attractive.

Optimum plant growth and substrate permeability for the wetlands at Tara Mines were achieved using a substrate consisting of 25% Spent Mushroom Compost (SMC) and a 75% fine grit. This substrate provides a rich source of Dissimilatory Sulphate Reduction (DSR) bacteria such as *Desulfovibrio* and other sulphur metabolites, which mediate the sulphate reduction reactions (BECKETT et al. 1997). These biological and chemical processes involve the reduction of sulphate under anaerobic conditions to sulphide. The resulting sulphides subsequently react with dissolved metals rendering insoluble precipitates. Cattails (*Typha latifolia*) and the common reed (*Phragmites australis*) amongst other aquatic plants are frequently employed for water treatment (KADLEC 1996). Therefore, *Typha latifolia, Phragmites australis* and *Glyceria fluitans* were planted at a ratio of 4:9:4 per m^2, respectively, in each wetland filter at Tara Mines.

Using programs such as WATEQ (DVORAK et al. 1992), mathematical modelling will figure prominently in predicting the fate of the ions (or compounds) and life span of these wetlands with respect to the retention of sulphate and heavy metals. Toxicity within the wetland habitat is predicted using the ratio of Simultaneously Extracted Metal (SEM) to Acid-Volatile Sulphide (AVS) as derived from ALLEN et al. 1993.

The presence of microbial activity (sulphate reducing bacteria) was determined qualitatively as indicated by the production of H_2S gas. A study identifying and characterising the specific microbes and their role(s) within the wetlands is being initiated. Conductivity output readings were consistently lower in both wetlands and by up to 31% compared to input measurements. At these levels, total ionic strength is linear to conductivity, and therefore, these values also account for up to a 31% reduction in ionic concentration. Results indicated that pH is well buffered in the wetlands around 7.6. Temperatures varied between 3 °C in December and 25 °C in July. Preliminary results indicate that the wetlands are functioning in terms of reduction in ion content of surface water. Plant growth is prolific and there is already a diverse volunteer invertebrate community indicating a healthy ecosystem within the wetland filters. Flow rates for water passing through the wetlands are presently set at 300 mL/min, which is the recommended flow rate for maximum retention of metals and sulphates for an equal area of filtration (CRITES 1994, STALKER 1996).

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