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Global Solutions

A COMMERCIAL APPLICATION OF VIROMINE™ TECHNOLOGY

CASE STUDY
ABERDARE EAST COAL MINE, AUSTRALIA

The application of ViroMine™ Technology to acid mine drainage seepage at Aberdare East coal mine resulted in significant reductions of all relevant metals and an increase in pH

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The Aberdare East Colliery is a closed underground coal mine located in Cessnock, New South Wales, 120 km north of Sydney. Coal washery tailings from the mine were impounded in a series of overlapping stacked cells in a small catchment on the site. Relatively clean water enters the south-eastern extent of the tailings and moves to the northwest down the hydrological gradient, before exiting at the north-western batter into a small creek. During passage through the tailings, salinity, metal content, redox potential, and temperature all increase, and solution pH decreases in the wastewater. Investigations indicated that the impoundment contained 109,445 m^3 of liquid, 337,793 m^3 of saturated fines, 720,113 m^3 of unsaturated fines, and 184,568 m^3 of clay capping.

Washery wastes were held adjacent to the main shaft (now sealed), a derelict coal laboratory and an area previously used for underground pit top buildings, including a coal processing plant. The washery waste area was within a site that contained rehabilitated coal products and reject dumps, old quarries, a haul road network, coal processing areas and natural bushland.

Benefits associated with the use of ViroMine™ Technology were identified as including: lowered sludge production during wastewater treatment; increased chemical stability of residues and therefore greatly reduced disposal costs; and a decreased susceptibility to dissolution of acid neutralising capacity from the soil/tailings profile that greatly reduced the likelihood of having to reapply more reagent after five or ten years and consequently a reduced safety margin for the application.

To sample the site, 19 test pits were dug and piezometers placed into the coal tailings: 18 into the coal slimes and one into the dam wall. Coal samples from the pits were analysed for pyrite content (using the chromium reducible sulphur method outlined by Sullivan, *et al*., 1998) to determine the required application rate of Virotec's chemical reagent Acid B Extra™, reaction pH, soluble acidity (see Lin, *et al*., 2000 for more details) and grainsize, which indicated that the coal tailings were <2.0mm and hence referred to as "coal slimes". Water samples were taken from the seepages and analysed for pH and the following heavy metals: aluminium, arsenic, cadmium, copper, chromium, iron, lead, manganese, nickel, and zinc.

Dam seepage at Aberdare

TABLE 1: PRE- AND POST VIROMINE™ TECHNOLOGY RESULTS FOR TREATED ACID MINE DRAINAGE SEEPAGE AT ABERDARE EAST COAL MINE

Parameter	Untreated Seepage	Treated Seepage	Site Background Conditions	Regulatory Guidelines for Discharge
pH	2.6	8.2	7.0	6.5-8.5
Aluminium (mg/L)	36.9	0.03	0.006	0.1
Arsenic (mg/L)	<0.001	<0.001	<0.001	<0.001
Cadmium (mg/L)	<0.001	<0.001	<0.001	<0.001
Copper (mg/L)	0.009	0.001	0.002	0.002
Chromium (mg/L)	0.008	<0.001	<0.001	0.04
Iron (mg/L)	168	0.001	0.75	No limit
Manganese (mg/L)	9.5	2.3	0.17	3.6
Nickel (mg/L)	0.65	0.008	0.002	0.17
Lead (mg/L)	<0.001	<0.001	<0.001	0.009
Zinc (mg/L)	0.68	0.002	0.006	0.03

From this data it can be concluded the application of ViroMine™ Technology to acid mine drainage seepage at Aberdare East coal mine resulted in significant reductions of all relevant metals and an increase in pH, all to within regulatory limits and all with 75-99% removal efficiencies (Clark, *et al.*, 2004). It should be noted that researchers also concluded the application of Acid B Extra reagent neutralised both the total actual acidity (TAA), which was present in the coal slimes at the time of treatment, as well as the total potential acidity (TPA), which may have caused further AMD leachate in the future.

TCLP analysis on the treated coal slimes indicated that the residual solids after treatment conformed to guidelines as an "inert" waste, meaning that the treated coal slimes could be disposed to regular landfill, and did not require further treatment or special disposal criteria, as shown in Table 2.

TABLE 2: TOXICITY CHARACTERISTIC LEACHING PROCEDURE ANALYSIS FOR TREATED COAL SLIMES AT ABERDARE EAST COAL MINE AFTER TREATMENT WITH VIROMINE™ TECHNOLOGY

Parameter	TCLP of Treated Coal Slimes (mg/L)	Regulatory Guidelines for Discharge
Arsenic	<0.001	0.5
Cadmium	<0.001	0.1
Copper	0.02	No Limit
Chromium	0.07	0.5
Lead	<0.001	0.5
Mercury	<0.001	0.02
Molybdenum	<0.001	0.5
Nickel	0.13	0.2
Selenium	<0.001	0.1
Zinc	0.04	No Limit

Unlike lime, which leaves large volumes of chemically unstable sludge, use of ViroMine™ Technology results in the formation of a non-dispersive sediment that supports healthy plant growth; the TCLP results shown in Table 2 indicate that it is difficult to re-leach (i.e., desorb) heavy metals bound to sediments during water treatment.

Whereas most metals removed by lime, clays and zeolites are initially adsorbed and can be desorbed if chemical conditions change slightly, most metals bound when Acid B Extra is used are held as structural components of minerals, are not exchangeable and are thus cannot be easily removed or re-released back into the environment. At Aberdare East coal mine, it was also found in side-by-side experiments that the amount of sludge produced as a result of applying Acid B Extra to treat the AMD seepage was 15 times less than that generated by the use of lime on a gram-for-gram basis.

REFERENCES

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