Preventing Pollution from Decommissioned Underground Mines

Earth Systems has been a global industry leader in the management of acid and metalliferous drainage (AMD/ARD) for more than 20 years. We have developed an innovative technology for rapidly lowering or preventing pollution from decommissioned underground mines. Based on mine void atmosphere control, it provides a cost effective alternative to “water treatment in perpetuity” or accepting ongoing water pollution.

There are more than 400,000 abandoned underground mines worldwide. Many of these discharge acid, metal and salinity contaminated drainage. The pollution is a result of the exposure of sulfide minerals (such as pyrite) within the mine to atmospheric oxygen. If not managed, pollution can continue for centuries. Solutions for the management of these legacy mines include hydraulic seals which flood the workings and prevent oxygen access to the reactive sulfides, or treatment of the discharge water via costly and ongoing chemical addition. Hydraulic bulkheads are difficult to engineer, can be expensive to install and have some history of catastrophic failure. When water treatment is chosen, it is often considered necessary in perpetuity. For most sites, particularly remote ones, pollution control has simply not been economically viable – until now.

Earth Systems has developed and successfully implemented an innovative, low cost and low risk alternative to existing AMD management options. The rate of pollution generation (ie. sulfide oxidation) from underground mine voids is directly proportional to their internal oxygen concentration. By controlling void oxygen concentrations, pollution can be either lowered or prevented. Earth Systems has developed processes for passively lowering internal oxygen concentrations and minimising the re-supply of air into the mine workings associated with climatic events (ie. mine breathing). Substantial reductions in pollution (50-60%) have been passively achieved to date following strategic engineering work programs that do not interfere with mine water discharge. Complete pollution prevention could be achieved via active inert gas injection, to overcome air entry due to barometric pumping.

CASE STUDY
The inert atmosphere technology outlined above has been implemented at two decommissioned, polluting mine sites in New South Wales (NSW), Australia, supported by the Derelict Mines Program of the NSW State Government Department of Planning and Environment. The sites are the Sunny Corner silver-lead-zinc mine and the Nevada gold mine. The Sunny Corner site is ranked as the highest priority derelict mine in the State of NSW. Approximately four months following the final on-site engineering works, there has been a 50% reduction in pollution from the Sunny Corner site and a 60% reduction from the Nevada site. These improvements are associated with low oxygen levels (down to 3 vol.%) in parts of the mines. Monitoring is ongoing, and decreasing pollution trends are continuing.

Staged Implementation

Inert atmosphere installations in underground mines are designed and implemented in a multi-stage process. Not all stages are necessary to achieve substantial pollution reduction. Solutions are site specific but can involve the following stages:

Stage 1: Feasibility Study
- Water quality assessment
- Site investigation and risk assessment
- Remote sensing investigations to map the subsurface architecture of underground workings
- Investigations to locate subtle air entry locations
- Surveys to identify void interconnection
- Predictive modelling of inert atmosphere performance
- Cost-benefit analysis

Stage 2: Mine air entry and drainage control design and implementation and installation of monitoring systems

Stage 3: Air entry control performance assessment and additional air entry control works if required

Stage 4: Extended water and gas monitoring and assessment of the need for an inert gas injection system

Stage 5: Design, supply, installation and commissioning of inert gas injection system