Passive treatment: A walk away solution?

As shown in Figure 5, problems with vertical permeability are predicated to occur -- five years after commissioning, although no account of ochre ageing is included in this prediction. A further complication at Pelenna is that during the period February to May 2000 minewater did not enter the system due to blockage of the minewater distribution network. Therefore, previously deposited ochre may have compacted, thereby potentially creating different sub-surface conditions which may affect long term permeability. However, the short term saving grace of the Pelenna system may be the ~1 m of freeboard available and the wet Welsh weather. Combined, these factors may provide sufficient head to allow flow to continue, albeit at a reduced rate for a longer period of time before remediation engineering is required or the system over-spills.

TREATMENT ALTERNATIVES
A number of SAPS have been installed worldwide and it is considered likely that the observations and predictions made are applicable to these other systems where surface ochre is accumulating.

Successful treatment of net acidic minewater requires separation of the alkalinity supplementation and Fe removal stages. The alkalinity should be added in an anaerobic environment and then the water exposed to conditions which may affect subsequent Fe reduction via processes such as sulphate reduction and iron sulphide formation, SAPS are also referred to as RAPS or Reducing and Alkalinity Producing Systems (Figure 1). Monitoring of the influent and effluent chemistry at the Pelenna SAPS reveals good precipitates are evident. However, another process may occur that enhances Fe removal. This is the well documented process of auto-catalytic Fe oxidation, where Fe(II) can be removed from solution by oxidation at the surface of previously formed ferric hydroxide\(^{\text{3+}}\). In order to assess the occurrence of this process, Fe concentrations over time were recorded in two beakers of iron (II) sulphate solution, one of which also contained fresh ochre from the SAPS. The beaker containing ochre resulted in significantly lower Fe concentrations over a relatively short time period suggesting that auto-catalytic iron oxidation is feasible as a method to enhance Fe removal. Further research is currently underway to assess the significance of this process.

SAPS LONGEVITY
The continuous accumulation of ochre on the surface of the SAPS could have significant implications for long term SAPS performance if it is not managed. In order to assess this effect, a full scale cross-section of the SAPS was reconstructed in the laboratories of the Division of Materials and Minerals at Cardiff University (Figure 3).
oxygen to enable efficient Fe oxidation. Long term treatment of net acidic minewater is possible, provided the water chemistry is first fully characterised, the treatment design is based on geochemical understanding and it is recognised that the system requires on-going maintenance which will incur operational costs.

The latter treatment option is particularly attractive and has recently been implemented at Ankaflote in Spain, and at Renishaw Park, in the UK. As the system relies on treating the minewater prior to discharge from the mine it is essential that mine planning is proactive and preparations are initiated prior to abandonment of a mining area. Successful long-term treatment using systems such as wetlands and SAPS requires on-going management and they should not be considered a walk-away option.

Treatment options available include:
- a modified SAPS system;
- anoxic limestone drains;
- bacterial remediation; and
- anaerobic reactive barriers inside workings.

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