

Understanding mine water treatment

Mine water, acid mine drainage and ochre

As coal mining in the UK has reduced, some arrangements to pump water out of the mines have stopped. This has allowed iron, found in the rocks within mine workings, to mix with underground water. As this mine water reaches the surface it comes into contact with the air and a chemical reaction takes place. The iron in the water changes state (from ferrous to ferric) which creates an acidic solution known as acid mine drainage.

In the UK, many of the coalfields contain a significant amount of limestone which counterbalances much of this acidity, resulting in a typical neutral mine water. Small particles of iron (ferric hydroxide) then form in the solution, which drop out of the water to create what is known as ochre. It is this material that causes affected streams, rivers and other watercourses to appear a red / orange colour and could pollute water supplies.

Types of mine water treatment

The Coal Authority treats mine water using a range of treatment techniques.

Active mine water treatment

The improvement of water quality by methods that require the pumping of mine water and/or the addition of chemical reagents.

Fully active mine water treatment schemes are not a preferred way of treating mine water. Active schemes are not visually appealing and do not add to the local ecology. The equipment required is often expensive to purchase and maintain. Active treatment is used as a short term solution, or when the required land area for a passive scheme is not available.

Passive mine water treatment

The improvement of water quality using only naturally available chemical processes and energy sources (e.g. gravity). These systems require only occasional maintenance in order to operate effectively over the entire system design life.

Passive treatment is the preferred method for the Coal Authority. Totally passive schemes are fed by gravity so expensive pumping arrangements are not required and maintenance costs are lower than for active schemes.

Combined active and passive mine water treatment

Schemes can have both active and passive elements with the need for pumping and dosing at the start of the process, whilst still passing the water through reed bed cells for final polishing.

Reed beds and mine water treatment

Passive settlement lagoons and reed beds are the most ecologically friendly way of treating mine water. As well as treating the mine water, these constructed wetlands, an increasingly rare habitat in the UK, form a home for many different types of insects and birds. These wetland areas can also support the creation of a public feature integrating picnic areas, paths, benches and viewing points.

Reed beds serve two main purposes in mine water treatment:

Filtration

This occurs both within the soil and subsoil of the reed bed and through the roots of the reeds themselves. As the water travels through the reed bed, the particles of ferric hydroxide become trapped and remain within the natural filter, whilst the cleaned water flows onwards. A successful treatment scheme is one where the reed beds are of a sufficient size that all of the particles are removed before the water re-enters the watercourse.

Settlement

This is the process by which the particles formed during filtration collect together and fall to the base of the reed bed.

There are commonly three types of wetland plant that the Coal Authority uses within its reed beds. These are:

- * Common Reed (*Phragmites australis*)
- * Bullrush (*Typha latifolia*)
- * Yellow Flag Iris (*Iris pseudacorus*)

The history of mine water remediation by the Coal Authority

The Coal Authority had no responsibility for dealing with mine water pollution from abandoned coal mines when it was established in 1994. It soon became clear to government however, that the Coal Authority was the public body best equipped to deal with mine water. Working with the Environment Agency and the Scottish Environment Protection Agency, the Coal Authority formed a mine water remediation programme. Schemes to clean and protect the nation's water courses and sources of drinking water continue to be delivered by this programme.

The European Water Framework Directive, which came into force in 2000 and was transposed into national legislation in 2003, is 'all encompassing' in nature. It requires that all bodies of water in the EU shall be of 'good ecological quality' within the timescales laid down. Waters impacted by mine water do not always meet this requirement and therefore the objective is to seek to treat those discharges which lead to non-compliance. A further requirement of the Directive is 'no degradation of watercourses from their current position'. This puts added emphasis on the Coal Authority's work to prevent any new discharges from occurring.

The success of the Coal Authority's coal mine water treatment programme has resulted in an extension of their powers, under the Energy Act 2011, to deal with pollution from metal mines. In 2011, Defra started to fund the Coal Authority, making use of their expertise and innovation, to tackle water pollution from non coal mining.