CASE STUDY:

OCRA removes heavy metals from mine affected water

REMEDIATION PROJECT
Coal Mine in a Heritage Listed National Park

MATERIAL
Mine Affected Water from Coal Overburden

VOLUME
Laboratory Pilot Trials

PRINCIPAL
Global Mining Company

LOCATION
New South Wales, Australia

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WATER SOLUTIONS:EVOLVED

SUMMARY

An Australian Coal Mining operation located in a heritage listed area invited **Evocra** to evaluate their current water treatment process and provide advice on possible solutions to meet their increasingly stringent water release criteria. The Client's intended outcome is to commission the installation of a solution capable of maintaining long-term compliance against its ever-decreasing discharge limits.

Like many mining sites this operation has historically been using a traditional pH adjustment, oxidation approach with dissolved air flotation (DAF) to remove heavy metals from the affected water. It was proposed that **Evocra**'s patented Ozofractionative Catalysed Reagent Addition (OCRA) process could meet the requirements of the client while significantly reducing the Client's operating costs.

Evocra has conducted a series of trials on raw water originating from the mine site utilising the OCRA process demonstrating that the technology does remove metals from affected mine waters to below discharge limits.

RESULTS

The raw water and treated water concentrations, and EPA discharge requirements, for cobalt, manganese, iron, nickel and zinc can be found in the table below. It can be seen that the OCRA process effectively removed 99.9% of cobalt, 83.3% of iron, 78.1% of manganese, 98.9% of nickel and 99.4% of zinc to below discharge limits. Note, a pH adjustment back to compliance will be necessary.

The OCRA process utilised ozone, a small amount of hydrated lime for pH adjustment, and filtration to 1.0 µm applied to the output water for removal of precipitates. Overall, the reagent usage represents a >80% reduction in reagent requirement compared to the current operation, not including the elimination of three reagents required by the current operation.

CONTAMINANT	MINE WATER	OCRA TREATED	PERCENT VARIANCE	RELEASE LIMIT
pH	6.39	9.43	_	6 – 8.5
Iron	25 µg/L	7.0 µg/L	72.00 %	300 µg/L
Cobalt	132 µg/L	0.1 µg/L	99.92 %	2.5 µg/L
Manganese	845 µg/L	185 µg/L	78.11 %	500 µg/L
Nickel	438 µg/L	5.0 µg/L	98.86 %	11.0 µg/L
Zinc	844 µg/L	5.0 µg/L	99.41 %	8.0 µg/L
Cadmium	0.44 µg/L	< 0.05 µg/L	88.64 %	
Copper	4.8 µg/L	< 0.5 µg/L	89.58 %	
Selenium	0.3 µg/L	0.2 µg/L	33.33 %	

ISSUE

Mining and other excavation activities have led to Acid Mine Drainage (AMD), also known as Acid Rock Drainage, which was recorded as early as c800BC. AMD is caused by the exposure of naturally occurring sulphide minerals oxidising and becoming highly soluble to be carried away with water.

AMD is a persistent and ongoing problem, as it continues to leach from waste rock to form sulphuric acid with a very low pH. With the acid numerous metals, some toxic (e.g. cadmium, mercury), are leached from the rock and then into the environment, spreading the detrimental effects.

The extent of some contaminations by AMD can cause water security concerns for the mine and even its local communities, particularly in arid areas. To combat these issues the mining community has been working to develop cost effective methods of treating AMD and alternative water sources.

Traditional methods of treating AMD involve using extensive amounts of a reagent (e.g. lime) to neutralise the acidic waters in situ, or by using energy-intensive reverse osmosis (RO) water treatment plants to remove the problem metals from the AMD-impacted water. Both create by-products to be managed indefinitely.

In contrast, the OCRA process limits ongoing environmental liability by capturing problem metals in non-reactive reagents, thereby reducing the potential for ongoing AMD generation and reducing overall mine closure costs. Reagent use is also reduced by 75%.

Emerging contaminants, such as PFAS, also increase the treatment requirements.

TECHNOLOGY

Evocra's patented OCRA process is a new generation technology that can be customised to meet the demands of the raw materials being treated. OCRA utilises micro-bubbles of ozone in a multiphase process that provides great versatility for the removal of contaminants and sediments via oxidation-reduction, precipitation, electrostatic flotation and if required reagent absorption, dependent upon the chemical group and species of interest.

OCRA's vast gas-liquid interface elevates oxidation-reduction potential (ORP) conditions of the OCRA chambers, degrading organic co-contaminants including petroleum hydrocarbons, and persistent contaminants as well as transforming metal ions into stable compounds and facilitating bubble adhesion for PFAS compounds. Degraded or stabilised byproducts are captured and removed via a number of industry established methods, providing a high-quality treated water. Collected contaminants can either be destroyed or disposed externally or where possible beneficially reused on site.

OCRA's ability to carry out several extractive techniques within a single reaction vessel provides significant advantages in reducing overall footprint and cost.

PROCESS

The multiple OzoFractionation columns of an OCRA-PFAS plant remove greater than 99.5% of regulated PFAS from raw influents. This arrangement also reduces the total measured PFAS concentration by more than 85%, in the treated water.

The OCRA process provides the following benefits:

- **Eliminates** down time from organic fouling due to its destructive treatment of almost all organic compounds.
- **Eliminates** process obstructions by removing suspended solids from the process fluid.
- **Reduces** the number of unit operations required for complex water contaminations by using the multifunction reaction chambers.
- **Reduces** waste volumes, which reduces on site costs and external transport and disposal costs.
- **Recovers** resources, water and valuable minerals.
- **Reduces** reagent usage, by up to 75% in comparison to traditional methods. Reagents include adsorption media, if required for polishing to higher quality discharges.
- **Removes** contaminants from the environment eliminating risks to human health as well as other ecology.

APPLICATION

OCRA can be installed either as a stand-alone process, an upstream bulk cleansing process for ultra-trace polishing processes or as a (pre- or post-) bolt-on to existing infrastructure. This versatility minimises any potential disruptions to present operations. OCRA plants are modular and can be scaled to meet any site requirements. OCRA is designed to be energy efficient, while the energised process fluid, produced in the high oxidation-reduction environment, increases reagent efficiencies.