

CLARENCE COLLIERY WATER TREATMENT

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ABSTRACT

Clarence Colliery is a coal mine that is located in the Blue Mountains North West of Sydney. New stringent effluent conditions were imposed on the Plant, as a key initiative improving the water quality discharge.

The existing 10 ML/d water treatment plant at Clarence Colliery was augmented to treat 25 ML/d of water from the mine. Waters from underground mining works as well as water in the Leachate Pond contained elevated levels of iron and manganese. Before this water could be discharge to the Wollangambe River, it had be treated to acceptable levels through the Clarence Colliery Water Treatment Plant.

The purpose of this project was to remove iron and manganese levels so as to consistently meet the discharge water quality requirements.

Clarence Colliery decided that the most effective long-term solution was to use an experienced water company to take responsibility for the scheme including the design and construction of the upgrade as well as maintaining the operations of the facility for 2 years with the option of continuing the term for a further 3-5 years.

KEY WORDS

Coal Mine, Clarence Colliery Water Treatment Plant, Leachate Pond,
ML/d, Iron and Manganese, Wollangambe River

1.0 INTRODUCTION

The existing 10 ML/d Water Treatment Plant at Clarence Colliery was augmented to treat 25 ML/d of mine water.

Water from underground mining workings as well as water in the Leachate Pond contain elevated levels of iron and manganese. Before this water is allowed to be discharged to the Wollangambe River, it had to be treated to an acceptable standard through the Clarence Colliery Water Treatment Plant.

The purpose of this project was to remove iron and manganese to levels that will consistently satisfy the discharge water quality requirements, as displayed in Table 1 below.

Table 1 Treated Water Quality

Water Quality Parameters	Units	Limit
Iron Filterable or soluble	mg/L	< 0.3
Iron Total	TCU	< 0.3
Manganese Filterable or soluble	mg/L	< 0.1
Manganese Total	mg/L	< 0.3
pH		6.5 – 8.5
Suspended Solids	NTU	5

The Treated Water Quality as shown in Table 1 shall be met based on a 90% ile performance requirement over a 12 month operating period.

1.1 PROCESS

The treatment process used a combination of pH correction, metal oxidation, chemical conditioning, flocculation and flotation. The unit processes are summarised below.

1.2 MINE WATER PUMPING & LEACHATE WATER PUMPING SYSTEMS

The Clarence Colliery Water Treatment Plant receives the majority of the raw water from approximately 80 pumping stations located within the mine. These 80 pumping stations have the combined capacity of pumping up to 25ML/d from the mine's operations.

In addition; Leachate from the Leachate Pond is shandied with water from the mine to a selected proportion designated by the Plant Operator.

1.3 AERATION, PERMANGANATE DOSING & LIME DOSING

Raw water then flows to the Aeration Tank where the pH is increased by the addition of hydrated lime. At this stage Potassium Permanganate is also dosed into the Aeration Tank. Together with a high pH and the introduction of the Potassium Permanganate the iron and manganese will begin to oxidize and precipitate from the raw water. Aeration of the water assists to oxidize and remove the iron and manganese present in the water.

1.4 FLASH MIXING / HYPOCHLORITE & SURFACTANT DOSING

Prior to the water entering the Flash Mix Tank, Sodium Hypochlorite is dosed (for further oxidation) as well as a surfactant. In the Flash Mix Tank the surfactant is mixed with colloidal particles and the precipitated iron and manganese. The surfactant creates a hydrophobic state around the colloidal particles thus enabling them to be removed by the flotation process.

1.5 POLYMER DOSING / FLOCCULATION

The water then flows to a new Flocculation Tank where a polymer is dosed to further strengthen and enlarge the size of the particles. The flocculated water then enters the Dissolved Air Flotation (DAF) unit.

1.6 DISSOLVED AIR FLOTATION (DAF)

The DAF unit floats the flocculated solids/sludge, which accumulates on the surface to form of a sludge blanket. A skimmer paddle then assists the flocculated sludge into a small skimmer trough (located with in the DAF unit). At the same any settled sludge is scaped into the Sludge Pit at the bottom of the DAF unit.

The skimmed sludge then gravity flows to the DAF Sludge Tank which is separate to the DAF unit. Alteration of the duration/interval timers for the operation of the skimmer/scrapper can be selected by the operator to improve sludge flocculation. Settled sludge collected in the Sludge Pit is regularly flushed by an automatic de-sludging valve and flows to the DAF Sludge Tank.

1.7 TREATED WATER DISCHARGE

The clear DAF subnatant flows to the Treated Water Lagoon from a standpipe. Sulphuric Acid is dosed just prior to the standpipe to adjust pH to the required discharge limits.

Not all the DAF subnatant flows to the Standpipe. A portion of the water is used for the onsite Recycle Water System. The recycled water is pumped to a Saturator were it is mixed and saturated with air under pressure (typically 450 – 600 kPa). The air-saturated water is expanded through dispersion valves and mixed with the DAF influent to assist in the flotation of solids. The recycle flow rate is manually set on the dispersion valves to achieve the desired recycle flow rate and Saturator pressure. The Saturator level is automatically maintained within a set band by the opening and closing of the air inlet solenoid valve in response to predefined high and low levels.

1.8 SLUDGE SYSTEM

Sludge from the DAF Sludge Tank is pumped to the existing Sludge Lagoon via the duty DAF Sludge Pump which operates on level control within the tank.

1.9 ON-LINE MONITORING

On-line analysers are used the monitoring of pH and (Red-Ox) reduction oxidation potential. This allows for effective process optimisation as well as monitoring for discharge suitability.

1.10 CONTROL SYSTEM

Critical alarms are sent as text messages to mobile phones carried by the operators and each operator has their own notebook computer enabling them to remotely dial back into the plant's control system.

2.0 OPERATIONAL ISSUES

2.1 Importance of pH Control

Maintaining the correct pH in the aeration tank and the treated water lagoon is critical for the operation of the water treatment plant. The main problems that do occur are drift in probe measurements and flow restrictions / blockages in the lime dosing delivery pipework. To minimise these problems we perform the following preventative maintenance:

- Clean the pH probes weekly and check the calibration at least one a month.
- Flush the lime dosing system twice a week.
- To prevent overflows, check the operation of the high level alarm float switch weekly.
- Replace the lime slurry dosing line to the Aeration tank every six months.
- Inspect the operation of the acid dosing pumps and change the duty cycle monthly.

2.2 Power Outage Problems.

The Clarence region is often susceptible to frequent storm activity and as a result the water treatment plant frequently experiences power failures where all or individual areas of the plant are affected. Once power is restored we can remotely logon to the control system and reset the treatment plant, although sometimes it is necessary to visit the site and manually reset the equipment.

Of course, this usually happens in the middle of the night or on a Sunday afternoon.

3.0 CONCLUSION

The upgraded Water Treatment Plant at Centennial Coal's Clarence Mine operations now has the capacity of treating up to 25ML/d of mine waters as well as Leachate from the site Leachate Pond to a much higher standard that satisfies and complies with the new water quality requirements, before being discharged to the Wollangambe River.

The outcome from the upgrade of the water treatment plant now means that the process can effectively and efficiently remove iron and manganese to levels as tabled earlier in this paper.

EGL Operations has developed a great relationship with the Management and Staff at Centennial coal's Clarence operation. Our Operator's have a sound knowledge of the operation of the water treatment plant and any issues that come up are investigated and resolved immediately with relative ease.

The water treatment plant is a fully automatic operation controlled by SCADA / PLC. Continuous trend data is produced and forms part of our monthly reports to the Client. The operator remotely logs on to the Control System daily, from any location and reviews the plants performance as well as attending to any set point adjustments.

Our operators generally visit the site twice a week for batching of chemicals and routine maintenance and inspection. Any plant faults are relayed from the SCADA system via SMS Messaging to the Operator's mobile phone. These faults are attended to either by remote login or if required, with a site visit.

This water treatment plant is ideally located in the mountains above the Lithgow township, and we have found it to be a very operator friendly treatment plant.