CASE STUDY

AqMB™ simulating water solutions

GHD

Project Summary

Organization:
Energy Australia

Solution
Industrial Water Treatment

Location
New South Wales, Australia

Project Objectives

- Forecast impact of changing water quality on power station operations & costs
- Evaluate alternative treatment options
- Benchmark designs for integrated system
- Validate selected process

Products Used
AqMB Designer ™

Fast Facts

- The GHD team built process designs/models using AqMB from scratch within hours
- Enabled an integrated process model for minewater treatment, cooling tower performance, blowdown treatment through to brine concentration, crystallisation
- AqMB lifecycle evaluations framed project scope and design

ROI

- Modeling project delivered for $45,000 AUD
- Significant time & cost savings for the project concept design and vendor evaluation phase
- Significant project de-risking and capital savings via use of AqMB to test multiple scenarios accurately

AqMB helps a large complex industrial reuse project go from concept to reality

GHD uses AqMB throughout the project life-cycle from options study, concept design to vendor selection and validation to steer the project to completion

Deteriorating cooling water supply affects operations of a large power station

Energy Australia (EA) currently operates the 1,400 MW capacity Mt Piper Power Station (MPPS) which is located in the Lithgow region west of Sydney.

The water used in the cooling circuits of the power station is supplied from a number of sources including Lake Lyell and storage dams owned by EA. These are fed via a combination of local rainfall and nearby mine water discharges.

Energy Australia has observed over recent years a deterioration in its cooling water makeup quality which can detrimentally affect future operations and potentially limit power supply.

Underground mine requires continuous dewatering of 42 megalitres per day

An underground coal mine is located nearby and is also the predominant source of coal for the MPPS. To undertake mining, water is extracted from underground workings at a rate of 36 to 42 ML/d.

Currently, raw water is treated to remove suspended solids. It is then discharged into Coxs River at a licensed discharge point at a salinity of approximately 1,200 µS/cm electrical conductivity (EC). The Coxs River is part of the catchment which flows into Warragamba Dam, Sydney's main drinking water supply.

The coal mine received a development consent for the expansion of the mine. This has prompted the mine to target a salinity of 500 µS/cm EC (90th %ile) to prevent acute and chronic toxicity to aquatic species. Therefore a significant reduction of raw water salinity is required before discharge.

Power station and mine work together to improve Coxs River water quality

To achieve Coxs River salinity discharge limits, the mine and EA have agreed to work together to implement a water treatment and reuse solution which is mutually beneficial to both parties and the environment. The solution involves transfer of dewatered minewater to MPPS for treatment involving desalination and then utilisation within the power station The resultant brine produced from desalination will then be further treated and managed at the MPPS zero liquid discharge facility (which is also being upgraded).

GHD has played a key role in the project as the Client Engineer and has extensively used AqMB Designer (in addition to Energy Australia) for a range of applications to enable project de-risking.

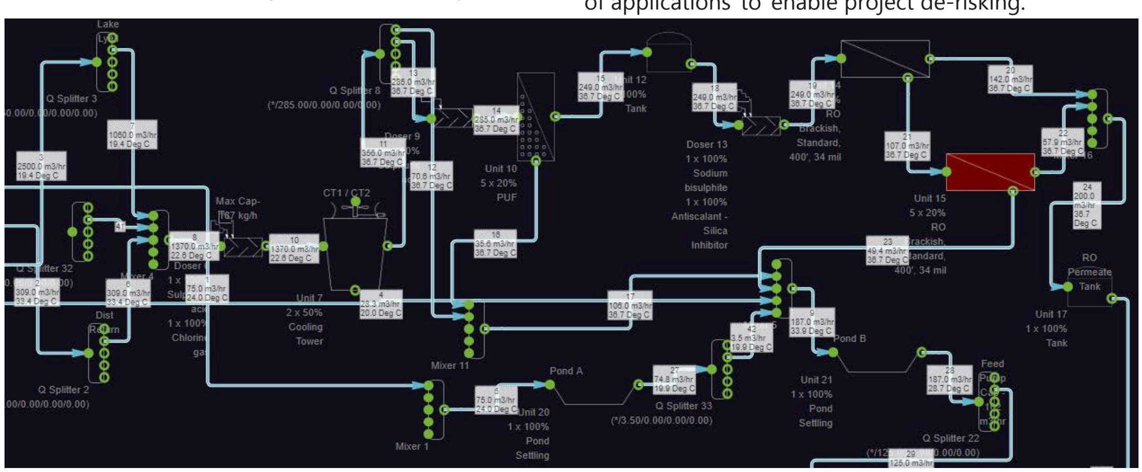

Figure 2: AqMB Designer flowsheet of the EA Mt Piper cooling tower blowdown water treatment system

"The benefit to Energy Australia & the project from using AqMB Designer greatly exceeded expectations"

— Peter Griffiths, Environment Manager, Energy Australia

AqMB utilised for range of water treatment simulation and design applications:

Modelled multiple alternative mine water treatment schemes - AqMB's Designer software was used to simulate different treatment schemes that would ensure compliance with the EPA consent whilst evaluating lifecycle costs. This enabled quick determination of a preferred concept design taken forwards to the next phase of the project.

Forecasting the impact of deteriorating cooling water on the power station - Energy Australia used AqMB Designer and its timeseries capabilities to model the impact of deteriorating cooling water makeup quality upon their entire process over several years. It identified when cooling tower blowdown design constraints were to be exceeded and determined when process equipment required replacement or upgrade.

Integrated system modelling for benchmarking performance - Use of treated mine water for cooling water make-up will result in higher volumes of brine (of differing chemistry) and a higher salt load. AqMB process simulations revealed a potentially detrimental impact on the existing zero liquid discharge (ZLD) facility. AqMB Designer was able to simulate from raw water through to salt storage to identify constraints on the existing facility and determine which water quality parameters might exceed compliance limits. This highlighted the need to upgrade to the ZLD facility.

Evaluated alternative power station water treatment and brine management options - To provide accurate information before seeking market participation, Energy Australia needed to evaluate different treatment options. AqMB Designer was able to quickly evaluate alternative concept designs and provide plant performance, water quality and lifecycle cost information to narrow down potential treatment schemes. In consultation with GHD and technology vendors, potential treatment schemes were assessed before a suitable treatment scheme was carried forward for the basis of design.

Rapid and accurate integrated process simulation and design

Process design and forecasting for complex water and brine treatment systems is possible using AqMB Designer due to integrated process modeling which includes a sophisticated chemical speciation engine and >30 process unit models. AqMB's ability to quickly and accurately model a large number of scenarios allowed significant reduction in risk, implementation time-line and cost for GHD and the overall project.

Stream #		227 - 236	228 - 161
Unit Operation		Falling Film E	Falling Film E
Stream Name		Distillate	Concentrate
pH (25 deg C)			6.31118
Alkalinity (total)	mg CaCO3/L	7.83452	132.622
Conductivity (25 deg C)	uS/cm		62039
Conductivity (at stream temperature)	uS/cm		149097
Density	kg/L	0.960626	1.09378
DOC	mg/L	0.0112725	20.4378
Flowrate	m3/hr	121.631	6.64147
H2O mass flowrate	t/hr	116.756	5.87845
Insolubles mass flowrate	kg/hr		193.445
ORP	mV		-190.027
Osmotic pressure	kPa		13108.7
pH (at stream temperature)			5.91355
Solubles mass flowrate	kg/hr		1192.52
Specific enthalpy	kJ/kg	408.367	336.938
Specific heat capacity	kJ/(kg.K)	4.20778	3.40341
TDS	mg/L		179557
Temperature - Design	Deg C	97.0505	99
TOC	mg/L	0.0112725	20.4378
True Colour	HU	0.0563623	102.189
TS	wt. %		19.0792
TSS	mg/L		29126.9
Turbidity	NTU		14563.4
UV254	cm-1	0.00033817	0.613133
Aluminium (total)	mg/L as ion	0	0.0445394
Ammonia (total)	mg/L as N	0.00047355	94.3203
Arsenic (total)	mg/L as ion	2.1524E-07	2.53283
Barium (total)	mg/L as ion	7.693E-07	3.5696
Bicarbonate (total)	mg/L as HCO3		75.9805
Boron (total)	mg/L as ion	1.6141E-06	6.64909
Bromide (total)	mg/L as ion	0	0
Cadmium (total)	mg/L as ion	0	0
Calcium (total)	mg/L as ion	0	8422.62
Carbon Dioxide (total)	mg/L as CO2	693.121	0
Carbonate (total)	mg/L as CO3		4.06445

Figure 2: Extract of a AqMB Designer mass balance output for selected streams

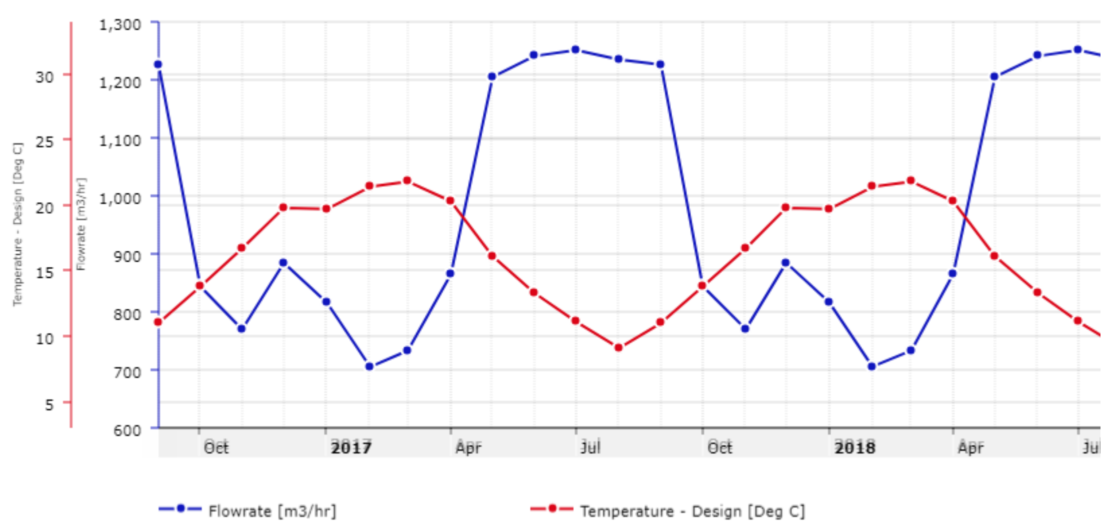

Figure 3: AqMB Designer time series output detailing make-up requirements during changing seasonal conditions

To find out more about AqMB at: www.aqmb.net

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AqMB™
simulating water solutions