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Attached is a joint presentation on the OptiFlox® System by Peabody Energy Australia and Science Developments Pty Ltd. The presentation will be given today at the Australian Coal Preparation Society's Symposium being held in Emerald, Queensland.

Yours faithfully
Intec Ltd



Kieran Rodgers
Managing Director

Wilpinjong Coal Pty Ltd, a wholly owned subsidiary of Peabody Energy Australia, is trialling a new technology and method to assist CHPP operations in the chemical treatment of fines tailings in conventional thickeners or clarifiers.

CHPP plants continually experience coal fines feeds that do not remain homogeneous. The types and concentrations of the particles in such slurries vary significantly as coal extraction moves from one pit to another within the mine site. This variation in the loading and composition of the material can cause ineffective chemical usage and inadequate control/clarification which cannot be solved by today's conventional optical sensing devices commonly installed in thickeners.

Highly turbid or 'blackwater' events can therefore occur resulting in wash plant's shutting down and production slowing or ceasing. Substantial losses in productivity and revenue can therefore result. The value of lost revenue due to productivity losses from inadequate wastewater clarification is estimated to range from \$1.6M to almost \$10M per annum depending on the size of the operation.

Developed by Science Developments Pty Ltd, this OptiFlox® technology addresses this issue by continuously measuring in real time the appropriate particle characteristics of coal tailings. As a result, this technology automatically determines and maintains the optimal coagulant dose rate required even when the characteristics of the slurry feed to the thickener continually change. Optimal flocculation conditions are thereby maintained to enable consistent and reliable clarified water to be produced.

The OptiFlox® System enables coal productivity to be maximised through minimising the number of shutdowns caused by the return of excessively turbid water to the wash plant. Further benefits in the form of increased yields, reduced magnetite consumption, improved underflow dewatering and chemical cost savings may also be realised through optimal thickener performance.

1. Director – Business Development, Science Developments Pty Ltd.
2. Director – Process Engineering, Peabody Energy Australia.
3. Senior Process Engineer, Peabody Energy Australia.



Improving Fines Thickener Performance

New OptiFlox® Technology

***CQ Symposium - Emerald
14 September 2016***

Thickener faced hydraulic & solids loading challenges

- In 2010 coal production increased from 800 to 1,200t / hour
- In 2015 belt press filters were installed – over 80% of filtrate volume is returned to thickener

Objective: To improve the thickeners performance and responsiveness to the constantly changing loads.

Two Chemical Related Issues Identified



1. Fix pH – New lime plant



2. Fix & achieve consistency of good flocculation. Inconsistency was caused by changing levels of clays in the feed.

Faced ongoing chemical dosing challenges.



New innovative technology



Continuous real time measurement
of clay particles



Technology automatically determines

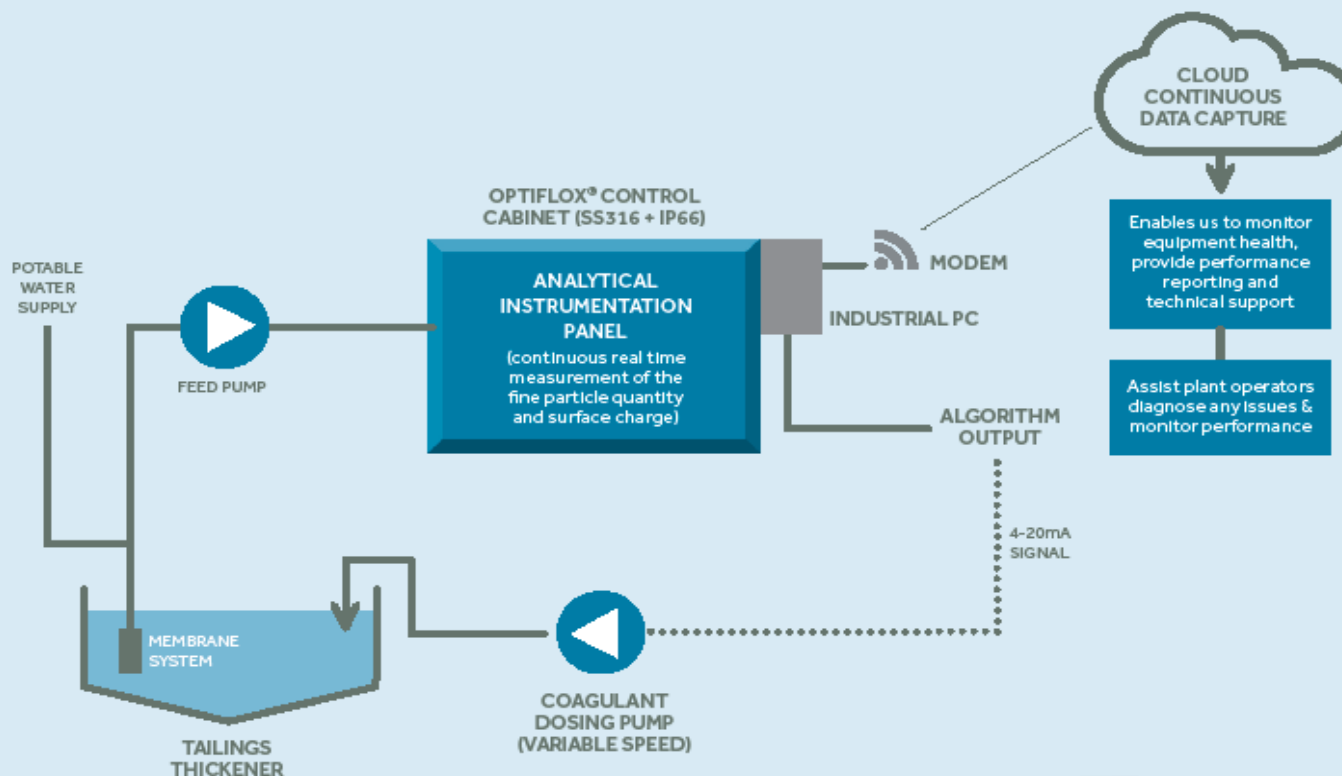
- **When** to dose coagulant
- Knows **how much** should be dosed
- Knows **when to stop** dosing coagulant



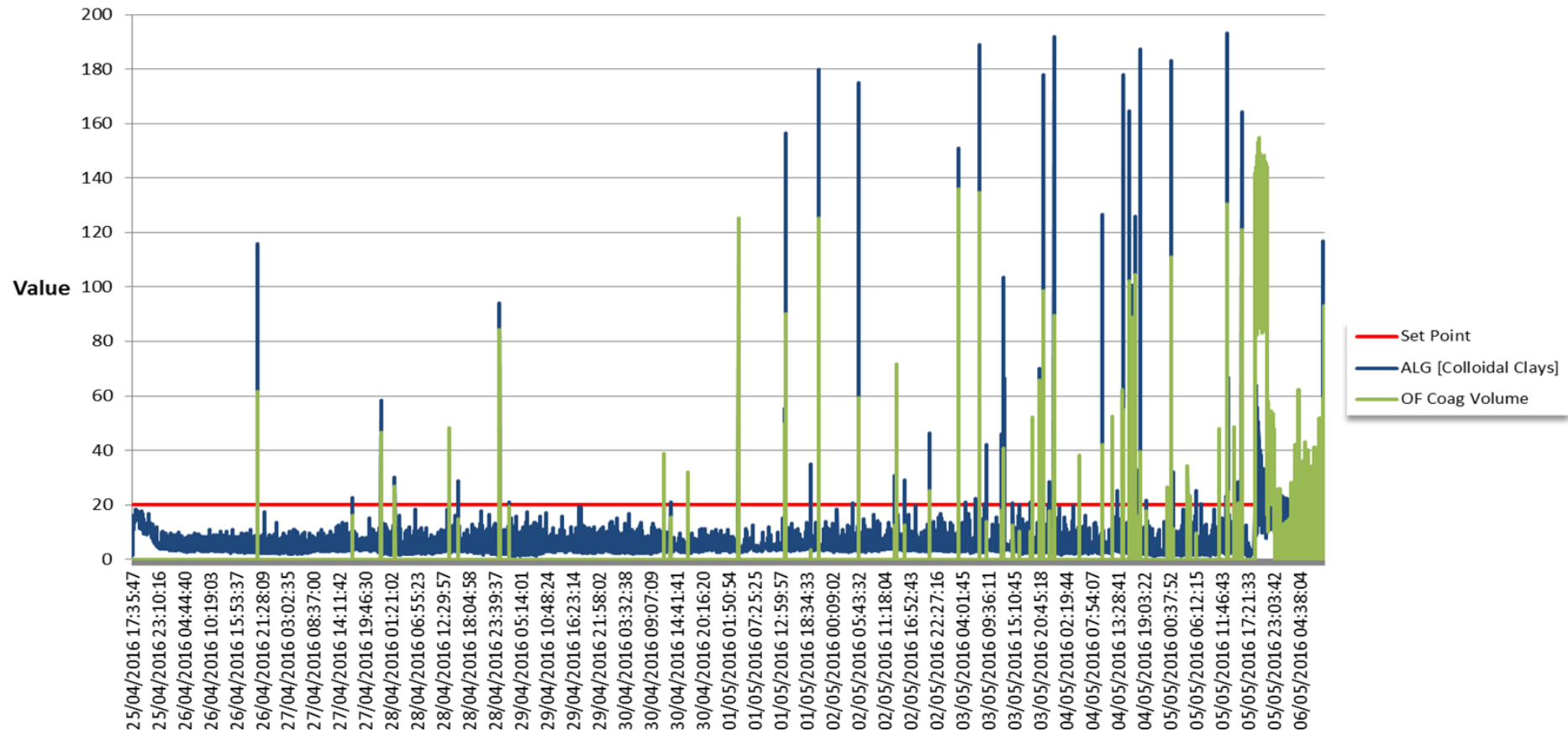
OptiFlox® System Overview



OPTIFLOX® TECHNOLOGY PROCESS



Continuous Real Time Data Capture - Performance Monitoring & Analysis



Key Learnings to Date



- Fixed rate coagulant dosing is not optimal – at times under dose and over dose.
- Can distinguish between when you have a clay problem and a flocculant problem.
- Assists the site's control room understand if poor flocculation is related to a clay [coagulant] problem or polymer problem.
- **Productivity tool:** Less downtime....helps reduce blackwater events.
- **Cost savings:** Can be days or weeks when no coagulant dosing is required.

Next Steps



Continuing to trial with the potential to roll out to other sites.

OptiFlox[®] System

Taking the guesswork out of thickener performance.

**A new innovation for delivering productivity improvements
and cost savings.**

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Background

The OptiFlox® system has been developed to assist in treating wastewater in mining and mineral processing applications.

In these operations, the wastewater streams comprise of suspended solids or tailings that require treatment. It is well known however that these wastewater streams do not remain consistently homogeneous. As extraction moves from one location to another within the mine site, the types and concentrations of suspended particles and the slurry pH vary significantly. These suspended particles can include fine particles such as colloidal and sub colloidal clay particles. This will cause the flocculation to become less effective resulting in poor separation and turbid water overflowing from the thickeners. This ineffective flocculation will at most times be caused by an increase in these anionic clay colloids relative to the other suspended particles in the wastewater.

Therefore the clarity of the water from the thickener deteriorates to unacceptable levels resulting in the wash plant shutting down and production slowing or ceasing. Substantial losses in productivity and revenue can result.

The challenge

The challenge therefore lies in applying a robust system that continuously measures the appropriate parameters of the particles of the slurry at the appropriate point in time and location during the treatment process; and knowing **when** to dose coagulant, knowing **how much** should be dosed, and knowing **when to stop** dosing coagulant.

Furthermore, plants need to be able to achieve this in a reliable, low maintenance, continuous and automated way.

Conventional wastewater treatment

The conventional automatic control of flocculation in thickeners will not solve this problem, that is, the problem of ineffective flocculation caused by the increase in anionic clay colloids relative to other suspended particles in the water.

Automatic control of flocculation in thickeners is currently used at many mines with floc settling rate, floc size and shape interpretation, floc density measurement, sludge blanket characteristics and final turbidity of settled suspension all being measured to different degrees.

Optical Sensing Devices

One of the most common approaches is to use optical sensing to determine the settling rates for flocculated solids introduced to the thickener and then adjust the polymer rates accordingly.

Optical sensing is useful for controlling optimal polymer dose rates but ineffective in distinguishing deterioration in flocculation performance due to the change in particle surface charge resulting from presence of colloidal clay particles.

For example, as the concentration of anionic clay colloids increases, the flocs in the thickener can become smaller and smaller and do not agglomerate well. This results in an increase in settling time and worsening discharge clarification/turbidity.

Optical sensing devices respond to a slower settling rate by increasing the flocculant dose rate; this can make the situation worse due the anionic nature of the conventional polyacrylamide polymer.

Turbidity Measurement

Another common control approach is to measure the turbidity of the wastewater being discharged from the thickener and to use this value to control coagulant dosing.

The problem with this method is the inherent delay in sensing a deterioration in flocculation performance as retention time in the thickener can be hours. Response time is therefore too slow and coagulant dosing may not be optimal as the slurry characteristics may have changed again during this lag time.

OptiFlox® System solution

The new OptiFlox® System is an integrated package consisting of new technology (equipment), new proprietary coagulant chemistry designed specifically for mining slurries and an interactive cloud based analytics package for equipment health, performance tracking and reporting.

New OptiFlox® technology

Developed over a 3 year R&D period, OptiFlox® System is a breakthrough technology that continuously measures particle characteristics of slurry in order to maintain optimal flocculation conditions through automatic, real time control of coagulant dosing.

A provisional patent application has been filed in Australia relating to the technology.

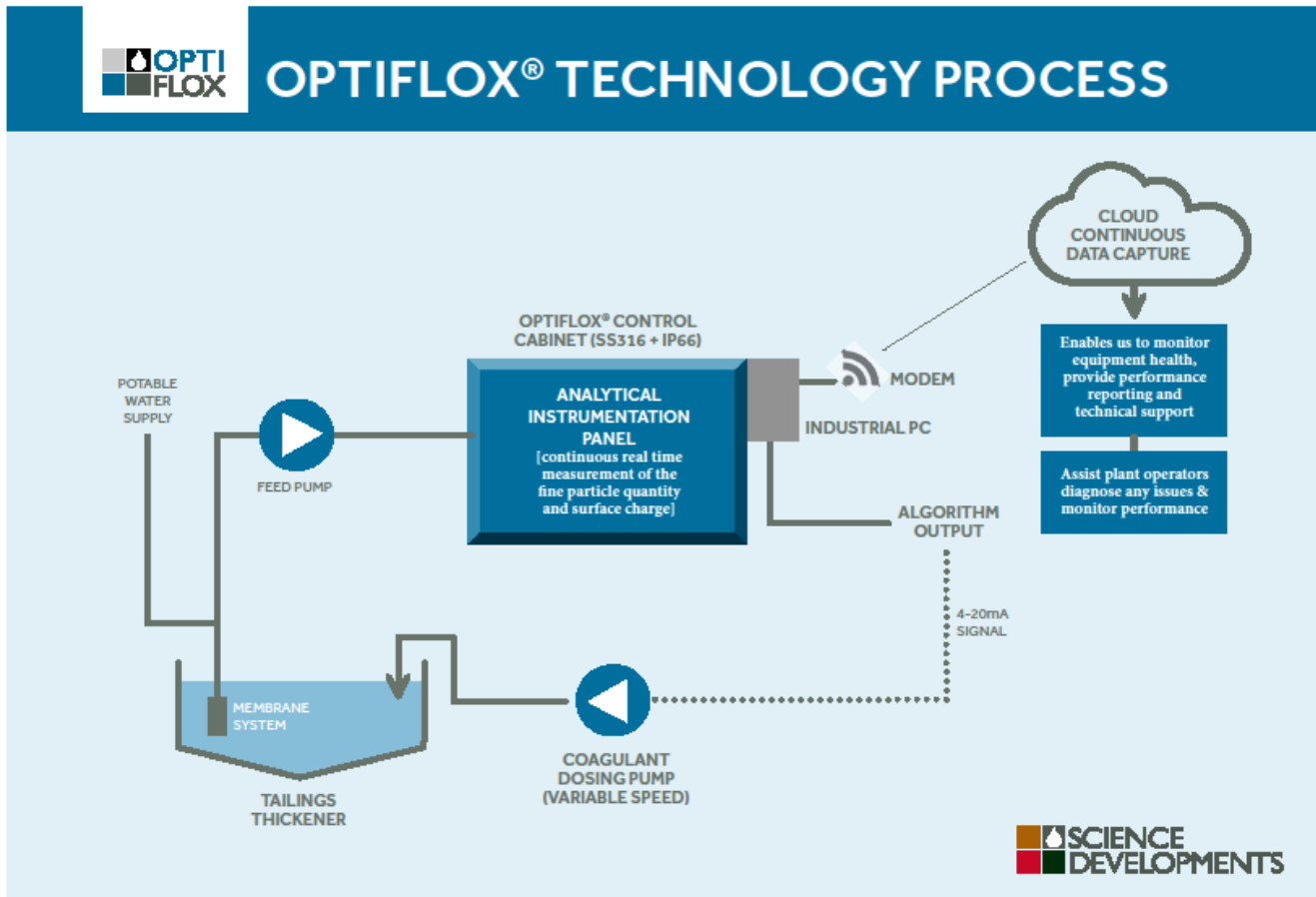
In brief, the role of the technology is to continuously measure the change in fine particle quantity or surface charge resulting from the introduction or increase in anionic clay colloids, relative to other suspended particles in the water. It therefore accurately measures the vital characteristics that influence water clarification performance.

The new system is installed at the existing tailings thickener. The technology does not replace the existing “optical sensing” flocculation device, but serves to maintain optimal flocculation conditions and therefore thickener performance. The equipment has been designed and manufactured to withstand the harsh conditions of mine environments.

The way it works

The system works by obtaining a continuous sample of slurry in the wastewater stream. This sample is collected from the thickener. This continuous sample is filtered and measured (with the appropriate instruments contained in our unit) according to the critical elements or parameters that impact treatment performance. These parameters relate to the quantity and/or charge of the particles. Refer process schematic on the next page.

When the parameters drift from the desired value or set points as measured in the side stream offtake, the system is advised that the main flow of the wastewater requires a change in the treatment regime. When the parameter deviates from the desired value, corrective action in the form of coagulant dosing can be implemented immediately and automatically to maintain optimal flocculation during this wastewater stream treatment. The coagulant dosing is therefore maintained until the appropriate measured value returns to the desired set point or set range.



This technology is therefore able to consistently and accurately know when to dose coagulant, define how much coagulant should be dosed and know when to stop coagulant dosing.

It should be noted that the desired value (or set point) of the parameters will always vary and / or can be changed according to each individual mine's desired treated wastewater clarification (or turbidity level) required.

Furthermore, this OptiFlox® System is not intended to replace the existing "optical sensing" flocculation devices which are useful in varying flocculant dose rates in line with changes in solids loading. Its role is to complement and enhance flocculation control enabling optimal flocculation and thickener performance.

OptiFlox® performance reporting and analytics

The continual measurement of both the slurry characteristics and chemical usage enables translation of this data into meaningful reports for the site. Utilising an interactive cloud-based service, this analytics package offers concise performance reporting and insights to help guide and improve future treatment decisions.

Key Benefits of the OptiFlox® System

- Mine productivity increases due to less shutdowns caused by excessively turbid water returning to the washery from the thickener;
- More reliable solid/liquid separation performance due to improved flocculation control even when slurry feed characteristics are frequently changing;
- Optimises coagulant and flocculant usage/costs and eliminates poor performance due to under or over dosing;
- The advantage of continuous real time measurement alleviates the weakness of previous lag time processes;
- Measurement of the wastewater stream used to measure and detect changes in the appropriate parameters is done without interference with the main flow of the wastewater stream; and
- Data capture in respect to measured values and coagulant dosing, which in turn provides better understanding of slurry characteristics and solid/liquid performance; and also enables the correlation of tailings characteristics (e.g. clay content) with specific locations.

For further information please email or call

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