OptiFlox ® System

Taking the guesswork out of thickener performance.

A new innovation for delivering productivity improvements and cost savings.

Background

The OptiFlox® system has been developed to treat wastewater in mining and mineral processing applications. This paper however specifically focuses on its application in the coal mining sector.

In coal processing operations, the wastewater streams comprise of suspended solids or tailings that require treatment. Equipment such as gravitational settlers, clarifiers or thickeners is generally used in the treatment of these tailings.

It is well known that the treatment of tailings in most coal mining operations involves the application of low to medium charge density anionic polyacrylamide flocculant to the coal slurry as it enters the thickener. The application of such flocculants enables good floc formation, which in turn delivers relatively fast settling and sufficiently clarified water for return to the washery for re-use.

Unfortunately however, these wastewater streams do not remain consistently homogeneous. As coal 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.

Sometimes referred to as 'blackwater', 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. In fact the value of lost revenue due to productivity losses from inadequate wastewater clarification in thickeners is estimated to range from $1.6 million to almost $10 million per annum depending on the size of the site.

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 to 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. [Note: it is widely known that deterioration in thickener performance when using an anionic flocculant can be reduced via the addition of a cationic coagulant prior to adding the anionic flocculant.]

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.

The challenge

The challenge therefore lies in applying a robust method/system that continuously measures the appropriate parameters of the particles of the coal 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, coal mining plants need to be able to achieve this in a reliable, low maintenance, continuous and automated way.

OptiFlox® System solution

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

New OptiFlox® technology

Developed over a 3-year R&D period, OptiFlox® System is a breakthrough technology that continuously measures particle characteristics of coal 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 the coal mine.

The way it works

The system works by obtaining a continuous sample of coal slurry in the wastewater stream. This sample is collected via a side stream offtake located at an appropriate point along a feed tailings pipe or thickener centre well of the wastewater treatment process. 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.

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 wastewater treatment decisions.

Technical expertise and support

This product is supported with ongoing technical and practical in-field assistance. We bring a significant depth of technical knowledge of the underlying chemistry and coal wastewater treatment processes. This has been gained through our extensive in-house R & D of our new OptiFlox® technology and chemistry in the coal mining sector; as well as our extensive R & D of the underlying chemistry and unique polymerisation technologies relating to the broader wastewater sector.

Benefits of the OptiFlox® System

The key benefits of the system are:

- 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;

- 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; and

- Performance reporting for site management.

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