THICKENER OPERATION OVERVIEW

Maximising Tailings Thickener Underflow Density within Operational Constraints

ABSTRACT

This document provides an overview of the general processing plant process at Cadia Valley Operations, the operating principles of a thickener and the constraints the system must operate within.

Unearthed Challenge

Process Overview

At Newcrest's Cadia Valley Operations (CVO) located within the Orange region of NSW, ore containing gold and copper is extracted from the Cadia East orebody and conveyed to the surface's coarse ore stockpile (COS). From the COS, ore is then crushed to further reduce its size in preparation for grinding. Within the grinding circuit consists two mills, the SAG mill and ball mill that further reduce the ore's size to flakes where typically 80% of particles are approximately 100µm in size (P80).

Once the ore has been reduced to this size, it enables far more efficient extraction of the precious metals (gold and copper) from the rest of the slurry. The extraction of the precious metals is achieved in the flotation circuit. Here chemical reagents and air are added to the slurry and agitated via mechanical means within the flotation cells to liberate the precious metals. The precious metal containing component, known as concentrate, floats to the top of the flotation cells and is sent for further refinement in subsequent sections of the processing plant. The waste product, known as tailings, does not float as it contains almost no precious metals and is sent to the tailings thickener.

The purpose of the tailings thickener is to recover water from the slurry and effectively increase the slurry's density to reduce volumetric storage requirements. The recovered water is recycled within the processing plant, lessening the demand on nearby water resources.

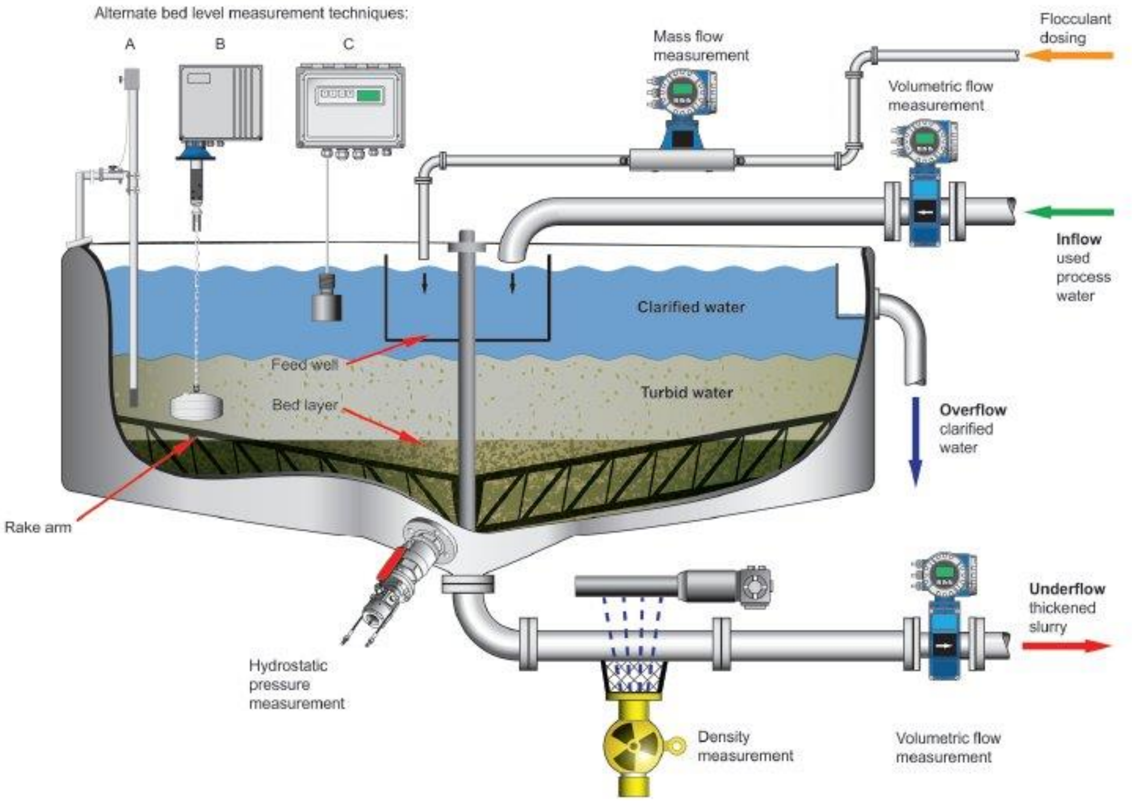

Figure 1: Thickener General Arrangement

Within the thickener, slurry enters through the feed well where it is mixed with flocculent to aggregate the solids within the slurry, effectively aiding in the settlement of the solids. The concentrated collection of solids exit the thickener via the underflow stream and is sent to a tailings storage facility, whilst the clarified water exits via the overflow stream and is redistributed to the processing plant.

The bed level is a critical interface of solids and process water within the thickener. If uncontrolled, this can lead to excess water being extracted through the underflow or an unacceptable quantity over solids entering the overflow stream. Both scenarios are extremely undesirable. A key indicator of excess solids in the process water overflow stream of CVO's thickener is a sharp increase in clarometer readings (AIC88055.PV).

Once the tailings underflow slurry has been pumped to the tailings storage facility, the process water and solids continue to segregate. Below is an image of one of the tailings storage facilities at CVO.

Figure 2: Tailings Storage Facility

Figure 2 above provides a good representation of the separation between solids and process water. The high concentration of solids viewed in the top left corner of the image is dry solids, and there is a gradual increase in water content towards the right side of the image. Through this process, only 30% of the water sent to the tailings storage facility is recoverable and returned to the process plant in contrast to the 100% recyclable content of water from the thickener overflow stream. The main driver for this significant reduction in recoverable water content is surface evaporation at the tailings storage facility.

Process Constraints

There are a number of constraints the tailings system must comply with to enable safe operation. These are listed below in Table 1.

Table 1: System Constraints

Constraint	Value
Maximum Underflow Pipeline Pressure	850 kPa
Maximum Rake Torque	40 %
Maximum Bed Pressure	19 %
Maximum Current Draw of Underflow Pump	500 A
Maximum Slurry pH	9.5

To prevent the solids from settling within the discharge pipeline of the underflow pumps, a minimum pipeline flowrate must be maintained at all times. This is absolutely critical, as a blocked underflow discharge pipeline would result in a total shutdown of the processing plant. The minimum pipeline flowrate is dependent on the % solids concentration within the underflow process stream. The relationship between % solids and minimum flowrate is provided below.

Table 2: Minimum Underflow Pipeline Flowrates

Underflow Solids Concentration by Mass %	Minimum Underflow Flowrate
54%	618 m^3/hr
55%	707 m^3/hr
56%	791 m^3/hr
57%	866 m^3/hr
58%	940 m^3/hr

Process Disruptions

Within the provided dataset there are occasionally very aggressive reductions to the tailings thickener underflow %solids concentration. When observing Figure 3 the disturbance to the % solids is abrupt and the recovery back to the prior level of % solids is also fairly rapid.

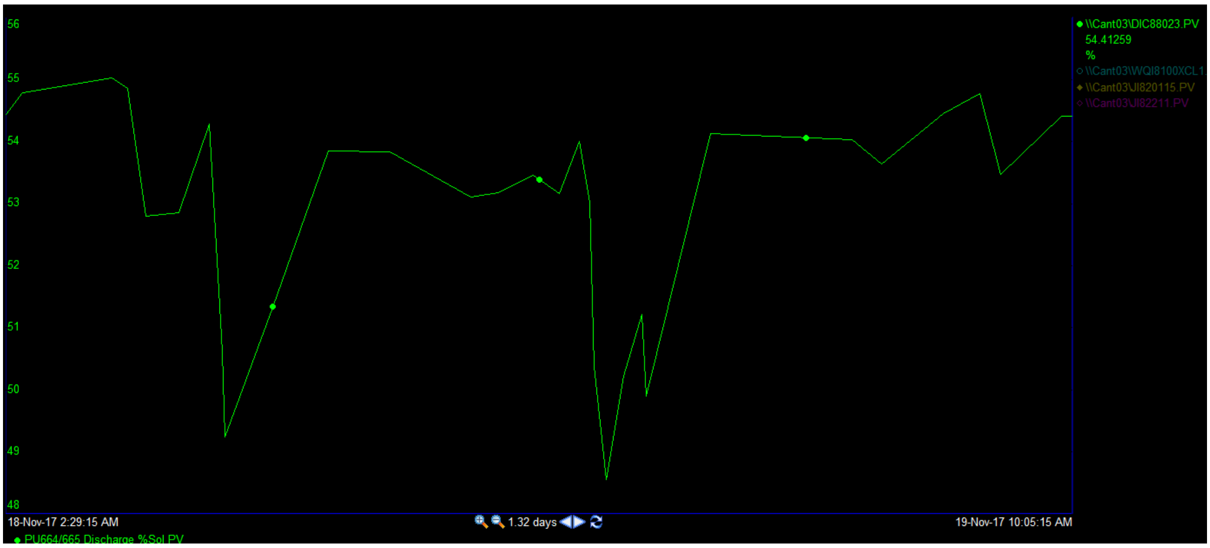

Figure 3: Thickener Underflow % Solids Changes

This rapid change in % solids is directly related to a major upstream circuit disturbance. When a mill encounters an unplanned shutdown (aka trip) this results in a sudden starvation of feed to all downstream plant areas. In Figure 4 below, the yellow line represents SAG mill power, magenta is ball mill power, and blue is the feed into the flotation circuit.

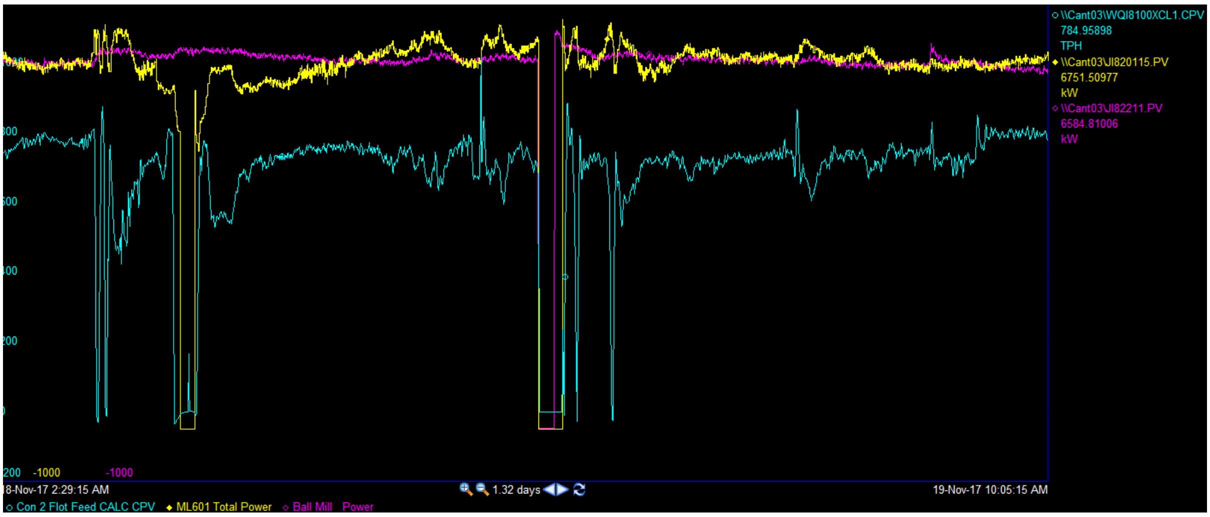

Figure 4: Effect of Mill Unplanned Shutdown

It is noticed that as soon as either mill trips there is an immediate loss of feed to the flotation circuit. Remembering the tailings thickener receives the waste product from the flotation circuit, the downstream effect of the lost flotation feed directly impacts the solids feed rate into the thickener. Data for flotation circuit feed rate has been provided to enable identification of these incidents.

Process Configuration