OreBind™ Technology brings Tailing Storage Facility footprint back into use 9 years early at a savings of $4.2 million

NALCO Water
An Ecolab Company

CASE STUDY – MINING
CH-1632AP

BACKGROUND

A coal producing mine operating in the Surat Basin Queensland anticipated the premature filling of their tailings dam volume well before designed completion. With an annual production of 2.0 MTpa and an interburden containing a very high proportion of swelling clay, the Tailings Storage Facility (TSF) was not readily consolidating. Due to customer requirements and the mining operation, the CHPP produces comparatively high volumes of ultra fine tailings compared with other operations of similar size. The mining operation uses barren pits as TSFs. The tailings produced have proven extremely difficult and slow to dewater, causing high costs and delays to progressive rehabilitation.

SITUATION

Geotechnical reviews of the old and current tailings cells were conducted to determine methods to rehabilitate the old cells. Known solutions to increase the speed of rehabilitation were cost prohibitive.

CUSTOMER IMPACT	eROI℠	ECONOMIC RESULTS
Water drains readily from TSF	WATER	Reduced make-up water required (17%) for process
Reduced CSG water required for make-up water	ASSETS	Reduced maintenance costs due to reduced chlorides in plant recirculating water circuit
Reduced TSF Dust emissions	AIR	Less water cart coverage to reduce the total site dust emissions
Higher Shear Strength to solids in TSF Reduced standing time waiting for TSF to dewater prior to rehabilitation Reduced TSF footprint required	EARTH	$4,220,000 reduced cost in overburden capping Land is rehabilitated more quickly (9 years early) saving on overburden transport mileage costs Savings on land required, construction and maintenance costs of TSF

eROI is our exponential value: the combined outcomes of improved performance, operational efficiency and sustainable impact delivered through our services and programs.

The site, working with Nalco Water, identified several key issues that needed to be addressed in order to maintain efficient tailings disposal:

- The current TSF was filling up at a rapid rate and its service life expectancy was significantly shorter than anticipated.
- TSF impoundment approval has become increasingly costly and slow.
  - Average approval time takes more than 18 months and the average impoundment life expectancy was about the same.
- TSF impoundment locations were getting farther away from the CHPP (due to mining operations) adding underflow pumping limitations to the operation.

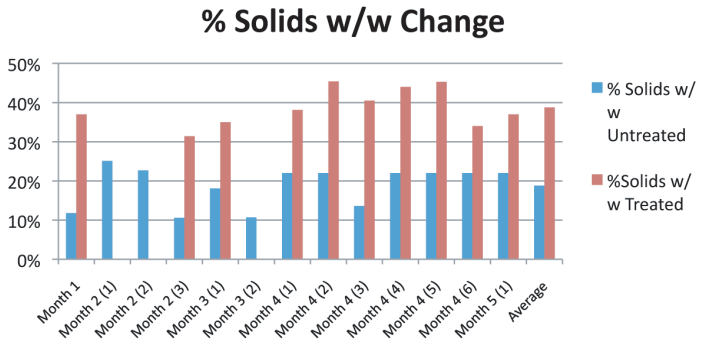

Figure 1 - Treated and Untreated % Solids entering the Tailings Storage Facility

Comment: The feed (thickener underflow) increased in solids % w/w from 19% to 39% on the application of OreBind causing a 17% increase in liberation of clean water

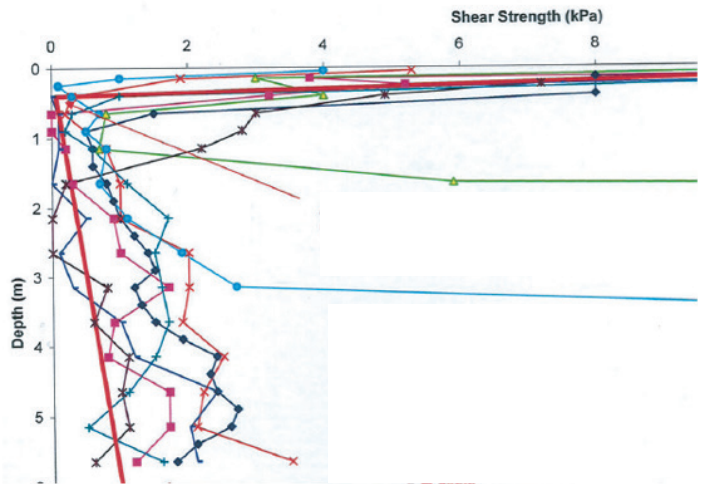

Figure 2 - Rheology of a Tailings Storage Facility with swelling clays

- Rehabilitation of completed and still wet tailings impoundments required large quantities of dry overburden as a covering.
  - Over burden is required to displace water in the pit and improve stability so that the area can be safely machined.
  - This procedure is very costly (machines removed from mining activity) and presents safety concerns due to unstable nature of the area being rehabilitated.
- Investigations showed that the highly shear sensitive clays would make mechanical dewatering extremely difficult.

Nalco Water offered a progressive solution using OreBind technology that could be simply and inexpensively implemented to evaluate the short and long term benefits.

Nalco Water was selected to conduct a trial based on the simple, low capital and realistic approach to the application.

The trial results were satisfactory, demonstrating a 112% increase in TSF life **during trial and actual TSF life increase >300%.**

SOLUTION

Simple application was the key principle adopted; the OreBind solution was applied with minimum shear, as the difficult characteristics of clay in the tailings product causes low aggregate strength and shear sensitivity.

Automated operation provided additional application savings of >$60,000 pa.

The OreBind application has demonstrated ability to achieve all the customer objectives for both maximising the life of and minimising the cost of managing their TSF.

Figure 2 indicates shear strength variations across and down through a TSF with mineralogy similar to the higher clay Surat basin tailings. Shear Strength measurements, using a Vane rheometer, of the impounded solids will indicate when the TSF is able to be safely rehabilitated. Figure 2 indicates that there is little consolidation (dewatering) of the solids in the TSF at depth. The top half metre can be seen drying out and crusting. This is typical of TSFs containing a significant proportion of swelling clays.

Figure 3 shows rheology improve-ments due to the application of OreBind technology. Shear Strength measurements (kPa) can be seen to increase at 10 locations of varying depths across the TSF.

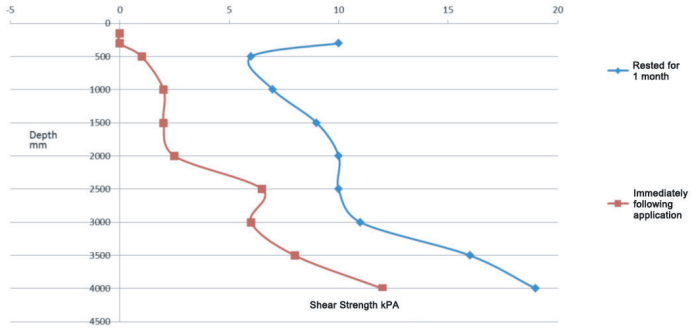

Figure 3 - OreBind Rheology Improvements in a Tailings Storage Facility

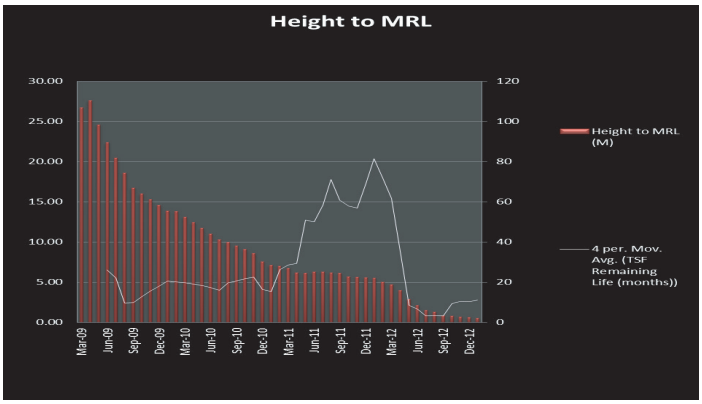

Figure 4 - Remaining TSF storage height to Mandatory Reportable Level

Average Height Increase TSF (m)		*TSF Life Remaining (Forecast months)*		*Predicted TSF End*
Y1 Q3 – Y2 Q2	*0.64*	*Before OreBind®*	*10*	*Y3 Q1*
Y2 Q2 – Y4 Q1	*0.30*	*With OreBind®*	*21*	*Y1 Q4*
Trial Verified Improvement	*112%*			

Table 1

The left hand axis shows the depth at which each measurement was collected and the top axis shows the Shear Strength as measured on the Vane rheometer. The trend shows that the Shear Strength increases as depth increases. The difference between the blue and red lines indicates that Shear Strength continues to increase with time indicating continued dewatering.

In 30 days, (subject to above seasonal rainfall), the average yield stress increase was 6.1 kPa on 10 measured points up to 4 meters in depth. Projected time to traffic is 5 months based on 32.7kpa (D6K Dozer).

The Figure 4 histogram indicates decay of TSF capacity with time. The red histogram indicates height in metres to the Mandatory Reportable Level (MRL) against the left hand vertical axis. The white line indicates a moving 4 monthly average of remaining operational life expectancy in months based on deposition rates. The introduction of OreBind in Year 2 Quarter 2 (Y2Q2) shows a significant deceleration in the rate of decay of TSF capacity (red histogram). The white line shows the consolidation of the new materials in the dam during the intermittent application of OreBind Year 2 Quarter 2 (Y2Q2) to Year 4 Quarter 1. (Y4Q1)

A full OreBind installation was implemented and commissioned six months after the initial trial and this can be seen having an effect on both the histogram and 4 month moving average in Year 4 Quarter 2. The rate of decay on TSF capacity can be seen to decelerate and the remaining months of capacity trend increases.

Between Year 1 Quarter 3 and Year 2 Quarter 2, without treatment, the TSF height rose on average 0.64 metres per month (see Table 1). This rate increase would have produced an operational life of 10 months. A new TSF would have been required by Year 3 Quarter 1.

OreBind treatment was intermittently applied between Year 2 Quarter 2 and Year 4 Quarter 1. During this time and with similar operating conditions, the TSF level rose on average 0.3 metres per month. This was achievable because additional clean water was being extracted immediately by the water recovery system without the need to regularly lift the pump head. Initially the TSF level cropped as additional trapped water was released.

RESULTS

The introduction of OreBind treat-ment to the site tailings stream delivered the following benefits:

- Increased life of existing disposal area by 300%
  - The OreBind process causes larger particles to form and settle while the water gravitates to a collection point to be pumped back to the process. This allows existing TSFs to increase their life expectancy even in the case of the finer swelling clay materials at this Surat Basin mine.
  - Smaller TSF footprint (33.3%) needed for new TSFs compared to existing land coverage.
- Increased recovery of return water
  - OreBind caused an immediate 17%release of more clean water from the tailings stream with continued dewatering occurring over time.
- Improved recovery of quality water
  - The make-up water at this mine is Coal Seam Gas water which is high in chlorides and extremely corrosive. The reuse of the TSF run off water reduced the corrosivity of the plant water. Over time this reduces corrosion preventative maintenance shutdowns and costs.
- Faster trafficable surface
  - Rehabilitation normally requires many years before earth moving machinery is able to safely work on top of the old TSF. The shear strength of the materials is a direct indication of firmness and safe working capability to commence rehabilitation. The OreBind procedure increased the shear strength allowing the projected safe working time to fall from >10 years for a 6 meter deep TSF to 5 months
  - Direct benefits mean that trucking rehabilitation costs are much less as the mine has not moved as far from the TSF. Overburden from current mining areas is used to rehabilitate old TSFs and as the distance to truck the overburden increases, the cost of mining coal increases quite markedly.
- Dust generate due to windage across the TSF is greatly reduced due to the nature of the bound aggregate formed. This reduces the total dust generated at site.

SAVINGS realised by using OreBind	
Extended TSF life	*->300%*
Reduction in rehabilitation costs	*-$4,220,000*
Increased volume of return clean water	*->17% immediately*
Reduced time for rehabilitation	*-5% of existing time*

OreBind control system

OreBind quick inversion and dosing equipment

OreBind Storage, Make-up, dosing and control equipment - compact

Nalco Water, an Ecolab Company

North America: 1601 West Diehl Road • Naperville, Illinois 60563 • USA
Europe: Richtistrasse 7 • 8304 Wallisellen • Switzerland
Asia Pacific: 2 International Business Park • #02-20 The Strategy Tower 2 • Singapore 609930
Greater China: 18G • Lane 168 • Da Du He Road • Shanghai China • 200062
Latin America: Av. Francisco Matarazzo • nº 1350 • Sao Paulo – SP Brazil • CEP: 05001-100
Middle East and Africa: Street 1010, Near Container Terminal 3, Jebel Ali Free Zone, PO BOX 262015, Dubai UAE

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