Rapid results

Carol Shobbrook and Michael Hodges explain how the dewatering of tailings pond slurries can be achieved quickly and easily using an innovative separation system.

Historically, ultra fine-grained material – such as clays, silts and organics – inhibit the dewatering of slurries at continuously high throughputs. This bottleneck means that industries ranging from waterway dredging to mining rely on impoundments or tailings ponds for dewatering.

However, the slow settling rate of material in tailings ponds can lead to a low rate of water recovery and inefficient, unsustainable handling and disposal of tailings in mining operations.

In confined disposal facilities or ponds, tailings require, on average, seven years to settle naturally and dewater sufficiently for restoration or remediation. Meanwhile, water recovery from tailings is not optimised, and as tailing ponds fill to capacity, mine operators must secure more land and necessary regulatory approvals to construct new ponds.

This unsustainable approach also brings with it operational and environmental costs, and attempts to mechanise and speed up the process of dewatering ultra-fine solids by using clarifiers, centrifuges and belt presses can be: expensive; susceptible to down time; and unable to process at a 1:1 ratio with high-volume inflows.

The mining industry is looking for technologies that can solve these problems in real time, are sustainable and will help operators meet ever-increasing environmental standards.

A SOUND SOLUTION

Hydraulic dredging combined with a relatively new type of high-speed dewatering equipment for handling ultra-fine solids offers potential as an alternative approach to clean up tailings ponds – for environmental remediation or to extend their capacity.

Genesis, a US-based company, holds patents on a dewatering system that works with portable hydraulic dredges to dewater slurry quickly from tailings ponds, or potentially a fine tailings flow upstream of the tailings pond.

The slurry is pumped to the Genesis Rapid Dewatering System (RDS), which instantly separates solids, including debris, sand, ultra-fine clays, silts and organics, while simultaneously returning clear water with <30mg/l of total suspended solids (TSS).

The RDS’s purpose is to achieve a 1:1 ratio of dredging (inflow) to dewatering of ultra-fine solids as small as 0.0007mµ at high speeds and volumes. The system can be operated continuously with minimal energy and maintenance requirements, and offers the benefit of immediate clear water recovery and the production of stackable, transportable solids which can then be discarded or further processed for asset recovery.

This low-cost and highly automated system with few moving parts has been in use at US waterway dredging projects with hydrophilic sediment since 2007. It has also been applied in circuits at aggregate plants and on paper pulp sludge tailings. Yet it also offers significant potential for applications in mining.

PROCESS FLOW FOR THE RDS

To apply this technology for cleaning out a tailings pond, a hydraulic dredge would pump to the RDS, which then uses a four- to five-step process to separate the solids from the water.

First, the Genesis Vibra-Snap, which is a coarse debris screen, removes material from 150mm to 4.7mm in diameter – such as trash, shells and vegetation, which is inevitably found in ponds and impoundments. These obstructions must be removed, or they will foul the downstream pumps in the system. The Vibra-Snap uses an innovative ‘breathing’ screen with apertures that expand and contract to ejection odd-shaped items. Its hyperbolic motion and up to 20g of force tumble and drain material at high speed.

Next, a de-sander separates and stockpiles coarse sand, if present. Genesis typically uses linear-motion shakers over hydrocyclones for sand recovery. The remaining fine-grained slurry is flocculated with a polymer through an automated...
The in-line system and pumped to the Genesis AquaScreen (see Figure 1). The AquaScreen strips the free water phase from the flocculated slurry, discharging huge volumes of clear water, which is immediately available for reuse or return to the pond. The AquaScreen technology’s unique distribution system overcomes the tendency of flocculated material to channel, and therefore can operate continuously with high throughput. Each AquaScreen unit processes up to 6,000L/min and, on average, 569m³/h of in-situ material depending on the flow densities.

The system is mobile and modular, and can be scaled up to any throughput without a significant increase in footprint (see Figure 2). Depending on the desired moisture content of the final cake, an extra step can be added after the AquaScreen. The flocculated mass coming off the AquaScreen can be gravity-fed to Genesis TerraCores for secondary or capillary dewatering (see Figure 3). Typically, eight TerraCore containers align each side of an AquaScreen unit. The interior of the TerraCore uses overlapping, concentric, dewatering zones in a panel structure to dewater the material. Relieved of its hydraulic load on the AquaScreen, the flocculated mass quickly gives up its remaining capillary water, which drains through a discharge pipe at the base of the unit.

Complete dewatering is measured in hours, depending on the material characteristics. Mine tailings, often hydrophobic, give up water faster than hydrophilic slurries. The resulting solids are removed from the TerraCores and can be stockpiled or transported (see Figure 4). The AquaScreen and TerraCores contain no moving parts, which helps to achieve the objectives of continuous, high-speed operation and low power consumption. An RDS with a footprint of 46m x 46m can achieve production rates of many thousands of litres per minute.

SUSTAINABILITY AND ASSET RECOVERY

High-speed dredging and dewatering of tailings ponds opens the door for many more options in tailings management and asset recovery.

The RDS methodology minimises the hydraulic loading of ponds, and thereby extends their capacity while immediately recovering water for reuse.

By consolidating fine tailings, the system captures and isolates metals and contaminants. A sample test on sediment from a lake dredging project in Florida, US (see table 1) illustrates the capture of these constituents and the clarity of discharge water. Some industry operators are also considering the technology for mineral asset recovery and upstream tailings thickening plants.

The rapid dewatering of tailings dredged from ponds or from upstream plants is an example of an environmentally sustainable tailings handling.

Table 1

<table>
<thead>
<tr>
<th></th>
<th>Lake Quality</th>
<th>Genesis RDS Effluent</th>
<th>Florida Discharge Limit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Arsenic</td>
<td>160ug/L</td>
<td>3.3ug/L (non-detect)</td>
<td>50ug/L</td>
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<tr>
<td>Copper</td>
<td>790ug/L</td>
<td>2.3ug/L (non-detect)</td>
<td>13ug/L</td>
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<tr>
<td>Iron</td>
<td>290,000ug/L</td>
<td>170ug/L</td>
<td>1,000ug/L</td>
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<tr>
<td>Lead</td>
<td>9,100ug/L</td>
<td>8.2ug/L</td>
<td>0.54-18.58ug/L</td>
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<tr>
<td>Mercury</td>
<td>4.0ug/L</td>
<td>0.062 (non-detect)</td>
<td>0.012ug/L</td>
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<tr>
<td>Nickel</td>
<td>250ug/L</td>
<td>2.3ug/L (non-detect)</td>
<td>1.6ug/L</td>
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<tr>
<td>Total nitrogen</td>
<td>16.67mg/L</td>
<td>11.35ug/L</td>
<td>2.3mg/L</td>
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<tr>
<td>Total phosphorous</td>
<td>4,500ug/L</td>
<td>48ug/L</td>
<td>0.2mg/L</td>
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<tr>
<td>Turbidity</td>
<td>150NTU</td>
<td>8.9NTU</td>
<td>49NTU</td>
</tr>
</tbody>
</table>

For more information, see www.genesiswater.com