MINING

Sludges & Slurries in Mining
Verder Solutions
for Mining Sludges

Verder offers many solutions for the transfer and treatment of sludges & slurries in Mining industry.
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When and why should you use Verderflex hose pumps?

**VERDERFLEX**

Higher pressure, lower flows, higher viscosities

**VERDERFLEX: Less and More : Why You Should Pump Slurries with a Peristaltic Pump**

**Less and More:**
Why You Should Pump Slurries with a Peristaltic Pump

- **Less Water** - Peristaltic Pumps Use Less Water
  Hose pumps can circulate slurry SGs of 1.6 to 1.8 or up to 80% solid content. The traditional centrifugal pump loses efficiency when the slurry SG reaches 1.3 or 30% solids. On the same duty, the hose pump requires less than 1/3 of the process water of a centrifugal slurry pump.

- **Less Power** - Peristaltic Pumps Use Less Power
  On the same 70 ore tonnes per hour plant, on thickener underflow duty at full flow, a VF125 hose pump absorbs around 20 kW whereas a slurry pump needs over 45 kW: a saving of over 50%. This directly translates into reduced electrical requirements.

- **Less Space** - Peristaltic Pumps Increase Down line Efficiency and Reduce Overall Plant Size
  Pulp density is critical to optimum plant performance, an increased solid content can reduce the number of post thickening filter stages, saving on the initial capital cost and reducing the footprint of mineral processing operation.

- **Less Pollution** - Peristaltic Pumps Reduce Mining’s Environmental Impact
  The traditional dosing solution, progressing cavity pumps have integral seals requiring regular replacement and representing a clear leakage risk. Peristaltic pumps are seal-less and consequently, have a much lower contamination risk.

- **Less Damage** - Peristaltic Pumps have a Gentle Pumping Action, ideal for Bio-oxidation Techniques
  The peristaltic pump has a very gentle pumping action that minimises damage to fragile cell cultures in bio-oxidation reaction techniques.

- **Less Chemical** - Peristaltic Pump’s Gentle Pumping Action Reduces Reagent Usage
  A peristaltic pump’s gentle low shear pumping action maintains particle size minimising the use of flocculent and other process reagents. E.g. progressive cavity or screw pump significantly increase reagent usage increasing operating costs and raising post processing costs.

- **Less Maintenance Costs** - Abrasion Resistant Peristaltic Pumps Lower Maintenance Costs
  Slurries are often acidic and or highly abrasive. A peristaltic pump’s only wearing part is the hose.

- **Less Downtime** - Longer service intervals and easy in-situ servicing reduce pump downtime
  In contrast, on a peristaltic pump, only the rubber hose is in contact with the pumped liquid and as the ultimate rubber lined pump, service life is measured in months, reducing pump downtime and as the hose can easily be changed in situ, maintenance hours are similarly reduced.

- **Less Special parts** - Corrosion Resistant Hoses Eliminate Costly Special Metal Impellers
  To pump highly acidic slurries, hoses are made from several standard elastomers, each proven in the mining environment to withstand process chemicals and avoiding the use of expensive exotic metal impellers.
When and why should you use Verderhus screw channel pumps?

**VERDERHUS**

Lower pressures max. 75 mwc, higher volume flows 1500 m³/h, viscosities up to 3000 cst.

**VERDERHUS: Less is More: Why You Should Pump Slurries with a Screw Channel Pump**

- **Not a Centrifugal Pump** - Unlike a centrifugal pump which action relies on the circumferential velocities/forces the Verderhus pumps display a semi-axial pump principle.

- **Clog free operation** - A corkscrew shaped impeller lays in a cone shaped casing. Through the rotating action of the impeller the fluid is literally being pushed away. The cone form of this pump ensures a blockage free operation.

- **Highly efficient** - BEP’s around 75-78% are standard. In addition, the efficiency of the pump is becoming better when the liquids' viscosity increases. Unlike centrifugal pumps the power absorbed does not change when the pump has to handle higher flow rates.

- **Solids, Density and Viscosities** - The pump can handle solids up to 13% with free passages of min. >40 mm. Density ranges up to 2.0 but ultimately only the motor power is the limiting factor. As long as the liquid, at around the pour point, enters the pump - it will be pumped.

- **Initial purchase cost** - Compared with other volumetric pumps, a Verderhus pump is an inexpensive solution for viscous liquids containing solids. The Verderhus design removes the need for a safety valve and the pump has few rotating parts and no linear moving components.

- **Operating expenses** - A Verderhus pump uses less energy when moving a liquid due to the design of the screw channel, which reduces the internal friction of viscous liquids. The result is a very low consumption of electric energy. Verderhus-Pumps offer a reduced payback period as the consumption of electric energy is approximately 75% of the life-cycle cost.

- **Power consumption** - A lower consumption of power reduces the associated costs of peripheral components such as frequency inverters, cables and switches.

- **Maintenance Cost** - The Verderhus pump design has very few rotating parts, which demands less maintenance thus shorter down times. The Verderhus range reduces the payback period with lower servicing costs and maximizes the efficient working life.
Verder’s smooth operation at the RPM Waterval Smelter

Verder Pumps SA (Pty) Ltd, provide mining supplies to most of the mines in the Rustenburg area. Of these, the Angloplat operation has 3 running VF125 pumps at their Waterval Smelter plant. With the change of processes at the smelter and the need for reliable quality pumps, Div de Villiers, Engineering Specialist at the Waterval Smelter, took into consideration the Verder range of pumps which are renowned for their durability, and are able to withstand the demand for the capacity for the pumping of slurries.

After a strategic consultation with Verder Pumps SA’s engineers, three VF125 pumps were acquired for the plant. The offloading pump, used for transfer the concentrate (SG 1.5) from the trucks to the tank, previously took one hour 45 minutes, whereas the offloading has been cut right down to 20 minutes.

The hardest working conditioner pump, runs for 10 hours per day and circulates the very dense (SG 1.70) slurry in the process to keep it in suspension. This prevents the slurry setting out and eliminates the consequent choking problems. The associated transfer pumps deliver this high density slurry to the filter plant 600m away.

The two transfer pumps typically operate for 4 or 5 hours per day reflecting the supply tanker delivery schedules. The conditioner pump works approximately 10 hours day the other two pumps only operate 4 to 5 hours a day when the slurry needs to be pumped. The pumps are limited to 50m³/h for SG of 1.7 even though the pump has a capacity to pump up to 80m³/h.

Mr. Gresse who has been with the tollbay smelter plant for 11 years says that the pumps are operating smoothly, with only the regular maintenance that has to be performed on the hoses. “We are extremely happy with pump’s operation.” he confirms. Due to the increase in demand on the pumping of slurries at the smelter, Verder has advised Verder that a second tollbay plant is on the cards by the end of the year.
"A pump so reliable - it’s only downtime is for hose replacement and annual plant maintenance!" claims Xstrata Alloys Rhovan’s Acting HOD Christelle van Vuuren, regarding the Verderflex pump installed at the operation’s precipitation plant.

All vanadium in the ore occurs in solid state in the titaniferous magnetite. After the first stage of processing, the magnetite concentrate is subjected to a conventional roast leach precipitation process for the recovery of vanadium. To achieve the desired final product quality, Silica (SiO2) is removed from the pregnant solution. Precipitation of Vanadium from the pregnant solution is achieved by the addition of Ammonium Sulphate ((NH4)2SO4).

The vanadium recovery process makes use of an evaporation process to recover sodium sulphate salt from the barren solution after precipitation. This salt is recycled back to the kiln, displacing the need for a portion of the sodium carbonate flux requirement. The VF 40 pump is used to pump the barren slurry at the plant, at approximately 6 – 8 m3/hr at 60% solids handling. Abrasive mining slurries have sub-micron solid contents in excess of 80% with slurry SGs in excess of 2.0. Only hose pumps can pump such dense fluids whilst maintaining high levels of plant availability unlike centrifugal pumps which suffer from continuous downtime and are unable to pump such high SG slurries; lower plant performance.

Since the plant was commissioned, the operation has replaced other hose pumps for the easier to maintain VF pump, due to its quick maintenance capabilities. “With no gland water used by the operation, the pump can run dry, and the rotor design and flange arrangement makes the pump a hit at our plant for easy maintenance,” says Harrison.

"It just runs and works when you need it to," confirms Van Vuuren. “The pump is only ‘offline’ for spare part replacement and planned plant maintenance. Quite simply: a reliable pump!” she adds.

VF pumps are easy to maintain, with hoses the only wear part in the pump. VF hoses are specifically designed and manufactured to minimise the effect of fatigue, resulting in an extremely long hose service life.
Vanadium pumping from titaniferous magnetite

A vanadium facility, located in South Africa is winning vanadium from titaniferous magnetite. The titaniferous magnetite is processed in various stages, using a.o. precipitation tanks and various positive displacement and transfer pumps. Vanadium occurs naturally in about 65 different minerals and in fossil fuel deposits. It is produced from steel smelter slag, the flue dust of heavy oil, or as a byproduct of uranium mining. It is mainly used to produce specialty steel alloys such as high speed tool steels.

Vanadium is found in many organisms, and is used by some life forms as an active center of enzymes. Magnetite and vanadium are of a very abrasive composition causing problems in the lifetime of process materials such as in wetted parts sections of pumps.

All vanadium in the ore occurs in solid state in the titaniferous magnetite. After the first stage of processing, the magnetite concentrate is subjected to a conventional roast leach precipitation process for the recovery of vanadium. To achieve the desired final product quality. Then Silica (SiO2) is removed from the processed magnetite concentrate (pregnant solution). Precipitation of vanadium from this processed magnetite concentrate is achieved by adding Ammonium Sulphate ((NH4)2SO4).

60% solids slurry

The vanadium recovery process makes use of an evaporation process to recover sodium sulphate salt from the barren solution after precipitation. This salt is recycled back to the kiln, displacing the need for a portion of the sodium carbonate flux requirement.

Barren slurry has to be pumped with approx. 60% solids handling, which is much too high for some pump types.

Flow range is about 6 – 8 m3/h. The ideal solution is a peristaltic pump. Because of the construction of the Verderflex peristaltic hose pump (only the hose is in contact with the wetted parts of a pump, so there are no moving parts to clog and no chance of cross contamintaion) a Verderflex VF40 peristaltic hose pump was chosen.

The Verderflex VF40 pump is capable of flow rates of 7.5m³/hr and pressures up to 16 bar. Like all hose pumps the only wearing part is the hose itself, keeping maintenance time to a minimum. Abrasive mining slurries have sub-micron solid contents in excess of 80% with slurry SGs in excess of 2.0.

“Only hose pumps can pump such dense fluids whilst maintaining high levels of plant availability, unlike centrifugal pumps which suffer from continuous downtime and are unable to pump such high SG slurries.”
Copper Thickener slurry & clarify transfer pumps

Gunpowder Aberfoyle Copper Mine, Queensland, Australia, successfully uses a total of 18 Verderflex hose pumps at their copper ore mining plant (14 x VF65s & 4 x VF125s)

**The process**
Copper ore is crushed and milled and mixed in a tank with the leaching solution. Copper dissolves into the leaching solution and is then electrolytically recovered. The residual solution still contains a significant amount of Copper and is separated from the leachate using a vacuum belt filter, prior to heating under pressure and being autoclave mixed to increase Copper recovery rate.

**Thickener / Clarifier Transfer Pumps**
2 variable speed Verderflex VF125 peristaltic hose pumps, fitted with 37 kW motors and with a nominal speed of 17 rpm but capable of flow rates up to 50 m3/hr (25 rpm), pump the post autoclave solution from the thickener / clarifier into leach residue storage tanks.

**Filter Feed Pumps**
2 VF125 pumps, and a stand by VF65 pump, pump the 40% solid content slurry from the storage tank over a vacuum filter again.

In a 3 stage process the liquid is treated in leach thickeners (CCD1, CCD2, CCD3) to remove the solids from the solution. Each thickener has 2 VF65 pumps to pump the solids back in the leach residue filter storage tank. Finally, the thickened solution is pumped into the electrolyte units.

5 other frequency-controlled VF65s, with 7.5 kW motors and nominal speeds of 28 rpm, are used across the plant and a further Verderflex VF65 pump acts as a standby spare.

**Hose Changeovers**
When one VF125’s hose fails, a standby Verderflex VF65 starts up and the other VF125 is temporally speeded up to maintain the same flow as was delivered with the pair of VF125 pumps. Resulting in process continuity.

*Using these processes the mine recovers over 98% of the copper from the base ore.*
After decades of uncontrolled industrial (mining) activities, water supply is under serious threat. Studies show that acid water levels in the country’s mines are rising at a staggering average rate of 0.59 m/day. The water situation is in fact threatening the population’s survival. At the heart of resolving this problem are the treatment of water and wastewater.

Peristaltic dosing pumps are used as part of the process to rectify the pH balance of acid mine water. It highlights a successful implementation at a uranium wastewater treatment plant, focusing on but not limited to: the cost of ownership; plant performance (plant availability and reliability); and dosing accuracy.

The impact of acid mine drainage (AMD) is devastating, with far-reaching and long-term effects on the environment. According to recent research, AMD could not only affect South Africa’s quality of water, but also poison food crops, destroy heritage sites and lead to a decline in agricultural production with related job losses, to name but a few.

**Peristaltic pumps for dosing lime**

According to the experts consulted by the Department of Water Affairs, the most suitable process to consider in dealing with the current AMD issues is the ABC (alkali–barium–calcium) process, developed by South Africa’s Council for Scientific and Industrial Research (CSIR), which consists of the following steps:

1. Lime and/or CaS pre-treatment
2. Barium treatment for sulphate removal
3. Sludge processing.

This is the most comprehensive treatment that will ensure that the treated water is fit to be introduced back into nature but is not necessarily suitable for human consumption.

The nature of the medium being pumped is an important factor when considering pump selection for a specific application. When pumping lime, the high viscosity of the medium often causes pumps to clog up, resulting in a maintenance nightmare.

Peristaltic pumps are a type of positive displacement pump used to convey a variety of fluids. The fluid is contained within a flexible hose fitted inside the pump casing. The actual pumping principle, called peristalsis, is based on alternating compression and relaxation of the hose, drawing content in and propelling product away from the pump,
in the same way that food is pumped through the body. This process makes a peristaltic pump an accurate dosing or metering pump, with an equal amount of liquid dosed each time.

**pH correction**
Correcting the pH is a very specific process and the pump used for dosing must be very accurate. Peristaltic pumps have a linear flow-speed characteristic and excellent repeatability, making them the most accurate solution available.

The liquid being pumped never comes into contact with any moving parts because it is totally contained within the reinforced hose. A rotating shoe passes along the length of the hose creating a total seal between the suction and discharge sides of the pump. As the pump’s rotor turns, this sealing pressure moves along the hose, forcing product to move away from the pump and into the discharge line. Where the pressure has been released, the hose recovers, creating a vacuum, which draws the product into the suction side of the pump, the priming mechanism. Combining these suction and discharge actions results in a self-priming positive displacement pump, the peristaltic pump. The perfect seal between the two sides of the pump means that there is no product slip; when coupled with the pump’s linear speed-flow characteristic it makes peristaltic pumps ideal for dosing.

Additionally, as the pumped liquid is totally contained within the hose, this makes a peristaltic pump an environmentally safe pumping solution with zero chance for contamination. This also reduces maintenance time as the hose is the only wearing part. The pulsation effect means that solids are kept in suspension. Build-up in the hoses is eliminated by using rubber hoses that are designed to maximize life expectancy and performance.

Hose pumps are designed to handle these tough operating conditions, ensuring optimal process flow.
Dosing Copperas Crystal at Kilroot Power Station

The Kilroot Power Station which serves Belfast required a dosing solution for the corrosive cooling water that was heavy in salts, resulting in the attacking of the filter screens and pipe channels. The dosing solution had to be a single turnkey package which could handle chemical in a crystal or liquid state, a mixing tank and pump rig.

Copperas crystals (solid Ferrous Sulphate FeSO4) are mixed at a power station to form a liquid that is re-circulated and dosed by Dura 15 pumps to form a protective iron coating on titanium condensation tubes.

Pumping bentonite for mining corridors

Bentonite is a clay mineral with very good adsorptive properties. Bentonite consists mostly of the mineral montmorillonite, in combination with approx 15% other minerals, such as silica, calcite, gypsum and feldspars. The structure of bentonite gives it the possibility to absorb tremendous amounts of water and other liquids. It has the ability to absorb water containing heavy metals, toxins, bacterias or chemicals.

Bentonite is an impure mineral clay, which is very thixotropic and is also used in the drilling industry, for pyrotechnics and eg in cat litter.
Carolina Stalite Company uses coal-fired rotary kilns to remove impurities from slate. Due to its lightweight nature, this purified slate, also called expanded slate, has a variety of uses including masonry, bridges, and other structures.

As with any coal-powered operation, EPA-regulated byproducts of combustion are released and must be dealt with. The plant had been using mechanical double-diaphragm reciprocating pumps to treat the flue gas with lime slurry. This pumping application is particularly tough due to pressures over 100 psi and the abrasive nature of lime slurry.

The slurry pumps were prone to failure. If a pump went down, the plant had only two hours to get the pumps operational, otherwise they would have to shut down due to EPA regulation. The plant lost thousands of dollars per year, plus the massive energy costs associated with bringing the plant down and back up. They needed a better pumping solution.

Verder provided a Dura 35 peristaltic hose pump to replace the existing diaphragm pumps.

Dura-series hose pumps from Verderflex offer several unique features including a vertical motor, one-piece flange assembly, and extended hose life. Verderflex pumps are helping the plant save money and energy by reducing downtime.
Three applications ranging from the very abrasive to mildly abrasive slurries from concentrator. Concentrate Slurry, Abrasive materials from three areas including very abrasive high grade nickel concentrate, mixture of copper and nickel and copper slurry with low nickel, flows up to 22 m³/h, up to 72% solids solids density of 4.29 - 4.97.

Pumps installed with expansion joints and flexible hose on suction to mitigate impulse losses on the pump, with an air dome (80 liter volume) and flexible hose on the discharge to mitigate pulsation effects on the pump and line.

Pumps are running with upwards of 4000 hours service on the hose. In the Metallurgist’s opinion the slurry is very abrasive and these pumps have replaced SRL (Soft Rubber Lined) centrifugal units that were continually being repaired as a result of the abrasiveness. They have saved well over 100 hours per year of downtime at the plant and exceeded their goal of 100% throughput.

Three Verder VF 80 Series hose pumps with Natural Rubber Hose, expansion joints to mitigate impulse loss on suction side and air dome on discharge of each pump. Three more standby units are currently being commissioned as part of independent concentrate pumping stations.

Thickener underflow slurry
Verder group worldwide

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