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Myths and Misconceptions Relative to the Deployment of Vertical Cuttings Dryers

Natural Resource Recycling • Product Classification • Fluid Recovery
Dewatering • Waste Management • Material Handling • Liquid/Solid Separation

Vertical Cuttings Dryer Basics

Two Basic Configurations:

Classical Fixed Speed Dryer

Provides for a fixed speed design that generates a set G-force output and dewatering residence time. Such dryers were designed with a high differential speed to ensure that no filter cake is built on the screen surface.

Modern Direct Dual-Drive Dryer

Provides for independently variable G-force, dewatering residence (a.k.a. "dwell" time), and filter cake wall thickness using a combination of gearboxes and variable frequency drives to control the VCD performance.

After Accumulated Decades of Experience in the Mining Industry, Elgin Introduced VCD's to the O&G Industry just 20 Years Ago. Since 2002, Elgin has Deployed More than 900 Units Globally.

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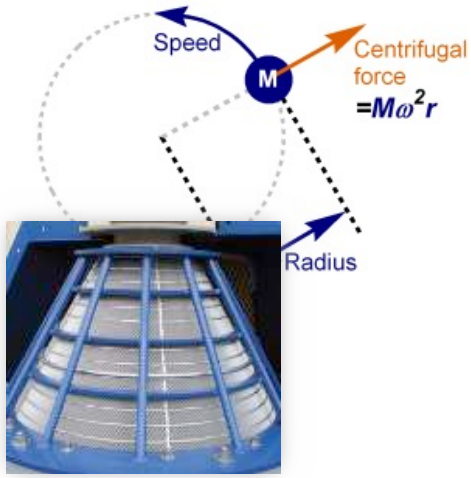
Vertical Cuttings Dryer Basics

A Washing Machine Designed for Rocks and Dirt

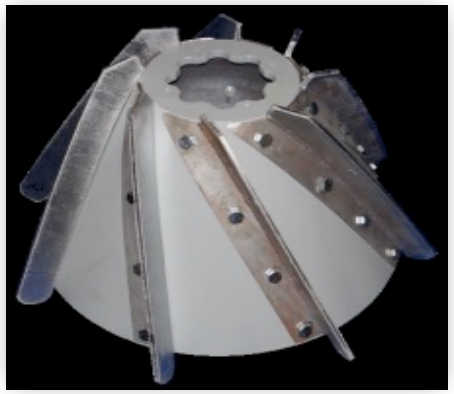
May The "G-Force" Be With You

Via the main-drive motor, rotational power is inputted to the screen. The rotational speed defines the resulting G-force imparted on the solids based on the speed and screen radius.



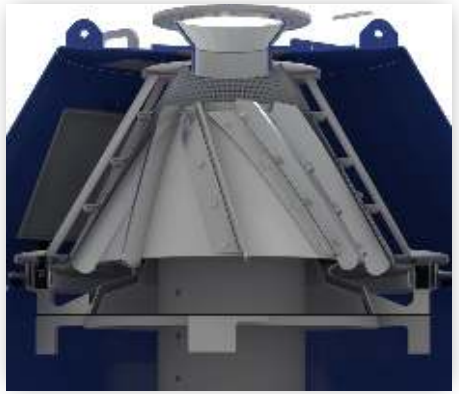
Residence…Time to Play

A specialized combination of gearboxes provides for an engineered period of residence time via the flite/rotor differential speed. This, combined with the surface area of the screen, defines the volume of dewatering that can be achieved.



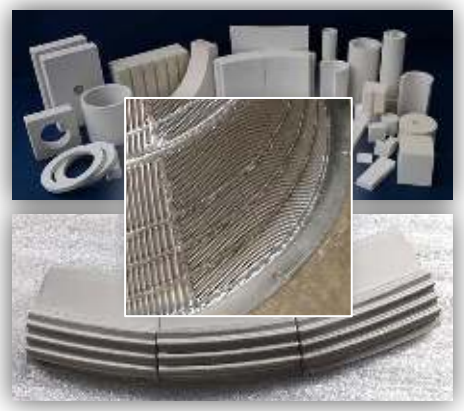
Differential Speed Makes This Different

By applying a differential speed between the flites and the screen, the build-up of solids across the screen surface can be varied. This results in "filter cake walls" that can be adjusted to provide varying levels of dewatering filtration.



Rocks are Hard & Dirt is Dirty

Due to the combined effects of G-force, and the naturally abrasive nature of rock, a continuous "sand-blasting" of the interior VCD surfaces occurs. To mitigate the effects, the flites, screens and various interior VCD body elements are engineered with specialized abrasion resistant devices.



The More Rocks to Wash, the Bigger the Washing Machine.
Ultimately, Sizing a VCD is Defined by the Desired Volumetric Throughput.

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Vertical Cuttings Dryer Basics

VCD Application is Driven By Interconnected Financial and Environmental Objectives

Drilling / Construction Fluid Reclamation

VCD's recover fluids from dewatered solids extracted from solid/liquid slurries. Shakers can discharge cuttings that are up to 25% by weight "wet". When unrecovered, this lost fluid will cost thousands per day.

Waste Solids Volume Reduction

By reclaiming fluid from the cuttings, the overall volume (or weight) of the cuttings is lowered, therefore lowering transport and disposal costs by the same percentage of fluid recovery, generating savings.

Waste Solids Declassification

Depending on the application, or even on the region in which the activity is occurring, the reduction of the fluid content can lower the disposal hazard classification of the waste dewatered solids.

For example, a conventional O&G drilling well will lose approximately 5 gallons a minute of drilling fluid with the discarded flow-line shaker cuttings. Over a 20-hour day, this would equate to 6,000 gallons (143 barrels).

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Vertical Cuttings Dryer Basics

Designed to Recover Fluids and/or Dewater Waste Solids Extracted from a Mixed Slurry

Drying Shaker

Coarse / Scalping Shaker

Vertical Cuttings Dryer

Discharge Solids Percent Moisture (%):	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
Flow-Line Shakers															OBM OOC- 15%to 25%															
																				WBM WOC- 20%to 30%										
Drying Shakers									OBM OOC- 9%to 15%																					
												WBM WOC- 12%to 20%																		
Vertical Cuttings Dryers		OBM OOC- 2%to 8%																												
				WBM WOC- 4%to 10%																										

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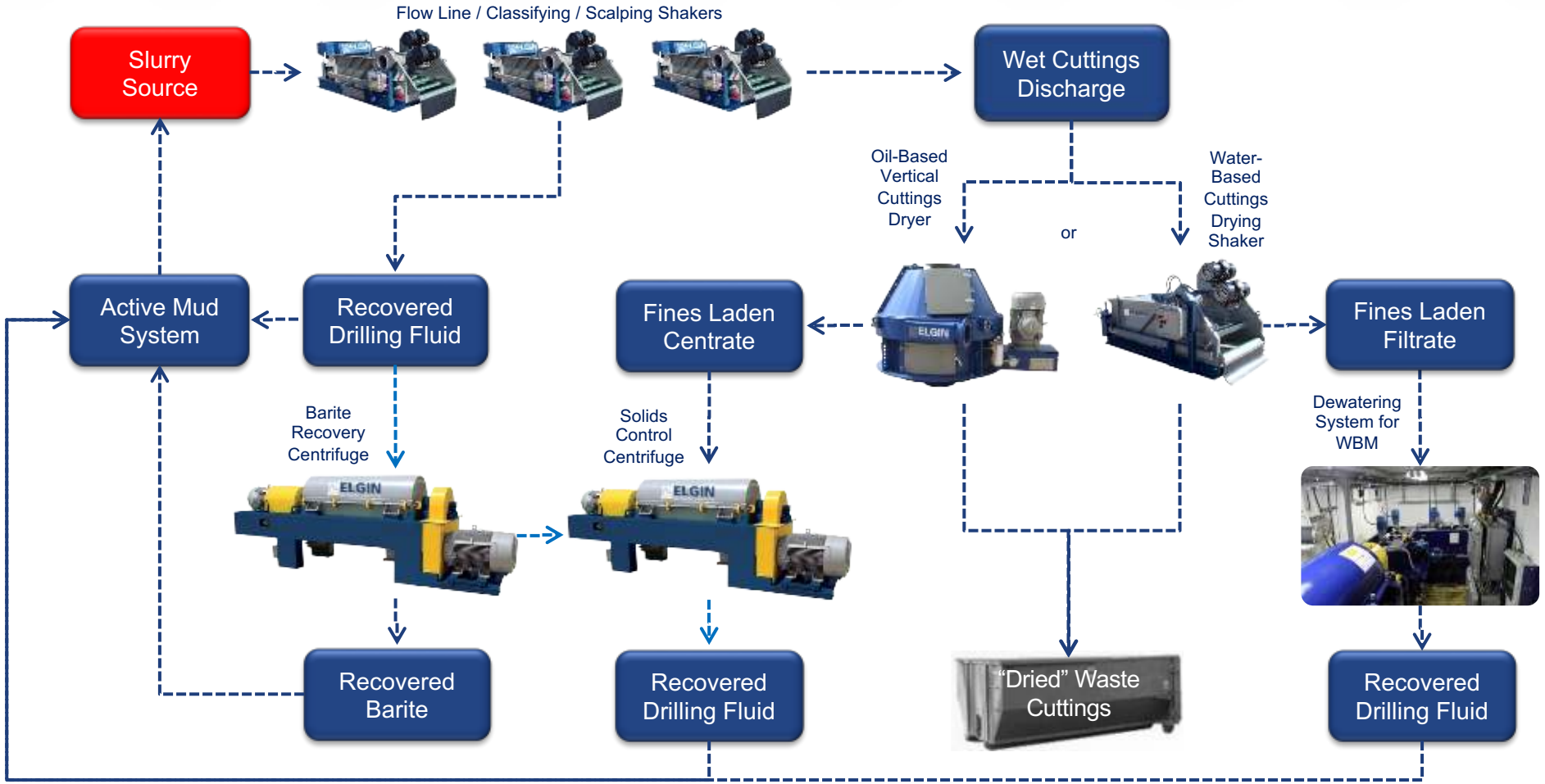
Vertical Cuttings Dryer Basics

Application of a Classic VCD within a Closed Loop System



Vertical Cuttings Dryer Deployment

A Mixed History of Success and Failure

Classical Fixed Speed Dryer

Provides for a fixed speed output design that provides for a set G-force output and dewatering residence time. Such dryers were designed with a high differential speed to ensure that no filter cake is built on the screen surface.

Classic VCD's, when deployed properly, performed admirably. However, the same VCD's, when deployed improperly, performed abominably.

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VCD Application Road-Blocks

Periodic Deployment Failures Have Tarnished the Reputation of VCD's

"VCD's Are Expensive to Deploy"

Due to the Higher Capital Cost, Deployment of Less Expensive Drying Shakers are Preferred.

"VCD's Are Difficult to Maintain"

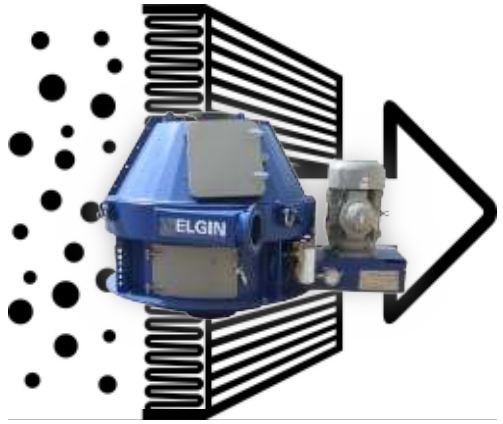
Due to the Number of Components and Replacement Parts, combined with the tendency to plug, VCD's are Difficult for Rig Personnel to Support.

"VCD's Can Create Hazardous Conditions"

Due to Their High Operating Speed, a Great Deal of Fugitive Oil and Dust Are Created. Further, drive belts violate the explosion-proof operating requirements.

"VCD's Have a Limited Operating Window"

"VCD's are unable to handle slurries that are too dry or too wet, when suspended solids are too large or too fine, or if the slurry is water-based".



Many Deployment Failures Were the Result of a Poor Understanding of the Application and Treatment Objectives.

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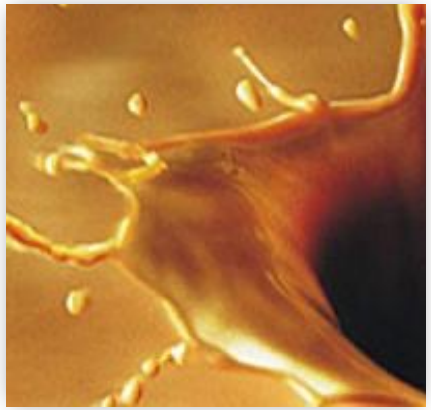
VCD Application Road-Blocks

The World of Misinformation and Fake News

"VCD's Have Little Value with WBM"

"Because Water-Based Drilling Fluids Tend to Have Low Cost of Make-Up, Drilling Fluid Recovery Presents Little Value ."



"VCD Generate Excessive Fines"

"Due to the rotational scaping action of the flites, cuttings are ground down prior to discharge from the VCD."

"VCD's Fail to Recover Enough Drilling Fluid"

"The volume of fluid recovered does not justify the deployment cost of a VCD."

"VCD's Can't Clean Cuttings Sufficiently"

"Discharge cuttings retain too high of oil or water-based drilling fluid for clean disposal."

Proper Deployment of VCD's Will Lower "Mud Bills". This has Classically Presented a Counter-Intuitive Business Model Relative to the Interest's of Drilling Fluid Suppliers.

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Modern Direct-Drive Dryers

VCD's Designed to Dispel the Myths and Misconceptions

Modern Direct Dual-Drive Dryer

Provides for independently variable G-force, dewatering residence (a.k.a. "dwell" time) and filter cake wall thickness using a combination of gearboxes and variable frequency drives to control the VCD performance.

Direct-Drive Dryers Provide a Completely New Operating Methodology and Standard for Cuttings Management and Fluid Recovery

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Features Associated with Modern VCD's

The Resulting Benefits Represent a New Paradigm in VCD Deployment:

Direct-Drive System Improves Safety

- By eliminating belts and sheaves operator intervention within the VCD body is dramatically reduced.
- By eliminating the belt-drive system, the VCD becomes both Class 1 – Division 1 and Class 2 – Division 1 compliance.

Differential Makes all the Difference

- The use of differential in a VCD is very different than convention decanter centrifuges.
- The goal is less about residence time, as it is about cake wall accumulation.
- Direct-drive dryer cake wall filtration allows a VCD to dewater much finer solids than classical VCD's.

Direct-Drive Dryers Drives Down Direct Costs

- Besides eliminating the belts and sheaves, the traditional oil pump, oil reservoir, oil filtration system, flow switch and pressure switch are also eliminated.
- By eliminating these elements, 75% of the service requirements of a VCD have been eliminated, therefore dramatically lowering downtime and operating costs.

A New Build to Mitigate Solids Build Up

- Direct Drive VCD's eliminate 70% of the traditional obstructions.
- Further, direct-drive shaft tunnels includes a sloped enclosure, reducing solids accumulation.
- Direct-Drive Dryers deploy a conical launder section that enhances centrate flow.

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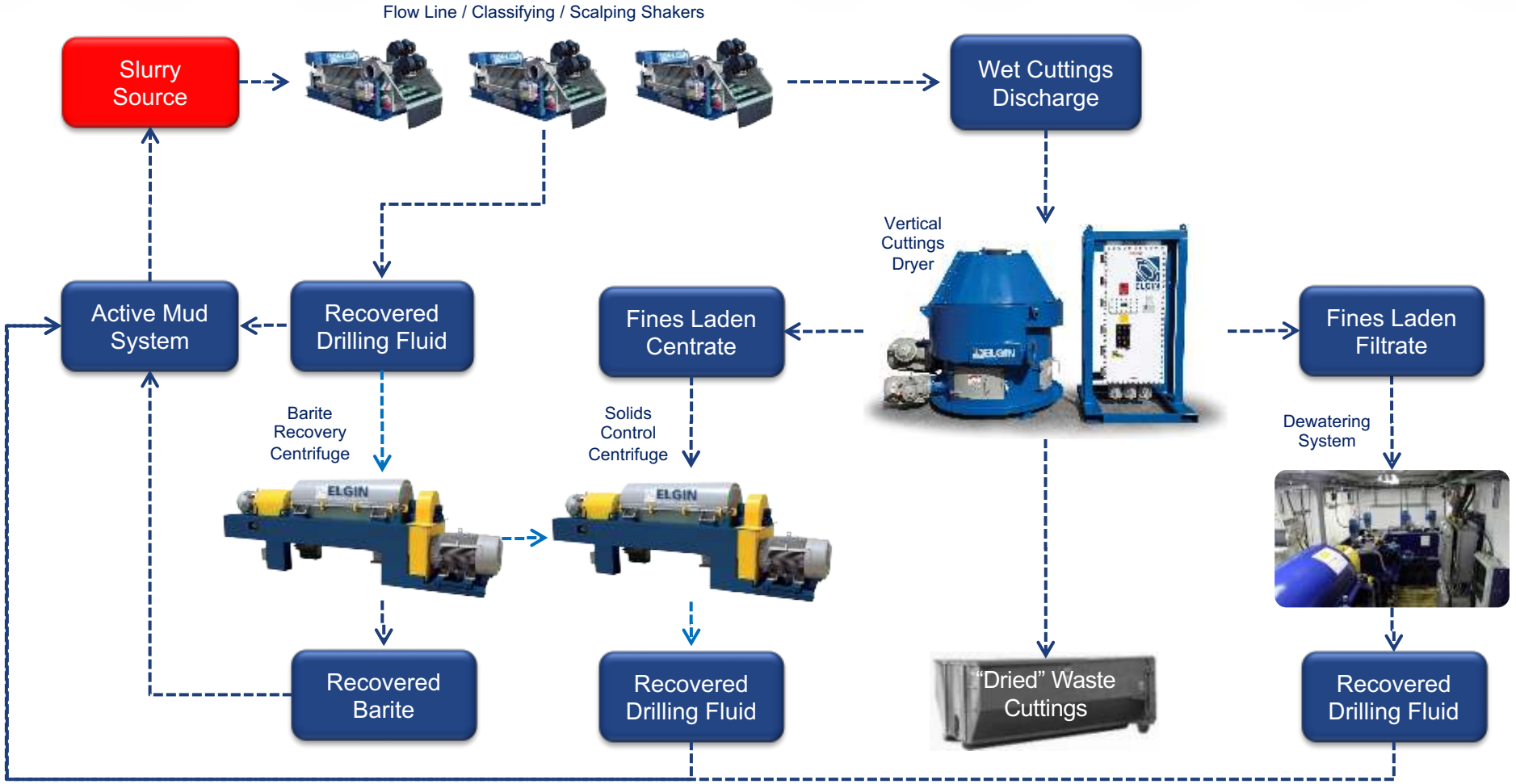
Integration of a Vertical Cuttings Dryer

Application of Modern VCD's within a Closed Loop System



VCD Application Road-Block Bridges

Proper Deployment of Modern VCD's Will Overcome Historical Challenges

VCD's Are Not Expensive to Deploy

Combined With an Ability to Recover More Fluids, a Reduction of Maintenance Expenses by 75%, and Lower Capital Equipment Prices, VCD's Have Never Achieved a Higher Return on Investment.

VCD's Are Not Difficult to Maintain

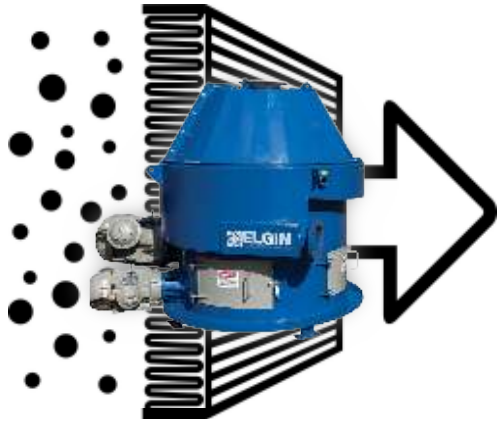
Given the Redesigned Drive System, and a 70% Reduction in Solids Discharge Restrictions, VCD's Have Never Been Easier to Deploy or Service.

VCD's Now Mitigate Hazardous Conditions

Due to the Ability of a Dryer's Performance Parameters to be Independently Adjusted, and Given its Full Adherence to All Explosion Proof Standards, VCD's Have Never Been Safer or Cleaner.

VCD's Have a Large Operating Window

Given the Ability to Independently Adjust both the Differential, the G-Force, Cake Wall Thickness, VCD's Have Never Had as Large of an Operating Window for as Many Different Industries.



VCD's Can Generate a High Return on Investment with Both Water-Based and Oil-Based Slurries with Suspended Solids Ranging from 30 Microns to 2 Inches (5 cm) and Moisture Contents as High as 90%.

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VCD Application Road-Block Bridges

Fact-Based, Field-Validated, Engineering-Verified Data

VCD's Generate Water-Based Value

Given the effectiveness to dewater water-based slurries, the ability to mitigate make-up costs and disposal costs has allowed VCD's to finally provide a equitable return on investment in water-based slurries.

VCD Concentrate, Not Generate, Fines

The ability for the VCD to utilize cake wall filtration and a low differential speed mitigates the effects associated with rotating flites grinding away at the accumulated cuttings.

VCD's Recover All Free Moisture

VCD's can be expected to remove 100% of the free moisture, 99% of the surface wetted moisture and 50% of the interstitial moisture.

VCD's Sufficiently Clean Cuttings

When deployed properly, VCD's will allow for disposal of cuttings in non-lined landfills as cap material. This opens up disposal site options and the disposal cost per ton.

Proper Deployment of VCD's Will Lower "Mud Bills". This has Classically Presented a Counter-Intuitive Business Model Relative to the Interest's of Drilling Fluid Suppliers.

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Noteworthy Fringe Benefits

VCD's Can Drive Value Beyond Recovered Fluid and Reduced Disposal Costs

O&G Rig Flow Line Shaker Performance

To cut costs and mitigate the risk of whole mud losses, drill rig operators commonly use coarse flow line shakers screens. This allows a high volume of fines to enter the active mud system.

Deploying fine screens and sending a wet cuttings slurry to a VCD will maximize flow line performance while garnering maximum drilling fluid recovery.

Hydrocyclone Underflow Dewatering

When a proper cake-wall can be maintained, and when co-mingled with coarse solids, ultra-fine and fine solids can be effectively dewatered with a VCD.

Elgin has received a number of field reports highlighting the ability of the VCD to accommodate fines as small as 30 microns when properly mixed with coarse solids.

Enhanced Tertiary Treatment

Given that VCD's can remove 100% of the free moisture, 99% of the surface wetted moisture and 50% of the interstitial moisture, VCD's are an excellent complement to thermal desorption technology.

By maximizing the dryness of the solids, the energy input for thermal desorption systems are reduced, providing economic benefit.

Allows for Land-Farming of Cuttings

Due to the level of dewatering possible with water-based fluids, when local regulations permit, VCD's will allow for land-farming of the cuttings.

This provides foundation drilling, dredging, and pipeline construction sites an opportunity to completely eliminate waste disposal trucking.

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Parting Thoughts

The Link Between Employee Education, Equipment Efficacy and Environmental Equity

As with all technology, its effectiveness is inherently limited by the quality of the personnel we entrust to deploy and operate It. The more we do to educate, certify and retrain our most valuable assets, the more our organizations, and the world we live in, will benefit.

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