All the Other “Stuff” You Need

Therese Wheaton
Jeff Seaton
Adam Karakas
Tom Ferrero

This Morning We Discussed:

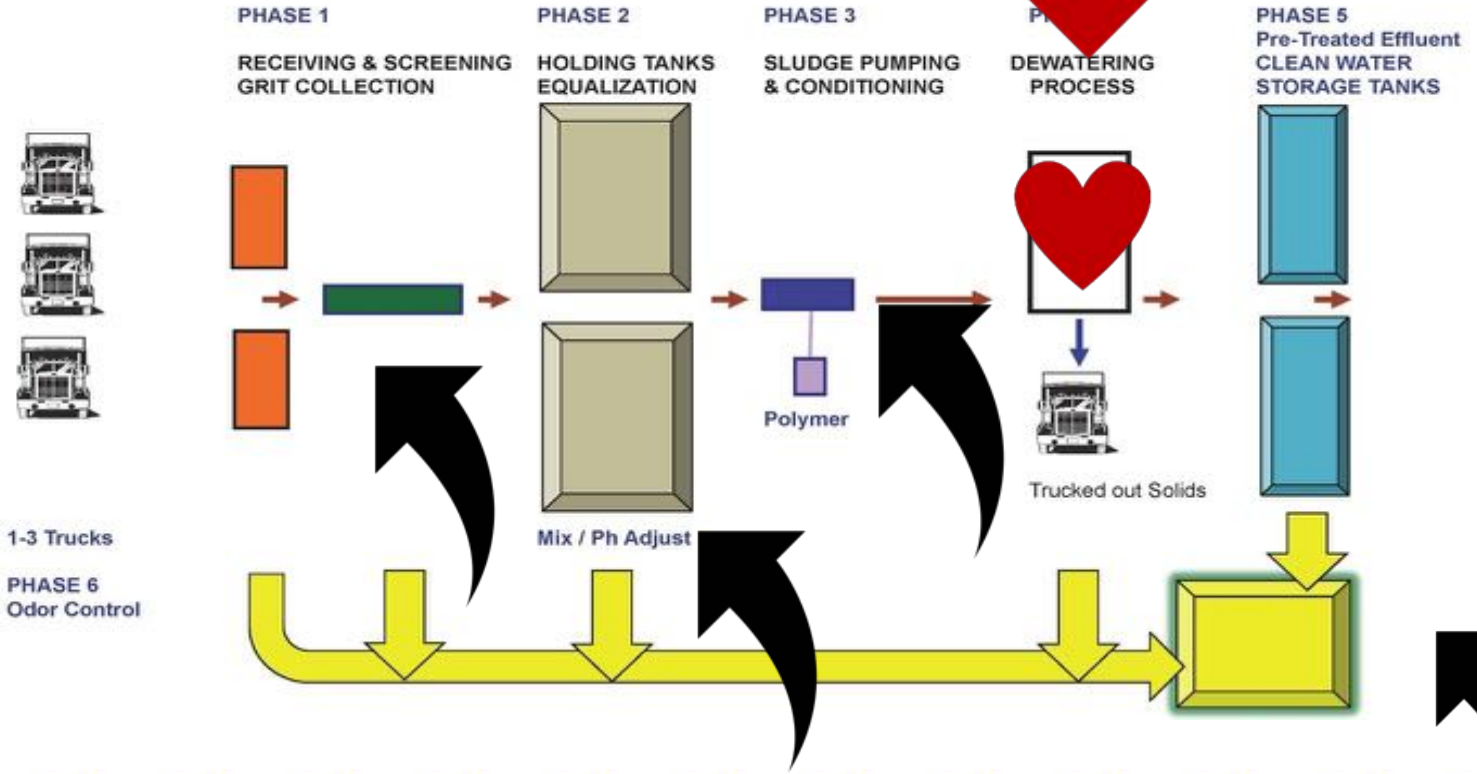
Dewatering to Make A Solid Waste

Solid Liquid Separation

Solid Quality

Water Quality

Crystal Environmental Flow Plan -- Advanced Sys ns 2013



PHASE 1

Provide Exceptional Customer Service!

Flow Meter

Manage Influent Flow

Grit Removal

12,000 to 14,000 Gallons of Receiving Area

One Million Gallons of Trucked Waste EQUALS
12-15 Yards of Grit!

Grit Removal

This is what could happen if “GRIT” is not addressed!

Pump & Grinder

Reduce Liquid to ¼” to 3/8” Particle Size

Screening Reduces Particle Size to ¼" to 3/8"

Screening

Screening

PHASE 1

Elevated Screening Devices

Screening

Screening

Screening

Screening

Screening

Screening… Used Options for Sale!

Jeff Seaton
Vice President
Boerger, LLC

Intro to Pumps and Grinders

TOPICS

- What is a Pump?
- Centrifugal Pumps
- Positive Displacement Pumps
- Pump Inspection/Repair/Maintenance

PUMPS:

WHY USE THEM & WHAT TYPE DO I USE?

WHAT DO PUMPS DO?

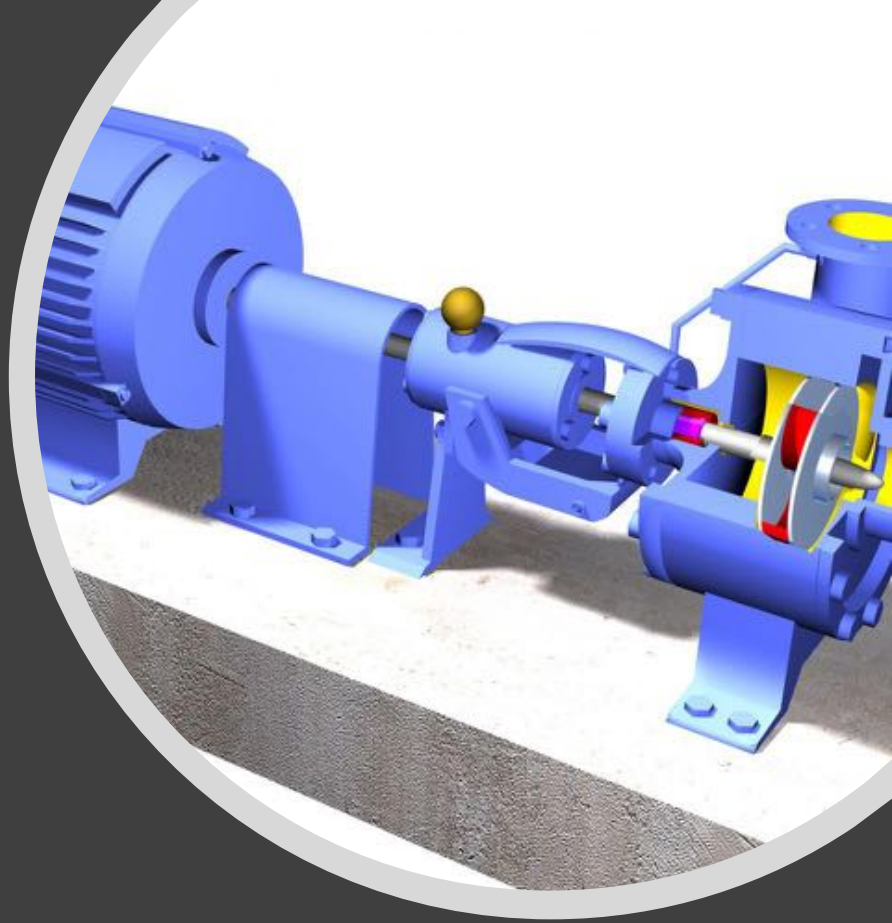
Pumps convey fluids, gasses and slurries by means of a mechanical action

Pumps typically operate by a rotary or reciprocating action that consumes energy to perform mechanical work by moving the fluid

Once you‘ve figured out what type of liquid you are working with you can start to investigate what type of pump would be best suited for the application

CENTRIFUGAL PUMPS

- Best for water-like fluids
- Excellent pulseless flow
- Typically electric-driven
- Handle continuous fluid transfer at high flow rates and low pressures
- Simple design
- Quick Installation
- Maintenance is low
- Repairs are easy



CHARACTERISTICS:

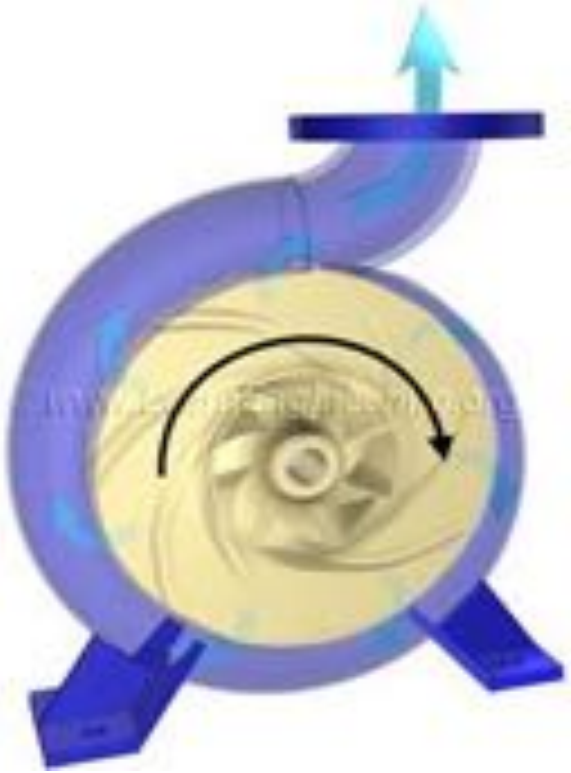
- Creating a resistance to the flow controls the kinetic energy of a liquid coming out of an impeller
- The first resistance is created by the pump volute (casing)
- When the liquid slows down in the pump casing, some of the kinetic energy is converted to pressure energy
- It is the resistance to the pump’s flow that is read on a pressure gauge
- A pump does not create pressure, it only creates flow
- Pressure is a measurement of the resistance to flow

THE HEART OF CENTRIFUGAL PUMPS

- Centrifugal pumps are used to induce flow or raise pressure of a liquid
- At the heart of the system lies the impeller
- It has a series of curved vanes fitted inside the shroud plates
- The impeller is always immersed in media
- When the impeller rotates, it makes the fluid surrounding it also rotate
- This imparts centrifugal force to the water particles, and water moves radially out

- Rotational mechanical energy is transferred to the fluid, at the discharge side of the impeller
- Low pressure at the eye of the impeller helps suck fresh water stream into the system again, and this process continues

- The impeller is fitted inside a casing
- Water collected inside the casing will move in the same direction as the impeller to the pump discharge
- Direction of rotation is key as a centrifugal
  pump can only rotate in one direction
- Direction of flow is not reversible



TYPES OF IMPELLERS

- The impeller type used for the discussion so far is called an closed impeller
- The vanes are closed from both the ends with shroud plates
- Other types of impellers which are used in industry are semi-open and open impellers
- If the working fluid has foreign debris or high solids concentration it is preferred to use an open style of impeller
- One trade-off to an open style impeller is less efficiency

Open Impeller

- Vanes attached to a central hub (shaft)
- Passes stringy material and easy to clean
- Not efficient

Semi-Open Impeller

- Adds a back plate – increased strength
- Improves efficiency
- Can still pass most solids

Closed Impeller

- Adds a front plate
- Most efficiency but clogs easily
- Higher rate and pressures

MECHANICAL DESIGN ASPECTS

- The mechanical design of centrifugal pump is always challenging
- A shaft is used to connect between the impeller and motor
- Since water pressure inside the casing is high, a proper sealing arrangement is imperative to arresting the water leakage through the shaft casing clearance
- Mechanical seal or stuffing box based mechanism is used for this purpose

- The impeller is mounted on a cantilevered bearing frame
- On the suction side of impeller it is not advisable to fit a bearing, since it will block the flow
- As a result the bearings have to be fitted at the other end
- For high flow rate pumps, a bearing housing with cooling oil may be necessary for improving the life of the bearings

Positive Displacement Pumps

DIAPHRAGM PUMPS

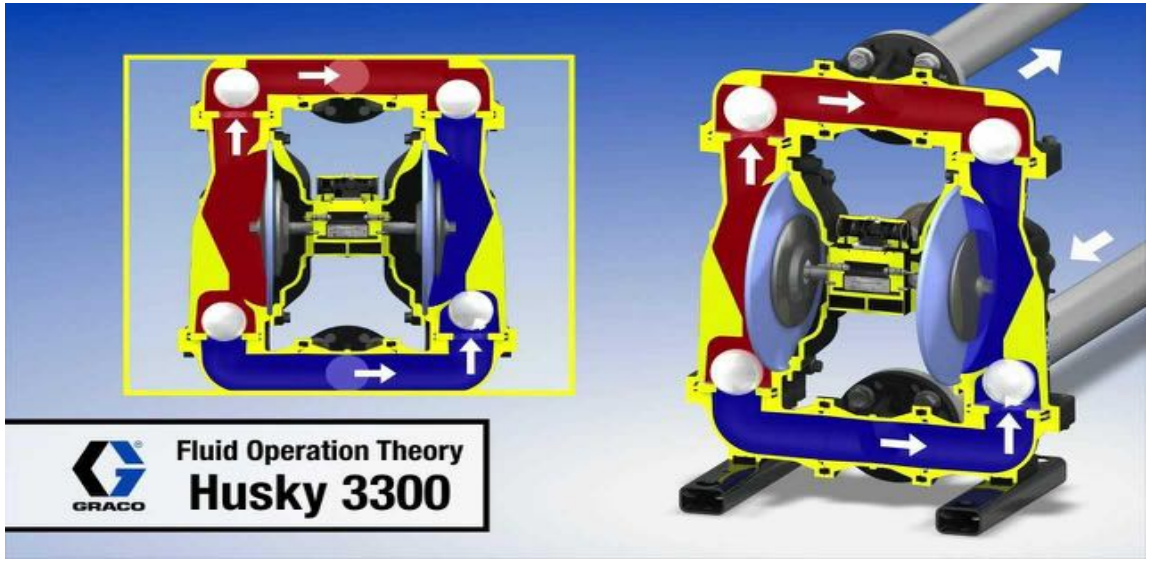
- A **diaphragm pump** (also known as a **Membrane pump**, **Air Operated Double Diaphragm Pump)** (AODD) is a positive displacement pump that uses a combination of the reciprocating action of a rubber or thermoplastic diaphragm and suitable valves on either side of the diaphragm (check valve, butterfly valves, flap valves, or any other form of shut-off valves) to pump a fluid.

CHARACTERISTICS

- They can handle sludge's and slurries with a relatively high amount of grit and solid content
- Suitable for a wide range of discharge pressures
- Have good dry running characteristics
- Can be up to 97% efficient
- Ability to perform suction lift
- Have good self priming capabilities
- Can handle highly viscous liquids

- Those employing volumetric positive displacement where the prime mover of the diaphragm is mechanical, working through a crank or geared motor drive, or purely mechanical, such as with a lever or handle
- This method flexes the diaphragm through simple mechanical action, and one side of the diaphragm is open to air

- Those employing one or more unsealed diaphragms with the fluid to be pumped on both sides
- The diaphragm(s) again are flexed, causing the volume to change



PROGRESSIVE CAVITY PUMPS

- The Progressive Cavity Pump is a positive displacement pump
- It is an extremely versatile pump that can be used in many different pumping applications
- Ability to perform suction lift
- They can handle sludge's and slurries with a relatively high amount of grit and solid content
- Suitable for a wide range of discharge pressures
- They can handle highly viscous liquids.

CHARACTERISTICS

- Progressing cavity pumps are a special type of rotary positive displacement pump where the produced fluid is displaced axially at a constant rate
- This characteristic enables progressing cavity pumps to convey viscous, abrasive, multiphase and gaseous fluids and slurries over a wide range of flow rates and differential pressures

HOW THEY WORK

- The progressive cavity pump consists of a helical rotor and a stator
- The rotor seals tightly against the stator as it rotates, forming a set of fixed-size cavities in between
- The cavities move when the rotor is rotated but their shape or volume does not change
- The pumped material is moved inside the cavities

Rotary Lobe Pump

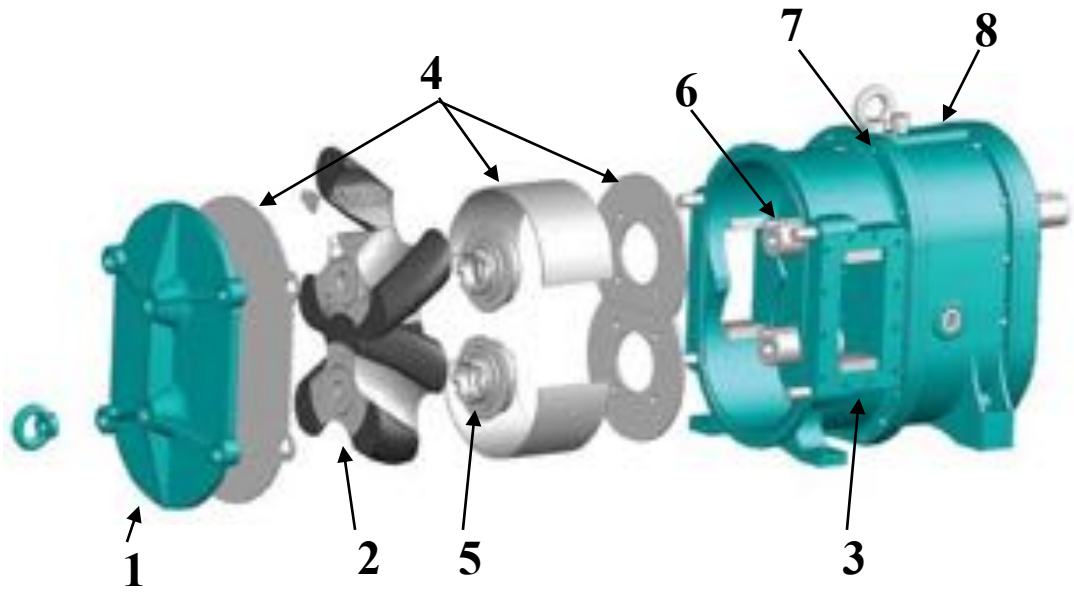
- Self-priming, valve-less positive displacement pump
- Gentle, pulsation-free conveying
- For viscous, solids-laden, abrasive, shear-sensitive products
- Product fills the displacement-chambers on the suction side and is rotated circumferentially to the pressure outlet
- The displacement rotors operate with minimized axial and radial clearance
- The rotors isolate the suction and pressure areas of the pump
- Reversible operation

KEY FEATURES & BENEFITS

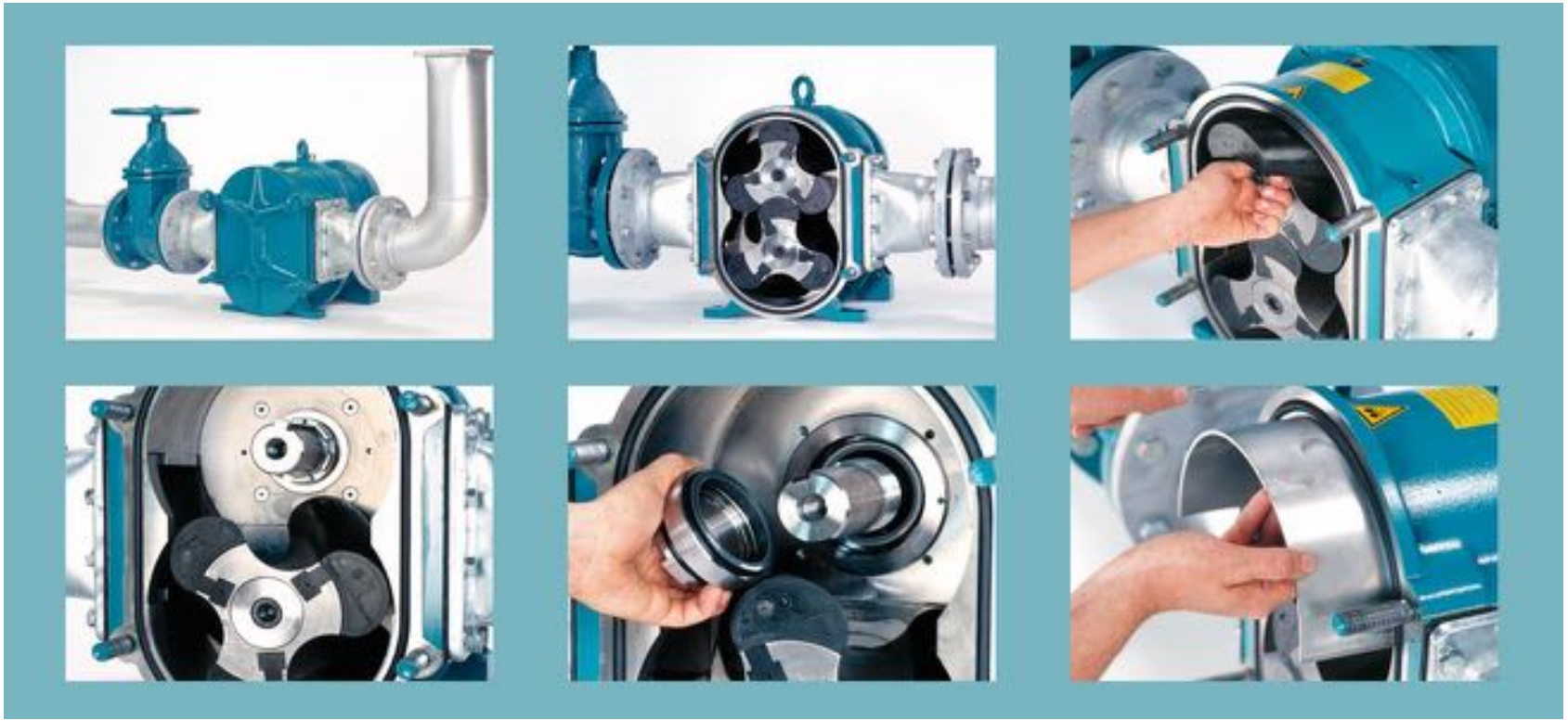
- Maintenance In Place = MIP - Low Maintenance Costs
- Compact Design - Large Flow in a Small Footprint
- Screw Rotors and Tips for Low Pulsation Operation
- Insensitive to Dry Run - Suitable for Self-priming
- Reversible Operation
- Oil Lubricated Mechanical Seals - No Seal Water Needed
- No Outboard Bearings - Larger Shaft Diameters have eliminated the Need for additional bearings in the front cover

COMPONENTS OF A ROTARY LOBE PUMP

1. Front Cover
2. Rotary Lobes
3. Pump Casing
4. Protection Plates
5. Shaft Seals
6. Pump Shafts
7. Intermediate Chamber
8. Bearing & Timing Gear



MAINTENANCE THROUGH THE FRONT COVER



ROTARY LOBES

Rotor types and materials for best possible compatibility with each individual product:

- Quick replaceable rotor tips for heavy duty operation
- Entirely elastomer coated rotors with non-wetted core
- Elastomers from NBR, EPDM, CSM, HNBR or FPM/FKM
- Stainless steel, PTFE, PUR etc for your specific application

ROTARY LOBES

dual-lobe, linear

tri-lobe, screw profile

tri-lobe, linear

dual-lobe, screw profile

tri-lobe, linear

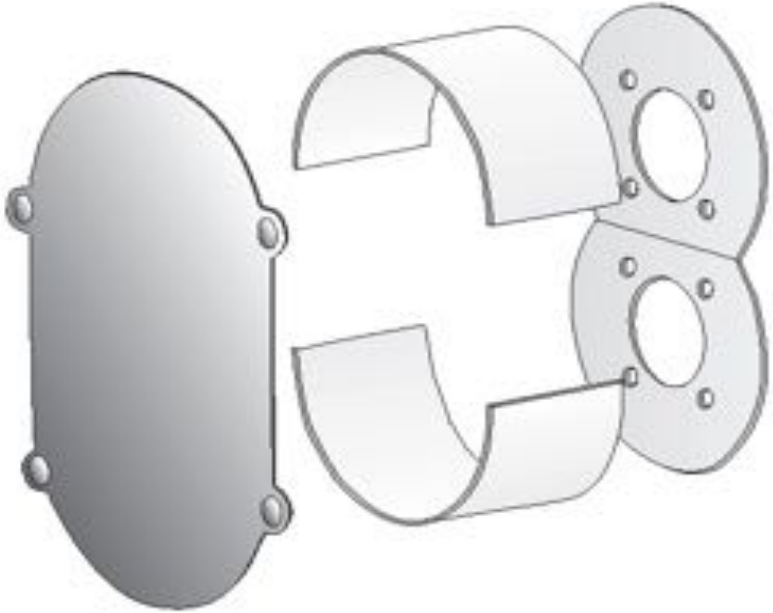
tri-lobe, screw profile

dual-lobe, linear

dual-lobe, linear

PROTECTION PLATES

- Axial lining plates and radial liners for maximum service life and easy maintenance.
- Available from through-hardened steel or hardened stainless steel, depending on the individual application.
- Eliminates the more-costly pump casing as a spare part. Pump casing **never** needs to be replaced!

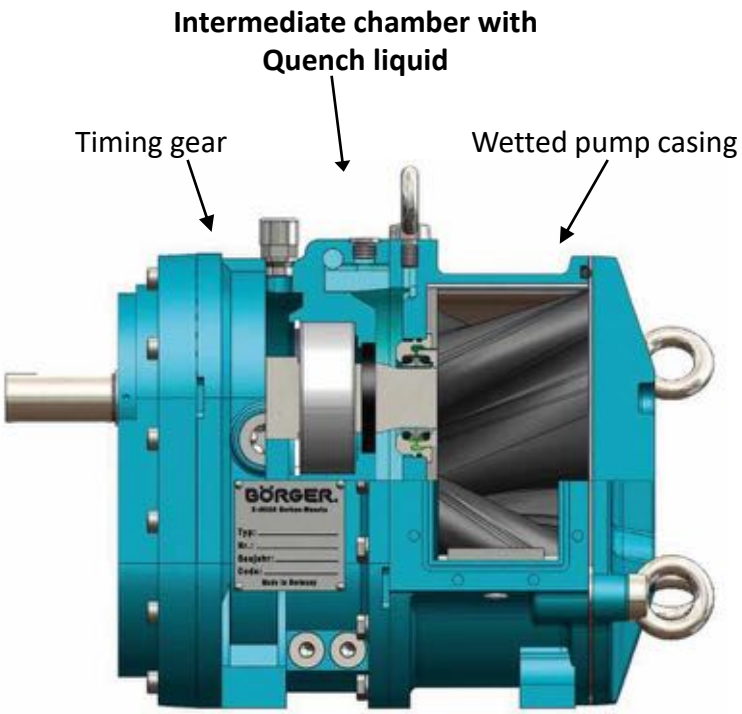


SHAFT SEALS

- Single acting mechanical seal with quench is the most standard
- All shaft seals are accessible through the quick release opening and are replaceable as a cartridge unit
- Available in a wide variety of materials
- Seals are independent of the rotor (i.e. rotor replacement doesn't compromise seal compression
- Special designs available, i.e. double acting, gland packing, etc.

INTERMEDIATE CHAMBER

- Quench fluid for mechanical seals, rotor/shaft-connection and for seal-monitoring
- Non-pressurized
- Protects the gear against penetration of conveying liquid
- Protects the wetted pump chamber against contamination with gear oil
- Seal failures are indicated by displacement of the quench fluid from the intermediate chamber to the outside of the pump.



BEARING & TIMING GEAR

- Separately sealed construction
- Precisely made gear wheels
- Designed to be Maintenance-free for the life of the equipment
- Two gearwheels ensure the synchronizing of the rotating shafts
- Heavy duty long life bearings

Grinding Technology

SINGLE SHAFT GRINDER

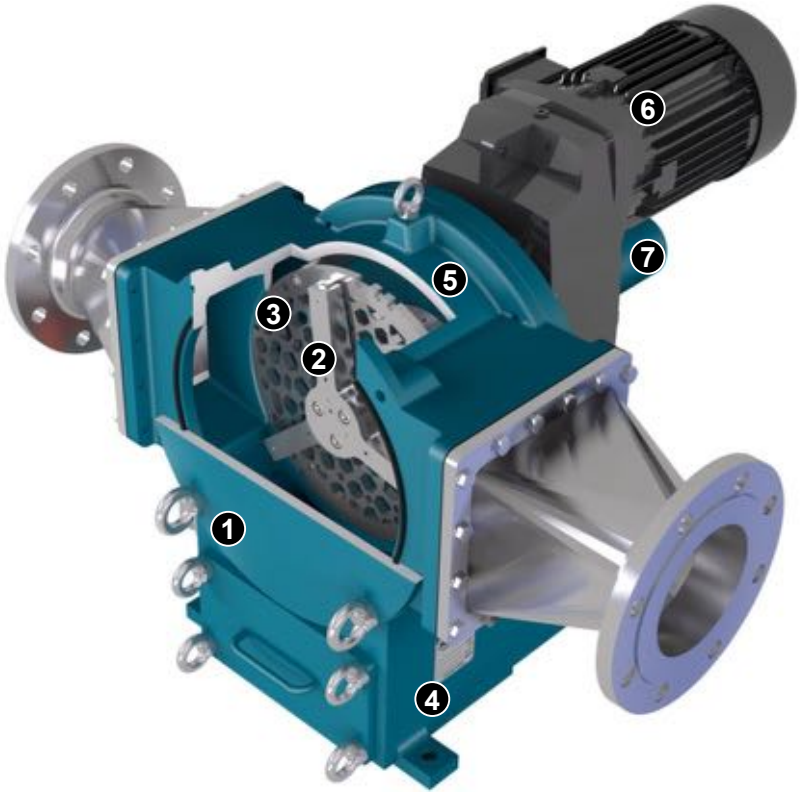
- Perforated disk macerator
- Design with or without debris collector
- Wide range of flow rates
- Degree of maceration variable thanks to choice of blade combinations

SINGLE SHAFT GRINDER

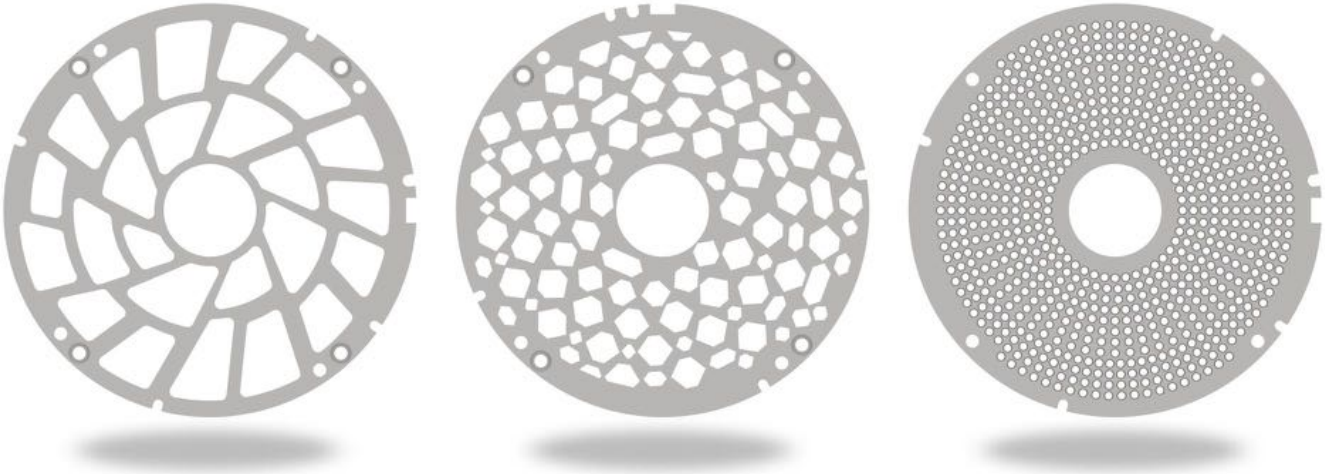
A single shaft grinder is a chopping unit with perforated disk and rotating blades on the inlet side for chopping solids contained in the liquid. The design of the perforated disk, the flow rate and the speed mainly determine the chopping result.

COMPONENTS OF A SINGLE SHAFT GRINDER

1. Front Cover
2. Blade Holder
3. Perforated Disk
4. Rock Drop
5. Casing
6. Drive
7. Tensioner



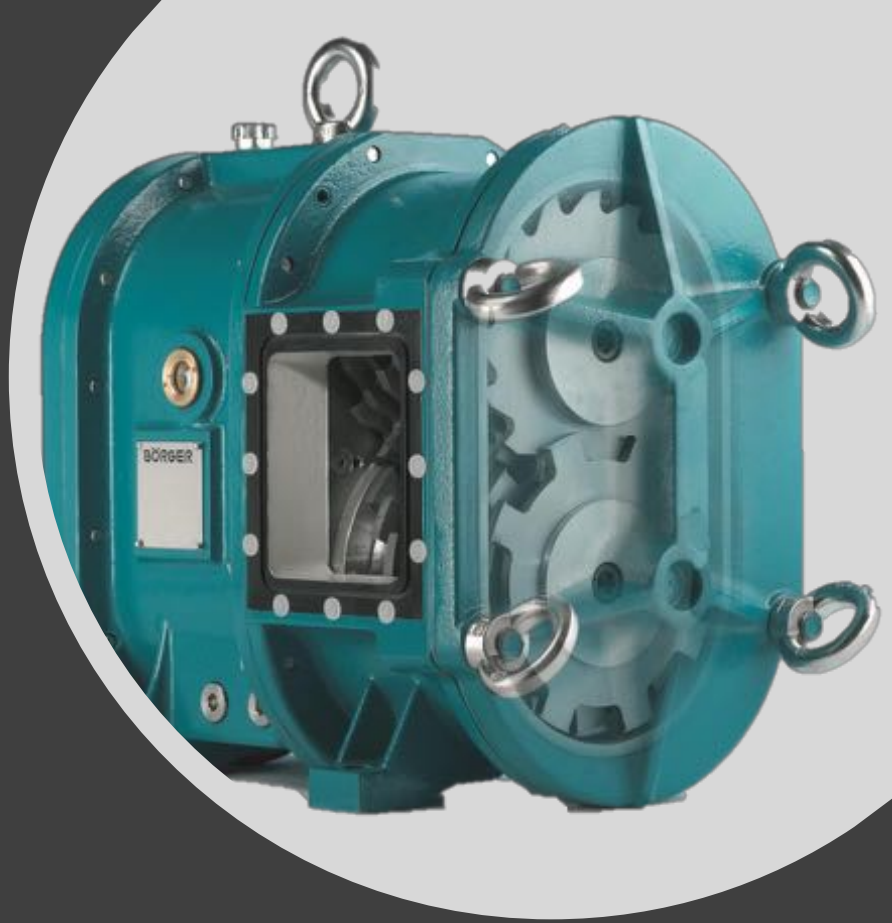
VARIOUS PERFORATED DISKS



- Various perforated disks are available, depending on the maceration result required
- The hardened cutting steel ensures optimum service life
- The perforated disks can be reversed = extended usability

TWIN SHAFT GRINDER

- Dual shaft grinder
- Different sizes
- Wide range of flow rates
- Low-on-space, compact design
- Degree of maceration variable thanks to choice of blade combinations



TWIN SHAFT GRINDER

- Dual-shaft grinder
- Individual cutting blades
- Powerful intake function
- Radial flow
- With rock dropout as an option

COMPONENTS OF A TWIN SHAFT GRINDER

1. Quick-release cover
2. Blades
3. Intermediate chamber
4. Carrier gear & gear reducer

BLADE CONFIGURATIONS

- The maceration degree is determined by the choice of blade configuration, the teeth profiles, the blade widths along with the flow speed
- Various different blade configurations possible
- The use of hardened steel ensures the blades are kept sharp for longer. Defective blades can be individually replaced or in some cases, as a cartridge

ANY QUESTIONS?

Thank You!

Equalization & Storage

- IN: Offload Truck at 500-1000 GPM
- OUT: Process Waste 60-120 GPM

PHASE 2

Holding Tanks…Sized for 50-100% of daily or weekly flow

PHASE 2

- Holding Tanks
- Equalization & Mixing
- pH Adjustment

Mixers

Mixers

Mixers

Air Mixers

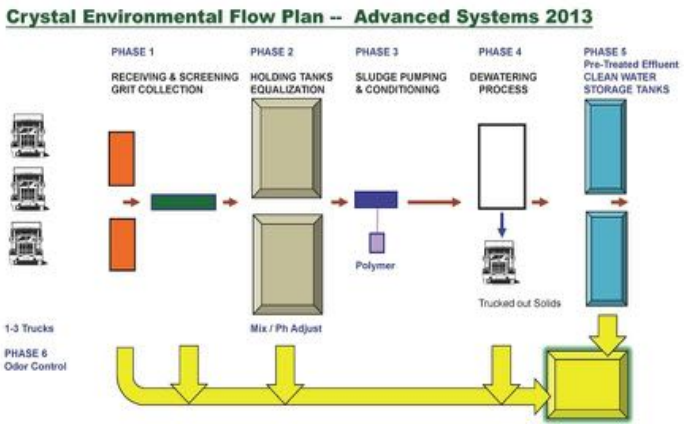
Equalization Tanks

Equalization Tanks

Equalization Tanks

Equalization Tanks

PHASE 3



- Chemical Conditioning
  - Polymer
- Chemical Addition

POLYMER FLOCCULANTS

ADAM KARAKAS

TIDEWATER PRODUCTS

FEBRUARY 20, 2019

A QUICK INTRODUCTION

- HAVE BEEN INVOLVED IN POLYMER SALES FOR 10 YEARS THROUGHOUT THE MIDWEST AND EAST COAST

- CUSTOMERS CONSIST MAINLY OF POTW (WATER/WASTEWATER) IN THE APPLICATIONS OF SLUDGE SETTLING, THICKENING, AND DEWATERING

POLYMER FLOCCULANTS

WHAT IS A POLYMER FLOCCULANT?

- A SYNTHETIC, WATER SOLUBLE POLYMER BASED ON ACRYLAMIDE AND ITS DERIVATIVES
- CAN BE ANIONIC (NEGATIVE), CATIONIC (POSITIVE), OR NONIONIC (ZERO) IN NATURE
- USED IN ALL ASPECTS OF THE LIQUID / SOLID SEPARATION PROCESS IN A VARIETY OF INDUSTRIES
  - WHICH VARIANT USED WILL DEPEND ON THE SLUDGE BEING PROCESSED

3 MAIN TYPES OF POLYMER FLOCCULANTS

ANIONIC POLYMERS

- PRIMARILY USED IN POTABLE WATER APPLICATIONS (DRINKING WATER TREATMENT)
  - INFLUENT CLARIFICATION
  - THICKENING & DEWATERING OF SLUDGES PRODUCED IN WATER TREATMENT PROCESS
- ALSO WIDELY USED IN INDUSTRIAL WATER TREATMENT APPLICATIONS
  - MINING (THICKENING & DEWATERING)
  - METAL PLATING (THICKENING & DEWATERING)
  - OIL & GAS (FRICTION REDUCERS)

3 MAIN TYPES OF POLYMER FLOCCULANTS

NONIONIC POLYMERS

- PRIMARILY USED IN WATER TREATMENT APPLICATIONS IN SIMILAR FASHION TO ANIONIC POLYMERS
  - INFLUENT CLARIFICATION
  - THICKENING & DEWATERING OF SLUDGE PRODUCED IN WATER TREATMENT PROCESS, THOUGH NOT AS COMMON AS ANIONIC POLYMERS
- ALSO HAVE USES IN TEXTILE AND PAPER INDUSTRIES

3 MAIN TYPES OF POLYMER FLOCCULANTS

CATIONIC POLYMERS

- PRIMARILY USED IN MUNICIPAL WASTEWATER TREATMENT APPLICATIONS
  - THICKENING & DEWATERING
  - SETTLING APPLICATIONS

SO WHAT DO FLOCCULANTS DO?

- THEY PHYSICALLY FORM A BRIDGE BETWEEN TWO OR MORE PARTICLES, UNITING THEM INTO A RANDOM THREE DIMENSIONAL STRUCTURE THAT IS LOOSE AND POROUS

HOW ARE POLYMER FLOCCULANTS SUPPLIED?

DRY POWDERS

- >95% ACTIVE POLYMER SOLIDS
- TYPICALLY SUPPLIED IN 50 – 55 POUND PALLETIZED BAGS
- SUPERSACKS (1,200 POUND BAGS) ALSO AVAILABLE

LIQUID EMULSIONS

- ~35% - 45% ACTIVE POLYMER SOLIDS
- TYPICALLY SUPPLIED IN 55 GALLON DRUMS OR 275 GALLON TOTES
- SMALLER QUANTITIES (5 GALLON PAILS) AND BULK DELIVERIES (5,000 GALLONS) ALSO AVAILABLE

- ADVANTAGES AND DISADVANTAGES TO TO BOTH FORMS
- DECISION BETWEEN DRY OR EMULSION WILL DEPENDS A VARIETY OF FACTORS

DRY POLYMER FLOCCULANTS
PROS AND CONS

<u>PROS</u>

- LESS EXPENSIVE THAN LIQUID EMULSIONS ON AN ACTIVE POUND BASIS
- RELATIVELY SMALL HANDLING / STORAGE FOOTPRINT
- SHELF LIFE FAR SURPASSES THAT OF EMULSIONS (YEARS)
- EASY TO CLEAN UP IF SPILLED

DRY POLYMER FLOCCULANTS
PROS AND CONS

CONS

- REQUIRE MORE EQUIPMENT THAN EMULSIONS TO PROPERLY MAKE DOWN / MORE LABOR INTENSIVE PROCESS
- NOT AS SOPHISTICATED AS EMULSIONS – LIMITED IN TERMS OF STRUCTURE OF THE POLYMER MOLECULE
- MESSY – DUST FROM BAGS CAN COAT SURFACES / MAKE FOR SAFETY HAZARD

EMULSION POLYMER FLOCCULANTS PROS AND CONS

<u>PROS</u>

- EASIER TO HANDLE AND MAKE DOWN VS DRY POWDERS
- MUCH MORE SOPHISTICATED THAN DRY POWDERS MOLECULARLY SPEAKING – BRANCHING AND CROSS LINKING POTENTIAL
- MINIMAL AMOUNT OF EQUIPMENT REQUIRED

EMULSION POLYMERS
PROS AND CONS

CONS

- GREATER STORAGE REQUIREMENTS THAN DRY POWDERS
- HAVE THE POTENTIAL TO FREEZE – LOGISTICS CAN BE CHALLENGING IN COLDER MONTHS
- SHORTER SHELF LIFE AS COMPARED TO POWDERS (~6 MONTHS)
- SPILLS CAN BE DIFFICULT TO PROPERLY CLEAN UP

YOU'VE DECIDED ON A FORM, NOW WHAT?

- THE NEXT STEP INVOLVES FINDING A COMPETENT POLYMER SALESPERSON
- THEY SHOULD PERFORM A SERIES OF TESTS (JAR TESTS) TO IDENTIFY A POLYMER, OR POLYMERS, THAT SHOW PROMISE WITH YOUR PARTICULAR SLUDGE
- IT IS COMMON PRACTICE FOR THE SALESPERSON TO THEN SUPPLY A SAMPLE OF SUFFICIENT SIZE TO RUN FULL SCALE (5 GALLON PAIL OR 55 GALLON DRUM FOR EMULSIONS, 50 POUND BAG FOR DRY POWDERS)

YOU'VE DECIDED ON A FORM, NOW WHAT?

THE GOAL IS TO TRANSLATE THE FINDINGS ON THE LAB SCALE TO FULL SCALE

STORAGE AND HANDLING / HOUSEKEEPING

DRY POLYMERS

- ALWAYS STORE DRY POLYMERS IN A COOL, DRY PLACE
- AVOID HUMID STORAGE ENVIRONMENTS
- LOOSE POWDER / SPILLS CAN BE CLEANED UP WITH A WET/DRY VAC
- ALWAYS WEAR PPE (GLOVES, GOGGLES, MASKS) WHEN HANDLING DRY POLYMERS
- PROPERLY STORED DRY PRODUCT CAN LAST YEARS

STORAGE AND HANDLING / HOUSEKEEPING

EMULSION POLYMERS

- EMULSION POLYMERS WILL REMAIN ACTIVE FOR 6+ MONTHS IF STORED PROPERLY
- AVOID EXTREME TEMPERATURES AND DIRECT SUNLIGHT (DON'T STORE OUTDOORS)
- DO HAVE A TENDENCY TO SEPARATE, SO IF NOT USED OFTEN WOULD BE BEST TO MIX PRODUCT PERIODICALLY
- AVOID CONTAMINATION WITH WATER
- CLEAN UP SPILLS WITH INERT MATERIAL (SAND, SAWDUST, KITTY LITTER) – DO NOT HOSE SPILLS WITH WATER!!!

FINAL THOUGHT…

- DO NOT BUY POLYMER STRICTLY ON PRICE
  - THESE ARE SPECIALTY CHEMICALS, NOT COMMODITIES, AND ALL POLYMERS ARE NOT CREATED EQUAL
  - CERTAIN CHEMISTRIES WILL GREATLY OUTPERFORM THEIR COMPETITION (LOWER POLYMER DOSAGE, HIGHER CAKE SOLIDS, CLEANER FILTRATES/CENTRATES) AND THESE EFFICIENCIES CAN ADD UP TO SIGNIFICANT COST SAVINGS OVER THE LONG RUN
  - PRICE IS IMPORTANT, BUT YOU HAVE TO LOOK AT THE TOTAL PICTURE WHEN ULTIMATELY DECIDING WHICH POLYMER TO USE IN YOUR APPLICATION

THANK YOU!

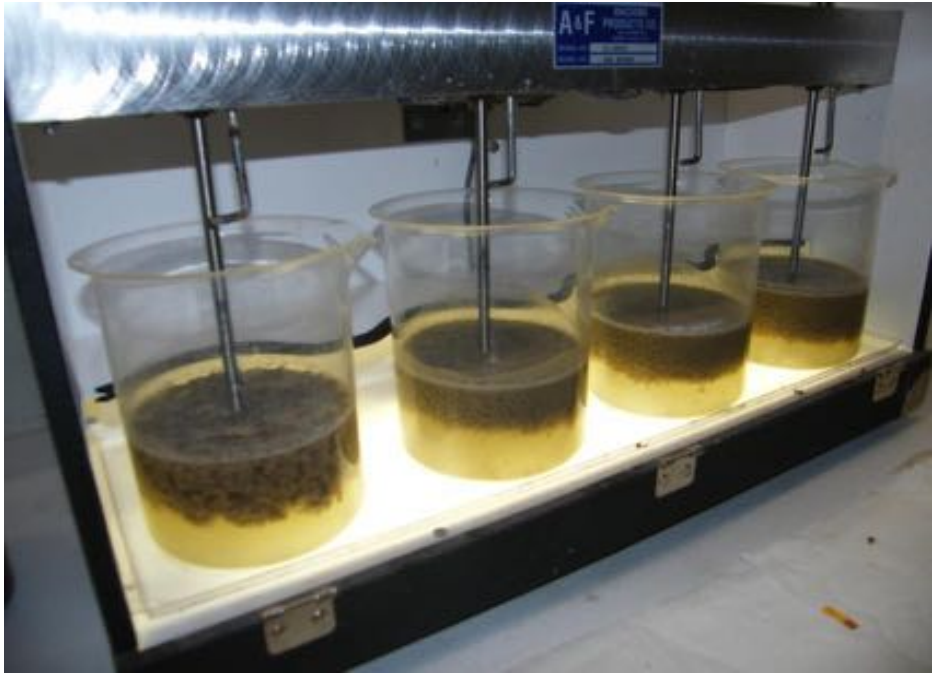
QUESTIONS?

Polymer Addition & Optimization

On Demand vs. Batch Process

ALL DEWATERING…

Chemistry Needs to be Optimum for RESULTS!



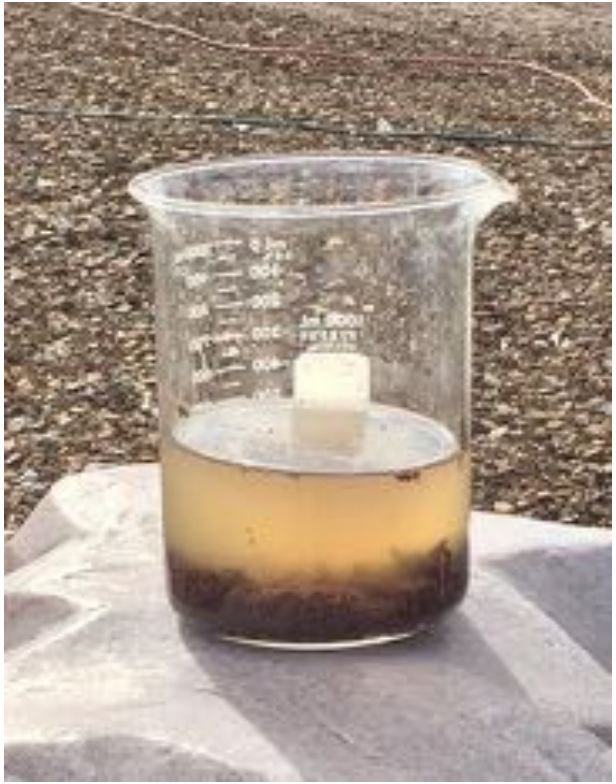
ALL DEWATERING…

Chemistry Needs to be Optimum for RESULTS!

ALL DEWATERING…

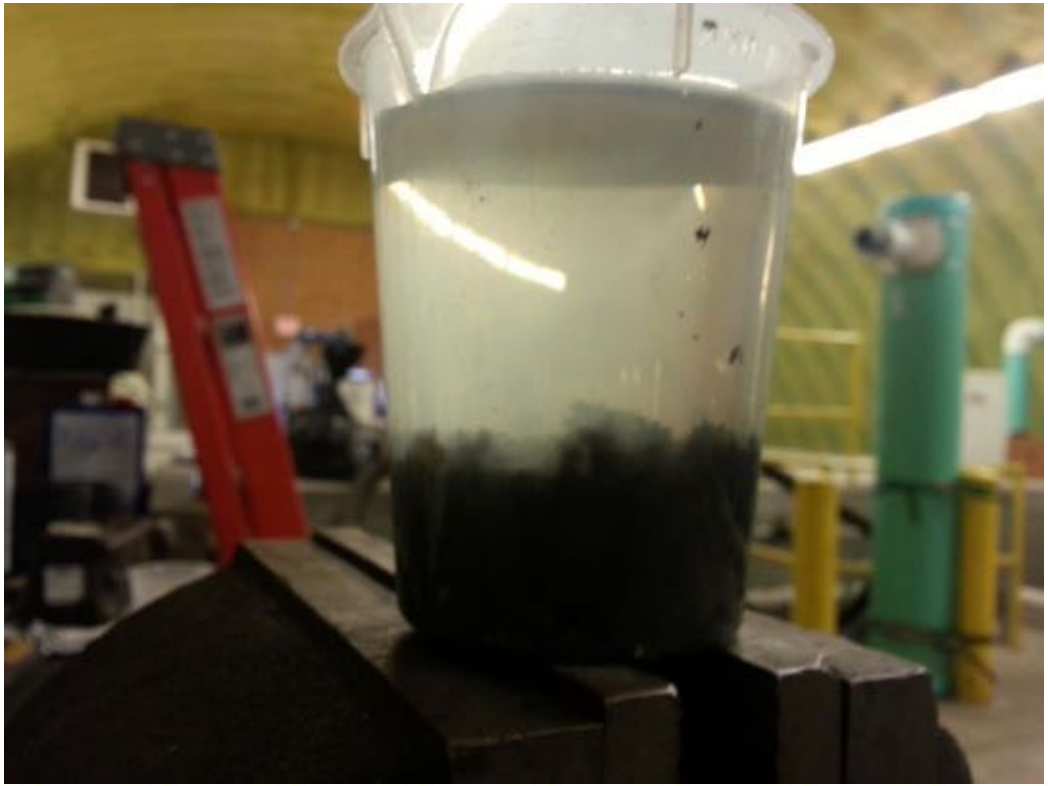
Chemistry Needs to be Optimum for RESULTS!

Thicken & Decant



Creative Mixing Chamber

Water Quality Standard….Online Chemistry



Tank Management

PHASE 2

pH Adjusting Zone Is Automated for Success

PHASE 2

Lime Stabilization Tank…pH Adjusting Zone

This Is Pumped to the Dewatering Phase…

Thank You!

Therese Wheaton
Crystal Environmental
800-328-9720

"Specializing in Industrial and Municipal Solids-Liquid Separation since 1992"

Biofilter for Odor Control

Tom Ferrero

Elkhart Environmental Processing Corp

NAWC Environmental, LLC

- Overview
  - Why Odor Control?
  - Available Techniques
  - Biofilter Construction

- Safety
  - Corrosion
    - Hydrogen Sulfide
  - Explosion
    - Methane
  - Health
    - Air borne disease

- Odor Control Strategy
  - Identify Sources of Odors
    - Septage Receiving Area
    - Screening and Grit Removal
    - Equalization Tanks
    - Processing – Dewatering
    - Filtrate
  - Estimate Degree of Control Required based on proximity of downwind receptors
  - Evaluate Options
  - Select Appropriate Strategy
  - Design and Construct

- Odor Control Strategy
  - Best Management Practices
    - Use quick-disconnect fittings
    - Avoid “Free Fall” of septage
    - Provide washdown facilities for spills
    - Ventilate tanks to odor control system
    - Everything inside!

- Odor Control Strategy
  - Best Management

- Odor Control Strategy
  - Best Management

- Odor Control Strategy
  - Best Management

- Odor Control Strategy
  - Best Management Practices

- Odor Control Strategy
  - Best Management

- Odor Control Strategy
  - Best Management

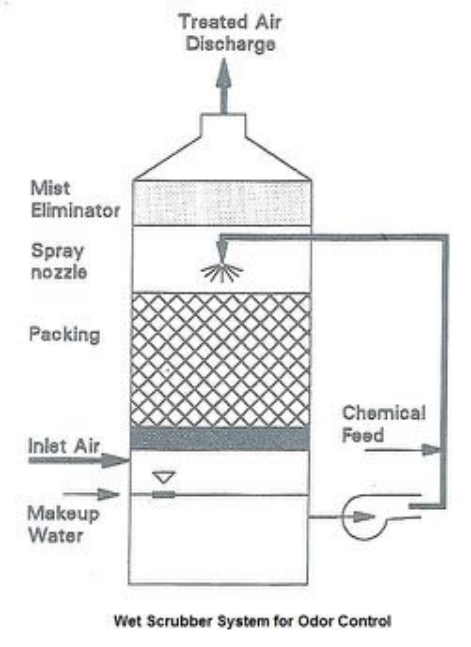
- Available Techniques
  - Remote Site
  - Odor counteractants (Misting)
  - Wet Scrubber
  - Activated Carbon
  - Biofilter

- Available Techniques
  - Remote Site

- Available Techniques
  - Misting (odor counteractants)
    - Sprayed into the atmosphere
    - React with odorous compounds
    - Encapsulate odorous compounds
    - Substantial cost of chemicals
    - 30 to 40% reduction of odors

- Available Techniques
  - Odor Counteractants

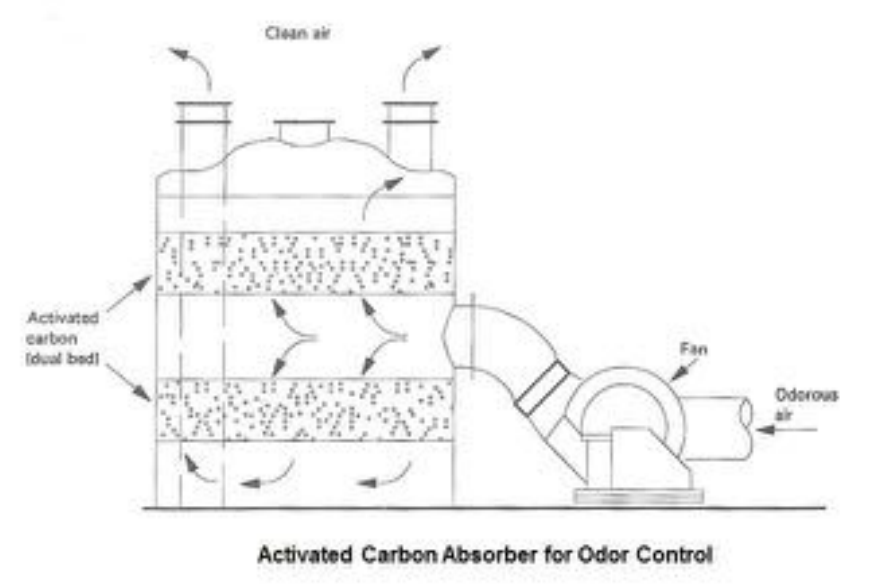
- Available Techniques
  - Wet Scrubber



Wet Scrubber System for Odor Control

- Wet Scrubber

- Available Techniques
  - Activated Carbon Absorber



Activated Carbon Absorber for Odor Control

- Available Techniques
  - Activated Carbon Absorber

- Available Techniques
  - Biofilters

-Passing odorous air through a media containing microbial populations

-Microbes use the odorous compounds as a food source

-Media must be kept moist and air must have good paths through media

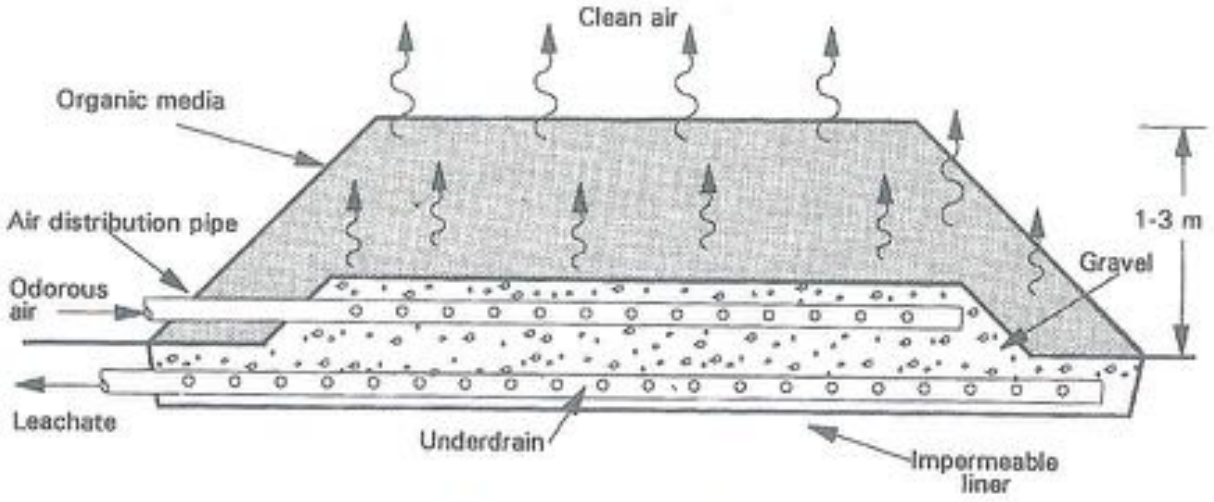
-Requires long contact times and low velocities

-Systems come in a variety of designs and media configurations

- Available Techniques
  - Biofilters

Technique	Cost Factors	Advantages	Disadvantages
Wet Scrubber	Moderate Capital and operating costs	Effective and Reliable	High Chemical Use, and spent chemical to dispose
Activated Carbon Absorber	Cost depends on frequency of carbon use	Simple, few moving parts, effective	Only applicable for dilute streams
Biofilters	Low capital and O&M costs	Simple, minimum O&M	Design criteria not well established, large land area
Odor Counteractants	Cost dependent upon chemical usage	Low Capital cost	Limited odor removal efficiency

- Biofilter Construction



Biofilter System for Odor Control

- Biofilter Construction

- Biofilter Construction

- Biofilter Construction

- Biofilter Construction

- Biofilter Construction

Typical Design Criteria for Biofilters	
Parameter	Value
Hydraulic Loading	2-10 cfm/sq ft
Detention Time	20-60 seconds
Media Depth	3-5 ft
Media pH	6-8
Pore Volume	40-50%
Moisture Content	50-60%
Media Constitutents	Bark Mulch, hardwood chips, biosolids or leaf compost
Humidity of inlet air	80-100%
Recommend air changes	6 volume changes/hour

Typical Design Criteria for Biofilters	
Parameter	Value
Hydraulic Loading	2-10 cfm/sq ft 15000 cfm / 2500 sf
Detention Time	20-60 seconds
Media Depth	3-5 ft
Media pH	6-8
Pore Volume	40-50%
Moisture Content	50-60%
Media Constitutents	Bark Mulch, hardwood chips, biosolids or leaf compost
Humidity of inlet air	80-100%
Recommend air changes	6 volume changes/hour

Typical Design Criteria for Biofilters	
Parameter	Value
Hydraulic Loading	2-10 cfm/sq ft 6 cfm / sq ft
Detention Time	20-60 seconds
Media Depth	3-5 ft
Media pH	6-8
Pore Volume	40-50%
Moisture Content	50-60%
Media Constitutents	Bark Mulch, hardwood chips, biosolids or leaf compost
Humidity of inlet air	80-100%
Recommend air changes	6 volume changes/hour

Typical Design Criteria for Biofilters	
Parameter	Value
Hydraulic Loading	2-10 cfm/sq ft 6 cfm / sq ft
Detention Time	20-60 seconds
Media Depth	3-5 ft 4 ft
Media pH	6-8
Pore Volume	40-50%
Moisture Content	50-60%
Media Constitutents	Bark Mulch, hardwood chips, biosolids or leaf compost
Humidity of inlet air	80-100%
Recommend air changes	6 volume changes/hour

Typical Design Criteria for Biofilters	
Parameter	Value
Hydraulic Loading	2-10 cfm/sq ft 6 cfm / sq ft
Detention Time	20-60 seconds 40 seconds
Media Depth	3-5 ft 4 ft
Media pH	6-8
Pore Volume	40-50%
Moisture Content	50-60%
Media Constitutents	Bark Mulch, hardwood chips, biosolids or leaf compost
Humidity of inlet air	80-100%
Recommend air changes	6 volume changes/hour

Biofilter for Odor Control

Questions?

Tom Ferrero

Elkhart Environmental Processing Corp NAWC Environmental, LLC

tom@ferrero.bz (267) 250-4068