TRAINING PROGRAMME FOR ETP OPERATORS IN TEXTILE INDUSTRY

Promotion of Sustainability in the Textile and Garment Industry in Asia - FABRIC

giz Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH

FABRIC Asia

Sludge dewatering operations

GIZ FABRIC – ETP Operator Course

Contents

- Operation and maintenance of sludge pumps
- Sludge thickening systems
- Sludge dewatering systems
- Sludge drying beds

Operation and maintenance of sludge pumps

Operation and maintenance of sludge pumps

Centrifugal pumps

Before starting

- **Check rotation** of pump for smooth turning
  - If coupling accessible, rotate by hand to make sure drive not stuck
- **Open inlet valve** in case of positive suction of pumps
  - For self priming pumps ensure inlet line not empty
- **Open discharge line** and **valve**
- Start pump

Operation and maintenance of sludge pumps

Centrifugal pumps

During operation

- Ensure discharge
  - smooth and without intermittent surge
  - In line with pump capacity
- Check for any leaking in mechanical seal.
  - If any leak, check at earliest for cause for seal breakage (such as dry running misalignment of seal rings)
- Once operation complete, switch off pump
- Flush pump if water provided

Operation and maintenance of sludge pumps

Centrifugal pumps

After operation and maintenance

- Look for any visible sign of impeller wear and tear
- Flushing with water jets if any blockage in inlet line
  - Check pump manual for flushing instructions
- Maintain pump with
  - periodical cleaning
  - flushing pipelines
  - applying oil and grease

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Operation and maintenance of sludge pumps

Submersible pumps

Before starting

- Level controllers setting
  - to start in maximum level
  - to switch off level just above pump top level.
- Ensure unit to which pumping already in operation (e.g. sludge thickener)
- After switching on pump, check control panel carefully.

Operation and maintenance of sludge pumps

Submersible pumps

During operation

- Ensure seal monitor signal normal.
  - If warning, switch off pump immediately
  - Lift it up and attend to the fault
- After switching on, check for severe vibrations or wobbling of discharge pipeline.
  - Indicating clogged cutter mechanism/grinder.
- Check sludge being pumped ensuring corresponding to designed level and continuous discharge

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Operation and maintenance of sludge pumps

Submersible pumps

Stopping operation

- Switch off the pump once **pump top exposed**.
  - Submersible pumps are cooled by surrounding water
  - Empty running burning motor

Operation and maintenance of sludge pumps

Dos and Don´ts using submergible pumps

What to do

- **Rotate pumps between running and standby** units in daily basis to keep good operating condition
- **Check amperage** of pump motors and compare it with standard values.
- **Clean level controller probe** at least once a week.

Operation and maintenance of sludge pumps

Dos and Don´ts using submergible pumps

What to do

- Check pump operation after switching on.
  - Check and immediately attend to any vibrations, jerks and noise.
- **Check level controller** operation occasionally by lifting same to stop and lower to restart
- Check sludge being pumped to make sure **mass pumped proportional** to **normal level**

Operation and maintenance of sludge pumps

Dos and Don´ts using submergible pumps

What to avoid

- **Never run** sludge pump **immediately after** adding any **conditioning chemicals**
  - Give 10 minutes of agitation before starting pump
- **Never** let sludge get **dried at pipes**
  - On prolonged stoppage, open and flush inlet before re-starting
- **Never start pump without agitator** in collection tank **switched on**

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Operation and maintenance of sludge pumps

Dos and Don´ts using submergible pumps

What to avoid

- **Never enter sludge sump** without checking for any H_2S and observing all safety precautions
- **Never run** pump if same **overheated** and showing any **wobbling**
- Never attend to pump without proper disconnection of power and wearing PPEs

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Operation and maintenance of sludge pumps

Progressive cavity pumps

Before starting

- Ensure agitator in sludge collection tank in continuous
  - If not, wait for at least 10 minutes before starting pump
- Use non-petroleum based lubricant when installing rotors into stators to preclude elastomer attack and resulting swelling
  - Castor oil inexpensive and good choice
- Open discharge line and valve
- Start the pump

Operation and maintenance of sludge pumps

Progressive cavity pumps

During operation

- Ensure discharge smooth without intermittent surge and in line with pump capacity
- Check condition of stator frequently
- Once pumping completed, switch off pump
- Flush pump if water provided

Operation and maintenance of sludge pumps

Progressive cavity pumps

After operation and maintenance

- Check stator replace with new rubber one if worn.
  - For every two stator replacement, replace/re-chrome the rotor as well
- Check for visible sign of impeller wear and tear.
- Use water jets if any blockage in inlet line
  - Check pump manual for instructions on same

Operation and maintenance of sludge pumps

Dos and Don´ts using cavity pumps

What to do

- Check and **replace any rotors worn** past chrome plating.
  - If chrome plating intact, re-chroming done
- **Check level controller** operation occasionally by lifting same to stop and lower to restart.
- Check and **immediately attend** to any **vibrations**, **jerks and noise**

Operation and maintenance of sludge pumps

Dos and Don´ts using cavity pumps

What to do

- Consider reversing used stators (flipped end for end) and reuse before opting for new
- **Check amperage** of pump motors and compare with standard values
- **Clean level controller** probe at least once a week.

Operation and maintenance of sludge pumps

Dos and Don´ts using cavity pumps

What to avoid

- Never allow sludge to get dried at pipes.
  - On prolonged stoppage, open and flush inlet before re-starting unit
- Never run pump if same overheated and showing any wobbling
- Never attend to pump without proper disconnection of power and wearing PPEs

Operation and maintenance of sludge pumps

Dos and Don´ts using cavity pumps

What to avoid

- Never run sludge pump immediately after adding any conditioning chemicals
  - Allow 10 minutes of agitation before starting pump
- Never enter sludge sump without checking for H_2S and observing all safety precautions
- Never attend to pump without proper disconnection of power and wearing PPEs
- Never start pump without agitator in collection tank switched on.

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Operation and maintenance of sludge thickener

Operation and maintenance of sludge thickener

Gravity thickener

- Before pumping, check unit
  - If empty, make sure clean and no debris.
- Once sludge level reaching scraper blade level, switch on scraper
- Ensure all bottom sludge guided by scraper to center
  - If not, adjust rubber squeeges
- Once thickener full, check overflow to be uniform and without thick sludge
  - If not, adjust V notch weir
  - If thick sludge in overflow, reduce feeding and solid loading rate

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Operation and maintenance of sludge thickener

Gravity thickener

- In case sludge conditioning, experiment with different chemicals and dosages before deciding on dosage
- On completion of pumping, empty thickener unless entire operation continuous
  - e.g. wasting of sludge, thickening and operation of dewatering unit
- Never allow sludge to be remain in thickener for more than 3 days

Operation and maintenance of sludge thickener

Dos and Don´ts using gravity thickener

What to do

- **Always run scraper mechanism** when sludge present in thickener.
- Ensure **no foul smell** in thickener present
  - If smell detected, empty unit and disinfect
- Ensure **skimmer mechanism adequate** to scoop scum
  - Adjust if needed

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Operation and maintenance of sludge thickener

Dos and Don´ts using gravity thickener

What to do

- **Empty tank** and drain clear lines cleared in case of **batch operation**
  - Even in **continuous** plants, drain fully **once in fortnight**
- **Check amperage** of thickener motor and compare with standard values
- **Check for gas bubbles** indicating unremoved sludge
  - If bubbles noted, increase sludge evacuation and empty tank if needed

Operation and maintenance of sludge thickener

Dos and Don´ts using gravity thickener

What to avoid

- Never **run thickener** if **torque alarm** occuring
  - If lifting arrangement, continue lifting
- Never allow **accumulation of thickened sludge**
  - keep underflow operation @30-50% of influent flow
- Never attend to thickener **without safety precautions**, especially safety harness, ropes and PPEs

Operation and maintenance of sludge thickener

Dos and Don´ts using gravity thickener

What to avoid

- Never allow **supernatant** to carry **high quantity of sludge**
  - Fix feed rate through trial and error
  - Resort to conditioning if needed
- Never allow **sludge blanket to get broken** by too much withdrawal or variations in influent feed rate
- Never **add** any **chemical directly** to thickener
  - except odor control chemicals like chlorine

Operation and maintenance of sludge thickener

Air floatation thickener

1. Close drain valves
2. Open valves on recycle water systems.
   - If thickener empty, open auxiliary water supply
3. Start re-circulation pump
   - If thickener empty wait till full and auxiliary water supply line closed
4. Start air feed
5. Adjust flow rates to required level fixed through trial and error

Operation and maintenance of sludge thickener

Air floatation thickener

6. Start chemical feed system
7. Run unit for 10-15 mins before feeding sludge to thickener to charge the unit with conditioning chemical and aerated water.
   - Identify optimum sludge feeding rate on trial and error basis
   - Once established, start sludge feeding

Operation and maintenance of sludge thickener

Air floatation thickener

8. Do visual check.
   - Problem with reaeration if large flocs carried over to recycle water
   - Chemical deficiency or overloading if turbid outlet
9. Before shutting down, run skimmer unit for extra 15 - 20 minutes for floatation retention tank having clean water.

Operation and maintenance of sludge thickener

Air floatation thickener

10. To stop unit shut off in following order:
    1) Air supply
    2) Re-aeration pump
    3) Recirculation pump
    4) Sludge skimmer
    5) Roller

Operation and maintenance of sludge thickener

Dos and Don´ts using floatation sludge thickener

What to do

- Check **torque reading** in monitor
  - If no torque monitor check shear pins
- Check **air bubble size**
  - If not satisfactory, adjust **compressor rate**
- Do additional recycle if need to dilute feed sludge or air appears insufficient

Operation and maintenance of sludge thickener

Dos and Don´ts using floatation sludge thickener

What to do

- Increase **air pressure** if degree of **solids concentration** and **subnatant quality** not satisfactory.
- **Check amperage** of unit motors to be in line with standard values
- Clean **level controller probe** at least **once a week**.

Operation and maintenance of sludge thickener

Dos and Don´ts using floatation sludge thickener

What to avoid

- Never run unit **without required air pressure** to ensure air saturation
- **Never vary sludge flow rate** during operation
  - Keep rate as constant as possible!
- Never attend to floatation thickener without proper disconnection of power
  - Wear PPEs!

Operation and maintenance of sludge thickener

Dos and Don´ts using floatation sludge thickener

What to avoid

- Never keep unit in “switched on position” if power shutdown.
  - To re-start operation, follow same sequence of start up as described earlier
- Never **exceed solid loading rate** of floatation thickener (in any case **not more than 15 kg/m²/h**)
- Never run unit with air to solids ratio of < 0.02 and > 0.04

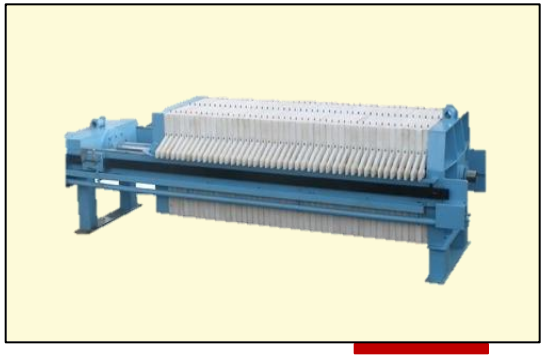
Operation and maintenance of sludge dewatering devices

Operation and maintenance of sludge dewatering

Operation of chamber filter press

Before starting

- Make sure
  - **plates aligned properly**
  - **cloths in place**
  - **light safety curtain**, if available, **switched on**
- Keep agitator in sludge tank running for at least 10 minutes before starting of feeding



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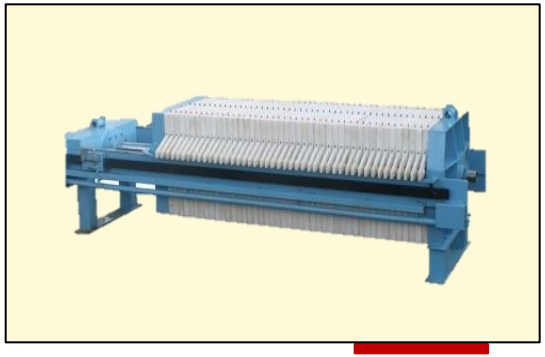
Operation and maintenance of sludge dewatering

Operation of chamber filter press

- Close press by switching on hydraulic closure
  - change in motor sound noticeable when plates fully closed.
- Start sludge pump and chemical dosing if chemical conditioning present.
- Observe **filtrate flow**
  - **every 30 minutes** during **early cycle**
  - **once in 10 minutes** towards **end of cycle**
  - cycle complete when filtrate flow trickling



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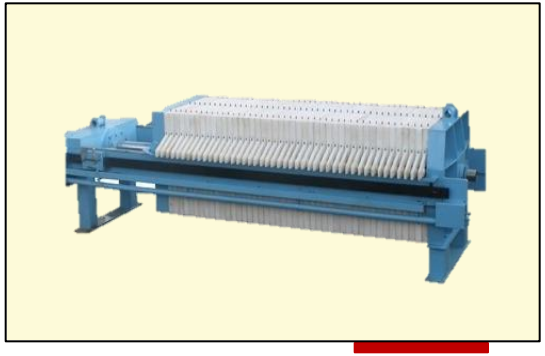
Operation and maintenance of sludge dewatering

Operation of chamber filter press

- **Pump pressure at maximum** operating level towards **end of cycle**

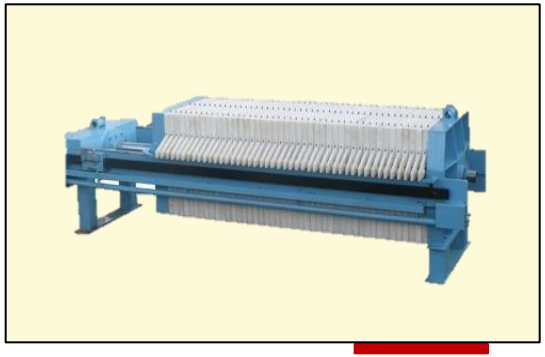


Operation and maintenance of sludge dewatering

Operation of chamber filter press

To stop operation:

- Shut down sludge feed pump
- Stop chemical conditioning in sludge tank
- Check for “no pressure” on pumping pressure gaug
- Keep press closed tightly.
- If press with central air drying system or steam flow from boiler, run blower or steam



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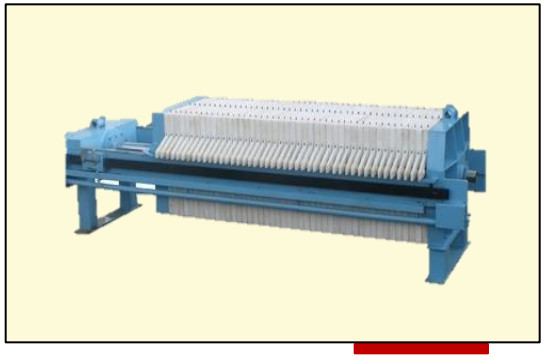
Operation and maintenance of sludge dewatering

Operation of chamber filter press

To stop operation:

- **Open plates** (manually, if not automatic) **one by one** to release cake
  - Push any stuck sludge using wooden spatula
  - Avoid damaging filter cloth!
- If no automatic cloth wash, wash with water jet
  - keep portable water pump with fine nozzle for jet with high pressure
- Close filter plates again and prepare for next cycle



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Operation and maintenance of sludge dewatering

Operation of chamber filter press

To remember indicators end of cycle:

- Filtrate rate reduced to trickle
- Sludge pumping quantity at minimum despite full pressure.

Operation and maintenance of sludge dewatering

Dos and Don´ts using chamber filter press

What to do

- **Drip tray kept closed** during operation
- Open drip tray before opening plates
- Check amperage of press and pump motors in line with standard values.
- **Wash cloths after every cycle**.
  - Do **intense cleaning once a week**
  - Replace when cloth worn-out

Operation and maintenance of sludge dewatering

Dos and Don´ts using chamber filter press

What to do

- Check pump operation after switching on
- Attend to any vibrations, jerks and noise immediately!
- Do trial and error, observe efficiency with different cloths and select best one for your ETP sludge.
- Check working of light curtain
  - Ensure unit stops when insertion between plates

Operation and maintenance of sludge dewatering

Dos and Don´ts using chamber filter press

What to avoid

- **Never** run **sludge pump immediately** on adding any conditioning chemicals.
  - Instead **10 minutes of agitation** before starting pump!
- **Never** finalize **chemical conditioning without trial**
  - Instead check different chemicals and doses
- Never start filter feed pump without agitator in collection tank switched on

Operation and maintenance of sludge dewatering

Dos and Don´ts using chamber filter press

What to avoid

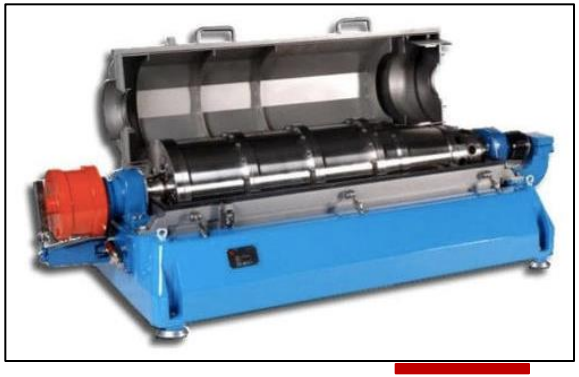
- Never **stop operation** of filter press and discharge cake **before completing operation cycle**
  - Risk of spoiling cloths
- Never run feed pump after power cut without ensuring that hydraulic closure sufficient.
- Never attend to filter/hydraulics/pump without proper disconnection of power
  - Make sure to wear PPEs!

Operation and maintenance of sludge dewatering

Operation of sludge centrifuge

Before starting

- Optimize polyelectrolyte (PE) dosing through jar tests in laboratory.
  - Dosing between 3 to 5 g of polyelectrolyte /kg dry solids in sludge.
- Dilute PE to 0.05-0.1% in preparation tank
  - Keep stock solution at 0.5-1%.



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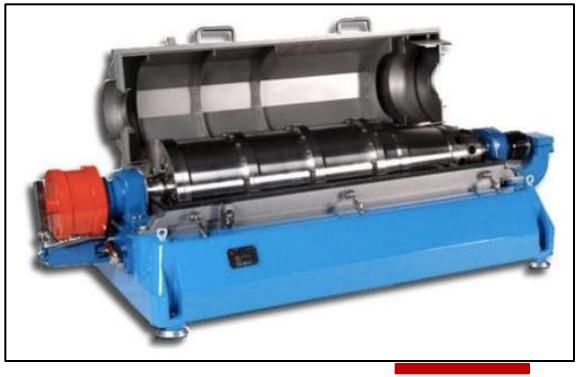
Operation and maintenance of sludge dewatering

Operation of sludge centrifuge

Before starting

- For oil lubricated centrifuges…
  - check oil level
  - start oil pump
  - check temperature and adjust cooling water.
- For grease lubricated centrifuged, ensure proper greasing
- Start centrifuge motor on empty load and check for any unusual vibrations or noise



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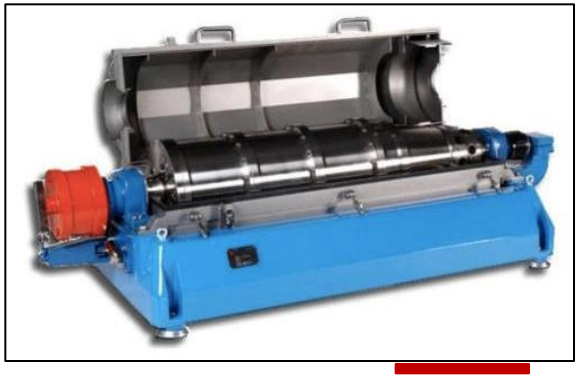
Operation and maintenance of sludge dewatering

Operation of sludge centrifuge

- Start up and run agitator in sludge tank
- Run feed pump and check sludge and centrate flow.
- Start dosing PE with dosing pump simultaneous to sludge feeding
- During operation too, **check oil level and flow** to bearings
- **Observe centrate**
  - To be clear and not excessively cloudy.
  - If too turbid, re-adjust polymer dosing



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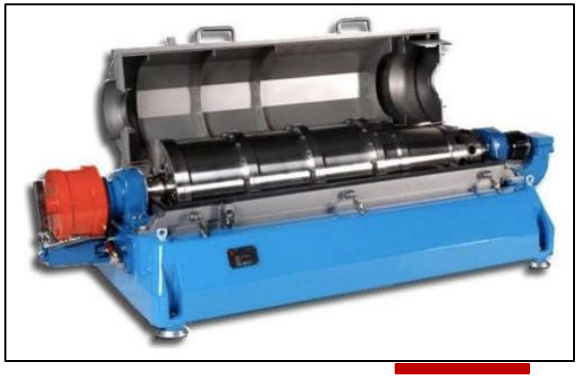
Operation and maintenance of sludge dewatering

Operation of sludge centrifuge

- Determine optimum sludge feed rate through trial & error.
  - Make adjustments with respect to solids load every now and then.
- If centrifuge with variable speed of rotation
  - increase bowl speed for less cake moisture and maximum recovery of solids
  - decrease conveyor speed if sludge too much moisture and centrate cloudy.



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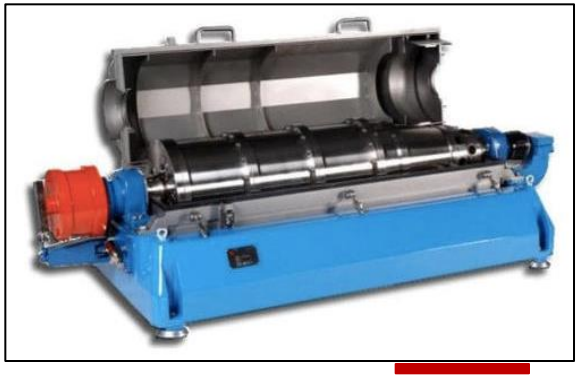
Operation and maintenance of sludge dewatering

Operation of sludge centrifuge

Stopping operation

- **Stop sludge feed** while centrifuge still in operation
- Thoroughly **flush unit with water** before switching off centrifuge
  - Continue flushing till it centrifuge stopping
- **Turn-off lubrication system and cooling water** only **after complete stop**.
- **Flush out all sludge deposits** before next cycle



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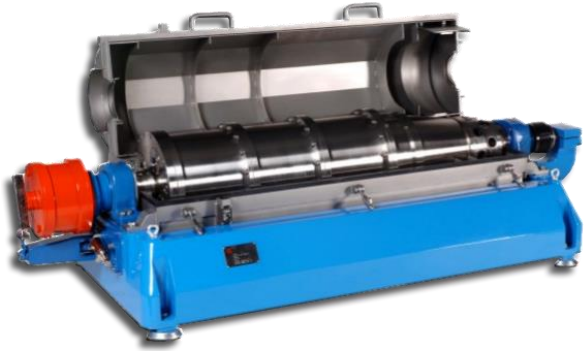
Operation and maintenance of sludge dewatering

Dos and Don´ts using sludge centrifuge



What to do

- **Check amperage** of centrifuge in line with limit
  - Excess amperage indicating **overloading**
  - Stop unit immediately in case
- **Check** for any **unusual noises** indicating bearing failures
- Optimize by testing centrifuge with (i) variable bowl speed, (ii) pool depth, (iii) conveyor speed and (iv) polymer dosage

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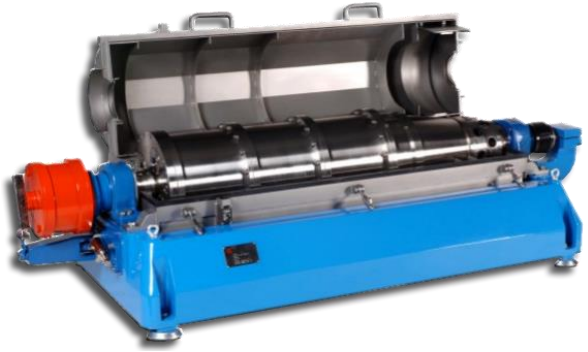
Operation and maintenance of sludge dewatering

Dos and Don´ts using sludge centrifuge

What to do

- **Follow start up procedures** if machine operation interrupted by power shutdown.
  - Do not start centrifuge with sludge inside!
- Only **liquid and smooth sludge to be fed** to the centrifuge without grit
  - Grit eroding centrifuge bowl.

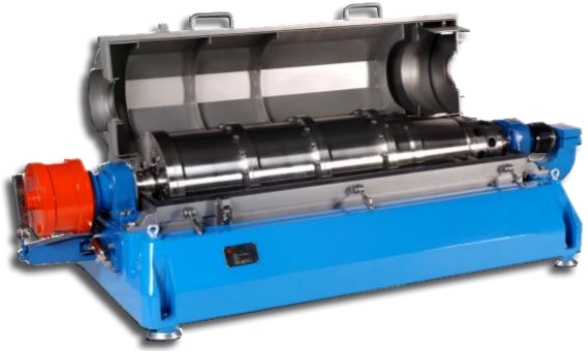


Operation and maintenance of sludge dewatering

Dos and Don´ts using sludge centrifuge

What to avoid

- **Never** run unit if **bearing assembly** becoming too **hot**
- Never switch on any centrifuge shutdown after torque overload
  - Allow sufficient cooling time!
- Never attend to centrifuge without proper disconnection of power
  - Make sure to use lock-out tag out procedure and PPEs

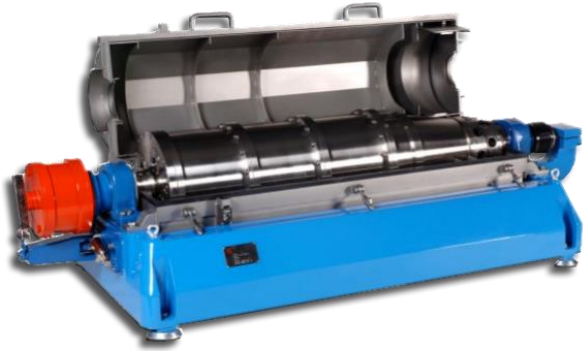


Operation and maintenance of sludge dewatering

Dos and Don´ts using sludge centrifuge

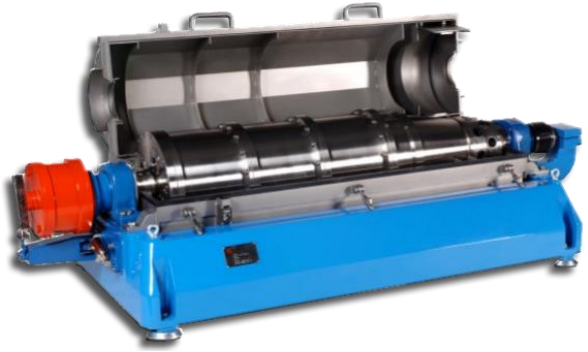
What to avoid

- **Never** run centrifuge **without built-in instrumentation**, manually over riding controls.
- Never start centrifuge unit **after tripping due to safety relays**
  - **Check relays** and attend to cause of overload after through cleaning.



Operation and maintenance of sludge dewatering

Operation of belt press



Before starting

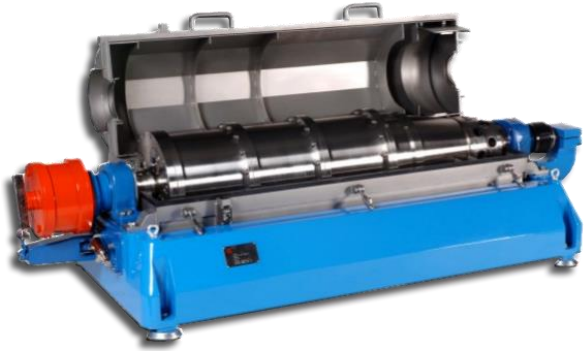
- Optimize polyelectrolyte (PE) dosing through jar tests in laboratory.
  - Dosing between 3 to 5 g of polyelectrolyte /kg dry solids in sludge.
- Dilute PE to 0.05-0.1% in preparation tank
  - Stock solution 5-10%.

Operation and maintenance of sludge dewatering

Operation of belt press

Starting operation

- Turn on air compressor and ensure air-pressure within specified range.
- Open filter cloth cleaning water pump
  - Water quantity not too small or high.
- Switch on vacuum pump and vacuum pump circulating water
  - Check vacuum reading to be within range



Operation of belt press

Starting operations

- Establish schedule with optimum values for
  - speed of belts
  - chemical pumping rate
  - sludge pumping rate

Operation and maintenance of sludge dewatering

Operation of belt press

Starting operations - Setting correct speed

- Initiate belt filter operation with lower speed
- Wait for vacuum adsorption on filter cloth
- When vacuum reached, open lowering valve, observe material thickness at lower end and adjust belt speed.
  - Material thickness to be in range of generally 2-3 cm
  - If material too thin, reduce speed; if too thick, increase speed

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Operation and maintenance of sludge dewatering

Operation of belt press

Stopping operations

- Close blanking valve
- Wait for filter belt to idle for 5 minutes
- **Wash residual sludge from cloth**!
  - sludge sticking on underside create tracking problem
- Turn off filter and stop water sprays as well as vacuum pump
- In case of **power shutdown**, **do not continue operation** but wash unit and re-start filtration cycle.
- Drain sludge and water and clean thoroughly with hose.

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Operation and maintenance of sludge dewatering

Dos and Don´ts using belt press

What to do

- **Control feed** to gravity portion of belt to prevent spillage of sludge
  - If excessive, reduce pumping rate.
- Prepare diluted PE afresh and **dose with freshly prepared PE**
- **Check guidance plates** positioning sludge towards belt centre with no sludge being squeezed out at sides of filter

Operation and maintenance of sludge dewatering

Dos and Don´ts using belt press

What to do

- **Scrape pressed sludge off** belt and collect in bin
- **Capture all filtrate and wash water** transferred back to equalisation tank in ETP
- **Check tightness of belt** before starting and re-starting belt press.

Operation and maintenance of sludge dewatering

Dos and Don´ts using belt press

What to avoid

- **Never operate** belt filter press **without properly working washing jet** unit
  - Prevent clogging of belts
- **Never** run unit with **misaligned belts**
  - Risk of permanent damage to belt sides
- Never attend to belt filter without proper disconnection of power
  - Apply lock-out/tag out procedures and use PPEs.

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Operation and maintenance of sludge dewatering

Dos and Don´ts using belt press

What to avoid

- Never run system with less than **optimum belt tension**
- Never allow dried sludge to escape doctor blades
  - Adjust and tighten blades if necessary!
- **Never s**top unit **without running washing cycle.**
  - Washing cycle needed on any re-start too!

Operation and maintenance of sludge drying beds

Operation and maintenance of sludge drying beds

Before admitting sludge

- **Clean drying bed** of any old sludge
  - Old sludge sticky and not dry enough to be scooped off.
- **Top up any sand** lost during previous sludge removal

Operation and maintenance of sludge drying beds

- Once drying beds ready, open sludge valve and start admitting liquid sludge
- Control and **regulate sludge admission**
  - liquid sludge to flows only on splash pad
  - not to spray to SDB ball or outside
- **Check filtrate line**
  - **filtrate to start flowing within 30 minutes** of sludge admission.
  - If no filtrate flow, stop admitting sludge and attend to issue

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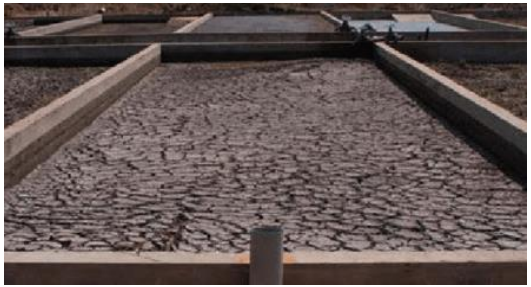
Operation and maintenance of sludge drying beds

During operation

- **Check filtrate**
  - to be **smooth and clear**
  - **without any sludge**
  - If excessively cloudy, stop admitting sludge, remove media and check issue.
- Stop admitting sludge once sludge level reaching design level
  - Usually **not more than 40 cm**



Operation and maintenance of sludge drying beds

During operation

- Leave bed to **dry for entire drying cycle**
- **Do not add any more sludge** until sludge fully dried and removed
- **Fully dried sludge cracking**

In case of rains,

- wait again until sludge fully dried.
  - rains after cracking of sludge draining out fast

Operation and maintenance of sludge drying beds

During operation

- Once sludge fully dried and cake formed, scoop out sludge
  - No vehicle or wheel burrows inside bed to collect sludge!
- Remove sludge cake carefully with minimal loss of sand
- Frequently check sand level in drying beds
- Top up sand lost on clean media
  - Sand to be clear of any debris
- Prepare surface and splash pad again for next round of sludge filling

Operation and maintenance of sludge drying beds

Dos and Don´ts using sludge drying beds

What to do

- **Keep** sludge drying beds and surroundings **clean and tidy**
- **Fill** chosen bed **to designed level**.
  - Do not admit sludge into multiple beds at one time!
- **Use drying beds in series** and come back to first bed only after filling last one

Operation and maintenance of sludge drying beds

Dos and Don´ts using sludge drying beds

What to avoid

- **Never** admit fresh sludge **to** any **beds partly filled** and under drying
- **Never keep** fully dried **sludge in drying beds for long time**
  - Be aware of rains wetting sludge again
- **Never** allow workers to **clean** filtrate line and sump **without observing all safety precautions**

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