What every operator should know about belt filter presses

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Knowledge	Principle	A practical consideration
Belt filter presses (BFPs)	Belt filter presses are used to dewater primary and/or waste activated sludges (WAS), such as those that come from aerobic or anaerobic digestion.	Belt filter presses are manufactured as either two-belt or three-belt units. The current preference is that belt filter presses have three belts, which enables the gravity zone to operate independently from the pressing zones. Belt filter presses basically have three different zones: ■ gravity zone, ■ medium pressure zone (wedge zone), and ■ high pressure zone (shear zone). Solids must be conditioned with polymer prior to being applied to a belt filter press. The polymer is used to release the water from the solids so that most of the water is removed on the gravity zone and additional water is then removed in the pressing zones. Approximately 60% to 70% of the water should be removed through the gravity zone with the remaining water removed in the wedge and shear zones.
Components	BFPs require several components that are both on the press and external to the press for successful operation.	Some external components include a polymer mixing and feed system, polymer injection ring, solids feed pumps, hydraulic (or pneumatic) power unit, spray water booster pumps, control panel, and dewatered solids conveyor (belt or screw conveyor). Some major internal BFP components include the belts themselves, rollers, flocculation tank, chicanes (plows), spray bars/nozzles, belt alignment sensors, and emergency pull cords.
Process parameters	To operate a belt press successfully operators must fully understand the process/operational parameters.	Several process/operational parameters are required to optimize belt filter press performance. These include ■ solids loading rate; ■ hydraulic loading rate; ■ polymer type, concentration, dosage; ■ belt speed; ■ belt tension; ■ type and concentration of feed solids; and ■ age of feed solids.

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Solids loading rate	The solids loading rate for a BFP is an important control parameter; the type of solids applied will determine the loading rate and the dewatered solids concentration.	The quantity of solids that are applied to a BFP are related to type of solids that are fed to the unit. For example, untreated primary sludge will have a different loading rate than waste activated sludge or anaerobically digested sludge. All solids will require polymer. The majority of facilities use a cationic polymer for solids conditioning. The polymer dosage rate also will vary with the type of solids applied. Many combinations of solids can be applied to a BFP, the list below shows a partial list of solids loading rates for the most common solids types and combinations. (Always check the BFP manufacturer's recommended solids loading rates.) ■ Primary sludge can be applied at 900 kg/(m•h) (2000 lb/m/h). ■ Primary and WAS mixture can be applied at 635 kg/(m•h) (1400 lb/m/h). ■ Anaerobically digested primary and WAS can be applied at 400 kg/(m•h) (900 lb/m/h). ■ Aerobically digested sludge can be applied at 340 kg/(m•h) (750 lb/m/h).
Hydraulic loading rate	Hydraulic loading rate is the quantity of water added in gallons per minute per meter (or liters per second per meter) to the BFP.	The hydraulic loading rate and solids loading rate are affected by the type of solids applied. For example, primary sludge will have one hydraulic loading rate and waste activated will have another. The hydraulic loading rate will depend on the type of solids, the solids concentration, condition of the solids, and other factors. As stated above, numerous combinations of solids can be applied to a BFP. Below is a partial list of hydraulic loading rates for the most common solids types and combinations. (Always check the BFP manufacturer's recommended hydraulic loading rates): ■ Primary sludge can be applied at 5 L/(m•s) (80 gal/m•min). ■ Primary and WAS sludge mixtures can be applied at 4 L/(m•s)(70 gal/m•min). ■ Anaerobically digested primary and WAS sludges can be applied at 4 L/(m•s) (60 gal/m•min). ■ Aerobically digested sludges can be applied at 5 L/(m•s) (75 gal/m•min). The condition of the feed solids also will affect the solids and hydraulic loading rates. Old or septic feed sludge will be difficult to condition and dewater and may not dewater at all.
Spray water	Effective BFP operation requires that the belts be clean so that water can pass through. Therefore, it is important that the belt is effectively cleaned with large quantities of water at the proper pressure.	Spray water keeps the belts clean. Several spray bars that contain fan type spray nozzles deliver the water. The spray water must be clean and maintained at a pressure between 690 to 862 kN/m^3 (100 and 125 lb/in.^{2}). If the water pressure falls below a preset pressure, a low water pressure alarm should sound. When the BFP is being shut down, the spray water and belts continue to run for approximately 15 minutes after the solids and polymer are stopped to clean the belts.
Hydraulic or pneumatic power unit	A hydraulic or pneumatic power system is important for BFP operation because it is used to tension the belts and operate the belt alignment system.	Older units used pneumatic power units while newer units utilize hydraulic power units. The power units supply the pressure to tension the belts and operate the belt alignment system. Typically, the hydraulic pressure for belt tensioning is between 1380 and 2760 kN/m^3 (200 to 400 lb/in.^{2}) and the pressure for the belt alignment is between 830 and 1030 kN/m^3 (120 and 150 lb/in.^{2}). These pressures are dependent on the requirements of the belt press manufacturer.

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Belt alignment	Belt alignment is important. The belt can be damaged if it travels too close to the sides of the press.	As the belt moves around the press it tends to move laterally toward the edges of the press. If the belt bunches to the edge it could break and/or be damaged. Sensors at the edges of the belt press adjust the belt back toward the center of the unit. When a sensor feels the belt, a signal is sent to the hydraulic or pneumatic unit that in turn adjusts a belt roller to move the belt back to the center of the press. If a belt breaks, broken belt sensors will send an alarm to alert the operator there is a problem. The broken belt sensor also will shut down the BFP, solids feed, and polymer feed.
Chemical conditioning	One of the parameters that makes a belt press effective is proper solids conditioning with polymer.	Solids conditioning with polymer is necessary to release bound water from the feed sludge. There are several types of polymer but typically a cationic type polymer is used for BFP conditioning. Polymer can be supplied in dry form or liquid form, but most facilities use liquid emulsion polymer. For polymer to be effective, the correct type of polymer, the proper flow rate, and the proper polymer concentration must be used. A polymer solution of 0.2% to 0.5% is normally used. In addition, the combined polymer and sludge feed must have the correct mixing intensity before entering the belt to be effective. Polymer solution is injected into the sludge prior to being applied to the belt filter press. The polymer is added to the sludge through an injection ring (or other mixing device) and then flows to the belt filter press. The quantity of polymer per quantity of sludge varies depending on the type and condition of the feed sludge. When polymer conditioning is properly achieved, the feed sludge that is applied the belt press forms small strong floc particles looking like cottage cheese. Proper sludge conditioning and floc formation will drain and dewater well on the belt press.
Filtrate	Filtrate is the water that is released from the feed solids and passes through the belts. The filtrate also contains the spray water that is used to clean the belts.	If the dewatering process is operating properly, the filtrate will be low in solids. The suspended solids concentration of the filtrate should be below a concentration of 1000 mg/L. The color of the filtrate is an important indicator for operators to determine how well the belt filter press is operating. ■ Light grey to clear filtrate indicates low solids and good performance. ■ White, slimy filtrate is probably low in solids but contains too much polymer. ■ Blackish, dark filtrate indicates high solids content and probably incorrect polymer feed, old polymer, feed sludge issues (overloading, septic sludge, etc.), incorrect belt settings, or other factors.
Drainage and containment system	BFPs drain away water released from the sludge as well as water added by the spray wash system.	The drain system for this water must be sized to handle the quantity of water released from the sludge and the spray water flow. Additionally, the drain should be placed in an accessible location – not beneath the center of the BFP. The drain will need to be cleaned and flushed regularly so the drain needs to be near the edge of the containment area where it is accessible. Lastly, the containment floor must be well sloped to the drain.
Troubleshooting	When there is a problem with a belt filter press the reduction in operational performance can be seen almost immediately.	Some common BFP press issues include the following. ■ **Belt blinding.** Too much polymer or improper spray water flow and/or pressure is preventing the belt from being cleaned. ■ **Low cake dryness.** The belt speed is too high, the polymer dosage is incorrect, and/or the solids rate is too high. ■ **Solids in filtrate.** The incorrect polymer dosage is being used, the solids loading rate is too high, or the feed sludge is old. ■ **Excessive belt wear.** The belts are aligned improperly and/or there is solids buildup on rollers/belts.

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