THE CHOICE OF BELT PRESS vs CENTRIFUGE FOR SLUDGE DEWATERING
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INTRODUCTION
The choice of Belt Press vs Centrifuge for sludge dewatering, is often a difficult problem for specifiers. Both technologies can produce dewatered cake of approximately the same solids content, but are quite different in a number of aspects.

When sludge dewatering was first introduced into municipal wastewater treatment plants in the late 1970s and early 1980s, a number of trials for comparison between the centrifuge and belt press were carried out. In most cases in the municipal wastewater industry, the belt press was chosen for its simplicity, lower cost, lower power, lower noise and ease of control, as well as lower polymer dosage requirements. Today, the power requirement has become a major factor, with carbon footprint and power cost increasing in importance.

An important consideration is that sludge (biosolids) dewatering is not an exact science. The process relies heavily on polymer flocculants, as well as the characteristics and variability of the feed sludge. All of these factors contain many unknowns, and hence the process performance prediction is often an educated guess. A further factor is that instrumentation to measure critical properties and performance on-line is limited, and hence for optimum operation, operator input can be critical.

Polymer flocculants are not standard chemicals, and vary greatly, including molecular weight, charge, and polymer chain configuration. The actual configuration of any particular polymer is a closely guarded trade secret, and finding the best polymer for a particular installation can consequently be a very time consuming process.
The **Centrifuge** offers one major advantage over the belt press, and that is that high solids capacities can be achieved in a very compact unit. This has made it the machine of choice for applications where sludge dewatering must be introduced into existing large plants on restricted sites, in heavily populated areas. High G force centrifuges can offer drier cake than the earlier designs, however this is at higher capital and operating cost, both in polymer and power, and is only applicable if the stability of the cake permits the use of larger G forces.

The **Belt Press** is a relatively newer technology than the centrifuge, and as a result, there is a wider variety in the design and quality of belt presses and the subsystems provided. This factor has sometimes led to incorrect assumptions about the operation of belt presses in comparison to centrifuges, where a poorly designed belt press was compared with a well engineered centrifuge.
Belt presses offer much lower power consumption, and typically half the polymer flocculant consumption. The power saving of belt presses is greatest where feed sludges less than 2% solids content are encountered.

In **summary**, the Belt Press is suitable for low power requirement simpler plant operations, and thinner sludges, and the Centrifuge is more suitable for large city plants, with sophisticated maintenance facilities available, and where space is limited.

**THE BELT PRESS FILTER**

**Advantages of the Belt Press**

- Power requirement and greenhouse gas emissions, even including washwater booster pumps, are typically 20% of a centrifuge.
- The Belt Press offers the lowest possible polymer dosage rate.
- The Belt press feature of separation of the Sludge/polymer mixing energy from the dewatering process, and variable control of this energy, allows the optimum polymer flocculation with low shear, which can be seen and controlled by the operator. The Belt Press will always have a lower polymer dosage rate in actual operation when compared to a Centrifuge.
- The Belt Press filter is easy to control - operators can see the effect of the polymer and the process through the press. Even when enclosed, it is possible to open covers and observe when necessary.
- The Belt Press is well suited to thin sludge dewatering as it is not necessary to accelerate a large mass of water containing very little solids as is required for the Centrifuge. As a result, throughputs of up to 180m³/h are easily achieved in a single Belt Press train, when the solids content is less than 1% solids.
- *High volumetric capacity available by increasing gravity drainage area.*
- The Belt Press is a very low speed device, (typically 3 to 10 rpm). The simple machine design makes it easy to maintain, so that even a small council workshop can do all maintenance that is required.
- The Belt Press is a low vibration machine, and does not require vibration isolation.
- Accidental damage is limited, and the Belt Press can generally handle a large variety of foreign material passing through it, without major damage.
- The Belt Press can never produce 'slops'. The cake formed by a belt press is always in a handleable state, due to the nature of the process. This ease of handling makes it better to transport or further dewater.
The Belt Press can be enclosed. It is not usual, but it is possible, to fit covers around all the zones of the machine of the Belt Press, so that it becomes enclosed to the same degree as a Centrifuge. Some designs are particularly suitable for enclosure, such as those with large solid steel frames, and a simple one level layout. (e.g. the Sernagiotto MDC model). Filtrate trays can be sealed, and piped to a central collection pipe, including belt washwater.

Disadvantages of the Belt Press

The Belt Press has the following disadvantages:

* Requires washwater. The press belts are continuously washed, usually by recycled clarified plant effluent water. This disadvantage is minimised by the fact that most plants today have effluent water systems for hose-down and clean-up. At some plants, recycled effluent water is not available, however, belt press gravity zone filtrate may be used instead. Depending on the pressure available, a booster pump may be required. The choice of multi-stage pumps for this application reduces the power consumption, so that even taking into account the washwater pumps, the total power requirements for the Belt Press are still far less than the Centrifuge.

* Greasy sludges are a problem. The Belt Press is not well suited to sludges containing high levels of oils, fats and greases. These greases tend to blind the filter belt, and whilst periodic washing can remove accumulations, this normally degrades the performance of the Belt Press. Chemical cracking of emulsions is required to enable dewatering.

* The Belt Press is sometimes said to produce large amounts of aerosols. This can be true for poor quality units, or badly maintained units, but today's high quality machines generally have close fitting filtrate trays, fully enclosed washboxes, and piped discharges, so that aerosols are negligible.

* The belt press is not as clean as a centrifuge externally, and requires more labour for cleanup.

* There are potential nip point hazards, which require proper guarding, safety lanyard switches for emergency stop, and handrails or similar devices to keep personnel at a safe distance. However, the machines move at a very slow
speed, (typically less than 0.5 km/hr), and usually the pressures are very low (less than 0.6 bar), and this minimises the entrapment hazard.

CENTRIFUGE

Advantages of the Centrifuge

* Does not require belt washwater. This is sometimes a good advantage where an effluent reticulation system is not yet available. However, the trend is to have effluent water at most plants.

* Good for greasy sludges. The Centrifuge is excellent for dewatering or separation of fats, oils and greases.

* Large capacity in small space. The Centrifuge can offer a large solids handling capacity in a very small space. This is advantageous in large plants.

* With low capture or high polymer dosage rate, can sometimes achieve higher cake solids than the belt press filter. The reason for this is the large amount of shearing as the sludge is moved through the machine, and the temperature increase in the sludge from the power energy dissipated. Increasing temperature improves dewatering.
Disadvantages of the Centrifuge

- High power consumption. The Centrifuge is powered by a large motor which have a high power demand. This generates greenhouse gasses and imposes a high load on electrical systems and requires expensive switchgear.

- High Polymer consumption. The massive shear forces as the feed is accelerated from zero to thousands of RPM, degrade the floccs and require polymers with strong shear strength as well as larger polymer dosages in order to re-form after being sheared.

- Polymer mixing not in control. The mixing action of the Centrifuge cannot be optimised separately for flocculation of the sludge.

- The centrifuge is a "black box" from which sludge and centrate are emitted, providing very little visual clues as to the process, hence automatic controls for the internal screw conveyor are required. These controls cannot match observation by a skilled operator, particularly if varying sludge characteristics are prevalent. In comparison, the Belt Press has visual data available from each zone, and much more information regarding the characteristics of the sludge, in order for the operator to evaluate controlling action.

- Centrifuge is a high speed rotating machine. As such, it requires careful specialist maintenance and is not generally suitable for overhaul by local personnel.

- Recent studies are showing that centrifuge treated sludges create more odour than a belt press after dewatering.

- Handling properties of the sludge cake are not as good as a belt press.

- High noise and vibration level. Centrifuge can have a higher noise and vibration level than the Belt Press due to its high speed operation. The installation places dynamic loads on the structure.

- The Centrifuge is not totally enclosed even though it appears to at first glance. The cake discharge is open to atmosphere, and some sludges tend to liberate more gases due to the centrifugal action, and these gases are released to atmosphere through the discharge opening of the centrifuge.

- Vulnerable to damage from rags and tramp materials. Internal apertures can be blocked by rags, and metals or minerals in the sludge can cause high abrasion wear or even catastrophic failure. Many installations require macerators upstream of the centrifuge, resulting in more power consumption, and extra equipment to maintain. However, in the event of a malfunction of lubrication, or entry of large tramp material or unusually abrasive sludge, a major failure can occur, which will require the Centrifuge to be returned to the manufacturer for overhaul. This can be extremely costly and inconvenient to the plant.
CONCLUSION
The Belt Press offers the lowest power and polymer consumption, and is particularly suitable for large volumetric feed rates and thin sludge. Where owner/operators are committed to lower greenhouse gas emissions it is the preferred technology.

The belt press is a simple, robust machine, and provides ease of operation, flexibility and local maintenance capability. Running costs are lower due to the much lower power and polymer cost and economical maintenance. Labour costs are slightly higher due to the need for housekeeping. Cake handling characteristics for a given solids content are better.

The Centrifuge is a high speed rotating machine, suitable for large plants with well screened sludges, where initial and operating cost, and high power requirements are not of primary importance. The high performance units can potentially offer a drier cake, and a compact package, especially for thick sludge throughputs greater than 70 m³/hr. Housekeeping operation is minimal, hence labour costs are lower, but power, maintenance, and polymer flocculant costs can be very high.

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