V-FOLD BELT DEWATERING TECHNOLOGY

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ABSTRACT

A critical aspect of the operation of any wastewater treatment plant is the effective dewatering of biosolids. The V-fold belt is a new technology that is suitable for small dewatering applications. There are approximately 40 V-fold belts throughout New Zealand and the USA. Two V-fold belt units are currently being commissioned for wastewater treatment plants in Australia.

This paper will present an overview of V-fold belt dewatering technology and provide information on its advantages and disadvantages compared to conventional sludge dewatering systems from an operations perspective. Operations staff will need to be aware of this new technology, as it is likely to gain widespread use in wastewater treatment in Australia, particularly for smaller applications. The paper will also present details on a full-scale trial of V-fold dewatering technology conducted in North Queensland in late 2005.

KEY WORDS
Sludge dewatering, Belt Filter Press, Centrifuge, V-fold belt

1.0 INTRODUCTION

A critical aspect of the operation of any wastewater treatment plant is the effective dewatering of biosolids. Reduction of the moisture content of biosolids is required not only to reduce costs of transportation and disposal, but also to make them suitable for composting, minimise odour problems and to make handling of the sludge easier. Dewatering often requires a fair amount of operator time and attention, due to the frequent occurrence of problems during the operation of dewatering equipment.

This paper presents the V-fold belt, a new dewatering technology that is especially suited to small-scale applications. The V-fold belt can be used as an alternative to a variety of conventional dewatering technologies, but this paper focuses on the comparison of this new technology with the belt filter press and the centrifuge.

2.0 DESCRIPTION OF TECHNOLOGIES

2.1 Belt Filter Press (BFP)

Dewatering in a belt filter press normally requires addition of polymer to combine the small solid particles into larger flocs, thereby enhancing the filterability of the sludge. After polymer addition the sludge is fed onto a porous material, which allows water to permeate, but retains the solids in the sludge. In this so-called 'gravity drainage section', the larger fraction of the water in the sludge is removed. After this initial thickening the biosolids are squeezed between two porous cloth belts and are conveyed past a number of rollers. The pressure exerted by the rollers, in combination with the shear forces from the belts force the water out of the material. The water permeates through the porous belts and is collected, together with wash water used to clean the belt, and returned to the water treatment section upstream. The end product of a belt filter press is dewatered cake with a typical dry solids content of 10-15%.

Figure 1: *A large belt filter press in operation*

2.2 Centrifuge

In a centrifuge, the sludge is fed into a rotating bowl, in which the solids are separated from the water by centrifugal forces, relying on density differences between the two constituents. The solids form a cake on the inner surface of the bowl and are scraped of the wall by a screw feeder and are subsequently discharged into a hopper or onto a conveyor belt. The remaining water stream is called 'centrate' and is returned to the wastewater treatment system. Just as is the case for a belt filter press, addition of polymer enhances the separation efficiency of a centrifuge. A typical centrifuge has the capacity to produce a cake with a dry weight solids content of 15-20%.

Figure 2: *A dewatering centrifuge*

2.3 V-Fold Belt

The new V-fold belt dewatering technology is similar to the belt filter press in so far that it uses a porous belt and a series of rollers to press the water out of the sludge. However, instead of squeezing the sludge between two separate belts, the V-fold belt only uses a single belt, folded in a V-shape across the centreline. The sludge is fed into the pocket formed by the two sides of the belt, which serves as a gravity drainage section before it is passed along a series of rollers, where the water content is reduced further by pressure and shear forces, to a final dry weight solids content of 9-13%. The V-fold belt technology is especially suited to small-scale applications (up to approximately 3000 L of slurry per hour). Although a relatively new technology, there are already approximately 40 V-fold belt type dewatering installations in operation across the USA and NZ.

Two separate V-fold belt units are currently being commissioned for wastewater treatment plants in Australia (Couran Cove Resort, South Stradbroke Island and Normanvile STP, Victor Harbour).

Figure 3 shows a sketch of the V-fold belt principle and an image of a V-fold belt in operation.

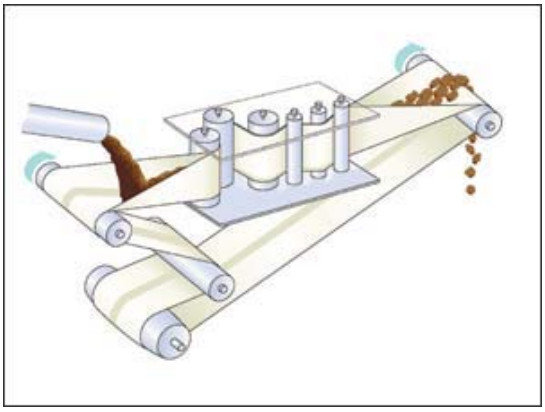

Figure 3: ***Sketch of the V-fold belt technology (source: Dayco Pty Ltd) and V-fold belt unit operating at Couran Cove Resort, South Stradbroke Island.***

3.0 COMPARISON OF TECHNOLOGIES

Table 1 lists a comparison of the three types of sludge dewatering systems described above on a number of relevant aspects.

Table 1: ***Comparison between belt filter press, centrifuge and V-fold technologies***

	Belt filter press	**Centrifuge**	**V-fold belt**
Footprint	Larger than centrifuge or V-fold belt	Smaller than BFP, larger than V-fold belt	Small footprint requirement. Polymer system can be mounted on unit to further save space. Reduction in associated building costs.
Capital costs	Similar to centrifuge, higher than V-fold belt	Similar to BFP, higher than V-fold belt	Lower than BFP and Centrifuge
Operating costs	Similar to centrifuge, higher than V-fold belt	Similar to BFP, higher than V-fold belt	Lower than BFP and Centrifuge
Energy consumption	Moderate	High	Low
Water usage	High wash water demands. Resulting return filtrate flow rate impacts water treatment process	Low-moderate wash water demands	Low-moderate wash water demands
Polymer consumption	Moderate (4-10 kg/tonne DW biosolids)	High (5-8 kg/tonne DW biosolids)	Claimed to be low-moderate

	Belt filter press	Centrifuge	V-fold belt
Robustness	Well-proven technology	Well-proven technology	Apparent robust technology but not yet widely proven. Largest belt width only 0.75m
Solids content of cake	10-15% DW. Product suitable for composting	15-20% DW, product suitable for composting	Expected to provide 9-13% DW solids cake. Product suitable for composting
Impact of varying feed concentration	Performance sensitive to variations in feed composition	Performance sensitive to variations in feed composition	Claimed to be capable of processing varying quality feeds
Manual wash required	Regularly	No	Regularly
Noise production	Low	High	Low
Labour	Process can be automated. However, belt can loose track and cause spillage of biosolids. Regular adjustments are required to ensure optimum performance. Regular manual wash down required. Typical operator input is 2-3 hr/d.	Unattended operation is possible. Very little operator supervision is required, when system operates continuously. However, operator attendance is required during start-up. Typical operator input is 1.5-2 hr/d. Considered to be more reliable than BFP.	Process can be automated. Belt is self-tracking (due to combination of horizontal and vertical rollers) Typical operator input is 1.5-2 hr/d.
Spare parts and Maintenance	Many moving parts require regular maintenance (greasing, adjusting etc.) This can generally be carried out by operating staff. Belt replacement is required typically every 1.5 to 3 years Overall annual maintenance costs are typically 40-50% lower than for centrifuges	Requires little ongoing maintenance. Major services required once every 2 – 3 years. Need to be carried out by specialists. Typically the bowl is sent away for repair about once every 2 – 3 years. This service could take a week or more.	Belt may have shorter life expectancy than BFP belt due to folding, but cost of replacement belt is lower.
OH&S issues	Operators are directly exposed to sprays, mists, polymer and sludge. Arms, fingers and clothes can get caught in moving parts. Springs on rollers are under high tension.	Centrifuges are fully enclosed which limits aerosols, mist, odours, polymer contact and sludge contact.	Operators are directly exposed to sprays, mists, polymer and sludge. Arms, fingers and clothes can get caught in moving parts.

4.0 V-FOLD BELT OPERATIONAL EXPERIENCE

On the 30th of November 2005 an experimental full-scale trial of the V-Fold dewatering technology was conducted at the Picnic Bay MIWR in North Queensland. During this trial, 5,000 litre of waste activated sludge with mixed liquor solids content of 16,700 mg/L was dewatered using a V-fold belt press with a belt width of 0.5 meter (note that this is less than the 0.75 m maximum belt width). The average throughput was 1,880 L/h, while a maximum throughput of 2,400 L/h could be achieved. Service water demand at average throughput was 1,200 L/h. The throughput capacity and service water demand will be higher for a V-Fold with a 0.75 m width belt. Assuming a linear relationship, the 0.75 m belt is expected to achieve around 2,820 L/hr (drive at 30 Hz) and possibly up to 3,600 L/h.

The filtrate solids content was 210 mg/L (single grab sample), while the cake produced during this trial had a solids content of 11.6% (based on 4 grab samples). The dewatered cake formed a stable solid mound and when pressed showed slight jelly like properties. However, the cake was easy to break-up into small particles and did not lose its stability when moved with a pitchfork to create a new mound.

Laboratory tests prior to the trial showed that liquid SNF EM 440CT polymer was most suited for the Picnic Bay MIWR sludge. The optimal polymer dosage was 6 kg active polymer per tonne total solids. It proved easy to quickly adjust the polymer dosage and even when no polymer was added, still a small amount of cake with a solids content of 10.2% was formed. However, without polymer addition the sludge did not floc and the feed envelope overflowed. The alum dose rate was 560 mg/L, which is very high for a typical wastewater treatment plant and lowering this dose rate could lead to increased polymer demand and lower solids content of the final product, although this was not tested during this trial.

The V-fold belt unit was easy to clean, all parts are easily accessible. The belt can be cleaned with the spray bars and a hose, while feed and filtrate pipe work can be backwashed. Overall the performance of the V-fold belt during this full-scale trial was very good. The robustness and simplicity of the process and the consistency of the cake produced particularly impressed the operators present at the trial.

Figure 4: ***Full scale test of the V-fold technology at Picnic Bay MIWR***

5.0 CONCLUSIONS

From the information presented in this paper it should become clear that the V-fold dewatering technology is an interesting alternative to the conventional belt filter press or centrifuge, particularly for small-scale installations. Advantages of this new technology include a small footprint, low energy and wash water consumption and low capital and operating costs. Of particular importance to operating staff are the self-tracking nature of the belt and the capability to process sludges of varying composition, thus reducing operator time for adjustments to the equipment. Disadvantages of the technology include that it is not yet widely proven, the product cake has a lower solids content than that of the competing technologies and the maximum belt size is only 0.75 m, thus limiting the suitability to small scale applications of up to 3000 L per hour. The Picnic Bay full-scale trial demonstrated that the technology is capable of producing a cake of consistent quality from waste activated sludge, is robust and simple and therefore attractive from an operations point of view.

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