



Case Study

Solving Sludge Pumping Problems

Ashbridges Bay Main TP, Toronto, Canada

The Challenge

Sludge is viscous and abrasive

Downtime-critical applications

Lobe pumps prone to excessive wear and breakdown

The Discflo Solution

No close tolerances in Discflo pumps prevent clogging

Non-impingement pumping reduces wear in abrasive service

Quick ROI due to reduces repair and maintenance



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A novel design of industrial pump is being used at the Ashbridges Bay Main Treatment Plant in Toronto, Canada, to solve some tough sludge pumping problems. Norrie Macdonald, Chief Works Supervisor Mechanical at the plant for two years, discuss the benefits the plant has reaped by installing Discflo pumps.

The Main Treatment plant has a design capacity of 818,000 cubic meters per day and serves an estimated population of 1,250,000 people. It provides complete wastewater treatment, including removal of suspended and biological solids, phosphorus removal, disinfection and incineration.

Sludge from the wastewater treatment process is both viscous and abrasive, leading to high pump wear rates and a potentially high incidence of downtime. Also, depending on where it is in the treatment process, the sludge can have a high solids content and possibly contain high volumes of entrained air or gas.

One of the areas of concern at the Ashbridges Plant was the digested sludge disposal area. The sludge contains approximately 3% solids and has to pass through a grinder prior to being pumped to the centrifuges. It is a critical application, which operates 24 hours a day, 365 days a year, at a flow of 12-16 liters/second to each centrifuge.

Up until 1995, Metro Works was using lobe pumps in this application. Because these types of pump need close tolerances to operate at optimum efficiency, they were prone to excessive wear and breakdown in abrasive and high solids service applications, such as sludge disposal. "The lobe pumps were costing us too much to maintain," says Norrie Macdonald, Chief Works Supervisor Mechanical at the plant. "As the lobes wore down, we had to speed the pumps up to maintain feed rate." The lobe pumps required complete overhaul after 3000 running hours, which in continuous operation all year round, means 2 to 3 times a year. Each overhaul is estimated to cost CAN \$10,000.

The second problem area at the Main Treatment Plant was pumping the thickened waste activated sludge from the Dissolved Air Flotation tanks to the digestion tanks. Here, the sludge is thickened from less than 1% to approximately 5% solids in a process that separates solids from liquid using dissolved air in water and a polymer coagulant. Originally the plant was using 10 progressing cavity type pumps to handle some 25 dry tonnes/day of this sludge. Although these pumps could handle the thickened sludge, they required overhaul about once every three years - at a cost of between CAN\$15,000 and CAN\$20,000 per overhaul.

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Case Study

Energy, Maintenance Costs Cut

US Filter, San Diego, California

The Challenge

- Pump in belt filter press sludge
- Eliminate mixing in grit chambers
- High pump breakdown and repair costs

The Discflo Solution

- Discflo pumps more reliable, less breakdown than previous pumps
- Reduced energy needs at grit chambers
- Discflo design ideal for viscous, abrasive, high solids fluids



Discflo pumps are cutting energy and maintenance costs at US Filter's Wastewater Treatment Plant in San Diego County. Vertical dry pit Disc Pumps have replaced progressive cavity pumps at the belt filter press sludge feed station - one of the toughest applications at the plant.

In addition, horizontal direct-coupled Discflo pumps have been installed to replace piston pumps for primary sludge pumping to an unstabilized sludge storage tank and to replace centrifugal recessed impeller pumps moving grit from the grit chamber bottoms.

As well as lowering the maintenance bill, the Discflo pumps at the grit chamber are also cutting energy costs. The grit chambers typically require mixers to keep the high solids content in suspension and reduce the load on the pumps. However, thanks to the Discflo pump's unique laminar flow design, US Filter has cut the mixer horsepower required and even turned the mixers off for short periods of time, without affecting the pumps' ability to move the extra thick sludge.

Since start-up in mid-2002, the Discflo pumps have proven both more reliable and less prone to breakdown in all these hard-to-pump applications, reports Gene Palop, US Filter's engineer on the project.

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Case Study



The Challenge

DAF sludge with high level of entrained air and high viscosity

- + Diaphragm pump failed to handle air in DAF sludge
- + Lobe pump required constant maintenance
- + Recessed vortex pump failed to handle viscosity and solids

The Discflo Solution

Discflo pump ideal for sludge with entrained air/gas

Handles high viscosities due to laminar flow operation

No close tolerances ensures no clogging from solids



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Test Turns Skeptic to “Disc-Believer”

Orange County Utilities, Florida

For over five years Orange County Utilities wrestled with pumping problems caused by the entrained air from their Dissolved Air Filtration System. After trying various pump designs, each with its own problems, they found the solution with the unique Discflo disc pump.

DAF is an important process that separates the solids out of the waste sludge. The DAF system pressurizes wastewater and then releases it causing millions of micro bubbles to form throughout the wastewater mixture. These bubbles attach to the sludge solids and float them to the surface, so the solids can be separated out and the liquid returned to the wastewater system. This high level of entrained air, however, makes it very difficult to pump. The sludge is also quite viscous, up to 500 cPs.

Gerber Pumps International, Discflo's distributor in for the municipal wastewater sector, had worked with the County to find a solution since 1995. They initially presented the Discflo pump, but the County was afraid to take a chance on something so different, so instead, they selected a Double Disc Diaphragm pump. The pump though was incapable of handling the air in the DAF sludge.

The next attempt at a solution was a positive displacement lobe pump. While this pump could handle the sludge, it required constant maintenance. The cost of pump maintenance and rebuilds piled up quickly. The constant maintenance was draining the County's budget. The pumps simply weren't affordable. Back to square one.

The next decision was to try a recessed vortex pump. The failure of these pumps was quick and decisive. They couldn't handle the viscosity or the solids content of the DAF Sludge.

In the meantime, Gerber Pumps built a trailer mounted demo rig, comprising a 604-14-2HHD Discflo pump with a 100 HP motor. In October 1999, they returned to the Orange County treatment plant to demonstrate the Discflo pump's capabilities with their new rig and tested the pump on the DAF system.

According to Stephen Gerber “Seeing does make believing.” The demonstration made believers out of the Orange County Utilities' staff. They agreed to purchase the pump under trail and test terms. Stephen reports, “Needless to say, they paid their invoice on time.” Not only were the County satisfied with their purchase, the facility is also looking at two more on-site applications as well as incorporating Discflo pumps into a current design build job.

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Case Study

Pumping Anaerobic Sludge

Metro Wastewater Reclamation District, Denver

The Challenge

Sludge contains high levels of entrained air and gas

High viscosity sludge

Reduce maintenance costs

The Discflo Solution

Discflo pump handles high viscosity fluids with ease

Discflo pumps up to 80% entrained air/gas

No downtime or repairs in two years since start-up

The Metro Wastewater Reclamation District in Denver, Colorado, has solved a persistent pumping problem by installing Discflo pumps. These pumps are being used to handle a viscous anaerobic sludge containing high amounts of entrained gas, and have operated with no downtime or repairs, other than routine preventative maintenance, since start-up two years ago (in 1995).

The Metro Wastewater Reclamation District processes about 150 million gallons of wastewater a day at its 170-acre plant northeast of Denver, making it the largest wastewater treatment facility between the Mississippi River and the West Coast. Moreover, it has among the lowest costs for water treatment in the US, compared with organizations of similar size.

One of the by-products of the District's wastewater treatment is a bio-solid sludge, sold for use as fertilizer to the surrounding agricultural area. This sludge, which comes from the primary and secondary treatment of the wastewater, undergoes anaerobic digestion in 10 digesters at the Central Treatment Plant.

With a solids content of between 2% and 4.5% by weight, a viscosity in the range 1300-5000 SSU, and high amounts of entrained gas, it is a difficult material to pump. The entrained gas was a particular problem, according to staff engineer Sherman Papke. "Our mixing equipment caused air bubbles in the sludge, which over time would collect and form air pockets. The old pumps would air lock and quit pumping fluid," Papke explains.

In addition, the pumps must work continuously to pump sludge from the digester, through a spiral heat exchanger, and back into the digester. This recirculation process ensures a constant temperature of 98⁰F is maintained in each digester. The loss of one of these pumps can result in a decrease in digester temperature, which upsets conditions in the digester and adversely affects sludge quality.

For 20 years, the District had used vertical centrifugal pumps to perform this recirculation task. However, the installed pumps were coming to the end of their life and required increasing levels of maintenance to operate effectively. In addition, the manufacturer no longer made that particular model of pump, so spare parts were difficult to obtain.

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Case Study

Metro Wastewater Reclamation District, Denver

The District then looked at Discflo pumps. After field testing a disc pump and talking to other wastewater plants that had installed disc pumps, the District decided to employ them in sludge recirculation. The initial order was for four Discflo pumps of 500 GPM capacity, one each at four of the ten anaerobic digesters at the Central Treatment Plant. They were put into service between February and June 1995.

One of the major factors in selecting these pumps was their ability to pump sludge that contained high amounts of entrained air. The Discflo pump is able to do this by virtually eliminating contact between the pump's moving parts and the fluid being pumped. So during pumping, the air and gas bubbles remain entrained in the fluid, rather than gathering in the eye of the pump and air-locking the system. Tests of the Discflo pumps in other industries have shown that fluids containing up to 80% air/gas entrainment can be pumped.

The District has experienced no operational or maintenance problems related to these pumps and no downtime other than routine preventative maintenance in the two years since they were put into service. There was a minor problem with one mechanical seal but this was supplied by an outside manufacturer and not related to the Discflo pump itself. All four pumps have run virtually continuously since start-up, and have been operating at or above the expected performance rating.

"It is difficult to find fault in a pump that runs strong, delivers the flow you are expecting and requires little or no maintenance" comments Sherman Papke, Project Manager at the District's Central Treatment Plant. "We anticipate these trends to continue and look forward to these pumps performing well for many years."

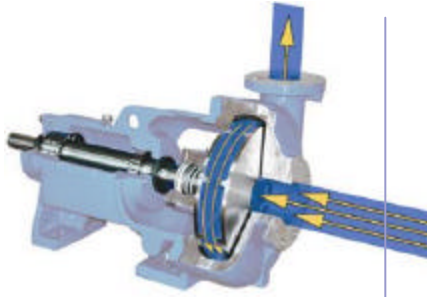
Based on the initial success of the pump, the District plans to purchase six more Discflo pumps in the coming year, to be installed by the end of August 1997. They will replace the remaining sludge recirculation pumps at the other six digesters at the Central Treatment Plant, and will handle the same material as the Discflo pumps currently installed.

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Case Study

Disc Pumps Only Ones to Work

City of Canby, WW Treatment Plant, Oregon

The Challenge

Sludge is corrosive and abrasive
High solids content too much for centrifugal pumps

The Discflo Solution

Trouble-free operation for four years since start-up
Non-impingement pump action ideal for abrasive, corrosive fluids
No solids clogging due to lack of close tolerance in pump wet end

Several disc pumps are being used at a state-of-the-art wastewater treatment plant in the City of Canby, Oregon. They are installed at various stages of the bio-solids treatment process to pump some very abrasive, viscous, corrosive and high solids content sludge. All three pumps handle up to 13% solids, and the majority of the sludge is mixed with lime and has a pH of 12-12.5.

"These pumps are the only ones that work in this application" says Steven Dee Hanson, Wastewater Treatment Manager for the City of Canby Wastewater Treatment Plant in Oregon.

"This is a new process and at first, we had to limit the concentration because the centrifugal pumps couldn't handle the thicker solids. For the Discflo pumps, it's no problem," says Mr Hanson. Apart from a seal problem on one of the pumps, they have operated trouble-free since start up in early 1994 (reported 1998).

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Case Study

Pumping 40% Lime Sludge

City of Boca Raton, Water Treatment Plant, Florida

The Challenge

- Lime sludge solids to 40%
- High repair bills for PC pumps
- Large solids caused plugging

The Discflo Solution

- Discflo pump handles high solids without clogging
- No breakdown or repairs in three years' operation
- No wear due to abrasion, due to disc pump's non-contact action

At Boca Raton WTP in Florida, a Discflo disc pump has successfully replaced two progressive cavity pumps. The pump, a 604-2HHD, is being used to pump 35-40% lime sludge - a byproduct of the water softening process, which is settled out the water in clarifiers. The City experienced yearly repair bills on each of the PC pumps of \$4000-\$6000 due to the abrasive nature of the lime sludge against the rubber stators and steel rotors of the PC pumps. Even though the 12 month run time between major overhauls was twice that of other municipalities in their lime sludge operation, it was not long enough for Ron Diedrich, the chief operator at the Boca Raton plant.

Ron initially installed a mining type slurry pump on a trial basis. The unit failed completely as it was not able to pass the large (2 3/4" diameter) chunks of lime sludge that periodically sloughed off the inside of the lime sludge system. In order to make sure there would be no plugging problem, Bert Gerber, Discflo's distributor in Florida, recommended the City try a Discflo model 604-2HHD, which could pass in excess of 3" diameter solids.

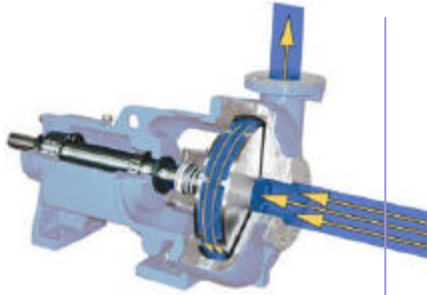
The pump was installed in August 1994 and has been running ever since with no downtime, repairs or plugging. The pump runs at 400 GPM, replacing two pump each at 200 GPM. Bert Gerber and Ron Diedrich took the pump apart last month (June 1997) to inspect it. "We found no signs of wear," says Ron, "and it is still in daily use."

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Case Study

Thicker Sludge Pumping Cuts Costs

City of Akron Wastewater Treatment Plant, OH

The Challenge

Frequent clogging and breakdown from stringy and large solids

Wanted to increase solids percent to reduce disposal costs

Keep retrofit costs low

The Discflo Solution

Discflo pump's clog-free design ideal for large and stringy solid

City increased % solids and cut disposal fees substantially

Discflo pump retrofit in piping for previous centrifugal pump



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Discflo's unique pump technology has solved a tough pumping problem at the City of Akron Wastewater Treatment Plant in Ohio. Installed in August last year, the disc pump has increased the percent solids pumped from the gravity thickeners by almost 2%, saving the City a substantial sum in waste disposal costs, as well as reducing maintenance and downtime.

Raw primary sludge from the gravity thickener process is one of the most difficult materials to pump. It contains solids up to 2 1/4" in size, ranging from 4.5% to 8.2% in concentration, as well as including stringy particles, such as hair and rags. The City processes around 0.78-0.90 million gallons per week of primary sludge from the gravity thickener process and mixes it with approximately 0.5 million gallons per week at 5.5% solids from its DAF thickener process. For the past 12 years, this mix has been sent to a 5-acre indoor compost facility nearby, built specifically for recycling municipal wastes.

"We wanted to increase the percent solids we were pumping, to reduce the cost of disposal," says Mike Mesek, Operations Foreman for the Solids Section at the Akron WWTP. "We knew the centrifugal pumps we were using couldn't handle any higher solids content than around 5%. The sludge could get so thick that the pump rate would slow down, and eventually come to a standstill."

"The solids were staying in the tank too long and the blanket depth would get too thick, as much as three feet, during storm conditions. At times, we would need two centrifugal pumps operating if the solids level was too high, and they would be pumping at less than 200 GPM combined!"

"Another factor that convinced us to try the disc pump was the cost of the pump compared to a progressive cavity unit. Not only was the PC pump more expensive, but also it would have required more retrofitting to install," says Mesek. "Because the disc pump is similar to a centrifugal, I knew it would be much easier to retrofit, with fewer piping modifications required."

A Discflo disc pump, model 604-14-2HHD, was installed in August 1997. "I noticed immediately, overnight, that the sludge being pumped was thicker," remarked Mesek. "And we have been able to increase the pump rate from 270 GPM with the centrifugal unit to a cutoff point of 370 GPM with the disc pump."

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Case Study

City of Akron Wastewater Treatment Plant, OH

After installing the disc pump, the plant achieved an increase in solids concentration of about 1.8%, which has reduced the volume of sludge to the composting plant by around 25%. This equates to a substantial saving in composting costs, by cutting the quantity of chemicals in the process and the manpower required. From these savings alone, the disc pump paid for itself in less than a month.

A second key benefit is that downtime has been virtually eliminated with the disc pump. The clarifier process runs seven days a week, 24 hours a day, with the solids being pumped from the bottom of the clarifier in cycles of two to 30 minutes.

"Downtime is critical", says Mesek. "If there's a problem removing the solids from the clarifier tanks, the tank becomes overloaded and slows down the entire disposal process. The previous pumps would frequently clog due to the density and the presence of stringy particles in the sludge."

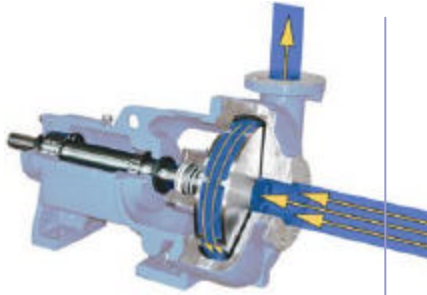
Also since start-up eight months ago (as at May 1998), the disc pump has required virtually no maintenance and no spare parts have been purchased. "The disc pump has definitely made life easier." The City of Akron will be installing a second disc pump later this year (1998) for pumping sludge from a new gravity belt thickener, which will replace the older DAF units.

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Case Study

Problem-Free Pumping for 10 Years

Village Creek TP, Fort Worth, Texas

The Challenge

Viscous, abrasive sludge with rags and large solids

High spare parts bill for existing centrifugal pumps

Pumps cavitating under 300 GPM

The Discflo Solution

Discflo pump design ideal for viscous sludge and large solids

Pump overhauled only once in 10 years' service

Varying flow rates possible without cavitation at 100 GPM



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A Discflo pump installed at the Village Creek Treatment Plant in Fort Worth, Texas, is still running well after 10 years' service. Says Ken Collingsworth, Senior Water Systems Mechanic for the plant: "I can only think of one time we've overhauled it in 10 years. It's been very minimal maintenance."

The Discflo pump, an in-line Model 403-2D, is installed in the return pump station and is used to remove waste from the bottom of the final clarifier to the incineration plant. It is a tough fluid to pump - viscous, abrasive, containing rags and other solids. The Discflo pump was originally purchased for a hot water application, but because of the product's low viscosity, it was not successful.

"I had read about the disc pump's operation," says Ken Collingsworth, "and realized it would be much better suited to the waste sludge pumping area, where we were having problems with the existing centrifugal pumps." Ken persuaded the Plant Manager to try the Discflo pump in the return pump station and the rest is history.

"We have used one disc pump to replace two centrifugal pumps. The centrifugals required quite a bit of repair and constantly needed new parts. But in ten years, I have only had to replace the shaft sleeve on the disc pump two or three times and overhaul it once."

Another benefit of using the Discflo pump has been better control of flow rate. The pump can pump as low as 100 GPM and up to several 100s GPM. The previous centrifugal pumps, on the other hand, suffered from cavitation below 300 GPM.

The disc pump has also proved easy to maintain and very reliable. This is especially important for passing solids. Comments Ken: "I've never had any rags plug it up, even though they plug up the other centrifugals at the plant. The disc pump allows solids to pass freely."

"I've been a maintenance mechanic for 27 years and from a mechanical standpoint, I've been very pleased with the disc pump."

This story was written in 1999. The pump was installed in 1989.

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Case Study

The solution to both sludge pumping problems was to replace the existing pumps with Discflo disc pumps. The first pump of this type was installed in the sludge disposal facility in May 1995, and since then, another five pumps have been installed there. One Discflo pump was installed in the sludge thickening facility to replace a progressing cavity pump in April of 1996.

"I first saw the Discflo pump demonstrated in 1993 at Highland Creek Treatment Plant in Metro Toronto" comments Norrie Macdonald, . "Then when I transferred to the Main Plant in 1995, they were installing a trial pump to replace a lobe pump. I was intrigued by its simplicity. This first pump gave us no problems, so it was an easy decision to replace the others. Provided the Discpac continues to operate trouble-free, these pumps should run easily on a five year maintenance check."

In both the sludge thickening and sludge disposal operations, the Discflo pumps have been trouble free since start-up. No repairs have been required to date on any of the pumps, and downtime in the critical area of sludge disposal has been negligible, with only routine preventative maintenance needed.

"The cost savings by replacing the lobe pumps has been noticeable" says Norrie Macdonald. "When you consider it costs almost CAN\$10,000 to completely overhaul a lobe pump after 3000 running hour and CAN\$15,000-\$20,000 for a progressing cavity pump, it will not take long to recoup our investment." The plant has also benefited by reducing the time spent on maintenance and gaining better control over preventive maintenance.

"As the plant continues to expand in the future, we expect the Discflo technology to be a part of that expansion." The Main Treatment Plant has requested another four Discflo pumps for its new centrifuges, which will be installed in 1998. In the meantime, three more disc pumps are being purchased to replace progressing cavity pumps in the waste activated sludge area.

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