Case Study

Disc Pumps “Godsend” for Dredging

Citgo Petroleum, Lake Charles, Louisiana

The Challenge

Sludge viscosity 20,000+ cPs

Solids content from 2-40%

Filter press cycle time 90 minutes

The Discflo Solution

Pump uses ‘viscous drag’ forces so pumping high viscosity easier than other pump designs

No close tolerances good for high solids, abrasive fluids

Disc pump cut filter press cycle time from 90 to 60 minutes

The head of an environmental waste clean-up project in Louisiana described the Discflo system as a “godsend”. The pumps, installed in 1994, were used to pump slurry that was dredged from a 23 acre, 50-ft deep site in Lake Charles. The site contained difficult waste products such as hydrocarbons, benzene and many other volatile fluids. The solids content ranges from 2-40%, with viscosities of 20,000 cPs and higher.

Six 806-20", and two 403-14" belt driven Discflo pumps were supplied to tackle this environmental nightmare. Two of the 806 pumps were equipped with 300 HP motors and the remainder with 200 HP motors. An additional feature of the Discflo pumps was that in meeting the flow requirements of the presses they could use the 806s to pump high volume at 300 ft of head and the 403s to pump low volume at 500 ft of head.

The D. R. Sperry Company supplied most of the filter presses. They had hoped to cycle the presses every 90 minutes at the onset of the project, however, with the Discflo pumps they were able to cycle the presses after only 60 minutes. This cut the projected production time by 30%.

A company representative said, “Our remediation company selected Discflo because of its ability to handle highly viscous product and provide the volume needed, together with its durability and lack of maintenance.”

Call Discflo now to find out how our pumps can solve your problems.

DISCFLO
Disc Pumps

Discflo Corporation
10850 Hartley Rd
Santee, CA 92071
Phone: (619) 596-3181
Fax: (619) 449-1990
Sales@Discflo.com
www.Discflo.com

The Challenge

Emulsifying oil in transfer

Changes in fluid conditions causing pump breakdown

Loss of pump performance due to abrasive wear

The Discflo Solution

No emulsification due to Discflo pump's laminar action

No loss of performance due to abrasive wear

Versatile enough to handle varying fluid conditions

Discflo Corporation
10850 Hartley Rd
Santee, CA 92071
Phone: (619) 596-3181
Fax: (619) 449-1990
Sales@Discflo.com
www.Discflo.com

Case Study

Solving Oil Emulsion Pump Problems

El Dorado Refining Co, Kansas

El Dorado Refining Company is a division of Equilon Enterprises LLC, a joint venture of Texaco Inc and Shell Oil Co. The plant is the largest oil refinery in Kansas rated at 110,000 barrels/day of crude oil processing capacity. Peter Hanas has been working at the El Dorado refinery for 9-1/2 years (as of 1997) as a staff reliability engineer. He is responsible for improving the plant's overall mechanical reliability. He was the first to recommend the use of disc pumps at the plant and has seven years' experience with this type of pump.

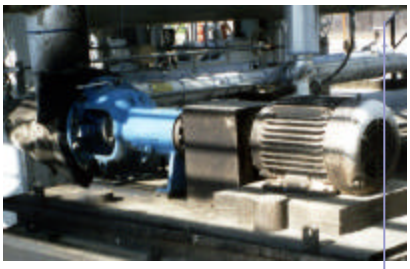
The first disc pumps were installed at the El Dorado plant in 1993 for sludge oil transfer and CPI oil transfer at the wastewater treatment unit. In the six years since start-up, the pumps have performed well with very little maintenance required and no unplanned downtime due to pump failure.

The fluid in the sludge oil transfer operation is moderately viscous (40cP), with no solids, and has a specific gravity of 0.877. The oil is in an emulsion state, which makes it difficult for a centrifugal pump to handle. The disc pump's laminar, pulsation-free flow, however, allows it to pump the fluid without losing prime and without cavitating.

Two 402-14-2HHD (4" suction and 2" discharge) disc pump models, with a disc assembly trimmed from 14" diameter to 12.95", were installed in March 1993. Each unit is on a Texaco Type API base. The pumps each handle 100 GPM at 50 psig with a flooded suction.

In the CPI oil transfer application, the disc pump is moving a heavy slop oil containing some solids - grit, dirt, etc. The fluid is somewhat abrasive and viscous (40cP) with a specific gravity of 0.877. A pump model similar to the above sludge oil transfer is employed. The pump conditions are 50 GPM at 40 psig with a flooded suction.

All three pumps installed in 1993 were new units and did not replace any previous pumps. However, for similar oil sludge applications at the plant, the company has used centrifugal type pumps and has encountered problems with erosion due to solids and operating problems due to the changes in pumpage composition and viscosity. Based on the above experience, the El Dorado plant has found disc pumps to be a much better fit for oil sludge applications.



Case Study

The tough challenge in pumping this fluid is the variation in fluid conditions. At different times, the viscosity, solids concentration and size, suction pressure and flow rate can all vary: the viscosity can be as high as 200 cP or as low as 1cP; the solids content can include sand, pieces of plastic and anything that enters the system earlier in the process; the pressure in the discharge line can swing by as much as 20-25 psig; and the flow rate can reach a high of 2000 barrels/day (58 GPM) or a low of 450 barrels/day (13 GPM).

For 40 years, the work of moving the slop oil had been performed by a reciprocating steam-driven pump. It had become, in the words of the Peter Hanas, "a reliability nightmare", generating over 30 work orders for maintenance in its final year of operation. The company then installed two electrically-driven centrifugal pumps operated in series to replace the old pump. These also proved unreliable; the solids in the slop oil would frequently clog the pump, causing either seal failure or loss of prime in the pump.

Next, the company tried a skid-mounted, self-priming centrifugal pump. It was an improvement over the previous centrifugal pumps, in that it had sufficient prime, however, the pump still suffered frequent seal failure due to clogging and loss of seal flush. “By that point, we were desperate” says Peter Hanas. “The slop oil transfer is a critical application and must be kept moving to ensure the plant remains running.” He suggested using a disc pump.

A 402-14-2HHDL model horizontal end-suction pump, with disc assembly trimmed to 11.26" diameter, was installed in December 1997. It was constructed in CD4MCU, with an API base, and the disc assembly was Maxalloy 350. The unit had a 40 HP explosion-proof motor, running at 3450 rpm and a John Crane Type 2800E dry running gas cartridge seal.

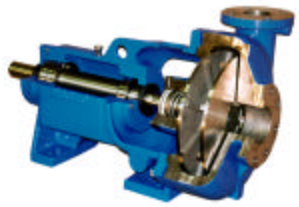
The pump was designed with a capacity of 35 GPM at 429 ft TDH (185 psig). There were however some start-up problems because the 185 psig was a “worst case” value and in reality, the system needed only 110-130 psig of pressure. The problem was solved by installing an inverter to achieve the lower discharge pressures required.

"We successfully proved to our very skeptical management that the disc pump would work in this application" says Peter Hanas. The inverter was installed in February 1998. Since then, the pump has performed very well, with no downtime or unplanned maintenance required.

Call Discflo now to find out how our pumps can solve your problems.

DISCFLO
Disc Pumps

Discflo Corporation
10850 Hartley Rd
Santee, CA 92071
Phone: (619) 596-3181
Fax: (619) 449-1990
Sales@Discflo.com
www.Discflo.com



Case Study

Crude Oil Tanker Transfer

Flying J Refinery, Salt Lake City, Utah

The Challenge

Cavitation from entrained air

MTBF of 2-3 weeks

Excessive parts costs

The Discflo Solution

Saved up to $40,000 in pump parts costs, plus labor

Eliminated pump failure

Discflo pump handles up to 80% entrained air without cavitating

Pumping crude oil from tanker trucks into the stage trucks was an expensive and frustrating experience for Flying J Refinery of Utah. There are a couple of reasons why the application was problematic. The viscosity of the crude varied depending on where from in the tanker it was being pumped. Secondly, as the crude level neared the bottom of the tank, the pumps would start pumping air and run dry, creating major cavitation problem.

The company had gone through many pumps in this application - centrifugal, gear pumps, screw pumps, and sliding vane pumps. Each had a poor performance record that included excessive maintenance requirements and expensive spare parts purchases. In one particular case, the cavitation was so severe that the pump's vibration caused the flowmeters a couple of hundred feet down the line to break.

Flying J learned about the Discflo pump technology in 1998. The first Discflo pump was installed in August of that year, a 402-14-2HHDH. It was so successful that two more pumps were added later.

According to the maintenance supervisor the lowest annual expenditure for pump parts alone before the Discflo was installed had been $40,000. This figure excluded the costs of downtime and labor. The Disc pump in stark contrast has yet to need a replacement part (as of May 2003).

Since start-up, Flying J has not only saved $30,000 to $40,000 per year in parts, but the company has also eliminated the costs of labor and lost production due to downtime. Plus, the problems of frequent breakdown and cavitation have been solved, saving the cost of replacing expensive flowmeters.

DISCFLO Disc Pumps

Discflo Corporation
10850 Hartley Rd
Santee, CA 92071
Phone: (619) 596-3181
Fax: (619) 449-1990
Sales@Discflo.com
www.Discflo.com

Call Discflo now to find out how our pumps can solve your problems.

Case Study

Offshore De-Siltering, Mud Pumps

Maersk Innovator I and II, North Sea

Discflo Disc Pumps are operating in some of the toughest applications on the Maersk Innovator 1 offshore platform. Commissioned early in 2003, the pumps are installed in de-siltering, mud charging and mud mixing operations.

Each pump (Discflo model 806-14-2HHD) is rated to move up to 1000 GPM with a TDH of 150 ft. The drilling fluid itself has some tough characteristics - a specific gravity of 2.0 and an estimated viscosity of 5000 cP. Unlike traditional centrifugal pumps, the Discflo Pump excels at handling viscous fluids, becoming more efficient at higher viscosities due to its unique pumping mechanism.

The Discflo Pump operates on the principle of "boundary layer - viscous drag", whereby fluid is moved through the pump due to the viscous drag between adjacent layers of fluid. With no wear rings, no close tolerances and an open, clog-free design, the Discflo Pump is an ideal choice for hard-to-reach areas and reliability-critical applications, such as offshore platforms.

Based on the success of the Innovator I pumps, Maersk ordered more units for its second platform, Innovator II. They were shipped in late 2003.

Call Discflo now to find out how our pumps can solve your problems.

The Challenge

Highly viscous fluid

Specific gravity of 2.0

Reliability-critical installation

The Discflo Solution

Discflo pump becomes more efficient at higher viscosities

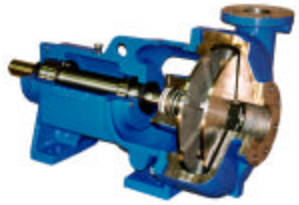
No close tolerances and open clog-free design

Exceptional reliability makes pump ideal for hard-to-reach areas

DISCFLO Disc Pumps

Discflo Corporation

10850 Hartley Rd
Santee, CA 92071
Phone: (619) 596-3181
Fax: (619) 449-1990
Sales@Discflo.com
www.Discflo.com



Case Study

Zero Downtime for Oil Sludge Pump

Mobil Oil, Torrance, California

The Challenge

Viscous, abrasive sludge

Varying solids content and size

Frequent pump failure

The Discflo Solution

Versatile pump to handle varying viscosities and solids content

No more abrasive wear

Exceptional uptime/reliability

Operational cost savings

Viscous, abrasive sludge, with a varying solids content and size, is a nightmare for most pumps. For the disc pump, however, it is no problem. This versatility is the key to the pump's success at a major refinery in Torrance, California.

The first Discflo units at the refinery were installed four years ago. They are pumping a viscous, abrasive sludge used in the quenching phase of the coking process at 400 GPM, 465 TDH. The sludge itself consists of water, hydrocarbons and about 10-20% solids by weight and varying in size, basically anything collected from the tank bottoms.

"The sludge's viscosity varies a great deal from one batch to another," comments Siegfried Hegers of Hegers Pumps, a Discflo distributor in California. "Sometimes, it is as viscous as water and at other times as much as 1000 cP. The disc pump's ability to handle variations in viscosity without breaking down was one of the key factors for choosing the Discflo design."

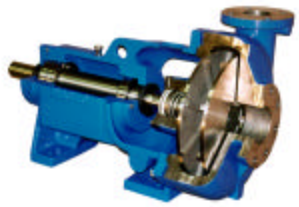
Previously, the refinery used multistage centrifugal pumps. These pumps would fail frequently in service due to the high solids content and abrasive wear. They would run only two to three weeks before repair was required. They had tried several different pump designs, all without success, before turning to Discflo. "They had had so many promises before from pump companies and were cynical about finding a pump that could really solve their problems," says Siegfried. "But in the end, the engineer just got fed up with the constant repairs to the existing pumps and felt he had nothing to lose by trying a "new" design of pump."

And it has paid off handsomely! Since start up, the pumps have performed exceptionally well. The problems of frequent breakdown and high wear have been solved. More importantly, the refinery has made and will continue to make considerable savings with the disc pumps.

DISCFLO
Disc Pumps

Discflo Corporation
10850 Hartley Rd
Santee, CA 92071
Phone: (619) 596-3181
Fax: (619) 449-1990
Sales@Discflo.com
www.Discflo.com

Call Discflo now to find out how our pumps can solve your problems.



Case Study

Pumping Drill Cuttings in Alaska

National Oilwell, North Slope, Alaska

The Challenge

Severe abrasion due to cuttings

High pump repair costs

Large solids clogging pump

The Discflo Solution

Discflo has no close tolerances to handle solids content

"Non-impingement pumping" reduces abrasion

Saved $1000s in pump repair and downtime costs

In 1994, National Oilwell was asked to evaluate a problem a drilling company was having with their drilling rig on the North Slope of Alaska. The company had been operating progressive cavity pumps to pump drill cuttings, which result from the oil drilling activity ranging several thousand feet beneath the arctic tundra. The resulting "cuttings" consisted of rock, gravel, sand, water, residual drilling mud and some remarkably well preserved wood from an ancient forest buried one thousand feet below the surface. Solids content of 1.75" or less averaged 50-55%, with the balance being predominantly water. The most damaging material came from the first 1000ft of drilling when the rig was cutting through unconsolidated solids very fast.

In years past, virtually all drilling by-products were diverted into a pit and the solids used to back fill the hole, solving the disposal problem. However environmental considerations required more ecologically sound disposal and therefore more handling of the waste. During the design period for the rig, someone had specified several progressive cavity pumps. This decision ended up costing the company $1000/day in repairs!

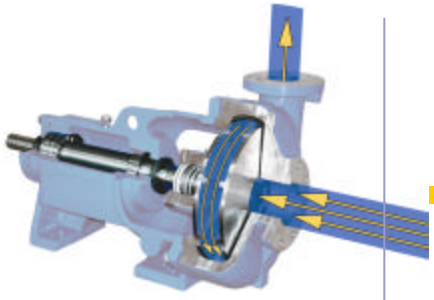
National Oilwell spent some time on location evaluating their system and then started searching for a solution. After considering then dismissing the 'traditional' types of pumps, they stumbled across the Discflo system, a pump with a totally unique operating mechanism that works on the principle of boundary layer-viscous drag. "It caught my attention because of a flying background and interest in the physics of flight. How could I be so stupid not to have thought of this?" said one of their engineers. "We presented the Discflo concept to the drilling people and it seemed to stick like a monkey's hand in a cookie jar. They installed a model 403-2D norchrome on test during "surface hole" and were very pleased with the results."

They deliberately set the pump up to run under worst case scenario conditions, to include fluid velocities somewhat higher than the more desirable 11-12ft per second for abrasive conditions such as these. When the drilling company disassembled the pump after a couple of weeks running, they couldn't believe how little damage there was. They redesigned their system around the Discflo technology and ordered several more pumps. This was a difficult pumping problem solved by a remarkably simple technology.

Call Discflo now to find out how our pumps can solve your problems.

DISCFLO
Disc Pumps

Discflo Corporation
10850 Hartley Rd
Santee, CA 92071
Phone: (619) 596-3181
Fax: (619) 449-1990
Sales@Discflo.com
www.Discflo.com



Case Study

Multiphase Booster Pump

Sincor, Zuata Region, Venezuela

The Challenge

Multiphase fluid, 4-phase

High sand concentration causing extreme wear rates

Emulsifaction of oil

The Discflo Solution

Discflo's unique open design handles high solids conc.

Non-impingement pumping reduces abrasive wear

Laminar flow through pump prevents oil emulsification

Sincor A.S of Venezuala plans to employ Discflo pumps to pump the notoriously difficult 4-phase fluid in it upstream surface facilities in the Zuata Region. Sincor choose the Discflo system based on its unique ability to handle high sand concentrations and high volumes of entrained gases, as well as Discflo's extensive experience in handling mutliphase fluids for a wide range of industries.

The application involves pumping an oil, water, gas, and sand fluid. Direct-coupled 20-inch Discflo models, using an 800kW motor, will be supplied. The pumps will be shipped in mid-2004 for start-up later in the year.

Multiphase pumping is now an accepted practice to the problem of handling fluid containing solids, liquids and gases. It not only reduces capital costs (by eliminating the need for vapor recovery systems and wellsite tanks), but also improves production rates and eliminates emissions.

The Discflo technology is uniquely engineered to solve many of the problems that plague positive displacement type pump systems in handling the extremely abrasive, high solids and gas-entrained fluids found in the oil industry.

Discflo pumps are neither PD nor centrifugal devices but rather use the highly innovative Discpac 'impeller'. The Discpac is a series of parallel rotating discs that moves fluid using the forces of boundary layer and viscous drag - natural hydraulic forces that are created by the discs' rotation. With fluid moving parallel to the rotating discs, fluid impingement on the pump's moving parts is minimized and flow is laminar rather than turbulent.

The result is unsurpassed durability and resistance to abrasion. The space between the discs is large enough (up to 8" in the largest models) to prevent solids from clogging the pump, allowing solids concentrations of up to 80% to pass through unimpeded. Similarly, entrained air and gases move through the pump without impinging on the discs, ensuring there is no mechanical failure or cavitation.

Equally important, the Discflo pump's laminar flow pattern prevents oils from emulsifying. This improves oil recovery rates compared to other pump devices on the market, and makes filtration easier, if necessary.*

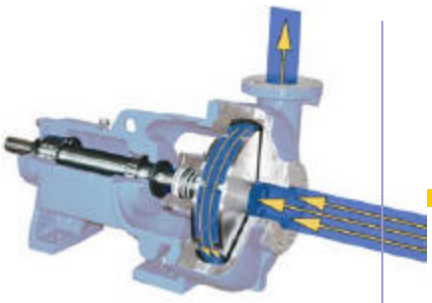
Call Discflo now to find out how our pumps can solve your problems.

* Contact Discflo for independent test data on emulsification..

DISCFLO
Disc Pumps

Discflo Corporation

10850 Hartley Rd
Santee, CA 92071
Phone: (619) 596-3181
Fax: (619) 449-1990
Sales@Discflo.com
www.Discflo.com



Case Study

Testing Confirms 90% Solids-Handling

Swaco, Corpus Christi, Texas

The Challenge

Can Disc Pump handle over 50% solids by volume

Can Disc Pump handle solids over 2-inch in size

Can Disc Pump handle oil-based cuttings

The Discflo Solution

Test showed Disc Pump handles up to 90% sand by volume

Test showed Model 403-14-2D pumps 2-inch solids (larger models can pump larger sizes)

Disc Pump "works very well" in handling oil-based cuttings

Discflo Corporation
10850 Hartley Rd
Santee, CA 92071
Phone: (619) 596-3181
Fax: (619) 449-1990
Sales@Discflo.com
www.Discflo.com

Independent testing by Swaco and MB Energy Services has confirmed that Discflo's Disc Pump can handle solids concentrations up to 90% by volume. The results also showed that Disc Pump technology works very well in handling oil-based cuttings, pumping this high-solids, abrasive fluid with ease.

The first test was carried out in May 2000 at the Corpus Christi facilities of Swaco, part of M-I Swaco, a world leader in solids control equipment, waste management services, and separation and screening products for the petroleum and industrial markets. It was designed to test the pump's solid handling ability, specifically to find out whether it could pass 2-inch solids and fluids with 50% minimum solids by volume.

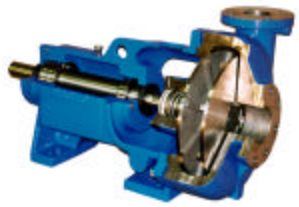
The Disc Pump under investigation was a Discflo Model 403-14-2D horizontal end-suction unit with back pull-out design. In the initial set-up, a 10HP 1760 rpm electric motor was used. The pump was connected to a mud tank by two 15ft long hoses, a 4-inch hose for the suction and 3-inch hose for the discharge. On the discharge side, the hose was connected to a 2-inch pipe and a ball valve before entering the mud tank.

At the start of the test, 9lb/gallon water-based mud was added to the mud tank. After the pump was started, material containing varying solids sizes were added to the tank until the pump was no longer able to pump. The following results were obtained:

1. Add one bag of pebbles. Pebble size is about ¼-inch to ½-inch. Pump ran for one minute, no problems were detected.
2. Add second bag of pebbles. Pump ran for about 5 minutes, no problems.
3. Add half bag of red volcanic rock. Rock size between ¾-inch and 2-inch. Pump handles volcanic rocks in the beginning. As more rocks were added, flow slowed down and then stopped but the pump was still running.

The next day, Swaco tested the maximum solid content the pump can handle. Play sand was added to the mud tank. Each bag weighs 50 lbs and has a volume of ½ cubic ft. A funnel test was run before the test started to determine the solids level.

See next page . . .



Case Study

Solution for Abrasive Solids Pumping

Texaco, Port Arthur, Texas

The Challenge

Pumping diatamaceous earth

Two-phase fluid

Weekly shutdowns for repairs

The Discflo Solution

No shutdowns, breakdowns or lost production for 3 years

"Non-impingement" pumping, laminar flow reduces abrasion

Pump designed to to handle multiphase fluids with ease

Transferring filter cake slurry to the disposal containers was a major headache for this leading motor oil and gas additive processing plant in Texas. For over 10 years, the pumps used by this motor oil and gas additive processing plant in Texas would fail frequently. The slurry being pumped was, at times, the consistency of peanut butter. At other times, the steam condensate would not mix sufficiently with the oily cake, creating a two-phase liquid.

Shutdowns were required once or twice a week, at an average cost of $650 for parts and labor. In addition, around four to five hours' production would be lost due to pump failure. As demand for their calcium sulfonate detergent additives increased, the plant could no longer tolerate this level of loss.

To resolve the problem, the plant engineers decided to try a Discflo pump, which could handle the wide changes in viscosity. Since installation in 1989, the pumps have operated problem-free for three years, with *no* mechanical failures, *no* shutdowns to replace worn parts and *no* lost production. The company estimated that the savings in maintenance costs are around $65,000 annually, and the time to recover the cost of the new pumps was less than three months.

Call Discflo now to find out how our pumps can solve your problems.

DISCFLO
Disc Pumps

Discflo Corporation
10850 Hartley Rd
Santee, CA 92071
Phone: (619) 596-3181
Fax: (619) 449-1990
Sales@Discflo.com
www.Discflo.com

Case Study

Swaco, Corpus Christi, Texas

Flow stopped after 20 bags of sand had been added to the tank. At this point, the mud weight was 12.6 lb/gallon. Solid content calculation showed that at 20 bags of sand, the solid content was around 91% by volume. Swaco gave the Disc Pump full marks for passing the solids size and solids content handling tests: “All the goals set before the test were achieved.”

The next step was to move the pump to MB Energy Services, an environmental services company also based in Texas, to test its handling of oil-based cuttings. The Discflo pump test was carried out in two stages. In the first stage, the pump was connected to a cutting trough and oil-based currings were circulated in and out of the trough. While in the second stage of the test, the pump was hooked up to a drier.

Swaco’s Sam Hu published these conclusions in June 2000 following the final phase of testing:

“Three goals were set before the test: a) cutting solid content should be above 50%; b) pump should be able to pass 2-inch size solids; c) pump able to transfer oil-based cuttings. The test done at Corpus Christie shows that the first two goals were met: a) the pump can pump pump cuttings with solid content up to 90%; b) 2-inch size solids can pass through the pump. The test at MB Energy shows that the pump can pump oil-based cuttings very well.”

Call Discflo now to find out how our pumps can solve your problems.

DISCFLO
Disc Pumps

Discflo Corporation
10850 Hartley Rd
Santee, CA 92071
Phone: (619) 596-3181
Fax: (619) 449-1990
Sales@Discflo.com
www.Discflo.com