

Hose VS progressive cavity pump



Progressive cavity pumps, also known as a PC, progressive cavity PD or as a helical screw pump are extensively used across various industries for the transfer of fluids. Characterized by their unique design, these pumps consist of a helical rotor that turns inside a helical stator. The rotor is typically made from metal, while the stator is made from a flexible elastomer, allowing for the tight sealing necessary for the pump's operation.

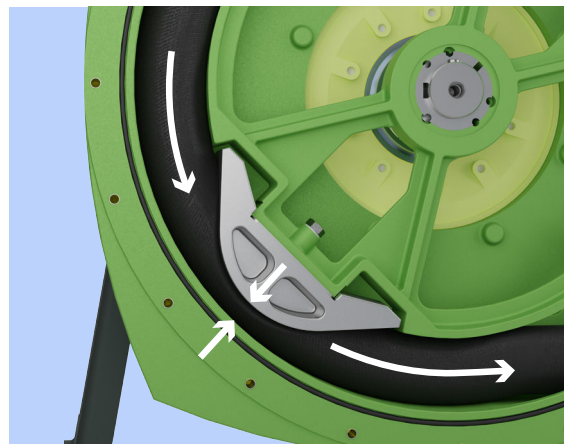
The operational principle of PC pumps lies in the creation of a series of discrete, progressive cavities as the rotor turns within the stator. This movement transports the fluid in a smooth, continuous flow from the inlet to the outlet of the pump with minimal pulsation. Due to this mechanism PD pumps is suitable for high viscous fluids, or fluids requiring low product damage without causing damage or wear to the pump components.

In summary, progressive cavity pumps are versatile, efficient, and reliable, offering solutions for challenging fluid handling applications across a wide range of industries.

A peristaltic pump is also positive displacement, a shoe or roller compress a hose that draw fluid into the hose, then but trapping a cavity of fluid between two shoes/rollers and then discharge the trapped volume. The smooth flow is suitable to protect shear sensitive liquids. PC pumps have very similar characteristics and advantages to peristaltic hose pumps but how does the two technologies, being both positive displacement pumps compare?

01 Transferring abrasive and corrosive liquids

Abrasive liquids, is characterized by their capacity to wear down or erode surfaces they encounter and pose significant challenges in pumping applications. The key word is “wear down” different materials is considered to reduce the rate of wear but cannot be prevented. These fluids often contain hard particles like silica, migmatite, chrome, ceramic or lime slurries, common liquids such as fruit juices or toothpaste contain particles that is harmful to pump components. To combat these difficult liquids pumps are constructed using robust materials chosen for their resistance to wear and corrosion.



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PC cavity pumps are often fitted with hard chrome stators to reduce the wear rate; but the pump has limitations to the level of abrasiveness and solids particle size the pump can withstand. PC pumps would not necessarily be engineers first choice to pump very abrasive liquids, lime slurry and some fruit juices has the same wear rate as most refined mining slurries. Rotor wear create other technical difficulties that are addressed in the next section.

In peristaltic pumps natural rubber hose material would be the manufacturers choice to transfer abrasive and solid laden liquids. Peristaltic hose pumps excel pumping solid laden liquids, pumps with shoes claim the ability to transfer up to 15% (of the hose inner diameter) incompressible solids without any pump damage.

Both a PD and peristaltic pump (hose pump) corrosive resistance is limited to the rotor, stator and mechanical seal materials available for PD pumps, and hose material for peristaltic pumps. Careful consideration to chemical compatibility must be exercised to avoid pump damage. Peristaltic pumps does not have any pump component in liquid contact except for the inside of the hose making the pump very suitable to pump corrosive liquids.

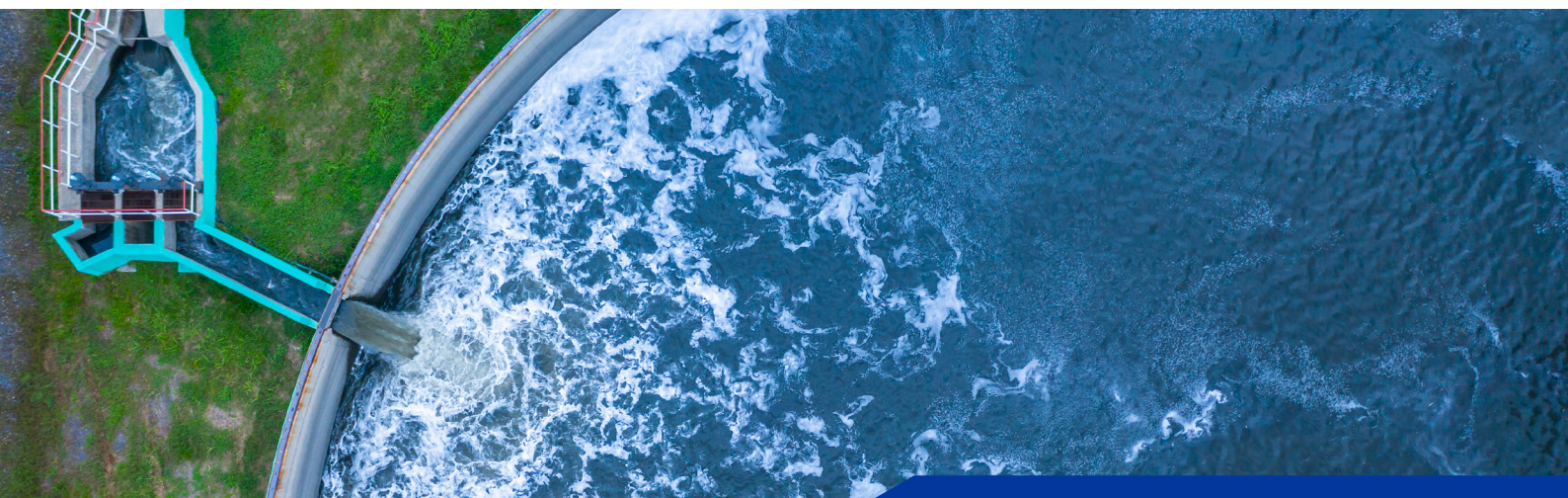
02 Volumetric efficiency

PD pumps is often used as metering or a dosing pump, however the level of accuracy the customer requires determine if the technology is indeed suitable. The working principle of a PD was discussed previously, in short a metal rotor rotates inside a rubber stator. It is worth discussing the working principle a bit more. The metal rotor should not be in contact with the rubber stator, any contact will heat both components, the liquid barrier between the rotating and static components act as a lubrication and a cooling barrier to manage any heat buildup (metal vs rubber).

The system in which a pump transfer a liquid creates resistance to flow or commonly known as "counter pressure, friction and components (but not limited to) all contribute to pressure that is measured in meters and commonly known as total dynamic head (TDH). As pressure builds backflow will occur between the rotor and stator and cause potential damage. A PD pump is technically therefore not a true positive displacement pump due to "losses" in liquid transfer.

If an abrasive liquid or slurry is transferred with any backflow between the stator and rotor, drastically increase the stator and rotor wear, the high wear rate and decrease in pump efficiency speeds up the pump wear until failure. The risk of viscosity shear increases with high viscosity/density liquids containing solids for example toothpaste or mango fruit pulp/paste.

The very nature of a peristaltic pump compress a hose to form a seal and prevent backflow, the compression point should be sufficient to withstand the system counter pressure. The rollers/shoes should be suitably shimmed to avoid any leakage but at the same time to protect the hose. As a result, for as long as the seal compression is maintained the peristaltic pump volumetric efficiency will remain to a near perfect (99,99%). A peristaltic industrial hose pump is therefore classified as a true positive displacement pump, the liquid what is drawn into the pump will be discharged in equal volume. With correct settings the peristaltic pump will therefore remain a very accurate dosing/dispensing pump at any pump speed or pressure.



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03 Dry running and product shear

Dry running or partial dry running will be harmful to most pumps, PD pumps require the liquid to cool the stator, rotor and lubricate the mechanical seal. Manufacturers of PD pumps highly recommend against dry running and developed many devices to monitor and protect the pump. Partial or intermittent dry running (potential cavitation) is just as harmful, subject to conditions the failure of dry running could be immediate, whereas cavitation failure rate is longer. In the event of dry run conditions, catastrophic failures require the replacement of almost all pump internals, while severe failures may necessitate replacement of the entire pump. Peristaltic pumps self priming ability allow the pump to run dry without any damage.

Product shear, PD pumps is very popular to pump liquids that require low shear, for example when considering flocculant, to protect the sensitive polymer a large pump at low speed create gentle liquid flow, a common practice and a “go to” solution for engineers.

Peristaltic pumps is generally not a high volume pump, the 99,99% volumetric efficiency and gentle flow path make the technology ideal as a low shearing doing pump with as little as 1% product losses. Sensitive liquids such as micro-organisms, bio-organisms, carbon, polymer of live fish is transferred without damage.

Customer feedback stated using a hose pump a 40% improvement in flocculation and a stable and efficient dosing station.

04 Parts costs

Progressing cavity pumps are precision engineered pumps and have significant replacement parts costs. A worn stator can cost 40 to 50% of the original pump cost, and it is generally accepted that the rotor is also replaced every second or third stator change. This is another costly part before additional rebuild incidentals such as seals and coupling rods are considered, resulting in maintenance event costs closer to 70% of the original pump cost.

In contrast, the hose pump has much lower parts costs, requiring nothing more than a hose and, depending on the duty, some food-grade lubricant, totaling less than 10% of the original pump price.

05 Servicing costs

The burnt stator illustration highlights the complexity of the stator replacement procedure: the pump must be removed to a workshop, specialist equipment used to remove the damaged stator, the associated assemblies stripped down, the replacement stator fitted, and the pump rebuilt with new seals. This process can easily take many hours and requires costly skilled tradesmen.

For hose pumps, the only service part is the easy-to-change long-life hose, a procedure that is normally carried out where the pump is installed and takes minutes, not hours. Additionally, semi-skilled staff regularly perform on-site hose changeovers, further lowering the servicing costs.



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06 Hidden servicing costs

Water companies are increasingly adopting unmanned or semi-skilled plant operations, placing a premium on service interventions and the availability of skilled maintenance staff, who are often located in a remote central engineering resource pool. Any pump or system issue results in a callout, with the associated time-consuming journey to get to the plant before starting work. Consequently, the impact of issues such as clogged pumps, worn parts needing adjustment, dry running burnouts, and routine component changes extends beyond the simple on-site time required to resolve the issue. There is also the often-neglected “travel to site” time, which can be significant as traffic congestion increases globally around major conurbations, representing a hidden cost of ownership.

07 Clogging and blockages

All hose pumps are truly reversible, being able to run backward or forward at the same flow rates. Often, hose pumps are reversed for a short period to clear system blockages simply by sending a remote signal to the pump’s inverter, clearing such problems without even needing a site visit.

The Initial Investment: typical lime dosing situation requires a pump to move 4m³ of lime per hour. A typical progressing cavity pump will cost around €2,500, and the corresponding hose pump will cost around €5,500. So, the hose pump will require an extra €3,000 initial investment, or €2.50 per day over a 5-year period.

Maintenance Event Costs: every time we change a stator, the cost will be around €1,750 for a spare stator, seals, etc., and it takes around 6 hours. In contrast, the hose pump spares will cost €500 and 2 hours to change. Let’s presume a common labour rate of €50 per hour. For all maintenance events, we’ve allowed 1 hour to travel to and return from the site.

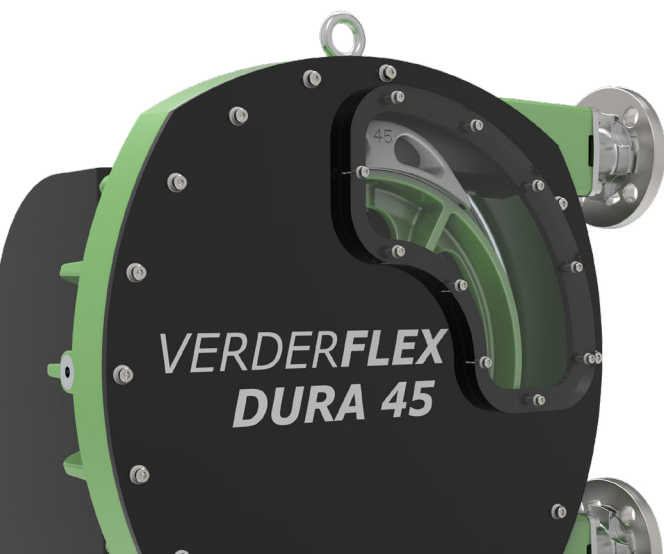
Maintenance Frequency: while it is possible to consider an extreme and atypical scenario to strengthen the argument, such an approach would not accurately reflect real-world conditions and is unnecessary for illustrating our point. Therefore, we will consider a more realistic situation where there are 4 stator changes and 3 hose changes per year, assuming no unplanned failures of the stators. By combining the event costs and frequencies, the resulting annual maintenance costs are €8,400 for the progressing cavity pump and a significantly lower €1,950 for the hose pump.



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Combining this data into a simple analysis as below:

TCO Calculator	Hose Pump	Progressing Cavity Pump
Cost per year	Dura 45	
Purchase cost price	€ 5.500	€ 2.500
# of pumps required	1	1
Total purchase cost pumps	€ 5.500	€ 2.500
Differential Cost	€ 3.000	
Differential Cost / month	€ 50	
Differential Cost / day	€ 2,50	
Attributable expenses		
Labour Cost / Hour	€ 50	
Annual Maintenance costs	€ 1.950	€ 8.400
# of maintenance visits per year	3	4
Labour Hours / Mtce Event	2	6
Labour Cost / Hour	€ 50	€ 50
maintenance cost per event	€ 100	€ 300
travel costs per event (1 hour)	€ 50	€ 50
spares costs per event	€ 500	€ 1.750
Annual Breakdown Repair costs	-	-
# of Dry Running Burn Outs p.a.	0	0
Workshop Labour Hours / Mtce Event		6,0
Workshop rebuilt costs / Event	-	€ 300
On Site Labour Hours / Mtce Event		2,0
spares costs per event	€ 500	€ 1.750
travel costs per event (1 hour)	€ 50	€ 50
On site Repair cost / Event	-	€ 100
Cost per Event	€ 550	€ 2.200
Total Annual cost of ownership	€ 1.950	€ 8.400
Annual Saving	€ 6.450	
Payback Time on Hose Pump Cost	10 months	
5 Years Savings	€ 32.250	
5 year savings as % of difference in pump cost	1075%	
Lifetime hose / stator (days)	120	90
# Changes per year	3	4



Conclusion

The popularity of positive displacement pumps must not be underestimated, the commercial value exceeds that of a peristaltic pump. Technically the ability are very good machines suitable to hard and difficult applications. PD pumps has higher volume and pressure option than peristaltic pumps, the latter has superior accuracy and maintenance costs. Considering abrasive, corrosive, dry running and maintenance cost the peristaltic pump would be the favourable technology. The difference between capital expenditure and maintenance cost will be the key deciding factor the buyer decide which technology will be the technology of choice.



More than 65 years of experience in professional pumping applications make VERDER the pump manufacturer of choice for customers from many industries on all continents. VERDER offers you process understanding, the technological expertise and the market insight to develop pumping solutions which rank among the best in the world. This is how we enable your progress.

