PREROSTAL™ VERSUS ARCHIMEDEAN SCREW PUMPS

For many years Archimedean screw pumps have been a popular choice for critical pump stations and waste water treatment plants because of their ability to handle large volumes of liquid, variations in flow and unscreened sewage without affecting performance. Typical applications have been inlet pumping stations for pumping raw unscreened sewage and return activated sludge, at interstage pumping where flow matching is desirable and for handling final effluent. However, as the industry becomes more sensitive to economic and environmental issues this workhorse is no longer as attractive as it used to be.

Today all companies are under extreme pressure to reduce costs and comply with environmental regulations. In the waste and water industry this means that companies are expected to design sewage and waste water pumping stations at the lowest possible costs yet with more and more built-in beneficial features. In this climate the Archimedean screw pump fails in a number or respects and this is where the Hidrostal Prerostal pumping system excels and proves to be a good alternative.

The Archimedean screw pump

The Archimedean screw pump is expensive to construct, especially for heads greater than 5.0 m. The hefty design of the pump means that it requires a large installation site which in turn results in increased civil works [high labour and concrete costs] as well as wasted space.

Costs of transport, installation and overhauling are high especially as special lifting equipment is required to install or remove for maintenance. Although it is considered simple and generally reliable it does have some intrinsic problems, particularly around the failure of bearings and gearbox, which are expensive to repair. It has also been known for the stationary screws to distort in hot sun causing the screw to bend and seize after 180º of rotation or rub against and wear the concrete trough which reduces performance and volumetric efficiency.

Environmentally it suffers too. The structure protrudes above ground level impacting on the visual appearance of the surroundings and causing possible safety issues. One of its main disadvantages, however, is that it can generate high levels of odour due to the large surface area of liquid trapped in the screw. Despite attempts to enclose the screw pump, odorous gases are released into the atmosphere. Additionally, gases [H₂S] are trapped under the covers which are extremely corrosive and attack mild steel screws, significantly reducing the life of the screw as well as reducing its efficiency thereby increasing running costs.

The Hidrostal Prerostal, however, offers all of the well known benefits of the Archimedean screw pump yet at the same time addresses many of the operational problems.
Hidrostal Prerostal™

The Prerostal system comprises a single or multiple Hidrostal screw centrifugal impeller pump which like the Archimedean screw pump provides excellent solids handling, high efficiencies and gentle/low shear pumping. Though, unlike the Archimedean screw pump, the system will cost considerably less to construct and operate, particularly when the lift is greater than 5.0 m.

Civil costs are substantially reduced because the prerostal system has a much smaller footprint and only requires a minimum sump size which alone can offer savings of up to 40% on construction costs. The station layout is also much more flexible as either wet or dry pumps can be installed.

One of the great benefits of using a prerostal system on dirty liquids, especially those which produce large amounts of floating material, is that every time a pump goes through its operating cycle from start to stop it will clean both the floor and surface of the sump of all solids. The absence of floating material, oils and grease which decompose in high ambient temperatures means fewer odours are generated. Odour emissions are also significantly reduced as there is no churning of the liquid, it has a small liquid surface area and low sump volume.
Analysis of the Prerostal and the Archimedean screw pump

The Prerostal System and Archimedean Screw Pump have many of the same characteristics but the Prerostal can be applied to much higher heads.

Both the Archimedean screw pump and the Prerostal share the following characteristics:

- Good solids handling
- Gentle pumping action
- No damage to floc
- No emulsification of oily water mixtures
- Gentle handling of Returned Activated Sludge [RAS]
- Flow matching [self-regulating]
- Removes floating material
- Equal depth of excavation

However, the Prerostal has clear advantages in the following areas:

- Higher efficiencies over life cycle, which means lower running costs
- Smaller civil structure which means lower capital costs
- Less land area
- No safety or odour problems, enabling siting close to populated areas
- Can be buried underground so no visual impact
- Pumps wet or dry installed to suit engineer’s preference
- More flexible pump station layout
- More flexible site layout
- Easy maintenance/repair, no special lifting equipment required
- Heads in excess of 20 m
- Less costly mechanical equipment if special materials are required.
The Prerostal™ is the ideal pumping solution for the following:

- Inlet Pumping Stations - Unscreened Raw Sewage & stormwater
- Interstage Lift - Stormwater & settled/screened sewage
- Return Activated Sludge [RAS]
- Industrial Effluents
- Feeding Sand Filters
- Feeding Oily Water to API Separators
- Removal of Floating Products

In summary, the Hidrostal Prerostal™ is cheaper to construct, more efficient to operate and offers many environmental benefits over the Archimedeian screw pump.

THE HIDROSTAL PREROSTAL™ – THE ALTERNATIVE TO THE ARCHIMEDEAN SCREW PUMP

The basis elements of a Prerostal pumping system are:

- A standard Hidrostal solids handling pump with its unique screw centrifugal clog-free impeller
- A partial weir incorporating an entrance channel located in front of a prerotation basin which regulates the liquid flow to the basin.
- A prerotation basin a matching profiled bellmouth [fitted to the pump suction] which causes the liquid entering the pump suction to be rotated in the same direction as the pump impeller prior to its entry to the pump.
Generally, most pumping stations consist of two or more pumps, but to describe how the system is able to automatically achieve self-regulation by matching the out-flow to the in-flow the following description of a single pump will show how the above elements interact to produce infinitely variable flow. The principles are the same for both wet and dry pit versions.

1] At this level inflow matches standard pump curve AB

2] Inflow rate less than pump capacity. Small amount of prerotation in basin gives new curve A-C so pump output matches inflow.

3] Inflow continues to fall. High degree of prerotation to give curve A-D so pump matches inflow.

The sequence of events show how automatic matching of discharge flow rate can be established with the proper design of weir height, entrance channel width, basin and bellmouth geometry, pump speed and correct impeller selection.

At the beginning of the sequence the controls are in their normal position and the pump is ‘OFF’. As the liquid enters the sump, the level will rise to the ‘START’ level activating the pump ‘ON’ switch and the pump begins to discharge liquid from the wet well. The rate at which discharge will occur is determined by the point at which the normal pump characteristics curve and the system head curve intersect. Point B on Fig 1A.

If the inflow rate exactly matches the discharge capacity of the pump the liquid level in the sump will remain well above the weir, no prerotation will be induced and the pump operates on its normal curve A-B in Fig 1 A.

If the inflow rate is less than the maximum capacity of the pump the liquid level in the sump will fall to a point where the level approaches the weir height and the liquid entering the basin is predominately via the entrance channel with only a small amount passing over the weir. See Fig 1B. At this point the onset of prerotation has occurred.

The action of the pump is to reduce the level in the basin, relative to the level in the sump. This adds velocity and induces rotation to the liquid in the same direction that the impeller is turning, until an equilibrium is established between inflow and discharge flow rates, resulting in a new performance curve A-C Fig 1B.

As the inflow continues to fall the level of the liquid in the basin falls to its lowest level. Fig 1C; tangential velocity and prerotation reach their maximum and pump capacity reaches its minimum as shown by Curve A-D in Fig 1C.