

# FARMER DEVELOPS SELF-CLEANING FILTER INTO A CENTRIFUGAL SEWAGE FILTERPUMP

Rotorflush Filters started in 1996 as a result of an invention by UK Dairy Farmer Jim Hosford. He designed a self-cleaning suction filter for use on the 2 kW surface mounted centrifugal pump pumping effluent from his dairy unit. This effluent consisted of cow manure, straw, silage, and sometimes leaves and plastic bags that had been blown into the lagoon. Now his filterpumps can be found in countless sewage plants and irrigation systems.

A large static screen filter supplied with the pump was blocking every hour or so making the system unusable. The self-cleaning suction screen he designed enabled the pump to work continuously for months on end with no maintenance. It had two internal backwashing jets that were powered by a proportion of the pump's output. The rotating jets continually backwashed the screen removing any detritus that was starting to blind the screen. After winning his category in the 1994 inventions competition run by the UK's Farmers Weekly magazine, he decided to start Rotorflush Filters to commercialise the invention. Hosford named his company "Rotorflush" after the revolving flushing jets inside the filters, which is a common feature of all its products.

## Developing the filterpump

The next logical progression was designing a self-cleaning intake filter that could be incorporated as an integral part of a submersible pump. This would make a much simpler unit that could be dropped into almost any water source and produce a pressurised filtered supply with no maintenance.

Initially the driving force was to solve several problems. Solids handling centrifugal pumps only develop relatively low heads. In many situations fibrous matter, string, plastic bags and other detritus will block even these pumps. If the pump does not get blocked then solids in the water can plug upstream valves and nozzles

The problem was that high pressure multistage pumps can only pass very

small solids and their inlet strainers soon get fouled if they are used in water containing any quantity of suspended solids. A self-cleaning intake filter solved these problems. This way, a multi-stage submersible pump that produces high pressures, could be used, the pump and upstream equipment are protected by the filter and the whole unit is very compact and simple to install.



*Filterpump fitted with control valve.*



*Production version on first customers pig unit wastewater lagoon (1996).*

## Manufacture

In the last year the company has invested in tooling to injection mould the backwash nozzles and rotating volute, previously these were fabricated in stainless steel. This made them expensive owing to the amount of fiddly welding and the shape varied slightly

through heat distortion. The geometry of the backwash assembly is critical to make it rotate at the correct speed. The whole assembly rotates on ceramic bearings. The thrust bearing uses two pump seal faces that ensure long life. The injection moulded rotating volute can be fitted with nozzles of differ-

ent lengths to accommodate different filter screen heights. Impellers with different widths can be accommodated depending on the amount of backwash required. At present the largest filter screen apertures are 300 microns, any larger than this will allow particles to block the nozzles. However Rotorflush plans to produce filter screens with up to 5mm apertures. The backwash nozzles will be replaced with rubber fan nozzles that it already uses in its other self-cleaning filter products. These

allow larger particles through without blocking. A vortex type backwash impeller will then be used that can cope with the larger particles coming through the coarse screen. Rotorflush has all its products manufactured in the UK, using a number of sub-contractors.

**Control valve**

Another result of a busy year is the development by Rotorflush of its own control valve. In most situations the self-cleaning filters will work for long

periods without maintenance. However in some situations very high levels of suspended solids may be present that can overcome the backwash of the filter causing it to block.

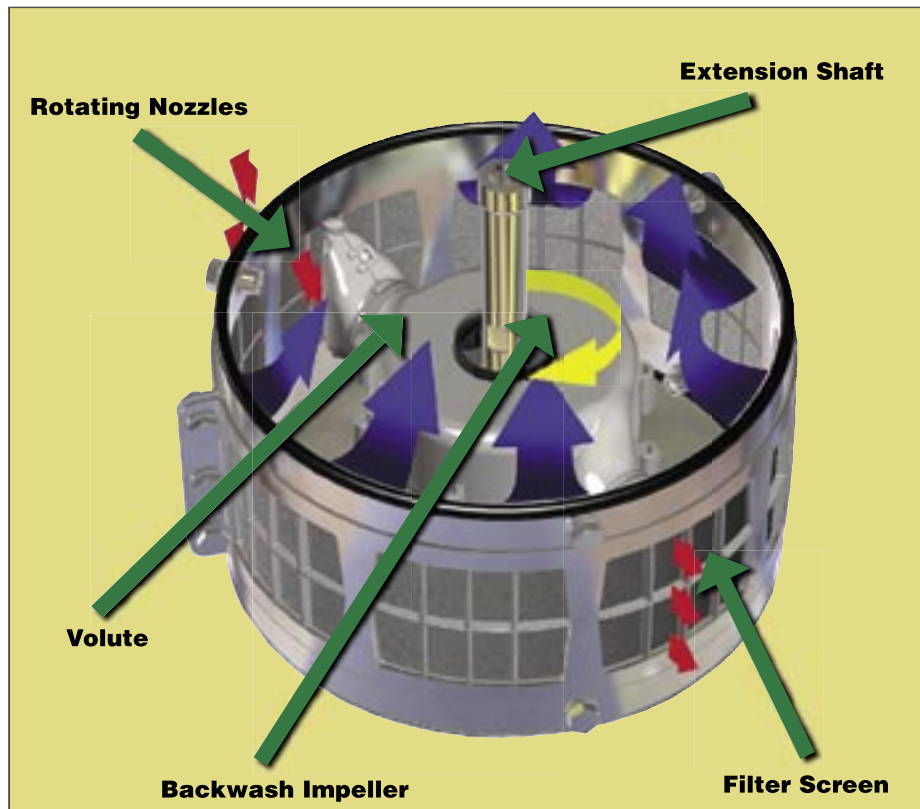
In sewage works f.i. where the filter-pumps are being used to provide wash water for inlet screens, occasionally, usually owing to a storm, the sewers will be scoured of debris and very high levels of solids arrive at the sewage works, causing the filters to block. The level of solids that the filter can cope with depends on the ratio of the main flow to the backwash flow. The higher the backwash flow in relation to the main flow, the more solids it will filter out without blocking. Adjusting the output of the submersible pump in response to the level of solids in the water ensures that the filters can never block irrespective of the solids loading in the water.

A number of solutions have been tried over the years, but in the end Rotorflush decided to develop its own mechanical control valve. A valve was required that would be able to throttle the output of the pump in response to the pressure differential across the filter. The valve needed to offer low flow resistance and not be affected by suspended solids. It needed to be able to throttle and shut off the pump's flow at pressures up to 10 bars.

With only 50mb pressure differential available, (the pressure exerted by a column of water ½ metre high), to provide the motive force to close the valve, careful design was required to balance the pressure and minimise friction. The all stainless steel valve uses rolling diaphragms to balance the pressures across the 50mm valve seat and a larger sensing diaphragm that has a connection to the inside of the filter. As pressure inside the filter drops during times of high solids loading the valve starts to close, restricting the output of the pump. The valve automatically keeps the output of the pump at a level where the filter can continue to clear the debris from the screen. It may only require a slight reduction in the pump's output to keep the screen clear and when the solids levels in the water subside the pump returns to maximum capacity.

**Applications**

The pumps have found a number of applications over the last 4 years. One



**How does it work?**

All filters on the submersibles work in the same basic way, but the method of providing the flow to the revolving jets is different. Instead of providing the backwashing liquid from the pump's output, an extra impeller and volute is provided driven by an extension to the main pump shaft.

The figure displays a computer generated graphic to show the self-cleaning intake filter that is fitted to the bottom of a submersible pump. The large blue arrows show the main flow that has come through the filter screen and up into the submersible pump, while the red arrows show the flow that is re-circulated by the backwash impeller and out through the screen via the nozzles. The yellow arrow shows the rotation of the volute and nozzles. The extension shaft is attached to the end of the main pump shaft and drives the backwash impeller. This impeller recycles the water that has already been through the filter screen, pressurising and expelling it through the nozzles. The nozzles are slightly angled and cause the backwash pump volute to rotate around the impeller at approximately 60 rpm. The water expelled through the nozzles passes back through the filter screen removing any detritus that may be beginning to stick to the screen. In fact it often moves particles away from the screen before they even come into contact with it. <<

of their uses is at sewage works where they are providing wash water for inlet screens where previously potable water was being used. The pumps are positioned either just after the inlet screens or in the primary, secondary or final effluent tanks. Even final effluent contains particles that block the spray nozzles on the head works screens. The pumps provide the pressure required and ensure that the nozzles stay clear.

### Industrial users comment...

A company that has experience with this kind of filterpump, is the Damar Group. This firm provides civil, mechanical and electrical engineering services to the water industry in the UK. They have been using the filterpumps successfully on their de-scumming equipment at sewage works. This involves pumping water from the outflow of the primary settlement tanks back to spray jets that disperse and sink the scum from the surface of the vessels. They are also being used to provide process washwater for inlet screens and sludge thickening installations.

When asked for their comments they said: "The design team from Damar chose the filterpump because it's the only pump available with a self cleaning inlet filter. The multistage submersible provides the pressure we need and the self cleaning inlet filter ensures that particles that would block the pump or the 2 and 3 mm spray jets, are kept out of the system. The pumps have per-



**Control valve, developed by Rotorflush itself.**

formed extremely well and enabled us to achieve our objective of providing cost effective wash water to the smaller systems with very low maintenance."

### Landscape Irrigation

Increasingly customers want to take water from natural water sources rather than from the mains for irrigation. Geoff Wood of Water Designs Ltd near Bath in the UK is another filterpump user. He designs and installs irrigation systems and has used the filterpumps to provide a filtered supply of water for landscape irrigation from lakes.

"The filterpumps are a simple and cost effective way to provide protection of the pump from weed and debris", Wood said. "They eliminated the need for complicated and expensive upstream

self-cleaning filters and have proved reliable and maintenance free even though we have one installed in a particularly dirty part of a lake".

A constant flow of filtered effluent needs to be provided to the analyser at sewage works and factories. Keith Perkins who manufactures analysers in the UK has been using filterpumps to continuously feed his analyser cells on sewage works. Keith: "The filterpump is an ideal solution for extracting a filtered sample for our analyser. There can often be weed and other detritus in the final effluent channel that would block a wastewater pump. The 125 micron self cleaning inlet screen provided on the submersible pump not only protects the pump from blockage but provides a filtered sample with no requirement for cleaning of conventional filters."

The filterpumps have been used for many other uses, including water recycling systems on vegetable washer units, prefiltering and pumping water contaminated with waste in the nuclear industry and a steeple jack company for filtering the output of water cooled chainsaws used for taking down chimneys. A recent enquiry is the use of the filterpumps to provide a filtered supply of cooling water to the seals on large pumps. <<



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