

# Newest pump technology uses only 2.7kW/m<sup>3</sup> for SWRO

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### Editor's Note

This paper describes a case study on Lanzarote in the Canary Islands, where an APP8.2 high-pressure pump from Danfoss A/S has been installed to evaluate the impact of its high efficiency on the overall power consumption of a containerized Reverse Osmosis skid from HOH Canarias. The race to reduce further the power consumption of small reverse-osmosis (RO) desalinators is a (hopefully) neverending story. The major steps have been membrane optimization, introducing applicable pretreatment and developing high-efficiency energy-recovery systems. The latest development on high-pressure feed pumps adds a new dimension to the race.

### Axial piston pumps - a proven technology

Since 1950, oil hydraulics has employed axial piston pumps as high-pressure pumps for mobile and industrial oil hydraulic applications. The principle is recognized as highly reliable with no service demand through its life in operation. Since 1989, Danfoss has developed and produced a similar pump for its range of water hydraulic components, and, since the launch to the hydraulic market in 1994, more than 8000 pumps have been sold to date.

For the last two years, tests have been carried out with pumps running on live SWRO applications throughout Europe. To cope with 40°C and 45,000 tds seawater, the pump material has been altered, and the APP pumps are thus made of Duplex and Superduplex materials.

All test pumps have been running continuously for more than 8000 hours without requiring any service. Part of the testing has been taking the pumps apart for inspection at frequent intervals, and the results have been very encouraging with no sign of wear at all assuming that the service life will be equal to freshwater pumps of 25-40,000 hours requiring no maintenance.

The pump is directly mounted on an electric motor via a bell housing. The APP pumps are lubricated by the

medium itself, and no valves or sealing requiring maintenance are used.

### High efficiency - low running costs

The first test at Lanzarote was carried out in a containerized unit producing 6.2 m<sup>3</sup>/h fresh water using 32,000 tds seawater at a temperature of 20°C. The APP8.2 pump was run by a 15 kW electrical inverter-driven motor at around 1350 rpm and 60 bar. The unit was equipped with a pressure exchanger from

Energy Recovery Inc., and the overall power consumption was calculated and measured to be as low as 2.65 kW/m<sup>3</sup> permeate production.

A parallel set-up was installed in the basement in a hotel nearby producing same amount of water under similar conditions and results.

The market for small-size desalinators is looking for anything below 3 kW/m<sup>3</sup> as a goal achievable with today's technology. Centrifugal pumps either mounted in series or as single-stage are seldom considering their efficiency well below the level of positive displacement pumps.

The use of a high-efficiency

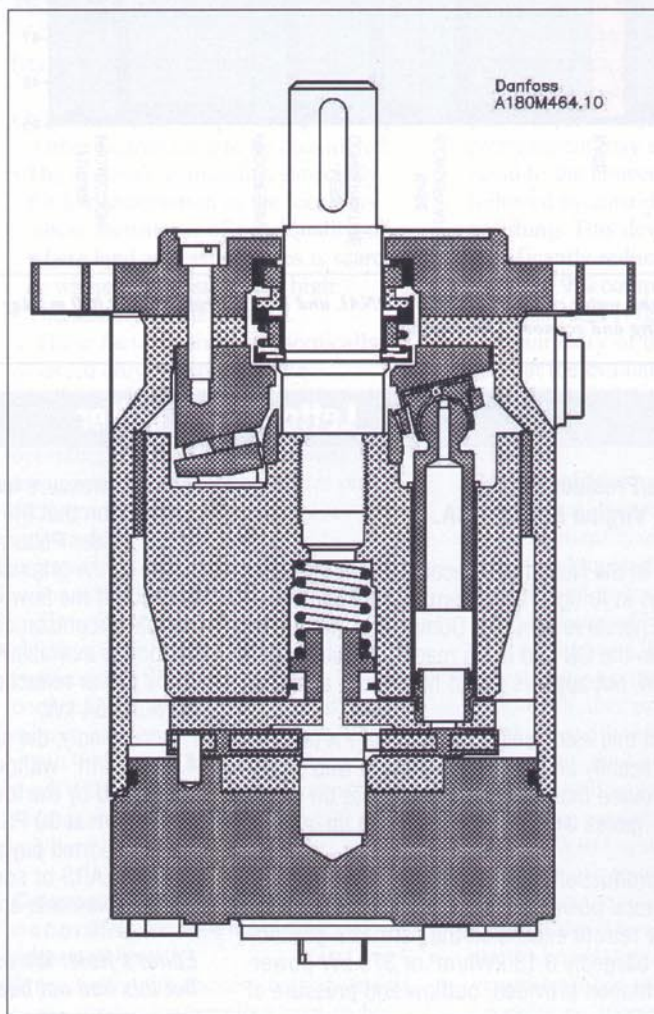


Figure 1 - Cross section of pump

# Manufacturer's Case Study



Figure 2 - The Lanzarote plant.

high-pressure feed pump to its maximum is for small desalinators below 20 m<sup>3</sup>/h feed flow and is of big interest throughout the world. Containerized units are not only used in hotels and marinas, but also as the main water supply for remote islands, on board ships and oil platforms.

The energy sources for driving these units are often diesel generators and other sources for which the fuel has to be transported over long distances, and the end product, electricity, is therefore

of a certain value.

One of the reasons for the low power consumption at Lanzarote and the possibility of getting even better results is that the pumps are being run in their optimum rpm band. This is despite the difference in efficiency being only around 2% between a pump speed from 1000 to 1800 rpm with typical values of 97% at 1800 rpm. Every optimization counts if the goal of less than 2.5 kW / m<sup>3</sup> shall be achieved.

Running-cost reductions compared

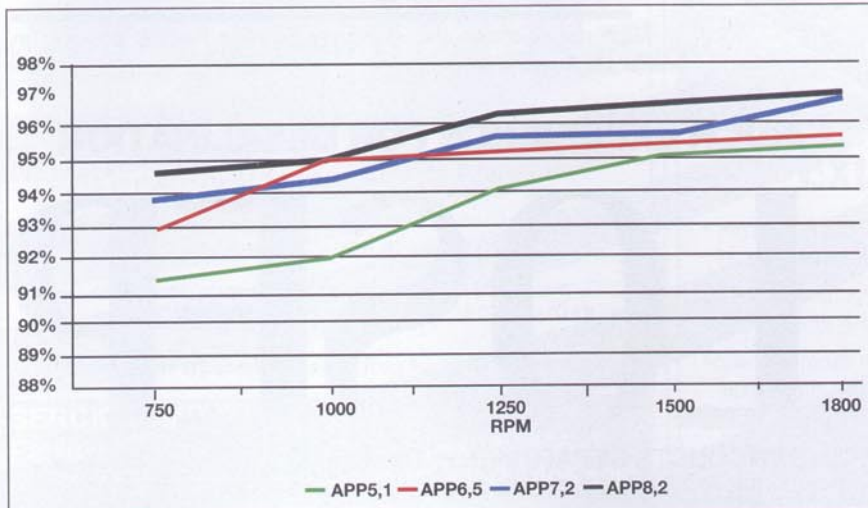


Fig.3 - Typical volumetric efficiencies

with the use of other pump principles were easily determined at Lanzarote. The RO-skid was originally equipped with two multistage centrifugal pumps mounted in series with an overall efficiency of about 65%.

The total efficiency of the APP8.2 pump at 1350 rpm, before it had been "run in", was measured to 92% at the test rig in Denmark. With a unit price of \$0.10 / kW/h on Lanzarote, the measured difference of one year's running cost is equal to a saving of no less than \$2,800 / year.

## Conclusion

The Danfoss APP pumps have been successfully installed and commissioned throughout Europe, USA and the Middle East during the past two years. The low running costs combined with long service life have been well accepted in the RO market.

In a world of a never-ending demand for applicable water made in the most cost effective way this "new" RO-pump has in several cases – and especially at HOH Canarias - proved to be an interesting competitive alternative to existing pump principles.

## About the authors



Freddy Ludvigsen was born in Denmark and now resides in Spain in the Canary Islands. He was General Manager of HOH Canarias

from 1991 until 1996 when he carried out a management buy-out.



Anders Valbjørn was born and resides in Denmark. He gained a B.Sc., Mech. Eng. in 1992 and since then has worked with Danfoss A/S in the Water Hydraulics Dept. He has been

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