ELGA VEOLIA

Technology Note 41

PURELAB® flex Ecological Enhancement

WATER TECHNOLOGIES

Introduction

As part of the relaunch of the award winning PURELAB® flex range, the team at ELGA has taken the opportunity to reduce the system's environmental footprint and incorporate some of the latest innovations in water purification technologies.

The Ecological improvements incorporated into the flex range have been made with the aim of reducing water and power consumption; in a typical usage pattern savings can be up to 20% for water and 55% for electrical power. Features contributing to these enhanced performance areas are explained in this technology note.

1. Utilisation of state of the art Reverse Osmosis membrane; this specially featured membrane gives significantly improved water flux which results in a decrease in reservoir filling time and in water usage.

2. Electrical power savings; optimisation of operational settings and minimised system operation significantly reduces electricity use. This was achieved by operating the unit with fewer refills (lowering reservoir fill level) and the introduction of 'Eco Mode'.

Enhanced Reverse Osmosis System Operation

The benefits of using the Aquaporin RO membranes include:

1. Reduced waiting times due to high filtration rate (measured at >20l/hr*).

2. Energy and electricity saving as RO-pumps are not needed in many situations where feed-water pressure is low; flow rates of >7.5 l/hr measured with feed pressure at 2 bar.

3. Reduced water usage.

**Measured with feed water pressure at 4 bar*

What are Aquaporins and how are they used in RO membranes?

Aquaporin proteins are specialist water channels, existing in the membrane of all living cells. They can be found in every living organism, from plants and animals to human beings.

Placed within the cell membrane, aquaporin proteins transport water, and only water, in and out of the cell. Nature and evolution has crafted these molecules making them extremely efficient and highly selective, for water transport and passage.

Certain cells have developed to require a very high level of membrane water permeability. Instances where this is crucial, include fluid secretion and absorption. For example, across epithelial cell layers in kidney tubules and exocrine glands. The proper functioning of the kidneys and the secretion of bodily fluids like saliva rely on the presence of aquaporins to enable sufficient water passage[(1)].

Some studies suggest that a single human aquaporin-1 channel can facilitate water transport at the extraordinary rate of approximately three billion molecules per second[(2)].

Assuming a molecular mass of 30 kDa[(3)] for the protein, then for each milligram of Aquaporin, this equates to almost 2 litres of water per second. Of course water passage is not only 'one-way' and, in practice, filtration-flows are lower. Membrane manufacturers state that one square metre of synthetic manmade membrane can filter around 50 litres of water per hour.

Aquaporin RO membranes have a special formulation to incorporate aquaporin proteins, (also known as water channels), within a membrane matrix during the fabrication process. This results in a significant improvement in performance in terms of water-flux as the embedded aquaporin proteins selectively facilitate the transport of water across the filter. It then becomes much easier to filter a given volume of water and so innovation using this natural technology also significantly improves energy-efficiency, compared with traditional synthetic polyamide RO-membranes. The high level of impurity-rejection is maintained and incorporation of the aquaporins into the RO membrane matrix can produce filters of exceptionally high performance[(4)].

Electrical Power Savings: Process Optimisation and Eco Mode

A variety of optimisations to the flex software, including introduction of an 'Eco mode', have been developed to reduce use of electrical power and water that is directed to drain, while maintaining the high purity of water that you expect from the flex range.

Settings remain fully customizable by users but will be factory set to reduce the environmental footprint.

Systems to improve performance include reduced frequency of reservoir refilling, and minimised process operation outside of 'working hours'.

Example of Enhanced Performance

Typical operating patterns have been compared, where 10 litres of purified water are taken in four 2.5-litre potions during a 9am to 5pm working-day. The original and improved versions of each flex system are operated with default software settings and with feed water delivered at 4 bar (2 bar for flex 2) and 16°C.

Summary of Savings:

PURELAB flex 3 & 3+

1. Increased RO production rate to approx. 20 l/hr
2. Water to drain is reduced by 20% through shorter RO operation time and fewer refill cycles.
3. Power used is reduced by 28 and 55% for flex 3 and 3+ respectively, through reduced purification component operation while 'Eco Mode' is active and during reservoir filling.

PURELAB flex 2

1. Power used is 17% less, through reduced purification component operation during 'Eco Mode' operation

Conclusion

The enhancements to the flex range will have a significant positive environmental impact; these improvements fall in line with the ecologically-based strategy and forward thinking within the Veolia group. Use of innovative components and the process optimisations implemented by the ELGA team have led to reductions in water and power use, by up to 20%, and up to 55%, respectively. Options for users to customise the process operation such as reservoir refill level remain to accommodate individual requirements and working patterns, however, the biggest savings will be made when using the default software settings.

References

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