

Super Concentrated Beer

Using Aquaporin Inside® forward osmosis



UNIQUE CUTTING-EDGE PRODUCT



HIGH ETHANOL RETENTION



PRESERVES SENSORY PROFILE



IMPROVED LOGISTICS



NOVEL BEER PRODUCTS



SHORTER PRODUCTION TIME OF BARLEY WINE

- ✓ Up to 80% ethanol retention
- ✓ Preserves nutrients and sensory profile
- ✓ Significant improvement in beer distribution logistics through up to 10x volume reduction
- ✓ Novel products can be derived from super concentrated beer

- ✓ Shorter production time of barley wine
- ✓ The Aquaporin Inside FO process can be easily retrofitted to existing processes and customized according to manufacturing needs
- ✓ Simple flush cleaning with water to sustain process performance

MORE REASONS TO SAY CHEERS!

To meet the demands of today’s beer consumers, it is no longer enough to use traditional brewing processes and techniques to remain competitive, while increasing productivity. Quality has become more important than quantity to remain competitive in the industry. The need for adopting to new alternative technologies is crucial to increase quality. The ability to adopt these alternative technologies will determine the strength and competitiveness of a brewery in the future. Forward osmosis is a novel technology to help overcome this challenge.

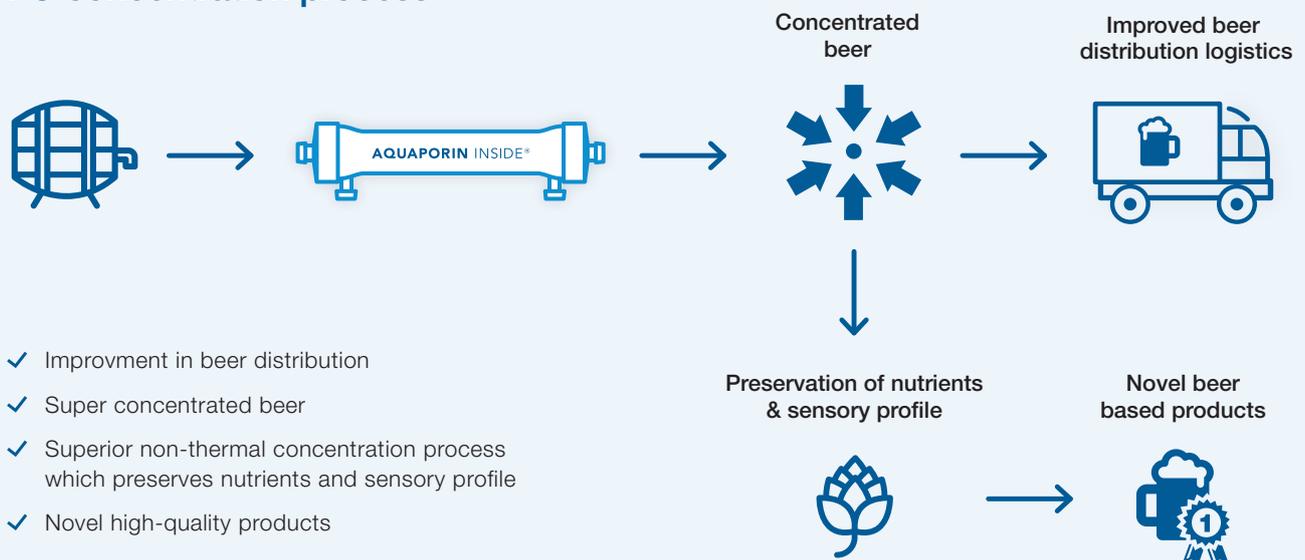
Adopting forward osmosis into the beer production offers several benefits. FO can concentrate beer which preserves the beer better and increases its shelf life. As water is extracted to concentrate the beer, the transport expenses can be reduced. During the extraction, valuable beer aroma compounds are retained to ensure high quality of the concentrate. This means that FO can be used favorably to produce low-alcohol or condense beer, as the concentrated beer can be rehydrated.

IMPROVED BEER LOGISTICS & INNOVATIVE PRODUCTS

Conventional process



Incorporating Aquaporin Inside® FO concentration process

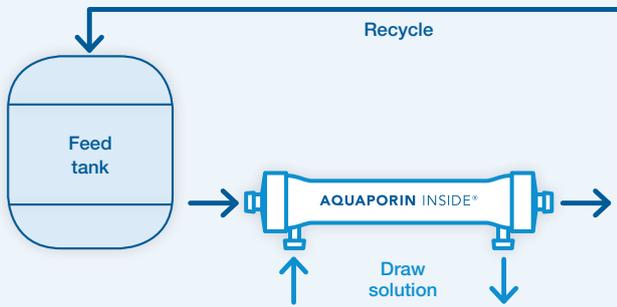


CASE STUDY

Beer concentration using Aquaporin Inside® HFFO2

Method

A lab-scale study using Aquaporin Inside® HFFO2 was carried out to validate the technical feasibility. Experiments were performed in FO mode where active layer of the membrane was facing the feed side.

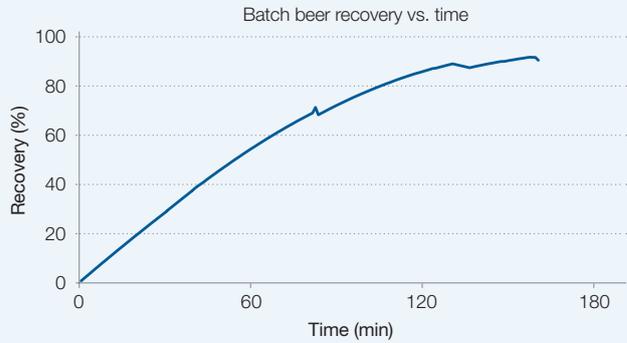


Mode of operation	Feed solution in batch mode Draw solution in continuous mode
Feed solution	40L lager beer (4.6% alcohol)
Draw solution	2M MgCl ₂
Operating conditions	1 LPM feed inlet 0.4 LPM draw inlet < 1.0 bar TMP FO mode (feed in lumen side), co-current, 25°C
Membrane type	Aquaporin Inside® Hollow Fiber Forward Osmosis module (2.3m ²)
Membrane QC	Before and after beer concentration

Results

HFFO2 batch beer concentration results:

- ✓ 10x concentration of beer in less than in 3 hours (90% recovery using MgCl₂ as osmotic draw solute)
- ✓ Up to 80% ethanol retention



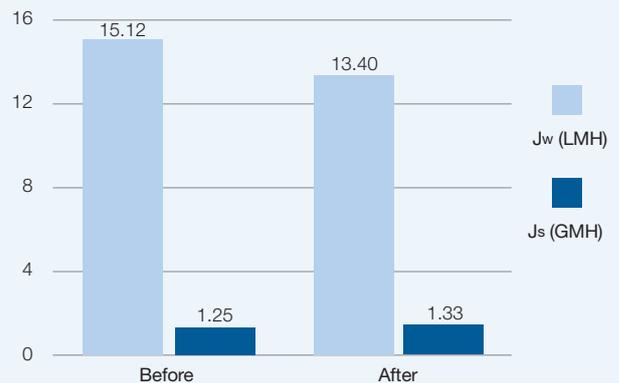
High quality concentrated beer

	Before concentration by FO	After concentration by FO
Alcohol % v/v	4.6 %	24.0 %
Color	Golden yellow	Dark brown
Aroma & Taste	Beer, slightly fruity	Strong fruity alcohol smell
Texture	Liquid	Slightly viscous



Quality control test

HFFO2 module performance is fully recovered after beer concentration and water flushing.



EXTENDING TO OTHER PRODUCTS



Step to pre-distillation



Wine concentration



Vodka



Soju, Sake, Baijiu, Gaoliang (Rice wines)



Whisky, Brandy, Gin, Ciders



Spirits

CONCLUSIONS



Aquaporin Inside® FO can be easily retrofitted to existing processes to attain higher quality beer at higher concentrations. In conclusion, FO can deliver novel and high quality products while improving overall distribution logistics.

Want to learn more about how Aquaporin Inside® FO can benefit your business? Please contact Aquaporin's FO experts at FO@aquaporin.com for more information.

About Aquaporin

Aquaporin A/S is a global water technology company located in Kongens Lyngby, Denmark.

Aquaporin is dedicated to revolutionizing water purification with its novel membrane technology.

The main goal of Aquaporin is to develop the Aquaporin Inside® technology which is capable of separating and purifying water from all other compounds.

The Aquaporin Inside® platform uses biotechnological principles in a technological context, which is a novel upcoming field with large commercial perspectives. This is a field where Denmark has taken an early global lead.

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