



Zooming in on NOLO beer production Webinar Oceania- 28th April 2022

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Personal CV about NOLO beer production:



- Global Technology Manager in Alfa Laval Brewery Systems
- 27 years in Alfa Laval Brewery Systems, last 11 years in Copenhagen HQs.
- 25 years experience in NOLO Beer production
- Experience in LO Alc Beer production since 1994
- Experience in NO Alc Beer production since 2002
- Direct hands-on experience with different NOLO Beer technologies such as:
 - Stop fermentation bio-processes
 - Centritherm, for 0.5 % ABV production
 - SCC-Spinning Cone Column, for 0.0 and 0.5 % ABV
 - De-alc (pure stripping with aroma recovery) for 0.0 and 0.5 % ABV
 - Low-alc (RO Membranes) for Craft for 0.5 % ABV.

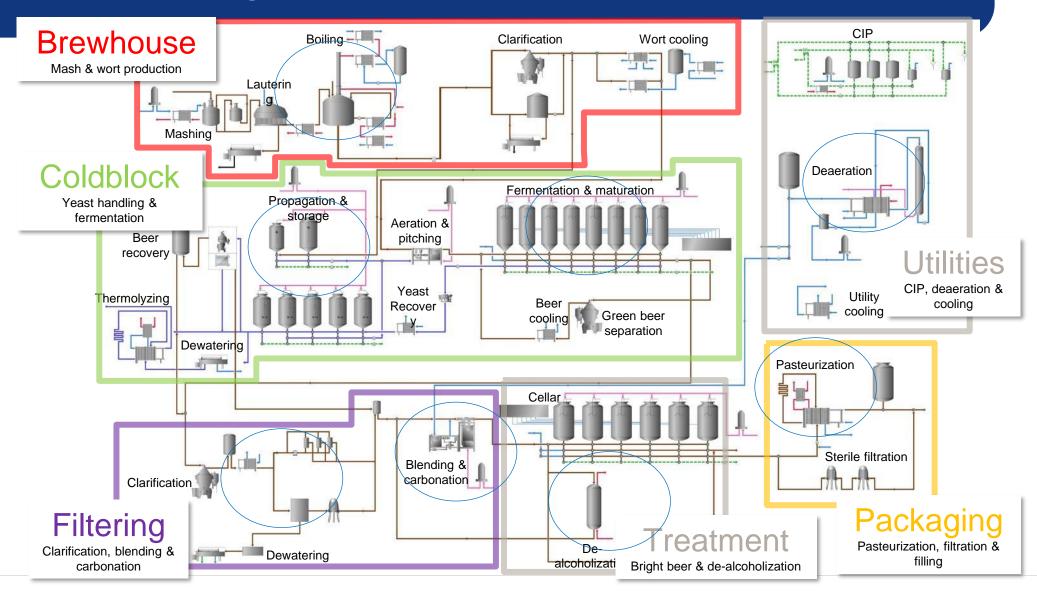
Agenda



- 1. Introduction to NOLO Beer production and brewing process
- 2. NOLO beer production methods-summary
- 3. NOLO beer production with De-alc (0.0 & 0.5 %ABV) by stripping ethanol
- 4. LO production with Low-alc (RO-Membranes) for Craft brewers.
- 5. LONO Revos concentration with No-alc (RO High pressure membranes)
- 6. Other process steps for NOLO beers
- 7. Operational comparison of different technologies
- 8. Q&A

The brewing process





What is NOLO beer?



De-alcoholized beer product with 2 levels:

NO (< 0.05 ABV, 0.0 beer)

LO (< 0.5 % ABV beer)

- Produced with natural brewing ingredients such as barley, malt, wheat, yeast, hops...
- As normal beer, NOLO beer needs final treatment to get a final product (dosing/carbonization/increase shelf-life treatments)

NoLo BEER - MAIN TECHNOLOGIES



Group A- Biological- Special yeast and fermentation stopped, for LO beers <0.5 % ABV or NO beers (0.0) beer at starting/small production. Example Christian Hansen-Neer-yeast strains...Supported by IsoMix, Centrifuges, beer coolers and flash pasteurizers.

Group B- Partial distillation/evaporation: It is required a partial evaporation on the feed beer product (~ 15 % depending on required stripping flow) using this evaporated product as stripping gas. Longer residence time. For NO and LO beers

Group C- Pure stripping with process water vapors: Just alcohol separation by stripping with process soft water as stripping gas flow below 45C. No product evaporation/distillation. Shorter residence time. For NO and LO beers. Ex. Alfa Laval De-alc

Group D- Membranes: RO and NF crossflow elements (multihousing) modules. Normally just for LO beers as NO beer requires too much DAW diafiltration water (not viable) Ex. Alfa Laval Low-alc or No-alc (Revos based)

Great success NoLo beers in the world











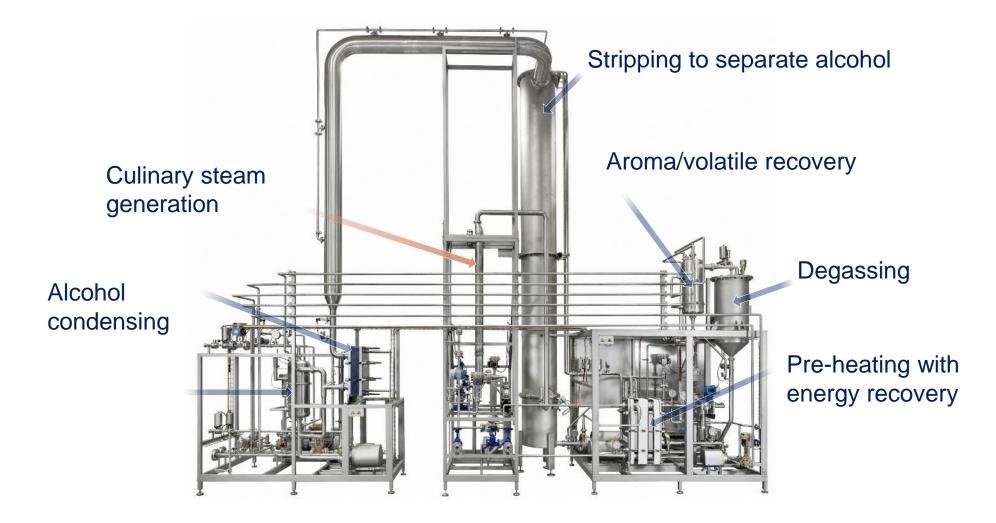






De-alc - Key dealcoholization steps





Why stripping is best



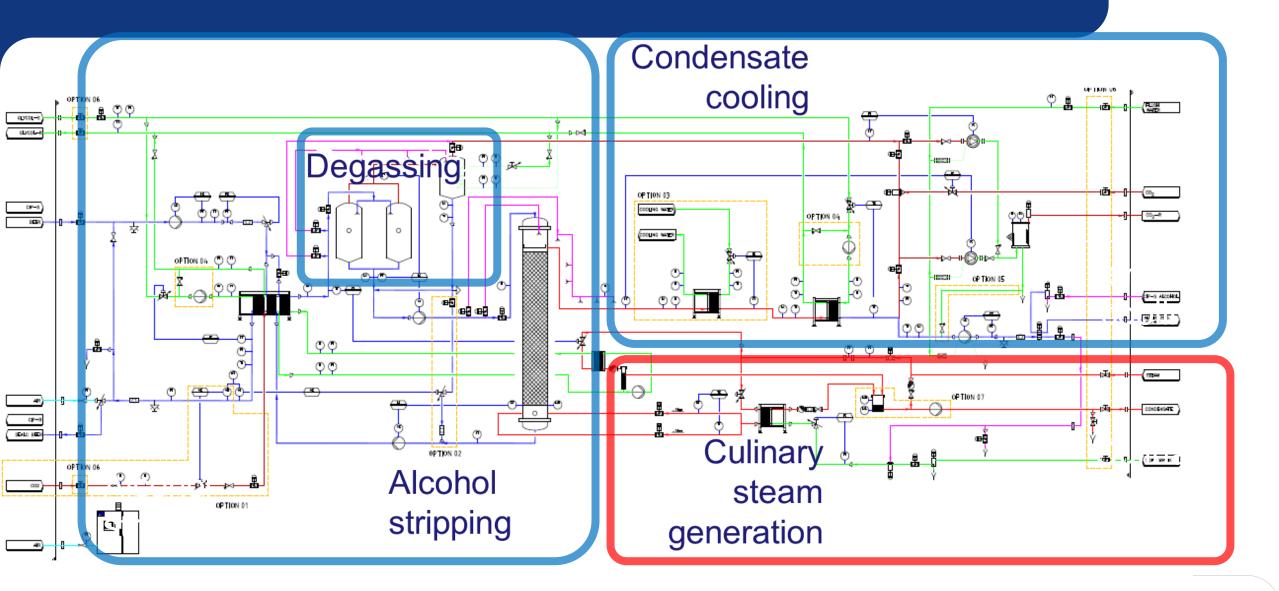
- A gentle, single-pass process with less than a minute of residence time

- Effectively removes ethanol from a liquid stream using a counter-current flow gas stream
- Always occurs in equilibrium at 80–110 mbar between 41–45°C under vacuum conditions
- Column provides huge contact area between the liquid and gas phases
- Column packing is very versatile for custom design and variable density and efficiency
- No boiling, just highly effective separation



De-alcoholization module 100 hl/h PID





Pure stripping for NOLO beer production



Main benefits in pure stripping NOLO production:

- 1. From 5 to 100 hl/h in standard capacities, ABV reduction from 13% to <0.05%
- 2. Efficient dealcoholization for all beers, lager/ale/wheat/IPAs/non-filtrated beers
- 3. Optimized for great no-burn beer taste, Dealcoholized beer profile close to the reference beer
- **4. Single pass**, low thermal impact, operating temperature < 45°C, 1 min in column...
- **5.** Full system cleanability, CIP/SIP of internal surfaces
- 6. Low steady-state running costs, low maintenance Less than 4 EUR/hl final NOLO beer in utilities

Dealcoholization

~L/~L

- Three applications in one unit



- Production of non-alcoholic (NAB<0.05% ABV) and low-alcoholic (LAB< 0.5% ABV) beers
- Partial removal of alcohol from fullstrength, high-gravity beer
- Separation of neutral, decolourized food-grade alcohol for use in other applications

De-alc - Utilities for 4 standard sizes, 100, 50, 20 and 10



	De-alc 100	De-alc 50	De-alc 20	De-alc 10
Mass Rate (hl/h)	100	50	20	10
Inlet/Outlet Temp. (C)	2-4 / 3-4	2-3 / 3-4	2-3/3-4	2-3 / 3-4
Inlet/Outlet ABV (%)	5/ <0.05	5/ <0.05	5/ <0.05	5/ <0.05
Production uptime (minus CIP)	~98%	~98%	~98%	~98%
Steady state dema	ind			
Soft process water (m3/h)	1.6	0.8	0.4	0.2
Stripping (steam kg/h)	1650	890	410	210
Cooling (kW)	1200	565	270	140
Electricity (installed) (kW)	35 (50)	26 (45)	16 (30)	12 (25)
Sealing Water (m3/h)	~6	~ 5	~ 4	~2
Air (m3/h)	<1.0	<1.0	<1.0	<1.0

Rental/test plant - 10 hl/h







Global brewery know-how for great 0.0 beer



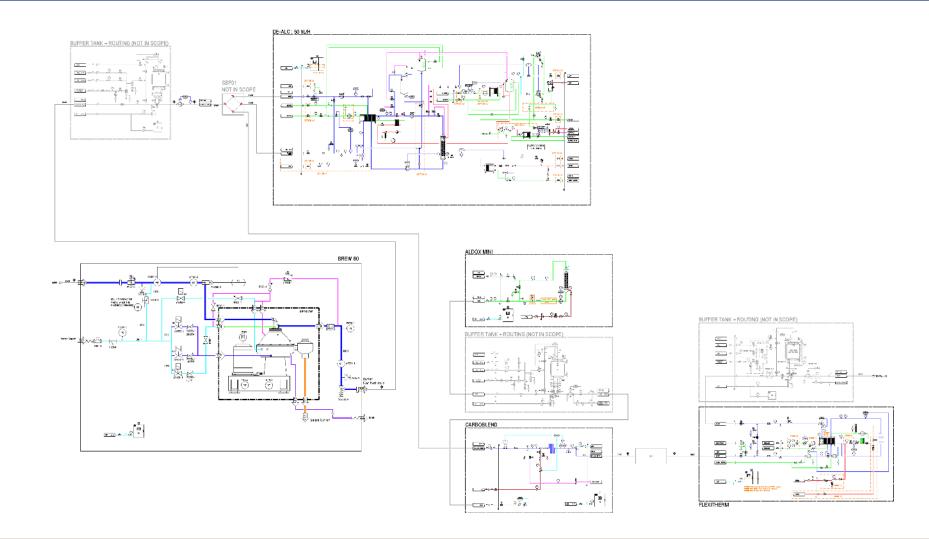


- 0.0 process starts in brewhouse and how beer is fermented
- Beer pre-treatment and post-treatment support is required
- Dealcoholization is a complete solution, not just a component

Low- and no-alcohol beer integration projects

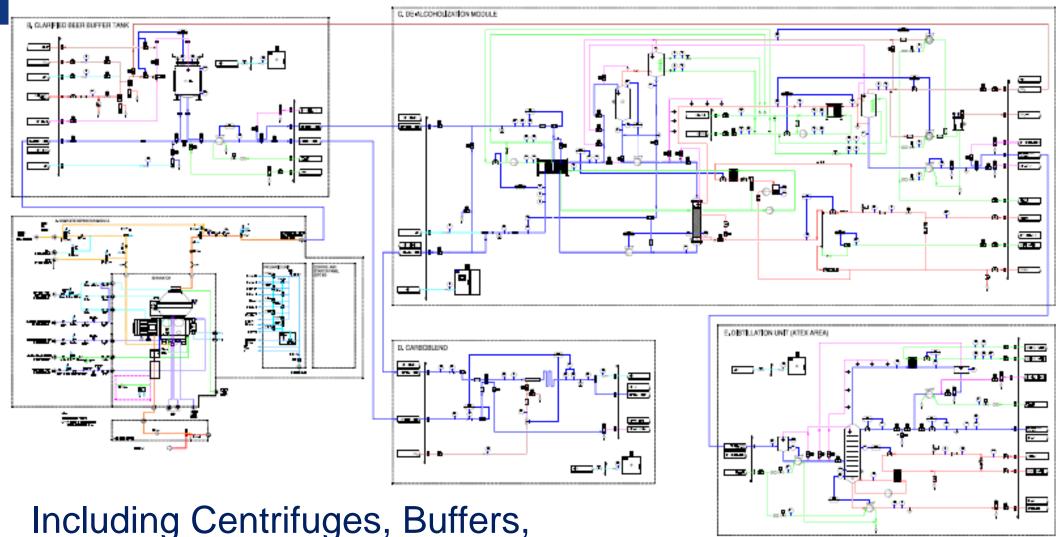


- Include Alfa Laval centrifuges, buffers, Carboblend, aroma dosing, cooling modules...



NAB/LAB integration projects

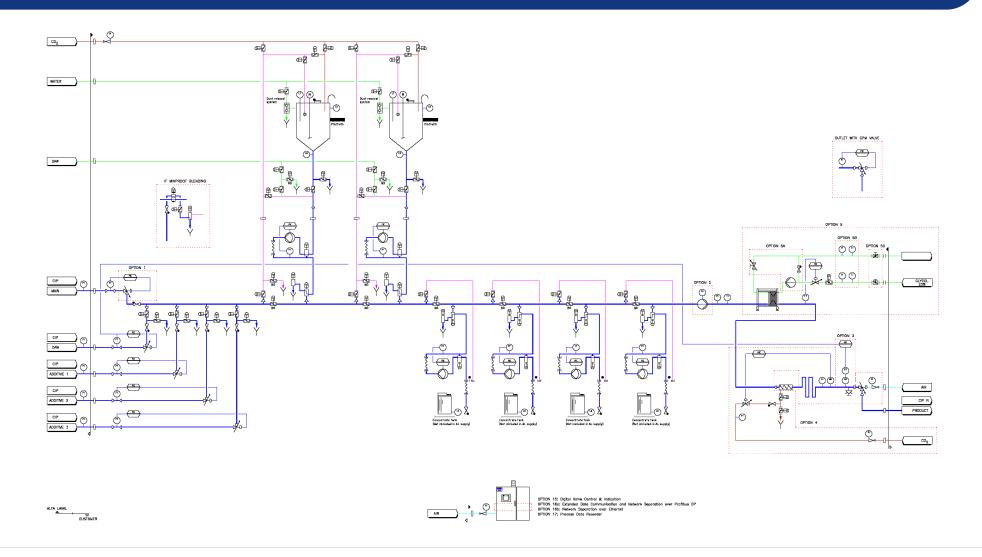




Including Centrifuges, Buffers, Carboblend, Aroma dosing, Cooling modules...

AlfaDose after Dealc for inline dosing





ALFADOSE LAY OUT





Low-alc – RO Module for LO-Beer for Craft Breweries



- Dealcoholisation with Membranes
- Cut-off and Cross-flow filtration
- RO (reverse osmosis)
- Aroma retention & Alcohol permeability
- Further applications
- Membrane Dealcoholisation Systems
- Trialling



Dealcoholisation with Membranes



Efficient and self-contained

Low heating and cooling demand (80% less than vacuum)

Does not interfere standard production

Operates as a stand-alone unit

Versatile unit

Large capacity range for Craft

Easy scale-up through the addition of extra filter modules

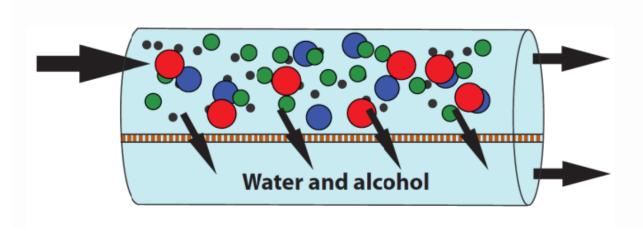
Added values

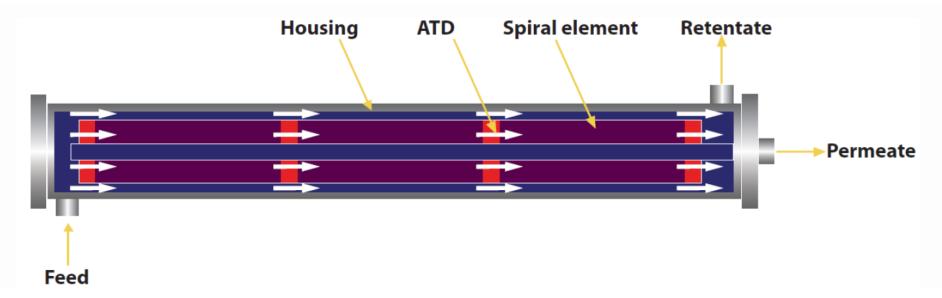
- Cloudy beers
- Hard seltzer
- Water filtration



Cross-flow Filtration Separation Principle

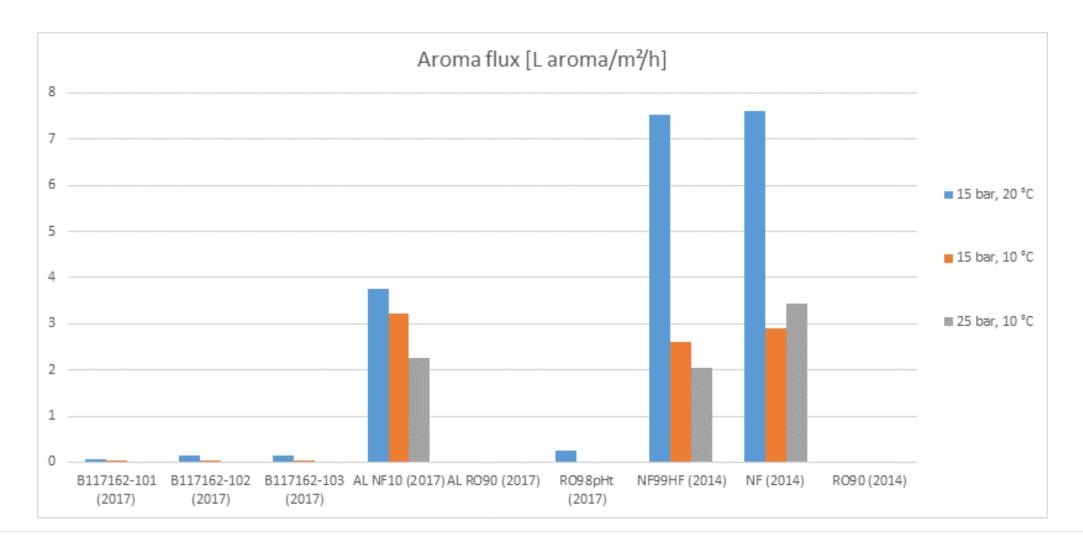






Aroma flux





Low-alc → Craft De-alcoholiser



Standardised semiautomatic RO plant for craft breweries.

Physical dimensions 4900 x 1800 x 2000, I x w x h, mm

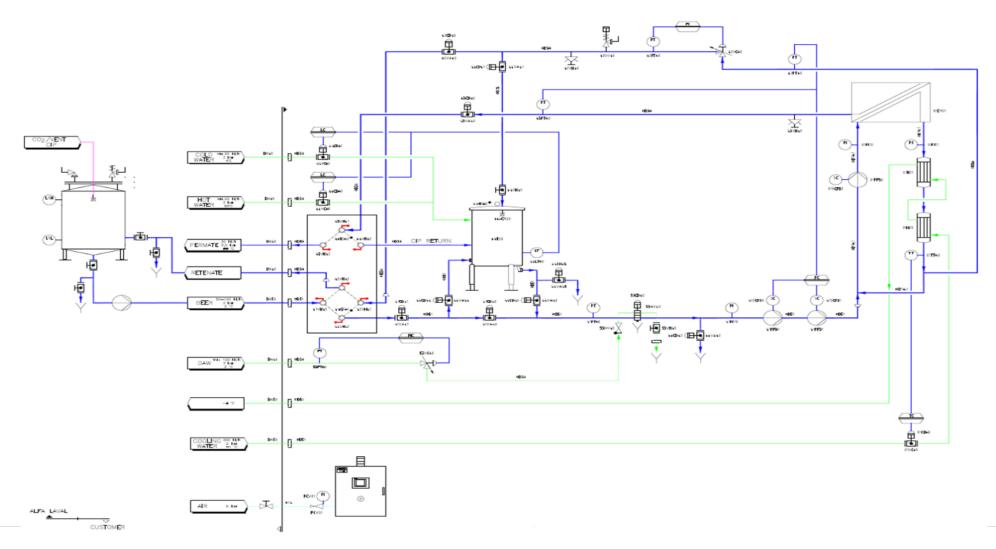
Requirements

- BBT/batch tank
- DAW
- Cooling
- Power
- Air



P&ID – Low-alc Craft De-alcoholiser





Capacities Low-alc - Craft De-alcoholiser





Low-alc 5-15 hl Low-alc 20-60 hl Low-alc 40-120 hl Low-alc 80-240 hl

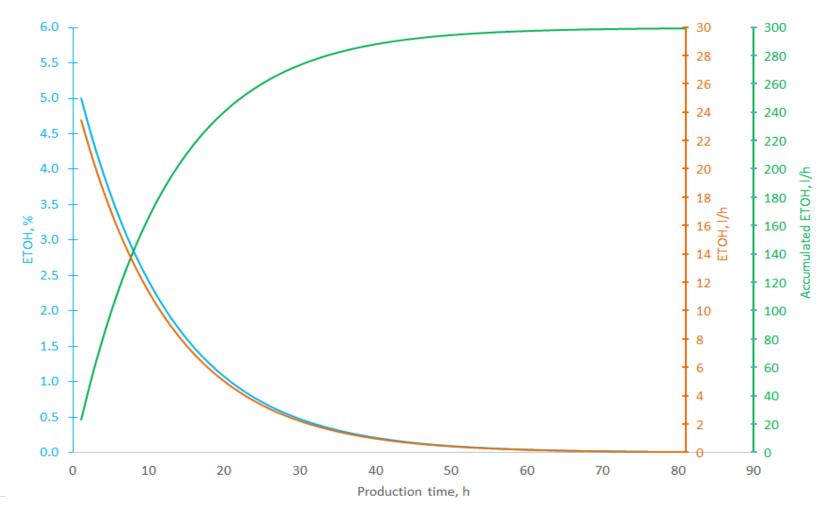
RO90	Siz	e l	Size II		Size	e III
Start volume, I	500	1500	2000	6000	4000	12000
VCF	3	3	3	3	3	3
Permeability, %	50	50	50	50	50	50
Start concentration, %	5	5	5	5	5	5
C1, %	10	10	10	10	10	10
C2, %	1.5	1.5	1.5	1.5	1.5	1.5
Total permeate, l	966	2897	3863	11588	7726	23177
Diafiltration water, l	632	1897	2529	7588	5059	15177
Avg flux, Imh	5	5	5	5	5	5
Production time, h	6	18	6	18	6	18
Nominal capacity, I/h	83	83	333	333	667	667
Final VCF	1	1	1	1	1	1
DAW for final adjustment, I	333	1000	1333	4000	2667	8000
Final volume, I	500	1500	2000	6000	4000	12000
Final concentration, %	0.50	0.50	0.50	0.50	0.50	0.50
Area needed, m ²	32	32	129	129	258	258
8038/30 equivalent	0.9197	0.9	3.7	3.7	7.4	7.4

From 0.5 % ABV to 0.05 % ABV in diafiltration



Process data

Process data				
Batch volume, I	6000			
VCF	1			
ETOH, %	5			
ETOH, I	300			
ETOH tartet, %	0.5			
ETOH target, I	30			
Flux, Imh	5			
Filter area, m²	140			
Perm. Flow, I/h	700			
Permeability, %	67			
ETOH target II, %	0.05			
ETOH target II, I	3			
Time to 0.5, h	29			
Time to 0.05, h	57			
0.5 to 0.05 % difference, h	28			

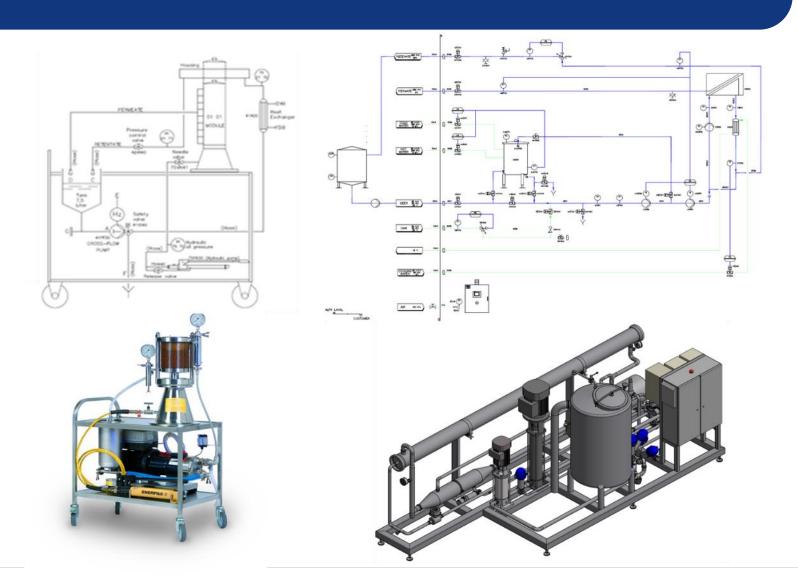


Trialling



Trialling

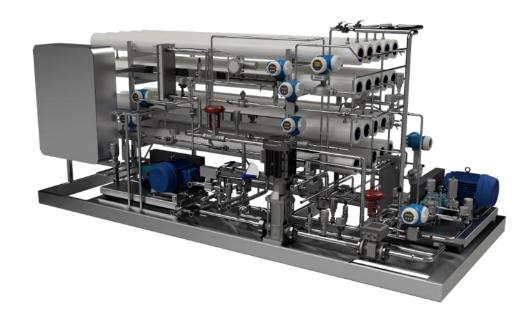
- Performance
- CIP efficiency
- Flavour:
 - retentate
 - permeate
- Product formulation



No-alc Module (Revos based concentration system)



- No-alc concentration system for dealcoholization



Alcohol removal to 0.0% levels with:

- Superior aroma retention
- Minimal diafiltration water requirements

For full-flavoured alcohol-free beverages

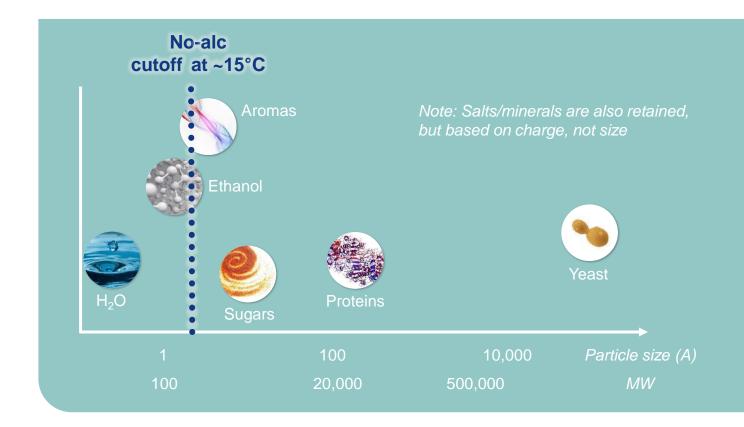
No-alc technology differentiation for dealcoholization



- Precision in separation

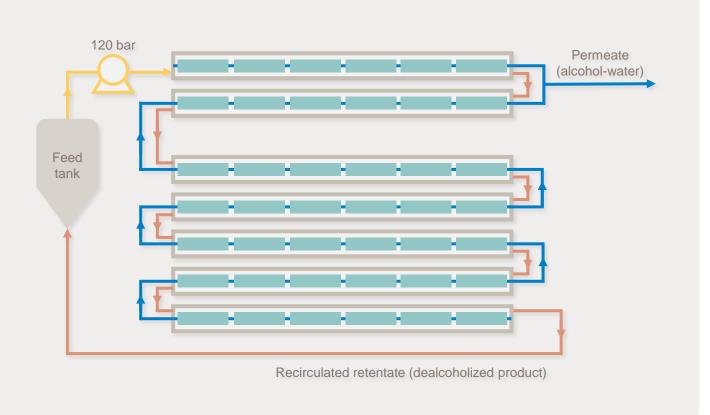
No-alc membranes' tight membrane pore structure separates ethanol from aromas

- Dealcoholization superior aroma retention in dealcoholized beers
- Dearomatization high purity ethanol-water base for hard seltzers



No-alc concentration system for dealcoholization





Dealcoholization with:

- Feed ABV: 4–8%
- Permeate ABV: 4–20%
- Dealcoholized product ABV:
 <0.05 after final dilution

No-alc process, patent pending

Other process steps for NOLO beer



- 1. Brew (wort) recipe for NOLO Beer.
- 2. Fermentation (standard or special fermentation)
- 3. Centrifugation after fermentation (stop fermentation or before NOLO module)
- NOLO beer Filtration or not.
- 5. CO2 in specs- Re-carbonization, if not done in same NOLO Module
- 6. Blending of DAW & adjustments Carboblender/Multi product dosing units
- 7. Flash Pasteurization for NOLO product

Alfa Laval Technologies for NoLo Beers in a nutshell!





De-alc for 0.0 or 0.5 % ABV Pure Stripping, no Distillation Continuous process with aroma recovery option for 0.5 recipes. Sizes: 10, 20, 50 and 100 hl/h



Low-alc for 0.5 % ABV
RO membrane elements in housings
Cross flow loop to separate ethanol
and water in permeate.
Batch sizes: 15 to 240-360-480 hl



No-alc for 0.0 and 0.5 % ABV. in combination with concentration RO high pressure membrane elements in housings.
Cross flow loop to separate ethanol in permeate, 3 and 15 hl/h feed

15 MINUTES Q&A – TIME FOR A 0.0 BEER





15 MINUTES Q&A – TIME FOR A 0.0 BEER



NOLO Beer Technologies Operational Comparison

NOLO Beer Product



NOLO beer Produc	t	Pros	Cons
Biological-Sp. Yeas	t	NOLO is possible	Not fully fermented beer. NO Beer, with certain capacity, and process limitations
Distillation		NOLO is possible	More product/aroma losses Impact in taste/freshness Final adjustments needed
Pure stripping		NOLO is possible Fresh good taste	Partial aroma losses in NO Final adjustments needed
RO Membrane		LO only possible	Keeps full aroma in LO product

NOLO Capacity Vs Investment



Capacity vs Investment	Pros	Cons
Biological-Sp. Yeast	Low/Med capacity	Mainly for small production of NOLO beer, at starting
Distillation	Med/Big capacity	Med/Big investment
Pure stripping	Med/Big capacity	Med/Big investment
RO Membrane	Low/Med capacity	Lower investment

NOLO Operating Cost



Operating costs	Pros	Cons
Biological-Sp. Yeast	Low/Med	Mainly yeast purchases, expensive if capacity increases
Distillation	Less water usage	Med/Big OPEX (steam/glycol) More electrical OPEX
Pure stripping	Less product losses	Med/Big OPEX (stream/Glycol) More water consumption
RO Membrane	Low/Med capacity	Med/Big OPEX (membrane/water

NOLO Maintenance



Maintenance	Pros	Cons
Biological-Sp. Yeast	Low	Only Med if capacity increases: HSS, PHE, other
Distillation	Low/Med	Mainly vacuum pumps
Pure stripping	Low/Med	Mainly vacuum pumps
RO Membrane	Low/Med	Med/Big OPEX (membrane/pumps)

Differences between distillation and pure stripping for NoLo beer production



- Distillation uses ~15% of feed product as stripping gas. Pure stripping not. Then, beer losses are ~15% higher in Distillation compared to Pure stripping (with virtually no losses as stripping gas is from process soft water) for same feed capacity.
- Distillation average residence time at warm temperatures is much longer than pure stripping and a portion of beer is heated by steam (and not close warm water) causing the typical burn taste in distillation, to be jeopardize later with lemon/citrus or other aromas.
- Pure stripping offers a great taste fresh base to build a great NOLO beer, without off taste
 or wrong flavors. From panel test experience and parallel test for many years with
 distillation the difference of NOLO beer quality with pure stripping is big.