



**What's the
buzz? – Non-
alcoholic beer
production**

Justin McKellar

DEFINITION OF ALCOHOL-FREE BEER

Canada, Germany, Hungary, US - **< 0.5%**

Italy: **< 1.2%**

UK Definitions:

Alcohol-free beer = no more than **0.05%** ABV

De-alcoholised beer = no more than **0.5%** ABV

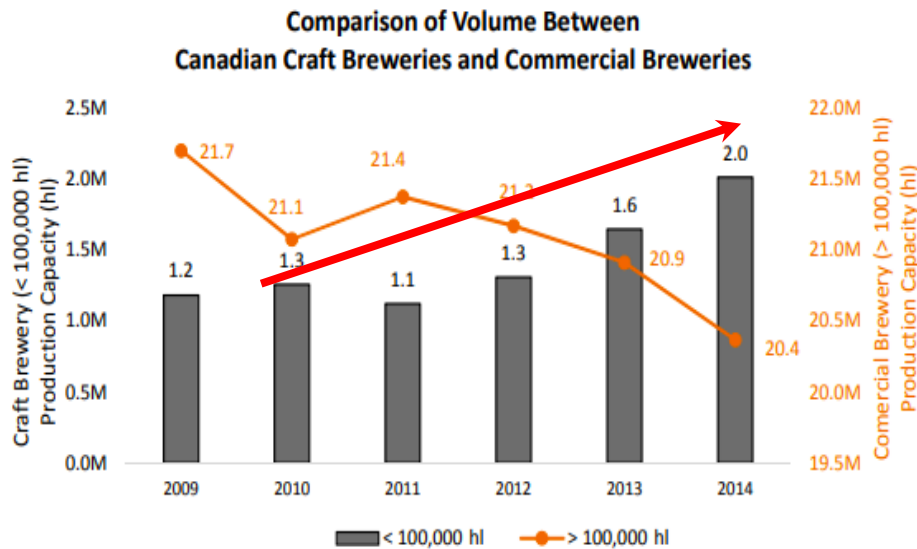
Low-alcohol beer = no more than **1.2%** ABV

DISCLAIMER – Check regulations of local government to determine labelling requirements.



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WHY THE BUZZ?



Sources: Brewers Association, Beer Canada

- Beer category flat for decade in Canada
- In Europe, non-alc is 5-10% of beer consumption
- Recent growth in non-alcoholic market resulted from technological improvements, better tasting beers, and increased marketing spend, and shifting consumer preferences.
- Complimentary to growth in “craft” segment, but there is **VERY FEW NON-ALC CRAFT OPTIONS**



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STRATEGIES TO MAKE NON-ALC BEER

BREW BEER AND REMOVE ALCOHOL	1. Thermal Dealcoholization
	2. Membrane Method
BREW BEER WITH NO ALCOHOL Other	3. Arrested Fermentation
	4. Fermentation with Maltose Negative Yeasts
	5. Cold Contact Fermentation
Other opportunities	Potential blending opportunities

****Many strategies above leverage common brewhouse techniques to reduce wort fermentability.**

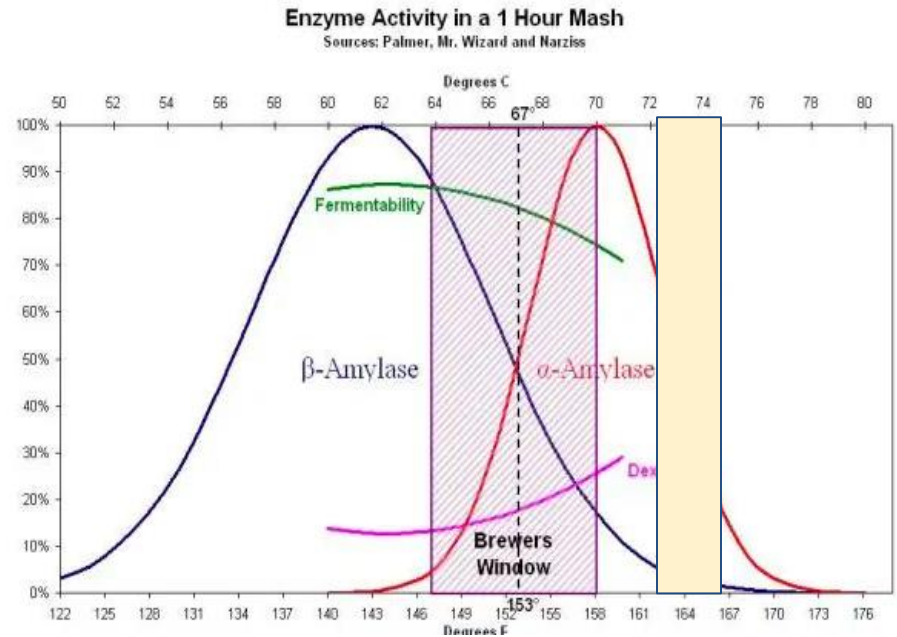


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WORT PRODUCTION FOR NA BEER

Process parameters

- Mashing procedure: low fermentation degree • single step infusion around 72 – 74 °C (161 - 165 °F)
- Wide range in Original Gravity 3 - 9 °P
- pH-adjustment to 4.5 - 4.7
- Hop Dosage: late or dry hopping
- Use of special wort with selected malts to improve body and aroma



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1. THERMAL METHODS OF REMOVAL

- Boiling point of ethanol is 78.37 °C (at 1 atm)
- Under vacuum, lowers to ~42 °C.

Option 1: Evaporate in kettle	Option 2: Thin film / falling film evaporation under vacuum (vacuum distillation)
<ul style="list-style-type: none">- CONS: high energy usage, a lot of oxidation by-products created, brewhouse time.- PROS: low capital investment	<p>Applying vacuum distillation (0.04 to 0.2 bar absolute) at 30 – 60 °C (86 – 140 °F) → avoiding thermal impact</p> <p>CONS: High capital cost, evaporation of aroma compounds (esters, higher alcohols), CO2 removed,</p> <p>PROS: can achieve 0.0%, with proper flavor management good flavor match can be achieved.</p>



1. THERMAL METHODS OF REMOVAL (CONT'D)

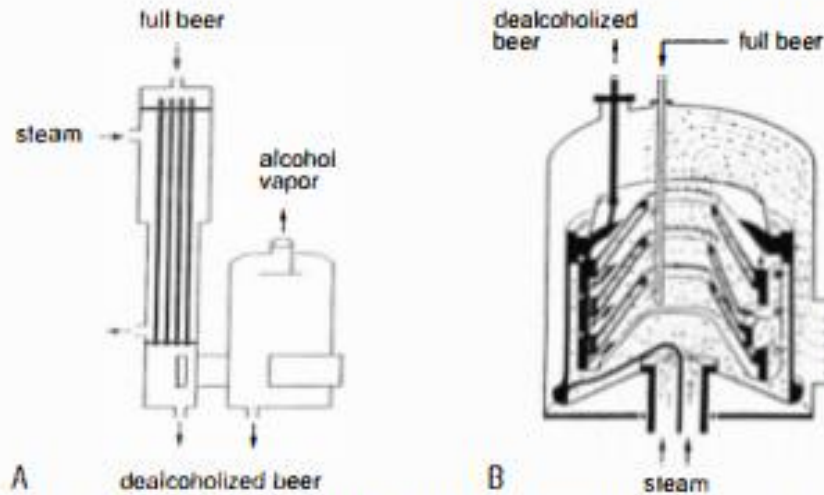


Fig. 5. Alcohol evaporators: A falling film; B. centritherm.

Source: Stein, W MBAA TQ vol. 30, no. (2), 1993, pp. (2) 54-57

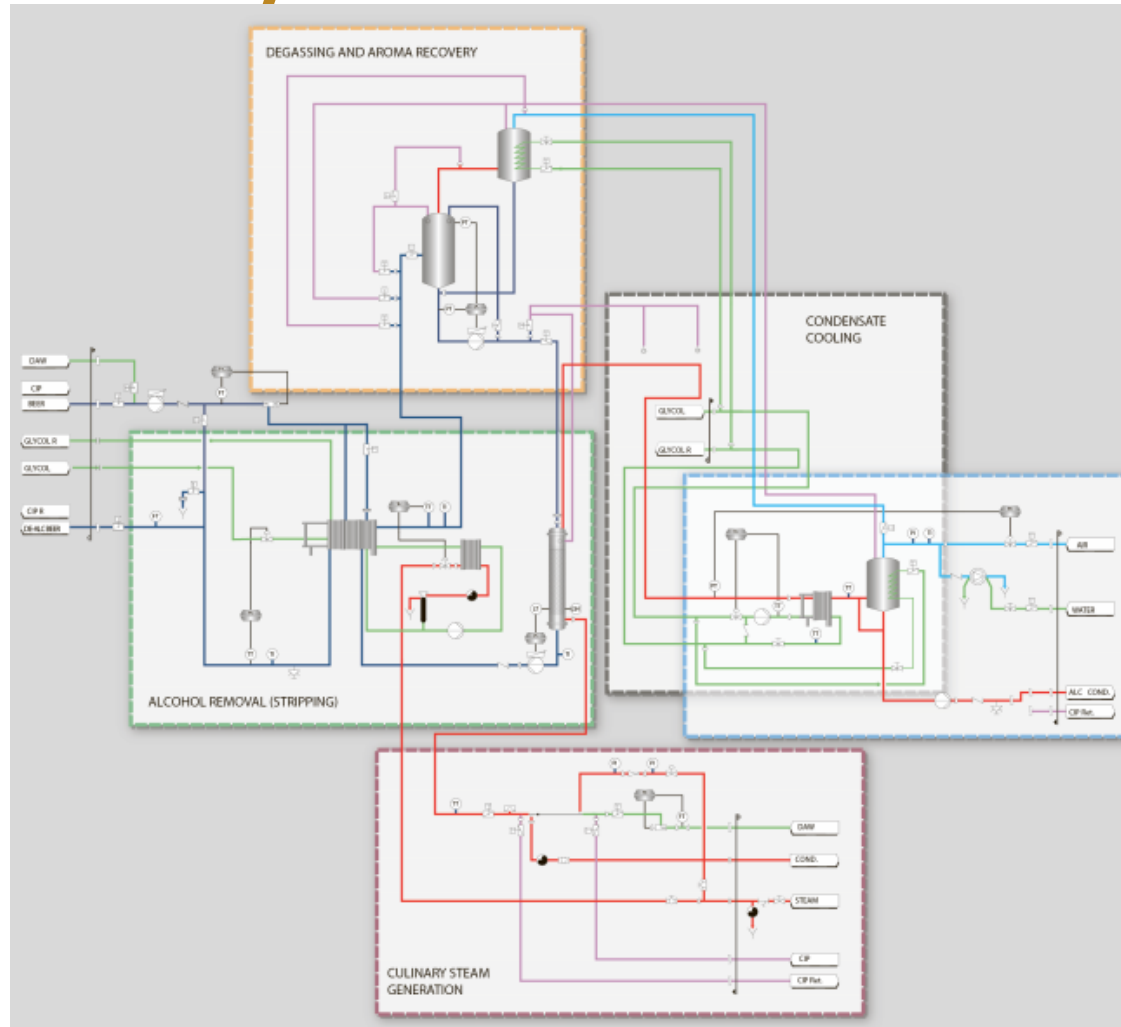


Source:: Alfa Laval



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1. THERMAL METHODS OF REMOVAL (CONT'D)



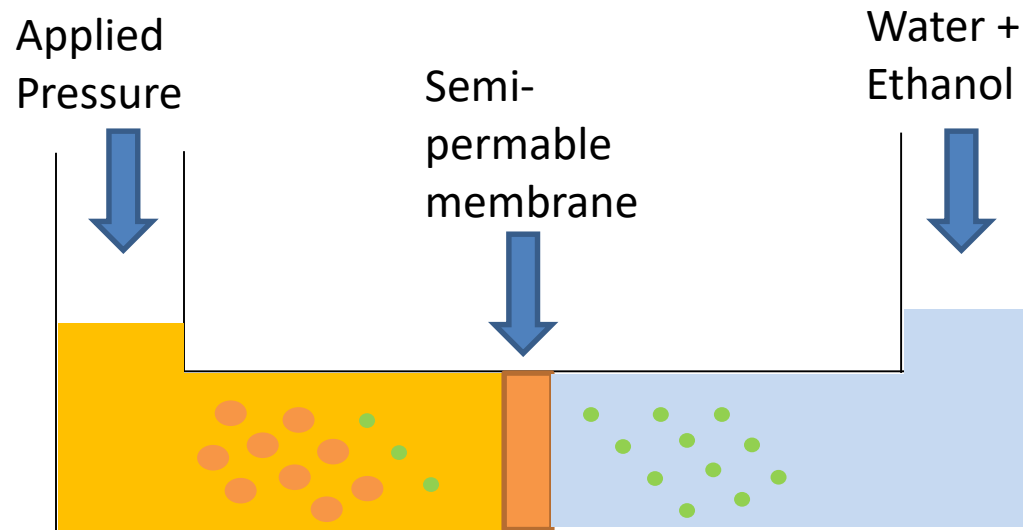
Source: Alfa Laval

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2. MEMBRANE METHODS OF REMOVAL

REVERSE OSMOSIS – WHAT IS IT?



- - Larger molecular weight flavour compounds
- - ethanol



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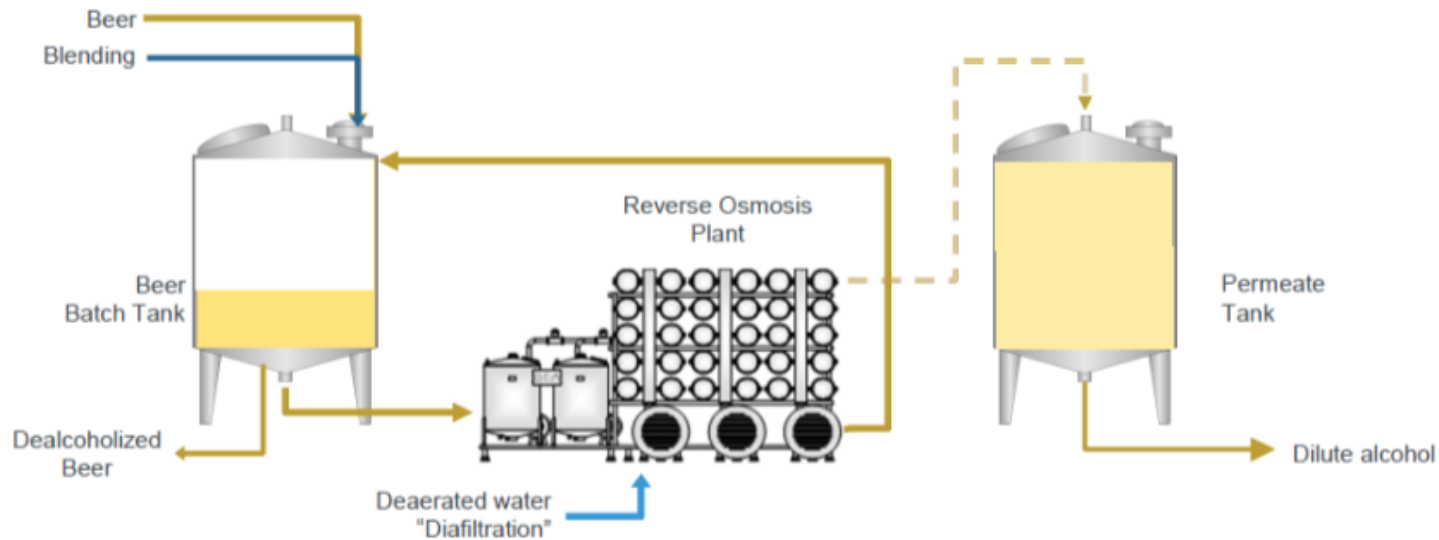
2. MEMBRANE METHODS OF REMOVAL

(CONT'D)

REVERSE OSMOSIS

1. Fill
2. Start Process
3. Concentration

4. Diafiltration (washing out the alcohol)
5. Dilution / Blending after batch end (by client)
6. Dealcoholized beer discharge to carbonization, pasteurization, filling



Source: GEA- Applications in Brewery – Beer Dealcoholization



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2. MEMBRANE METHODS OF REMOVAL

(CONT'D)



Source: GEA

Beer is processed through membrane plant via batch process.

PROS: Lower temperature processing, less esters/volatiles stripped,

CONS: 0.0% not feasible, high capital cost, high water usage / effluent load BOD



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3. ARRESTED DEVELOPMENT (OF ETHANOL)

See wort production re: mashing profile, pH, etc)

Fermentation at 5 to max. 8 °C (41 – 46 °F) for 24 to 72 hours

Interruption of fermentation at fermentation degree of app. 10 % → alcohol < 0.5 vol. %

To achieve interruption yeast count should be 0.1 mill. cells / mL using: centrifuge, filter, pasteurizer

Maturation at 0 °C (32 °F) for at least 10 days



4. USE OF MALTOSE NEGATIVE YEAST STRAINS

- Maltose makes up 50-60% of wort carbohydrates.
- Certain strains do not ferment maltose and maltotriose
- Only recently have they become commercially available.

Saccharomyces cerevisiae var. chevalieri

Saccharomyces ludwigii

Pichia kluyveri

Saccharomyces pastorianus

NEER™



SafAle™ LA-01



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NA BEER PRODUCTION - CAUTION PASTEURIZATION REQUIRED!

Drink Type	Recommended PU Range
Beer	15 - 25
Malt Beer	80 - 400
Beer Mix Drinks	35 - 100
Alcohol free beer	80 - 100
Alcohol free beverages	300 - 400
Fruit Juice	300 - 1000

PU equation for BEER • $PU = t \cdot 1.393^{(T - 60^{\circ}\text{C})}$

PU equation for fruit juice • $PU = t \cdot 1.259^{(T - 80^{\circ}\text{C})}$

t = pasteurization time in minutes T = pasteurization temperature in °C

Source: H.J. Manger: Füllanlagen für Getränke. 1. edition, Berlin: VLB Berlin 2008



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QUESTIONS?



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