



# Membrane Filtration: The Future of Craft Seltzer & De-alc Beer Production

*Case Study: Beer Dealcoholization*

*Featuring: Casey Harris - Brewmaster and Co-Founder*

*Topa Topa Brewing Company - Ventura, California*



- GEA Introduction
- Hard Seltzer
  - The Seltzer Market Today
  - The why, what and how
- Beer Dealcoholization
  - The Alcohol Free Beer Market
  - GEA Membrane Filtration Technology
- Case Study: Topa Topa Brewing Company
  - About Topa Topa Brewing Co.
  - Experience with Membrane Filtration and GEA
  - Thoughts from the Brewmaster
- Questions/Discussion



## Dairy Farming and Processing



Approx. one quarter of processed milk comes from GEA production systems

## Food



Every third chicken nugget is produced using GEA technology



Approx. every third process line for instant coffee was installed by GEA

## Brewery & Beverages



Approx. every second liter of beer is brewed with the aid of systems and process solutions from GEA

## Pharma



Every fourth liter of human blood for making plasma-derived products is processed using GEA equipment

## Chemical



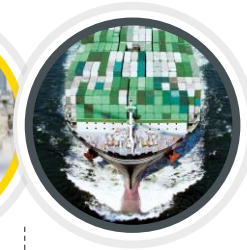
More than one third of all polymer producers are using GEA drying technology

## Utilities



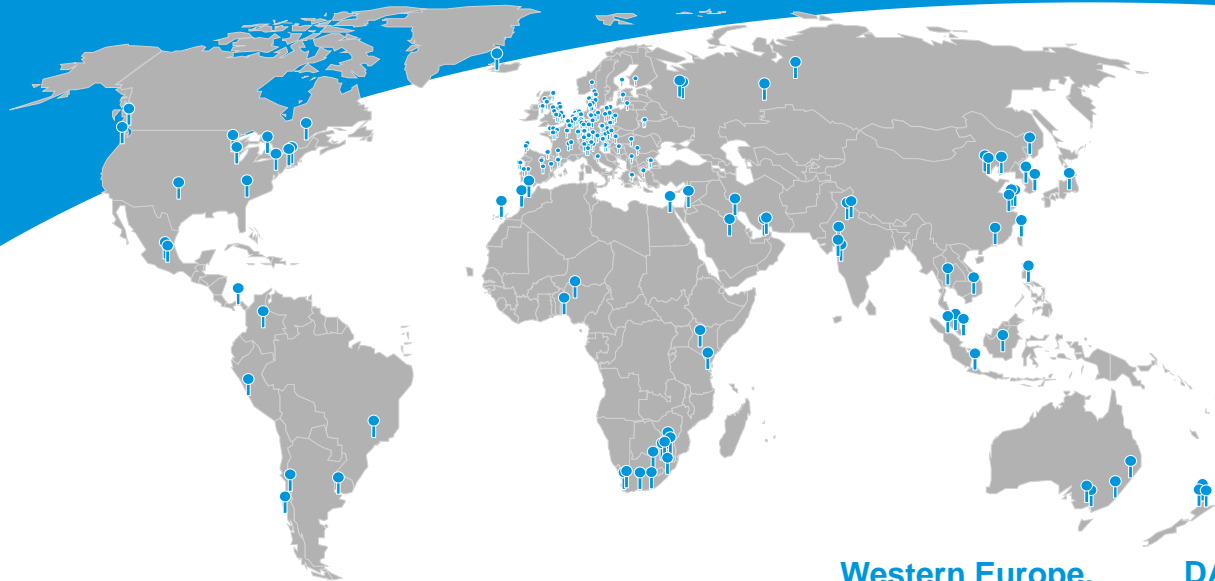
Each industry we serve utilizes industrial refrigeration technology from GEA

## Marine



Every second container ship in the world sails with GEA marine equipment on board

# Strong local presence around the globe



GEA locations  
(sales offices, service branch or  
other GEA sites)

Employees in 2019  
(FTEs)

Revenue in 2019

Regional revenue split in 2019  
(only continued operations)

## North America

1,675

€ 890 million

% 18

## Latin America

512

€ 365 million

% 7

## North and Central Europe

3,072

€ 684 million

% 14

## Western Europe, Middle East & Africa

3,278

€ 814 million

% 17

## DACH & Eastern Europe

6,861

€ 1,000 million

% 20

## Asia Pacific

3,092

€ 1,126 million

% 23

# Hard Seltzer



# Alcoholic Seltzer - Market Trends

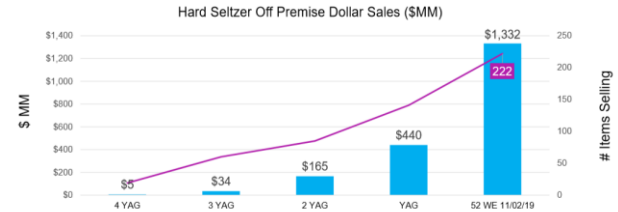
- Seltzer beer market drivers

- Health conscious consumers – low calorie content
- Regular “Water” market boom
- Unlimited flavor options – today's consumer loves choices
- Fashionable trade up from light beer
- Tax relief from ethanol based products, ie canned cocktails
- High profit potential for brewer

- Seltzer beer market trend

- Outperforming total beer
- Estimated that the US consumer market was shorted by tens of millions of CE's in 2019
- Unimpeded by COVID
- Seltzer isn't going anywhere

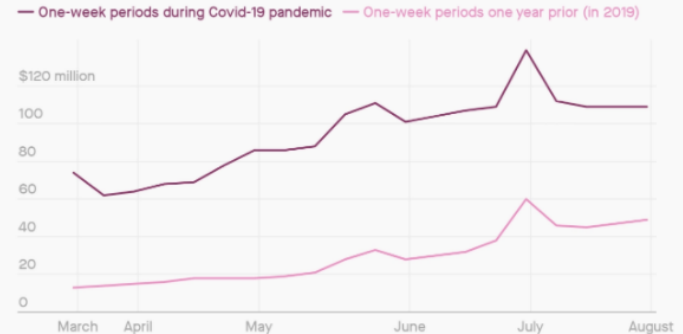
## HARD SELTZERS TO REACH \$1.5 BILLION THIS YEAR



Hard Seltzers generated \$1 billion with only 200 items on shelf!!

Source: Nielsen Off Premise All Outlet Scan; 52 weeks ending 11/02/19

## US hard seltzer sales



Quartz | qz.com | Data: The Nielsen Company | Note: Nielsen Total U.S. off-premise measured channels, one-week periods from the week ended March 21, 2020 through the week ended August 1, 2020

# Why Craft Brewers?

**Craft brewers have made a living distinguishing their products from the brewing giants... is this possible with hard seltzer? We are talking water here.**

**The short answer is yes!**

- **Creativity**

- Flavors such as exotic fruits and botanicals have only been slightly explored. Add blends and the possibilities are endless
- Marketing – The opportunity for clever names, logos, and collaborations is infinite
- Draught options, expand your tap room variety
- Wide ABV range is possible

- **Ease of entry into the market**

- Relatively straightforward transition for a traditional craft brewer to produce craft seltzer.
- Cost is manageable while return is high
- Same distribution channels as traditional beer



**It's not that hard!**

# What is Seltzer?

- Alcohol
  - Typically 5% - 8% ABV
    - Industry showing this range is widening
  - Generally referred to as “Neutral Base”
  - Fermented sugars from the Brewhouse
    - Sucrose, glucose, maltose, etc....
    - Each brewer’s recipe is unique
- Water
  - Water Quality is crucial
    - The main ingredient
- CO2
  - Higher CO2 levels than beer ~ 3+ Vol
  - Mouthfeel and flavor/aroma
- Flavor & Color (Optional)
  - Infinite possibilities

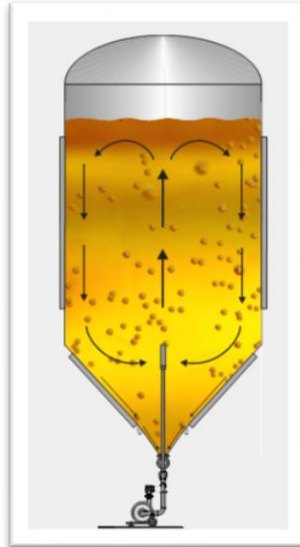
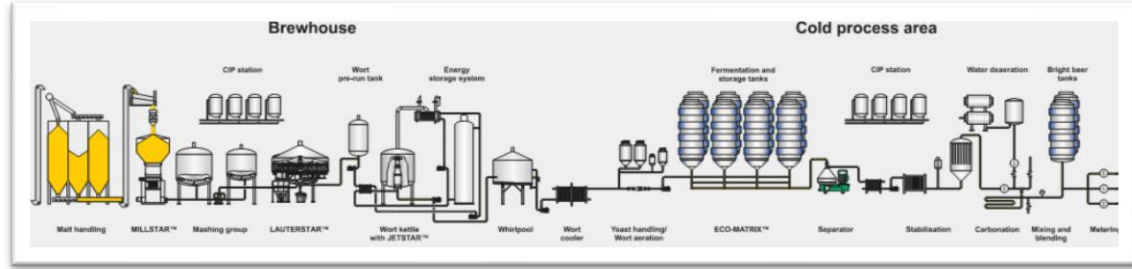




# Brewing Hard Seltzer – the GEA way

## Complete Process Coverage:

- Wort/Base Production
- Wort Aeration
- Yeast Handling
- Fermentation Optimization
- Centrifugation
- Membrane Filtration
- Flavor Blending Solutions
- Carbonation
- Flash Pasteurization
- Filling and packaging
  - Flexible «All-In-One»



# Membrane Filtration



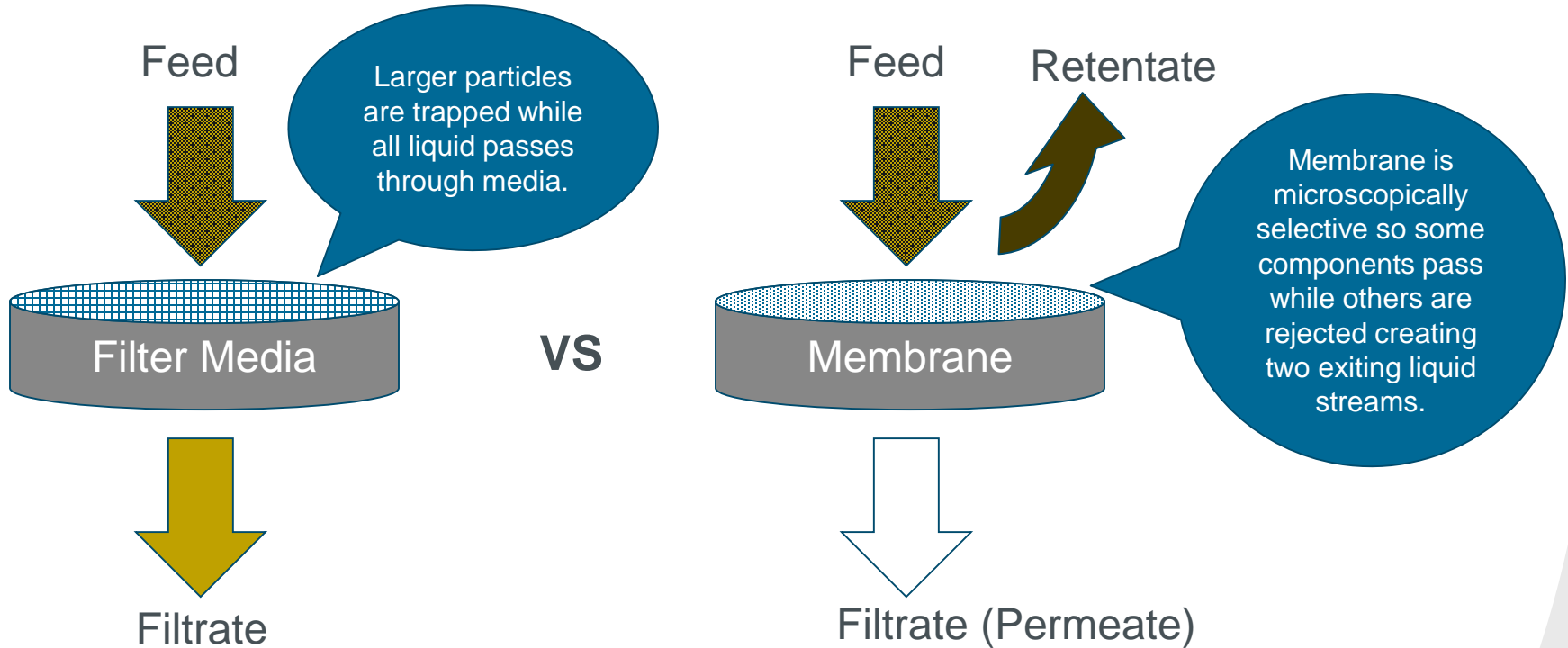
GEA is a world-leader in membrane filtration technology for:

- Beverage
- Brewery
- Vegetable/fruit juice and dairy industries
- 1,000+ systems sold over 30+ years
- Used in both process and process waste streams
  - GEA's membrane filtration technology began in the dairy industry but has grown dramatically as membrane technologies and new applications were developed.
  - Brewery Applications now has most activity in North America!

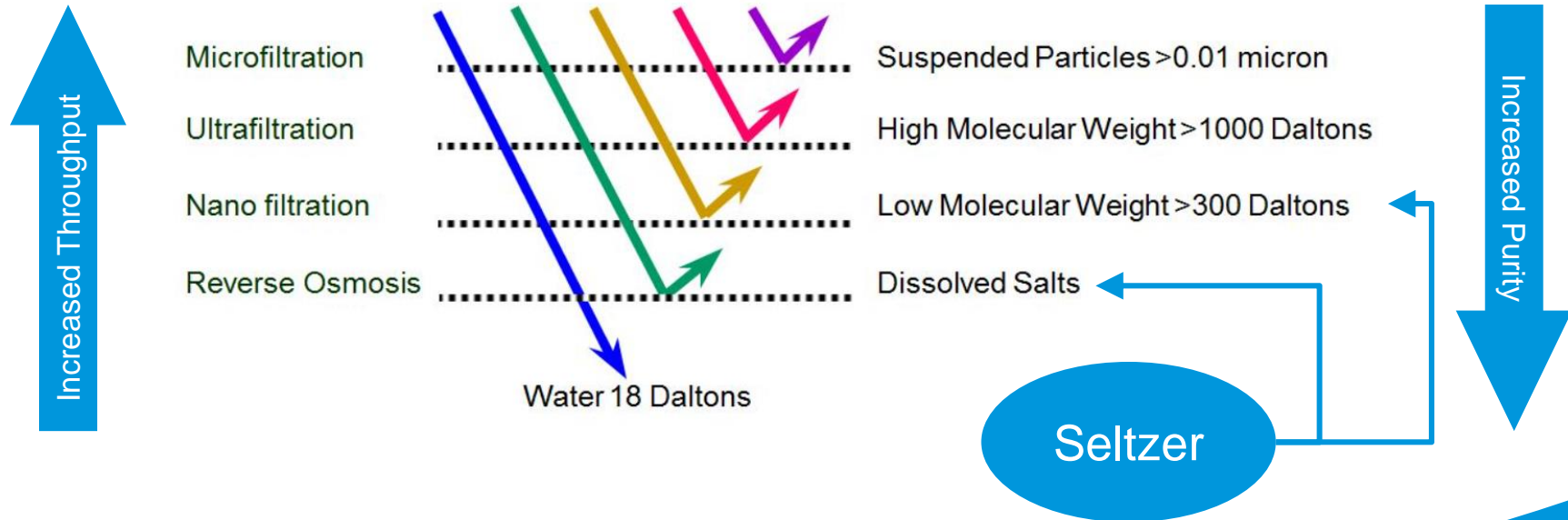


# Cross Flow Filtration Principle

## Traditional vs Cross-flow

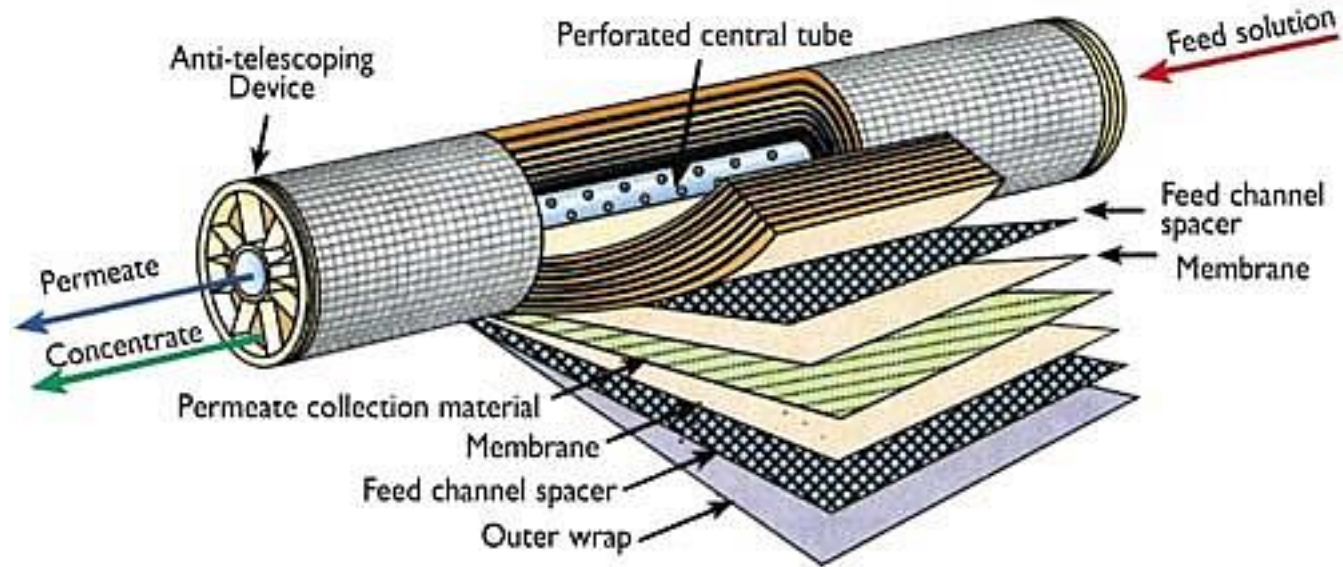


- Membrane filtration types can differ based on requirements.
- The appropriate level of separation is chosen based on a balance of factors such as feed quality, desired cleanliness of base, and overall production capacity needs.

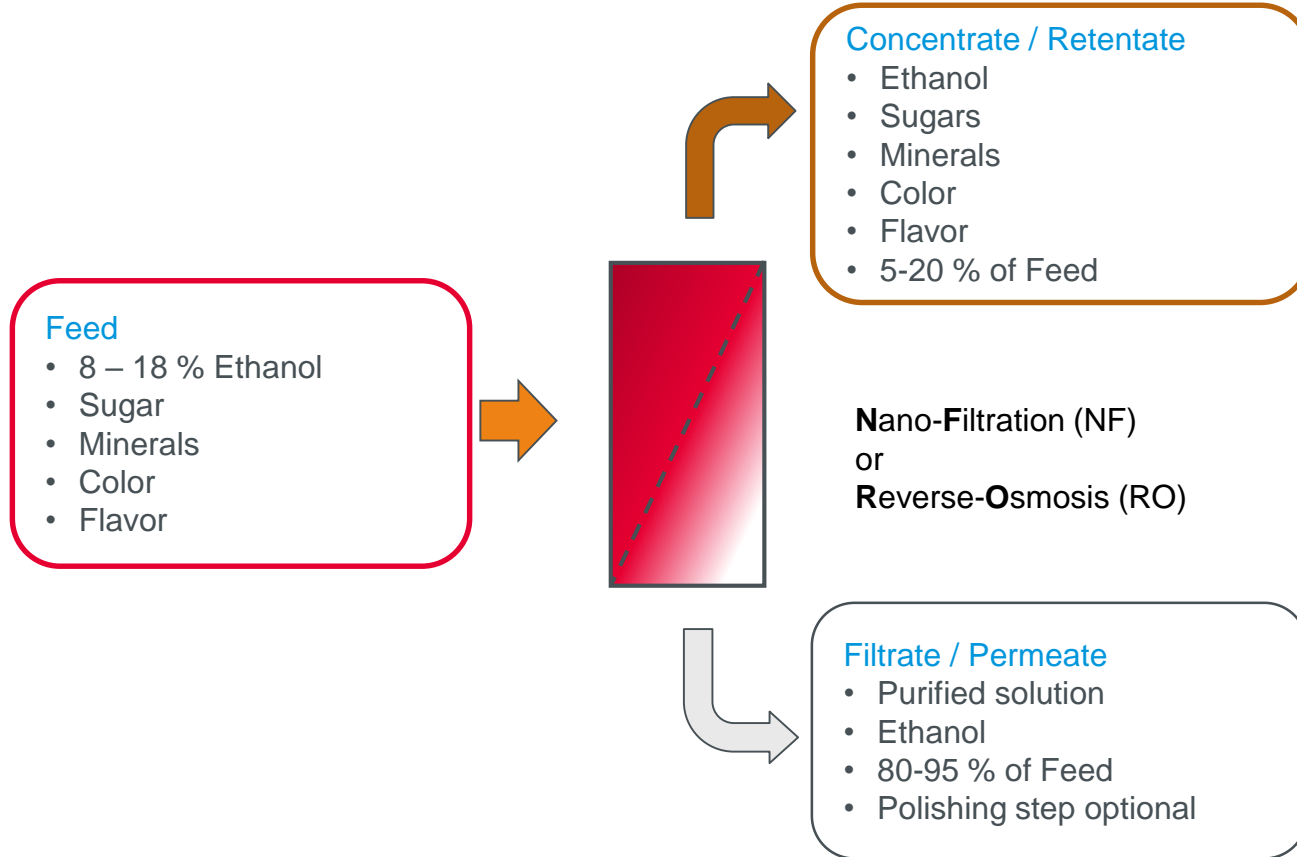




## Anatomy of a Spiral-Wound Membrane Element



# Principle Function of NF and/or RO

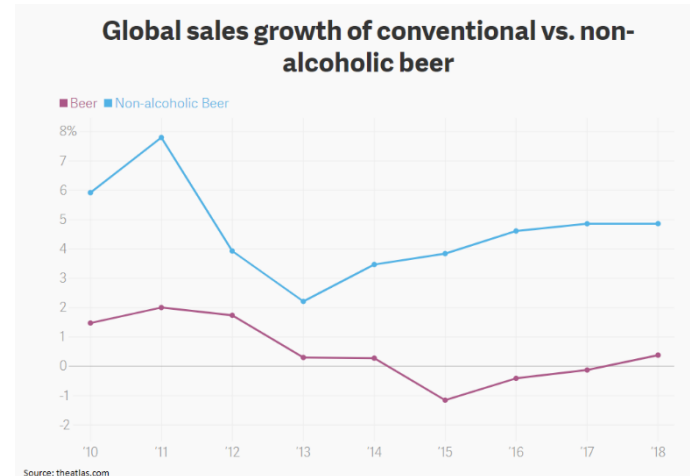


# Beer De-alcoholization





- De-alcoholized beer market drivers
  - Health conscious consumers
    - Lower calorie
    - Little/No alcohol
  - Non Alcoholic beverage alternative (i.e. soft drinks)
  - Pregnant woman and nursing mothers
  - People who abstain for other reasons
  - New technologies create opportunities for Better Beer!
- De-alcoholized beer market trend
  - Consistently outperforming total beer
    - Year after year growth
  - Europe has majority of market share
  - Compound Annual Growth Rate ~7.5%
  - Huge opportunity for North America Market



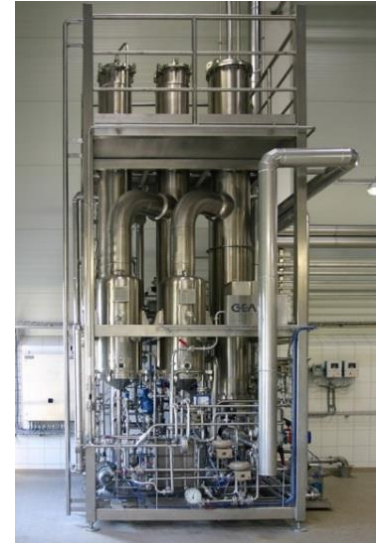
## Biological Methods (stopped fermentation, specialized yeasts, ...)



## Membrane Filtration (Crossflow Filtration)

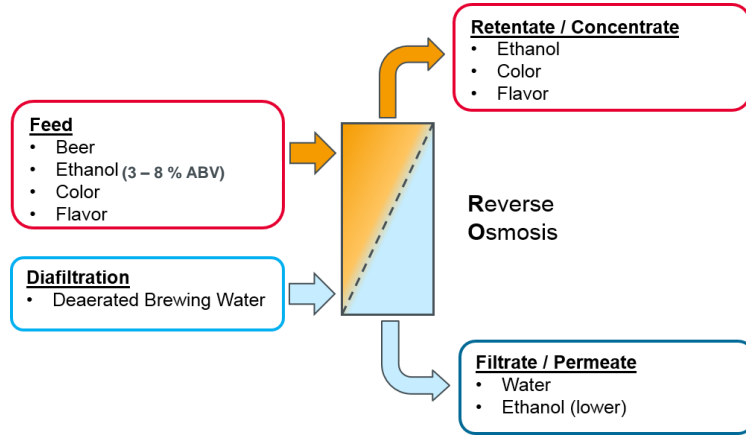


## Thermal Processes (Vacuum Evaporation / Distillation)



\*All Technologies available from GEA

# Principle of Membrane De-alcoholization

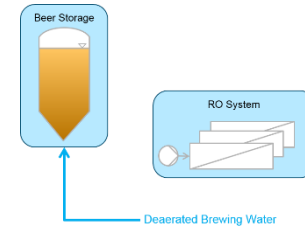
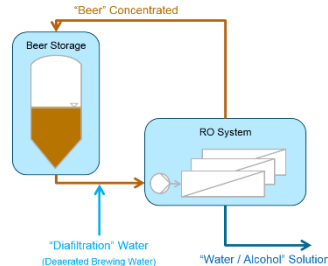
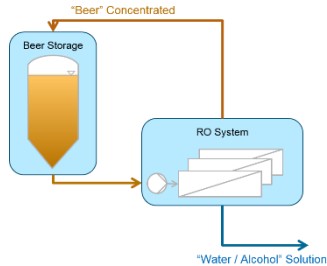
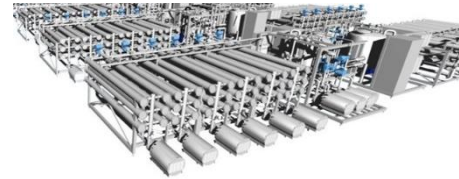


## BATCH OPERATION (Craft Breweries)

– 20 hL up to 500 hL/day, 0.05% - 0.5% ABV

## CONTINUOUS OPERATION (Large Production Breweries)

– 20-200 hl/hr, 0.5% ABV

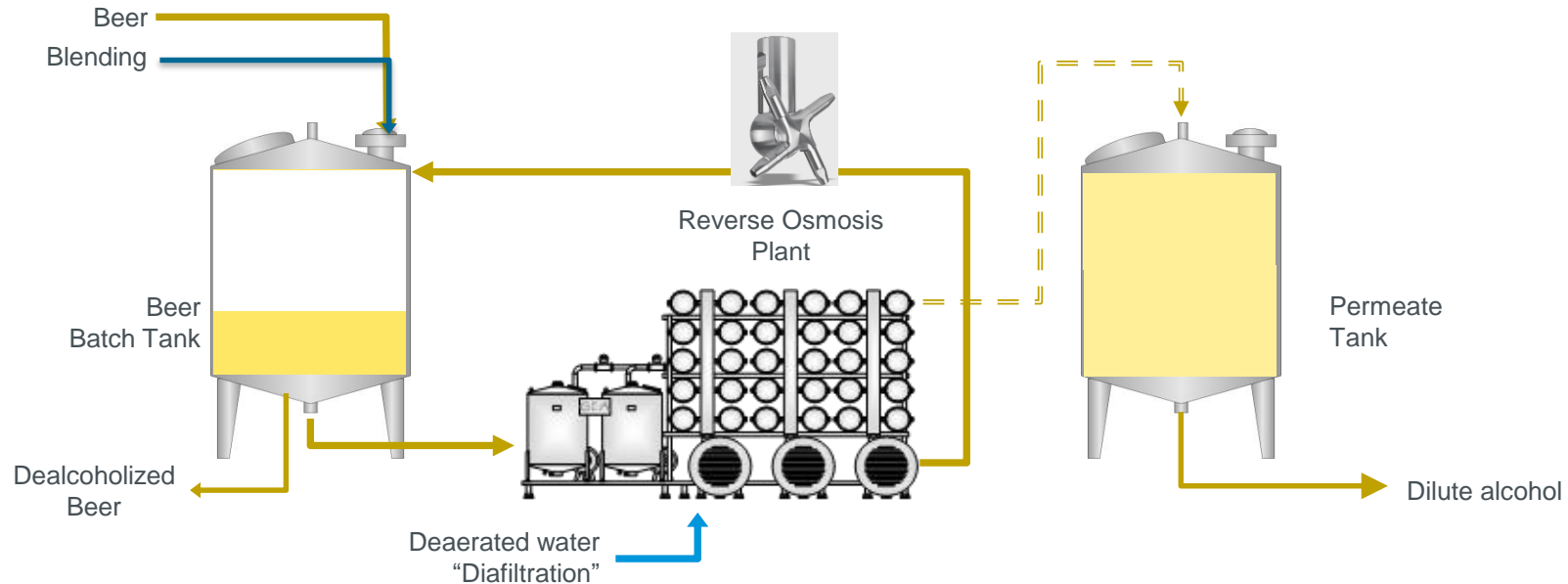


# De-alcoholization of beer - Batch plant operation

1. Fill Batch tank
2. Start Process
3. Pre-Concentration
4. Diafiltration (washing out the alcohol)
5. Water Blending after batch end
6. Dealcoholized beer discharge to carbonization, pasteurization, filling

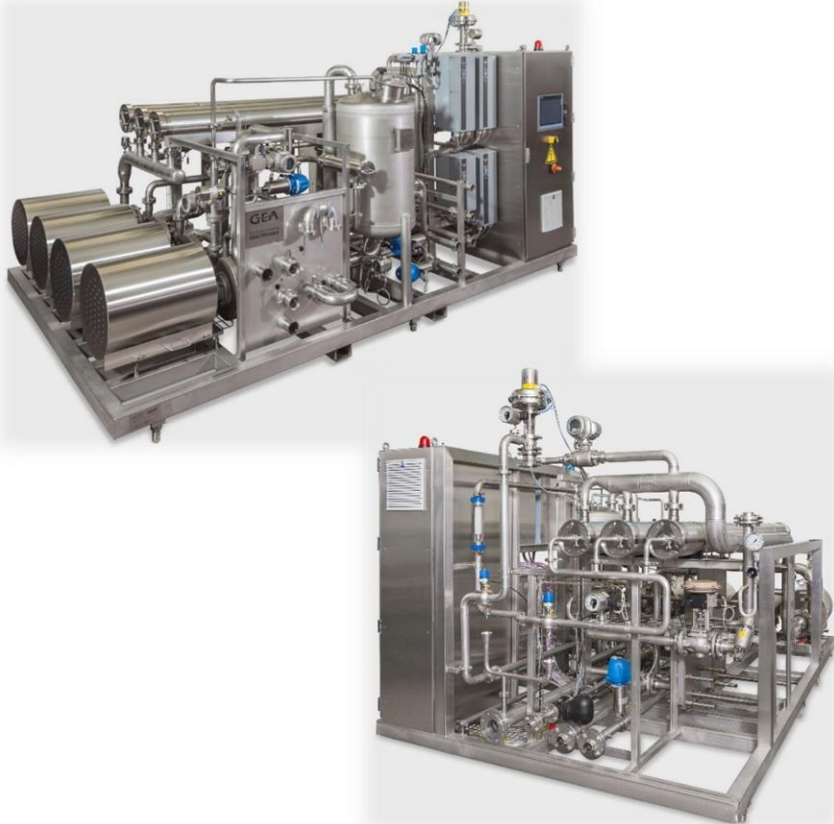
7. CIP cleaning of system (Tanks & Pipes with Brewery CIP)

- Special membrane cleaning program
- Sanitation: cold / chemical (<50°C)
- Membrane storage:  $\geq 24$  hrs down



# Membrane Dealcoholization

Batch operation (20 - 500 hl per 24hrs with CIP)



*Conveniently sized for Craft Brewers!*



*Fully and Semi-automated versions  
depending on need*

## Cross Flow Filtration



## Distillation



Processing temperature	Cold ( $\leq 10^{\circ}\text{C}$ ) – Low/No thermal Impact	High ( $\geq 38^{\circ}\text{C}$ ) – High thermal impact
Aroma losses	Reverse Osmosis - Very low (GEA “AromaPlus”)	Very high - Without “aroma-recovery” Moderate - With “aroma-recovery”
Capex	Low – Cost effective Investment	High
Explosion proofing requirements	Not Required (alcohol % is max as high as in mother beer)	Yes (additional cost/administration)

Cross Flow Filtration with “Aroma Plus” technology is GEA’s preferred method for dealcoholizing flavorful and aromatic beers...  
ie Craft brewed beers!



## Brewer Advantages

- Full flavor and aroma retention
  - Flavor, aroma, and color compounds stay in the beer
- Cold processing
  - Gentle on beer – No thermal impact
- Innovations
  - Reduced ABV Beer styles
    - “Session double IPA anyone?”
  - Ingredient additions post alcohol removal
    - Make multiple products from one
    - Purees, extracts, hop resins, botanicals, etc.
- Flexibility
  - Brew the beer you want
    - Decide what ABV you want later



## Technical Advantages

- Filtered or Unfiltered beers
- Modular design / expandable
- Food grade membranes - FDA approved
- Hygienic design
- Compact, skidded-system with full automation
- Integrated cleaning (CIP)



# Model R Pilot Plant

- Proof of concept
- Membrane comparisons
- Process optimization

GEA engineers have vast experience to assist our new and returning customers through the process of making both de-alc beer as well as seltzer





# Piloting at GEA - Hudson, WI

GEA Process Segment in North America



GEA Systems North America, LLC.  
Hudson, WI:

## Hudson, WI

- Employees: 200+
- Facility: 25,000 sq ft
- Manufacturing: 50,000 sq ft
- Warehouse: 18,000 sq ft



## Columbia, MD

- Employees: 170
- Facility: 45,250 sq ft
- Test Station: 17,650 sq ft
- Warehouse: 15,580 sq ft

GEA Systems North America, LLC.  
Columbia, MD



## Case Study: Topa Topa Brewing Co.

*Casey Harris*

*Brewmaster / Co-Founder*

OCTOBER 2020 – HUDSON, WI



# Topa Topa Brewing Co. - "Good Vibes, Great Beers"

- Born from a strong desire to produce a high quality, tangible product, Co-Founders Jack Dyer and Casey Harris founded Topa Topa Brewing Co. in 2015.
- Built on the core values of *quality, craftsmanship, and community spirit*, Topa Topa Brewing Co. works hard everyday to create a high quality product served up with a smile.
- These values are reinforced by committing to being a certified 1% For the Planet Company, as well as an Independent Craft Brewery.



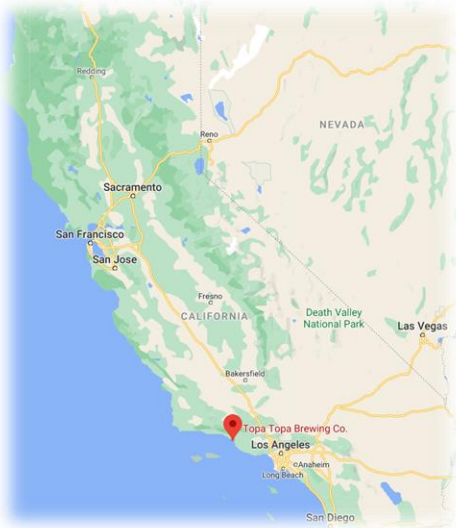
**FOR THE  
PLANET**<sup>SM</sup>



# Topa Topa Brewing Co. - Brewery Location / Taprooms

Topa Topa Brewing Co. newest production facility is located in Ventura, CA, nestled between the Topa Topa mountains in Ojai and the salty shores of the Pacific.

We believe the people should drink great beer! And we love that we get to craft great beer amongst a landscape and community that inspires us.



So next time you're near one of our tap rooms— whether in Ventura, Ojai, Santa Barbara or Camarillo— pull up a chair, grab a fresh pint, and enjoy the company!





# Topa Topa Brewing Company and GEA

- GEA CRAFTSTAR Brewhouse
  - Installed 2019
  - (4) Vessel 40 hL Semi Automated BH
    - MT, LT, KT, WP
  - GEA MILLSTAR 2.5 t/hr
    - High Performance and efficient Wetmill
  - GEA Wortstar – aeration & chilling
  - Water preparation skid
- GEA Centrifuge
  - HB-1S “Plug & Play Series”
  - Fully automated – Dual turbidity measurement / flow control
- Commissioning and Project Execution
  - Diploma'd Brewmaster
  - Project and Software engineers





Cold Chain Transport of Beer  
Both Inside and Out!



Dos Topas Mexican Lager  
Chief Peak West Coast IPA



Good Local German Food



# Piloting at GEA – Hudson, WI

TOPA TOPA BREWING CO., OCTOBER 2020



Single Element Membrane Housing

Surge Tank - Product Supply

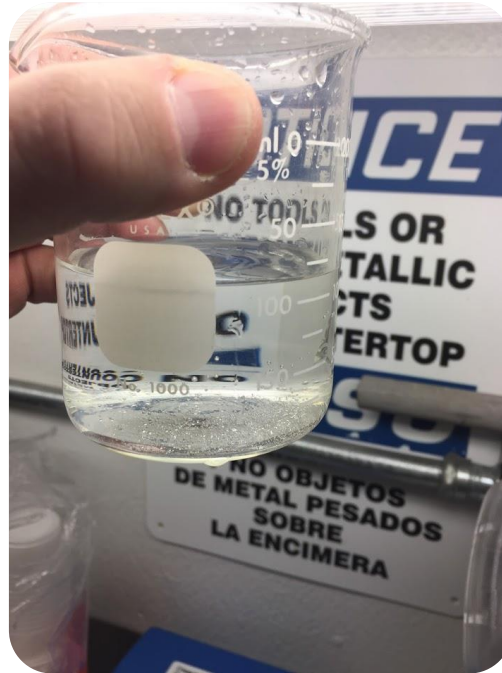
Small Liquid Cell (DAW)- Diafiltration Water



# Topa Topa Brewing Co. Piloting Results

## Product(s): Chief IPA & Dos Topas Mexican Lager

- Permeate (picture right) immediately came out clear, and free of significant noticeable taste or odor
- EtOH removed in Preconcentration step
- Diafiltration brought EtOH level well below needed level
- Basic bench blends at GEA
- Returned product to brewery at “full concentration” for back blend trials
- Recipe adjustments or blend rates may be required to achieve different levels of perceived bitterness, mouthfeel, etc. once alcohol is removed





- Low / Non Alcoholic Craft Beer
  - GEA Results
  - Why we chose to try de-alc
    - Increasing demand and taproom variety
- Craft Seltzer
  - Opportunities
  - Variety and creativity
- Membrane Filtration
  - Can it be Craft?



# Thank You!

- Find us on Facebook: GEA Craft Brewing or [www.gea.com](http://www.gea.com)

## GEA Contact

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## Topa Topa Brewing Co. Contact

### Brewmaster/Co-Founder

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/topatopabrewingco

