THE ENVIRONMENTAL IMPACT OF HAND SANITIZER ETHANOL

Gabe Cohen, Katie Mowat, Nathan Kreutzer

Advisor: Dr. Bruce Dvorak & Dr. Ashraf Aly Hassan

University of Nebraska Lincoln | Nebraska Center for Energy Sciences Research

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AGENDA

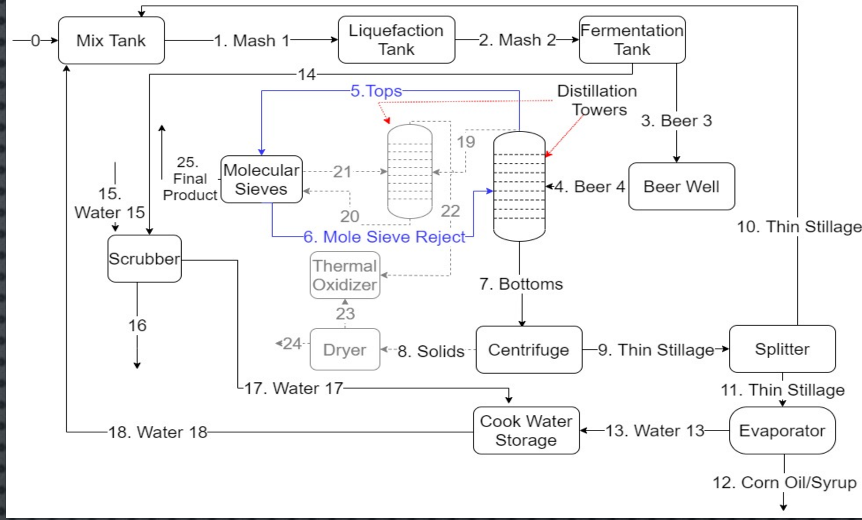
- Background
- Project Objectives
- Methods
- Data, Results, & Conclusion

BACKGROUND

- Covid 19 increased hand sanitized demand
- Isopropanol shortage
- Ethanol is a suitable replacement for isopropanol
- Ethanol must meet USP grade standards
- The FDA temporarily raised the USP grade standards

Compound	Interim Limits (PPM)	Standard Limits (PPM)
Acetal	50	*10
Acetaldehyde	50	*10
Methanol	630	200
Benzene	2	2
Sum of All Other Impurities	300	300

* Acetal and Acetaldehyde concentrations combine under standard limits



PROJECT OBJECTIVE

Help Ethanol Plants Meet USP Grade Specifications

- Identify location of various impurities produced during fermentation
- Help engineers determine new methods of ethanol purification
- Help optimize unit operations

Identify Streams for Use in Innovative Waste Treatment Methods

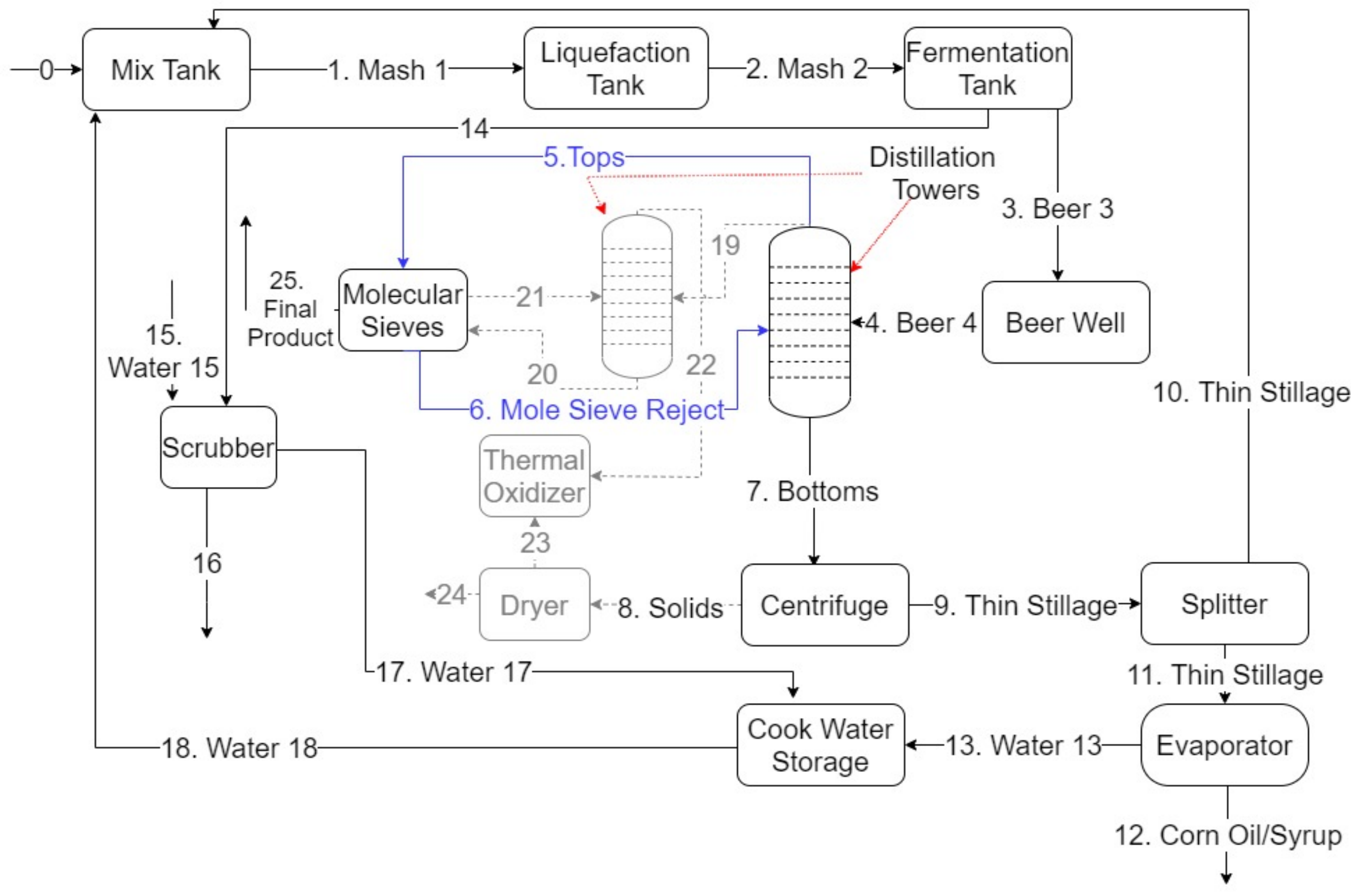
- Bio scrubbers require a specific nutrient solution
  - Total Nitrogen(TN), Total Phosphorous(TP), Total Suspended Solids(TSS), pH, Chemical Oxygen Demand (COD)

Environmental Impact of USP Grade Ethanol Production

- Determine if hazardous air pollutants are expected to increase
- Determine if CO_2 production is expected to increase
- Determine if water consumption is expected to increase

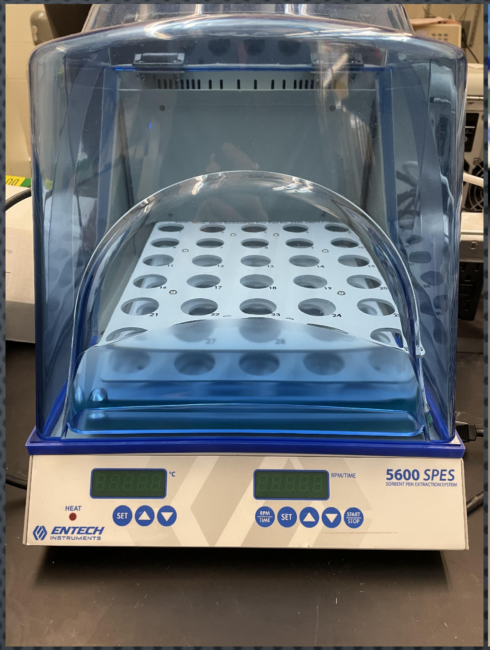
METHODS

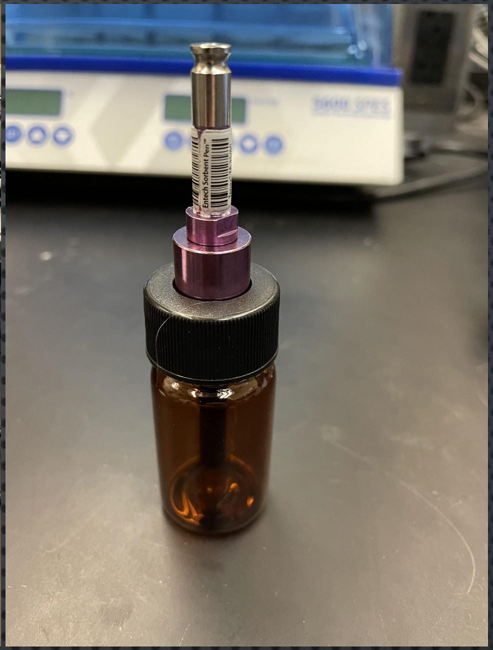
PROCESS SAMPLES



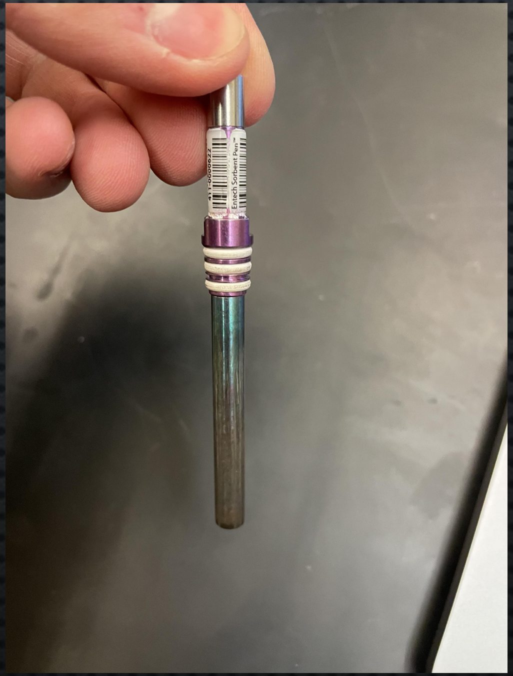
- 17 samples collected
- Major 2 types of ethanol plants
  - Follow black and blue process lines (Ethanol plant where samples were taken)
  - Follow black and gray process lines
- Assume most ethanol plants will have similar stream characteristics

IMPURITIES ANALYSIS



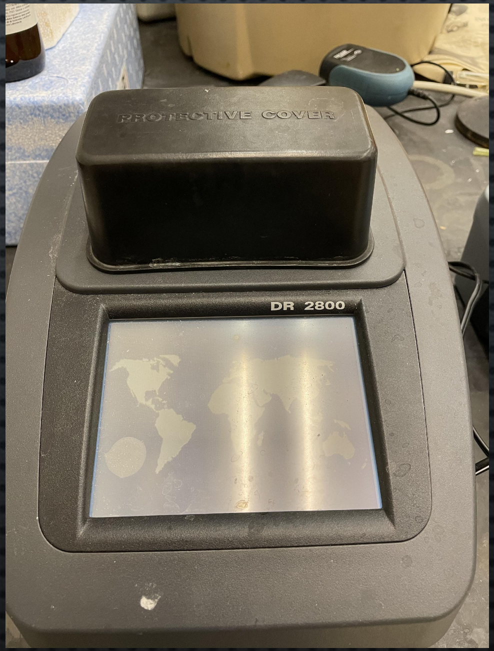


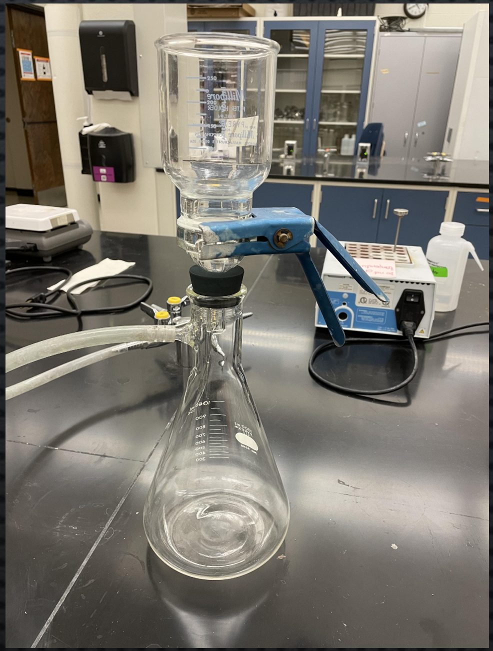
- Impurities tested for
  - Acetaldehyde, Acetal, Propanol, Methanol
- Samples containing high TSS are centrifuged
  - mash 1, mash 2, beer 3, beer 4, bottoms 7, thin stillage 9/10/11, and corn oil/syrup 12
  - Supernatant and solids are tested separately
- Vacuum assisted sorbent extraction (VASE) in conjunction with GC/MS are used
  - 2 mL liquid samples
  - 1 G solid samples
  - Vacuum set to 30 mmHg
  - Samples are placed in a 5600-SPEC for 3 hrs at 70^{O}C and 200 RPM
  - Samples are cooled for 10 minutes
  - VASE pins are placed in the GC/MS



WATER CHEMISTRY ANALYS

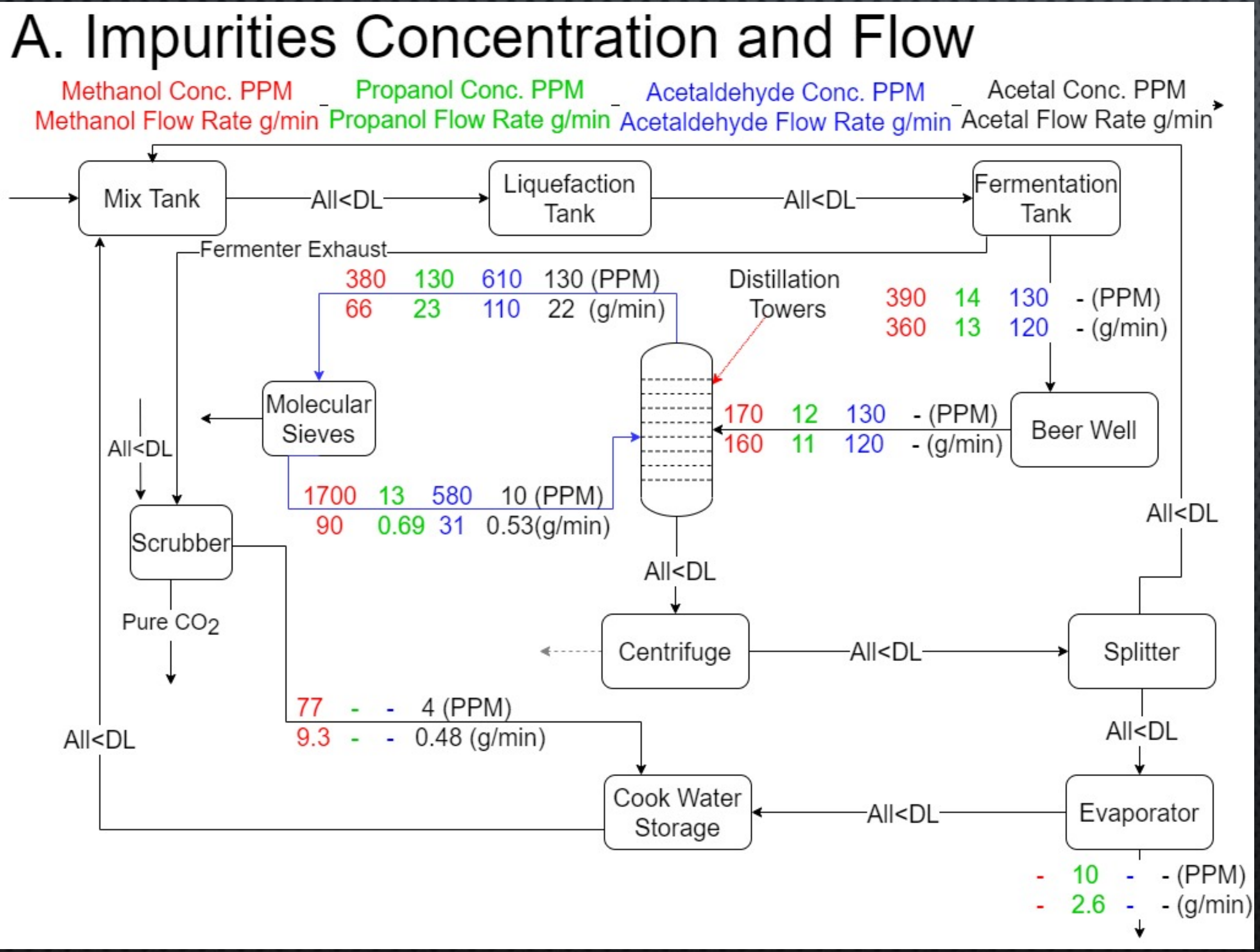
- Total Phosphorous (TP)
  - TNT 844 vial PhosVer®3 ascorbic acid method with acid persulfate digestion
- Total Nitrogen (TN)
  - TNT 826 & 828 vial by Hatch Method 10208 determines persulfate digestion method
- Chemical Oxygen Demand (COD)
  - TNT 820 vial by the reactor digestion method
- The previous samples are analyzed using a Hatch DR2800
- Total Suspended Solids (TSS)
  - Analyzed using the standard waste water analysis technique

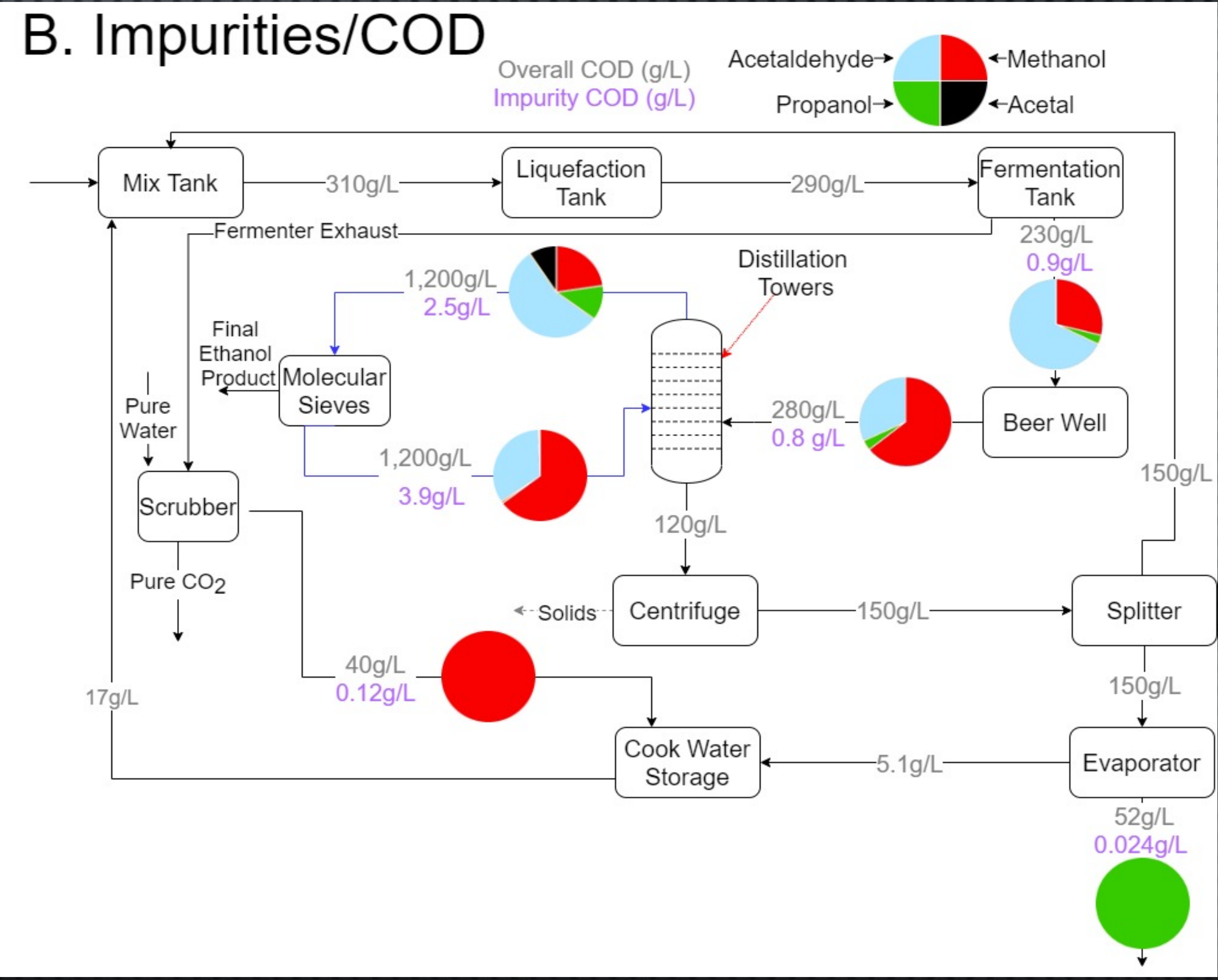




DATA, RESULTS, & CONCLUSION

IMPURITIES

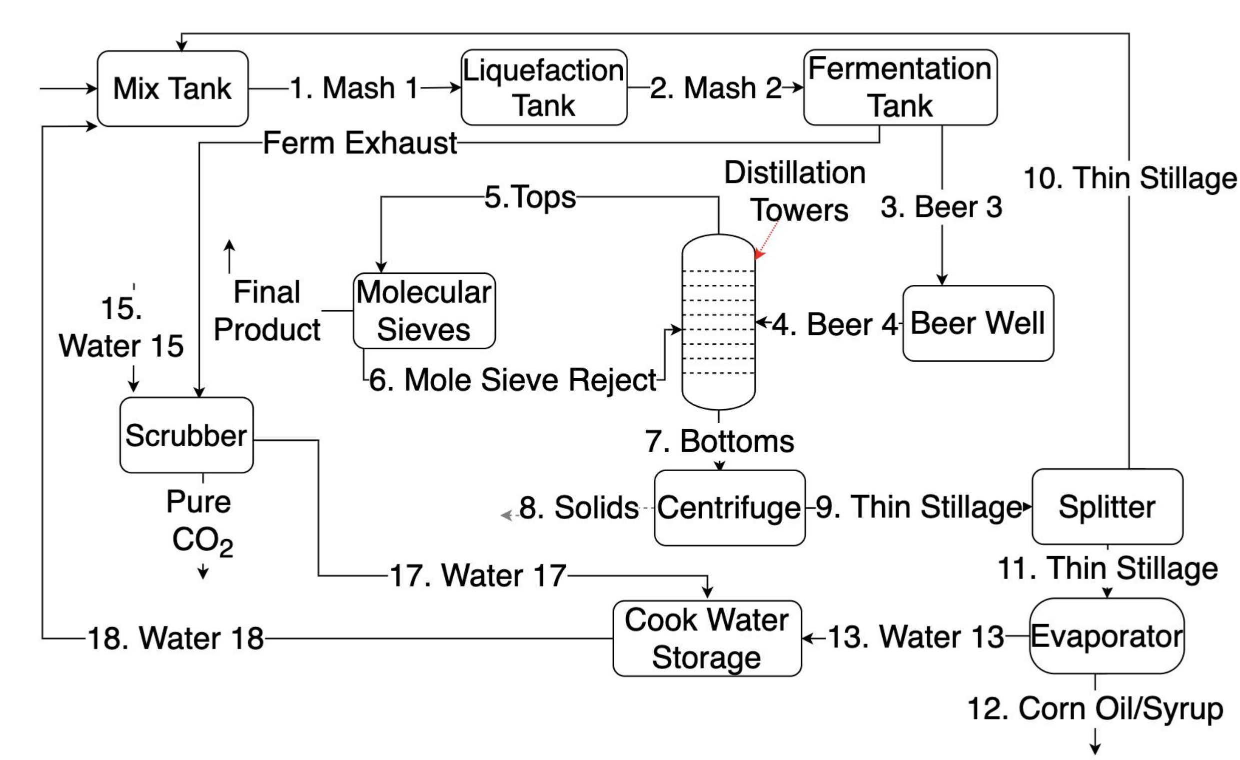




Detection Limit – COD = 1.0mg/L, Acetaldehyde = 7.5mg/L, Propanol = 5mg/L, Methanol = 9mg/L. Acetal = 5mg/L

WATER QUALITY

Stream	Name	TN (g/l)	TP (g/l)	TSS (g/l)	pH
1	Mix Tank Mash	5.2 ± 0.3	3.9 ± 0	110 ± 30	5.4
2	Liquefaction Tank Mash	5.6 ± 0.7	3.0 ± 0.1	99 ± 3	5.3
3	Fermentation Tank Beer	7.3 ± 0.1	4.7 ± 0.1	79 ± 6	4.7
4	Beer Well Beer	6.3 ± 0.2	41 ± 0	83 ± 11	4.1
5	Column Tops	8.3 ± 1	<DL	<DL	4.5
6	Mole Sieve Reject	7.4 ± 1	<DL	<DL	3.8
7	Column Bottoms	6.9 ± 1	4.6 ± 0.2	90 ± 3	3.4
9,10,11	Thin Stillage	7.1 ± 0.1	4.8 ± 0.1	45 ± 6	3.4
12	Corn Oil/Syrup	9.8 ± 0	8.4 ± 0.1	89 ± 9	3.3
13	Evaporated Water	0.037 ± 0	<DL	<DL	3.4
15	Well Water	0.18 ± 0.03	<DL	0.032 ± 0.001	6.7
17	CO_2 Scrubber Water	0.20 ± 0.04	<DL	<DL	5.8
18	Recycled Cook Water	0.039 ± 0	<DL	0.027 ± 0.001	5.1
*	Reboiler Condensate	0.0037 ± 9e-4	<DL	ND	5.9
*	Cooling Tower Blow Down	0.0012 ± 5e-4	0.0081 ± 0	0.056 ± 0.004	8.3
*	Cooling Tower Blow Down + RO Reject	0.027 ± 0	0.0039 ± 0	0.033 ± 0.002	7.7



<DL – Under Detection Limit. DL is as follows: TP = 0.5 mg/L, TN = 1.0 mg/L, TSS = 1.0 mg/L

Environmental Impact

- HAPs
  - HAPS are generated primarily in the fermentation process
  - Additional separation won't lead to additional HAPS
- Water
  - Purification techniques don't often use water
  - Additional purification won't lead to additional water usage
- CO_2 / Green House Gasses
  - Often secondary distillation is used for further purification
  - Secondary distillation often increases CO_2 by 5% to 10%, but possibly up to 100%
- CO_2 produced for hand sanitizer
  - Travel size (30mL) bottle of 70% ethanol requires 0.02 Lbs of CO_2

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