DALHOUSIE UNIVERSITY
FACULTY OF ENGINEERING

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Client:
Wild Wines & Spirits

Department of Process Engineering and Applied Science

Wood-Fired Apple Brandy Distillation

ABOUT WILD WINES & SPIRITS

- Located in Annapolis Valley, NS.
- Currently produces apple cider.
- Emphasize biodiversity, naturalness, simplicity, and the local character of their products.

OBJECTIVES & CRITERIA

- Design a wood-fired continuous distillation column for a variety of fruit wine feedstocks.
- Production of at least 4,000 litres of 55 to 60% (v/v) distillate from ~40,000 litres of apple cider (6-8% v/v).
- Portable distillation system.
- Less than 9ft in height.
- Dismantlable for transportation and cleaning.
- Incorporate traditional Normandy brandy production design.

DESIGN PROCESS

Steps conducted to complete design:

1. Literature review on all components & brandy production
2. Preliminary design of basic system
3. Detailed design of each component of the system
   - Friction Loss Calculations
   - Mass and Energy Balances
   - Aspen HYSYS Simulations
4. Final designed system with piping and instrumentation

AUXILIARY COMPONENT DESIGN

TOTAL CONDENSER

Column Length
1.20 meters

Column Diameter
6.625 inches

Heat Exchanger Type
Shell & Tube

Number of Passes
Two Passes

Number of Pipes
17

Inner Pipe Diameter
19 mm

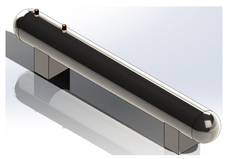

Figure 1. 3D Model of the total condenser

FURNACE & REBOILER

Furnace Firebox Volume
0.100 m^3

Reboiler Volume
100 Gallons

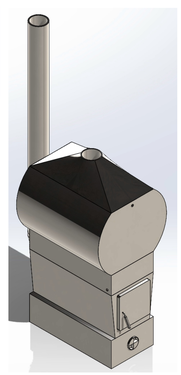

Figure 2. 3D Model of the reboiler and furnace

DISTILLATION COLUMN DESIGN

Material
Copper & Stainless Steel

Column Height
36 inches

Column Diameter
6 inches

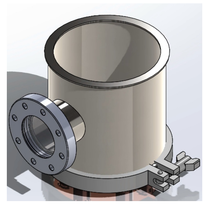

Figure 3. Tri-Clamp 6-inch Column Section

Tray Count
6 trays

Tray Type
Bubble Cap

Tray Spacing
6 inches

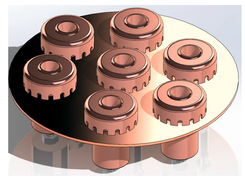

Figure 4. 6-inch Bubble Cap Plate with 7 Pro-Cap 36mm

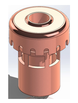

Figure 5. 36mm Pro-Cap from Still Dragon

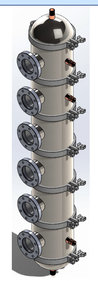

Figure 6. Assembled Distillation Column

ASSEMBLED SYSTEM

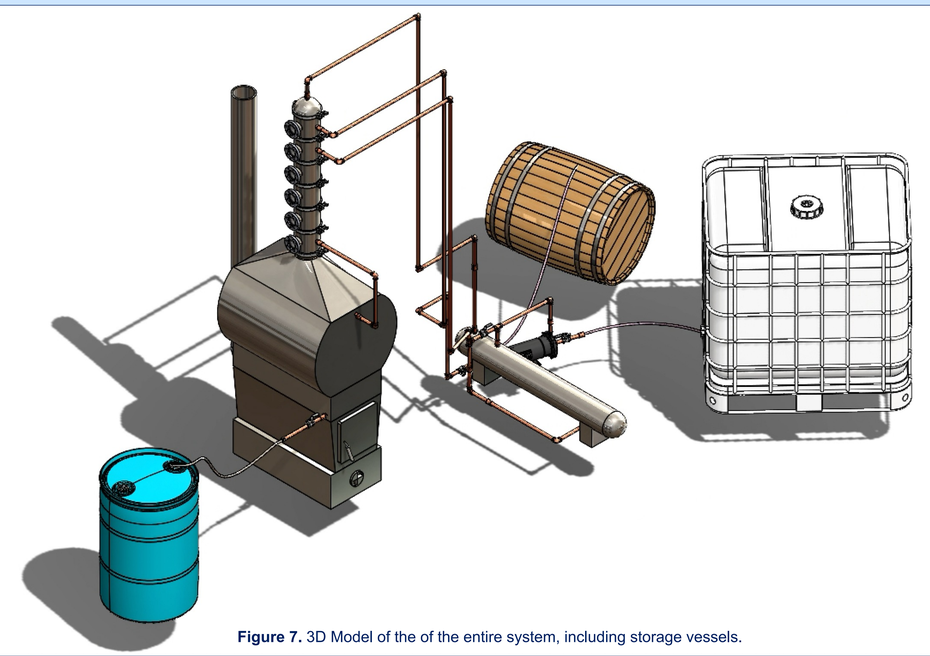

Figure 7. 3D Model of the of the entire system, including storage vessels.

CHEMICAL ANALYSIS

Compound	Inlet Cider Concentration (mg/L) [1]	Outlet Distillate Concentration (mg/L) [1]
Acetaldehyde	<10	43.18
Ethyl Acetate	36.04	110.26
Methanol	<10	22.34
1-Propanol	<10	47.85
Isobutanol	15.69	285.04
1-Butanol	<10	15.99
Isoamyl Alcohol	91.10	1598.65
Ethyl Lactate	27.29	46.02

PROCESS FLOW DIAGRAM

Equipment List

Label	Name
E-100	Total Condenser
E-101	Reboiler
F-100	Wood-Fired Furnace
P-101	Centrifugal Pump
T-100	Distillation Column

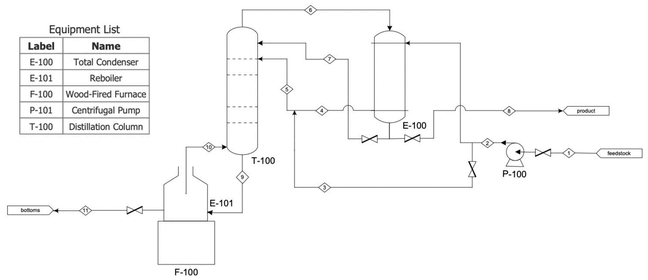

Figure 8. Process flow diagram of the system.

MATERIAL COST

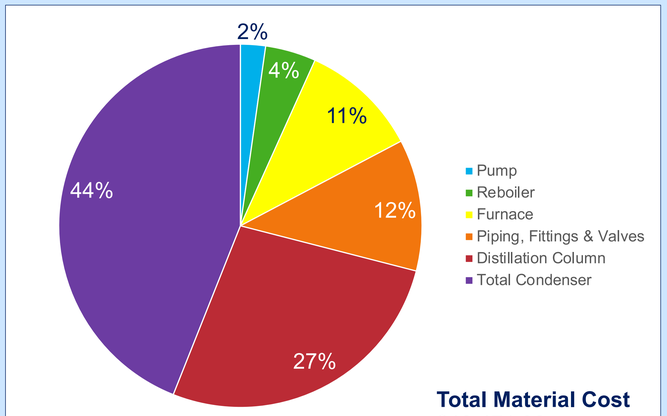

Figure 9. Pie chart of material cost by component.

Total Material Cost
$13,471.92

CONCLUSION & RECOMMENDATIONS

- Designed a wood-fired distillation system that is capable of producing distillate at a rate of 20 L/h with a feedstock rate of 200 L/h.
- Return on investment 3-5 years (3 years needed for brandy to age in barrels). Dependent on product pricing.
- A dephlegmator could be added for additional separation of the product stream.
- Routine cleaning and maintenance should be completed to ensure optimal operation of the system and quality of product.

REFERENCES

1. Craig-Barnes, H. (2022). *Wild Wines & Spirits Compound Analysis* (p. 1). Acadia Laboratory for Agri-Food & Beverage.
2. Still Dragon. (n.d.). *6-inch Stainless Steel Dephlegmator*. Still Dragon. Retrieved March 22, 2022, from https://stilldragon.com/6-dephlegmator.html
3. Still Dragon. (n.d.-b). *Complete 6" ProCap Plate Assembly*. Still Dragon. Retrieved March 24, 2022, from https://stilldragon.com/complete-6-procap-plate-assembly.html