CAPSTONE/SENIOR DESIGN EXPERIENCE 2018

Rapidly-Aged Boiler Bourbon Whiskey

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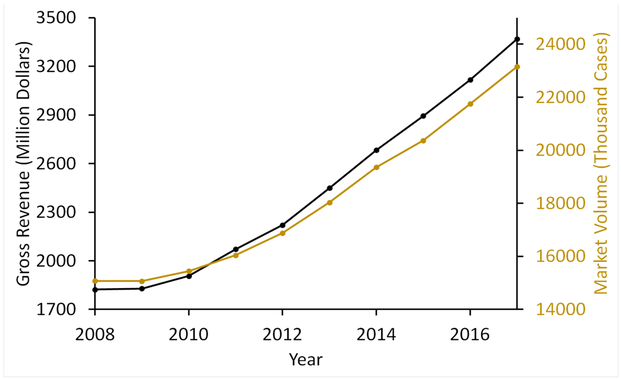
Purpose

To develop a method to rapidly accelerate bourbon whiskey production through the use of ultrasound technology and basic engineering and optimization principles

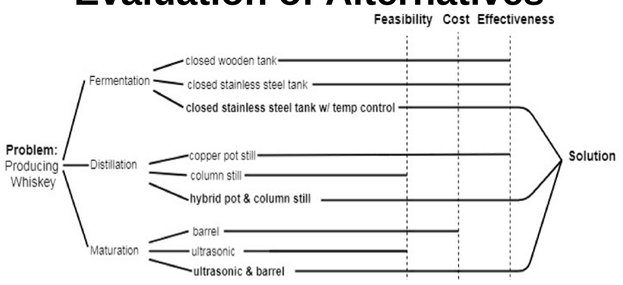
Background

- Alcohol product made in USA
- Fermented mash of at least 51% corn w/w
- Distilled to less than 160 proof (80% ABV)
- Barreled at less than 125 proof (62.5% ABV)
- Bottled at least 80 proof (40% ABV)
- Aged in new, charred American white oak (*Quercus alba*) containers
- After 2 years, “Straight Bourbon” name can be applied

Bourbon Market Growth, 2008-2017



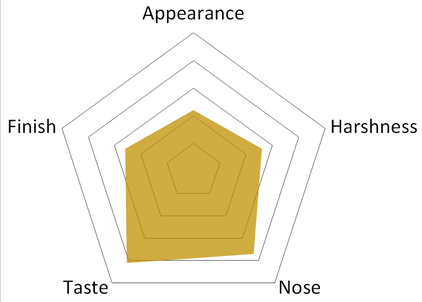
Evaluation of Alternatives



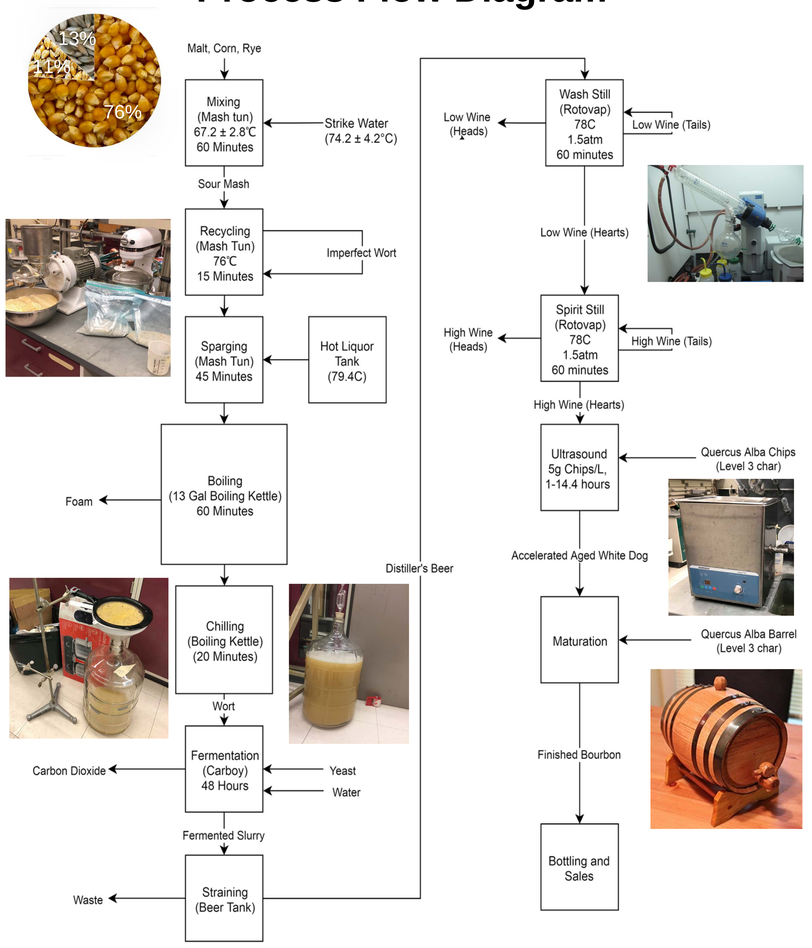
Final Product

Product Composition	
Serving size: 1.5 oz (44mL)	
Servings per Container: 17	
Corn	76%
Rye	13%
Barley	11%
ABV	40%

Tasting Analysis



Process Flow Diagram



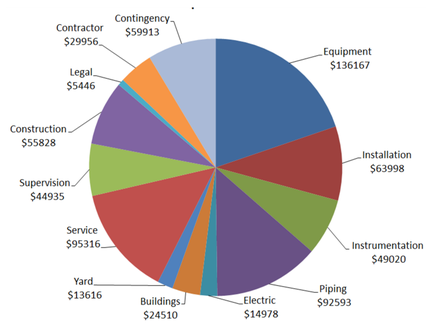
Project Impact

Benefits	Potential Drawbacks
• Production is more reactive to demand • Novel technique facilitates industry development • Easily scaled up for mass production	• Apprehension to diversion from tradition • Increased barrel throughput can generate environmental strain • Limited by ultrasonic technology development

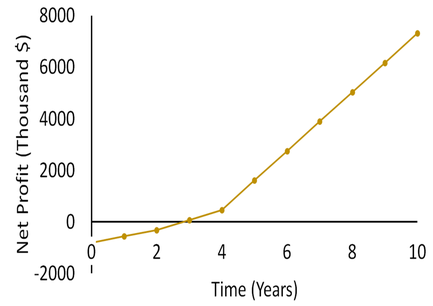
Economic Analysis

Year of Operation	Production Capacity	Bottles Produced	Product Age	Bottle Price ($)	Revenue ($)	Costs ($)	Net Profit ($)	ROI (%)
0	0%	0	n/a	n/a	0	807,470	-807,470	-100
1	50%	25,000	Unaged	20	500,000	257,272	-564,742	-70
2	50%	25,000	Unaged	20	500,000	257,272	-322,014	-40
3	50%	25,000	2 Years	30	750,000	357,472	70,515	9
4	50%	25,000	2 Years	30	750,000	357,472	463,043	57
5	100%	50,000	2 years	30	1,500,000	357,472	1,605,571	199
6	100%	50,000	2 Years	30	1,500,000	357,472	2,748,100	340
7	100%	50,000	2 Years	30	1,500,000	357,472	3,890,628	482
8	100%	50,000	2 years	30	1,500,000	357,472	5,033,157	623
9	100%	50,000	2 Years	30	1,500,000	357,472	6,175,685	765
10	100%	50,000	2 years	30	1,500,000	357,472	7,318,213	906

Total Capital Investment



Ten Year Profitability



Future Recommendations

- Identify and compare phenolic compounds in rapidly-aged versus barrel-aged product via high-perfomance liquid chromatography
- Optimize distillation times between heads/hearts/tails of product
- Continue experimentation with ultrasound exposure to determine effects on the aging process

Technical Advisor and Instructor:
Martin Okos, PhD

Acknowledgements
Qin Xu, PhD
Troy Tonner
Coleen Riley