PRODUCTION OF CANNED NITRO COLD BREW COFFEE FOR ONYX COFFEE LAB

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THE PROBLEM

Onyx Coffee Lab in Springdale, AR is requesting our help in commercializing a ready to drink nitrogen infused canned cold brew for retail sale. The client requests assistance in a system scale-up, product purification, and nitrogen delivery.

Onyx does not currently produce enough cold brew to expand their sales to a retail market. Their current brewing system is extremely inefficient, requiring a large amount of time and effort. Additionally, their current method of nitrogen introduction does not provide sufficient nitrogen in solution post-canning, and their system does not include bacterial control, as the product is sold fresh at Onyx locations. These factors render the current system unsustainable for future use.

THE PROJECT

After evaluating the requirements of Onyx for this project, the team developed design objectives and constraints.

OBJECTIVES

- Scale up brewing system to a 100 gallon/day capacity.
- Research and design a method of pasteurization for the cold brew coffee.
- Research and design a method nitrogen delivery in order to maintain nitrogen levels after packaging.

CONSTRAINTS

- Product must be considered legally safe to sell.
- Product must have appropriate nitrogen levels after packaging.

After determining these requirements, the team developed designs for three different project elements: the system scale-up, product safety, and nitrogen delivery.

SYSTEM SCALE-UP

Several tanks were examined, and a 50 gallon Cold Brew Avenue tank with a built-in filter was selected.

The team specified pipe lengths and fittings based on site dimensions, and a filter to reduce fine particulates in the cold brew was selected. Bernoulli's Equation was used to develop a system curve for pump selection.

System Scale-Up Parts List	
100 Gallon Brew Kettle	Keg Fitting
50 gal Cold Brew Avenue Tank	Tubing Clamp (10)
304µm Inline Mesh Filter	Tri-Clamp
Drum Dolly	1.5" TC to ½" Barb
½" Male QD with FPT (2)	TC Gasket (2)
½" Female QD with Barb (4)	10 ft of ½" Food Grade Tubing

PRODUCT SAFETY

Several product safety alternatives were considered, including UV pasteurization and heat pasteurization.

The team tested the efficacy of different product safety methods through the dilution and incubation of inoculated plates.

The team took samples of cold brew, and inoculated several plates with dilutions of both treated and untreated (control) cold brew. These samples were incubated for several days, and bacterial counts were taken.

Image illustrating low efficacy of UV pasteurization in reducing bacterial colonies.

NITROGEN DELIVERY

The N_2 concentration corresponding to the conditions at Onyx was set as the post-canning goal concentration.

A spreadsheet model utilizing Henry's Law, the Ideal Gas Law, and a literature derived equation (Gevantman, 2000) was developed. It modeled the post-canning N_2 concentration at any temperature and pressure, allowing the team to determine the N_2 required.

Canning tests determined that the majority of nitrogen losses occurred during the canning process, suggesting that liquid N_2 injection was the most practical delivery option.

The team then worked to specify an appropriate nitrogen injection unit, such as the Chart Industries UltraDoser.

THE OUTCOME

SYSTEM SCALE-UP

The full system is currently up and running, with the capacity of producing 50 gallons of cold brew concentrate (100 gallons diluted cold brew) daily.

NITROGEN DELIVERY

A nitrogen delivery unit has been specified. The specified unit has not yet been ordered or installed, however, the required nitrogen dosage has been determined, increasing ease of use post-installation.

PRODUCT SAFETY

After testing, it was determined that UV pasteurization is not a viable product safety option. Instead, the client will pursue heat pasteurization or an equivalent option.

SUSTAINABILITY

There are multiple ways to incorporate sustainability into the engineering design process.

This project provided a valuable experience in incorporating sustainable decision-making in the engineering design process, illustrating that sustainable designs are viable even in projects that do not possess a strong immediate focus towards sustainability.

This project illustrates the usefulness of sustainable decision-making in all engineering projects, encouraging the use of sustainable design in future projects, and fostering a positive outlook towards sustainable principles.

SYSTEM SCALE-UP

The system scale-up utilizes a properly sized pump operating at an optimum point on the system curve. This allows the pump to operate highly efficiently, reducing the environmental impact of the pump's electricity use.

NITROGEN DELIVERY

A liquid nitrogen injection system has very low gas waste, and functions with very low electricity requirements. This contrasts several of the project alternatives considered, which had considerable gas waste and electricity (pumping) requirements.

PRODUCT SAFETY

The project's social sustainability is highly dependent on the safety of the product. The use of heat pasteurization or an equivalent option will ensure that the product is safe for consumption.

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