DALHOUSIE UNIVERSITY
Department of Mechanical Engineering

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Soaker Pit Optimization Project

OLAND BREWERY
Generations of Great Maritime Brewing.

Problem Definition and Objective

The Client's soaker pit below the brewery bottle washer was continuously overflowing due to drain blockage from labels, glass, crowns, and other debris from the caustic tank cleaning process. Diatomaceous earth (DE) from the brewing process also accumulates in the pit. This was costing the Client an excess of $50 000 each year in vacuum trucks to clean out.

The objective for this project was to design a solution to mitigate the overflow of the soaker pit by preventing blockage of the pit's drain. This would reduce the frequency and ultimately the yearly cost of the vacuum trucks needed to clean out the soaker pit.

Requirements

High risk elements, critical to the success of the project as defined by the client and team are summarized in the following table:

Requirement	Description
Functionality	Shall eliminate drain screen clogging from labels and other debris to (100% reduction)
Safety	Shall ensure safe operation of the design from the exterior of the soaker pit (within 4 feet of soaker pit)
Safety	Should prevent pit overflow (occur no more than 2 times a year)
Usability	Shall allow for efficient running of the bottle line (weekly task at most for operation)
Durability	Shall be able to withstand 3% caustic solution (non-corrosive material, stainless steel)

Scope of Work

After a stage of research and analysis of the problem, it was determined that the design to be pursued would focus on mitigating the labels and pulp entering the pit.

The design solution required building upon the existing infrastructure in the pit to acquire this goal.

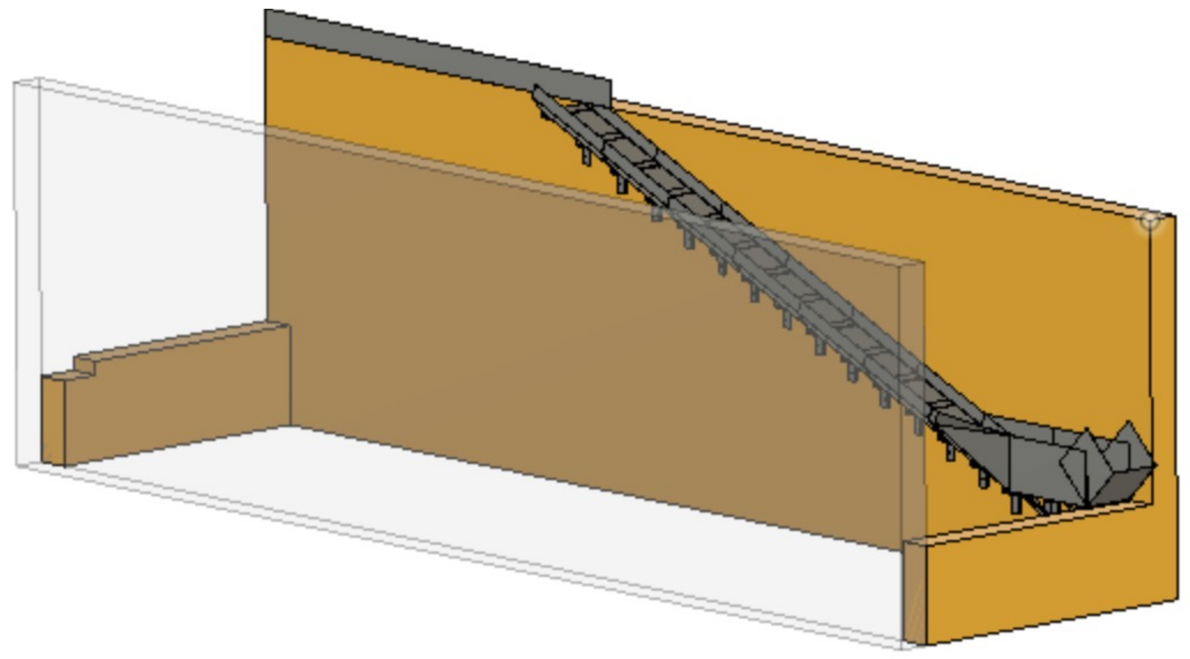
The team was tasked with the following:
- ❖ Performing calculations
- ❖ Designing the entire system (trough design, anchorage, separator)
- ❖ Creating SOP's
- ❖ Recommending an installation plan moving forward

Detailed Design

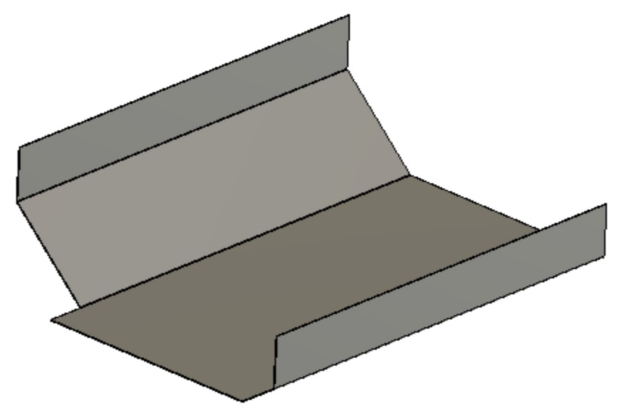
Sloped Trough

To understand the design process fully, it should be noted that the soaker pit is 46' long, 14' high, and 13' wide.

As the caustic tanks are emptied from the floor above the soaker pit, a pulp mixture of caustic solution, labels, and glue from the bottles is emptied onto the brewery floor and falls down the side wall into the pit below. The sloped trough design will catch the mixture and funnel it downwards out from the pit.



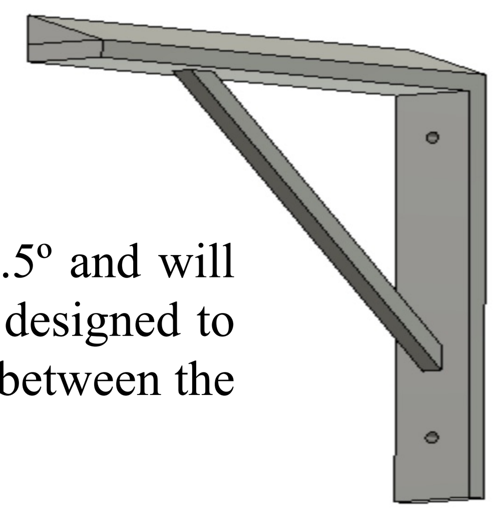
This design accounts for the drop of the mixture by maximizing the slope angle of 22.5º at which the trough is positioned. It also takes advantage of excess water pipes from the brewery by re-directing them to the top of the trough and utilizing the wastewater to flush out the trough.



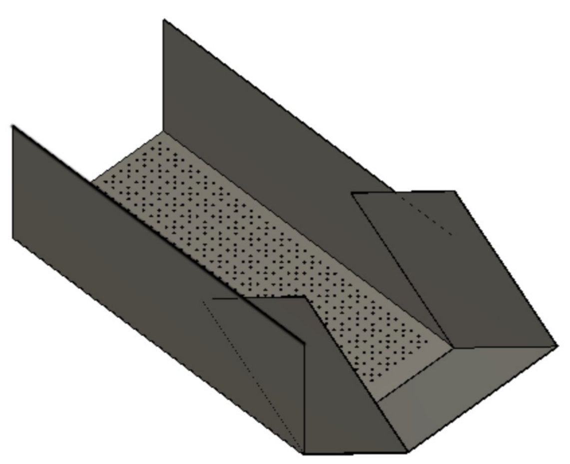
This design will be manufactured with 11-gauge AISI 304 stainless steel which can withstand the 3% caustic solution and the applied load. Each section of the trough will be made of 4' by 4' sections to allow for simplified installation and support design. Each panel will have an overlap that will be welded to the next section.

Supports and Anchors

This design will use a maximum slope angle of 22.5º and will bear a unique load, therefore unique supports were designed to account for this by using a AISI 304 welded wedge between the support and the trough.



Pulp Separator Design



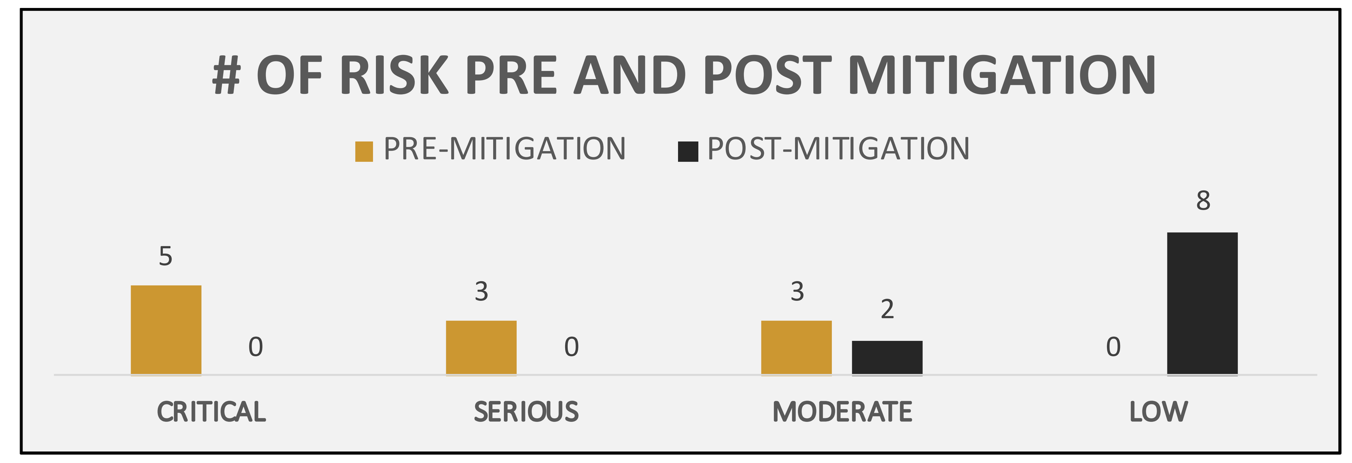
At the bottom of the trough, a separator is required to dispose of the mixture. The designed system* will utilize a perforated exit chamber to separate the liquid from the pulp mixture. The opening of the separator door allows for the solid materials to be removed and placed into an external vessel.

*The design for the separator will need to be refined and finalized going forward.

Safety Considerations

All components will be manufactured of AISI 304, to withstand corrosion from 3% caustic and possible abrasion from DE. The separator design incorporates a latch system with an enclosing door that has a mass of 39.15 lbs, to ensure safe and easy operation by the maintenance team.

- ❖ A risk analysis was performed to identify the most at-risk areas of the project scope.
- ❖ Mitigation plans were developed for each risk including PPE requirements, SOPs, and training.
- ❖ All potential risk factors became either Low or Moderate risks post-mitigation.



Design Validation

It should be noted that the design variables including density, volume, and therefore, overall applied load, were grossly over approximated to allow for a large factor of safety in the following calculations.

The design choices were made and verified by performing a stress analysis on the system to determine if the design could support the applied load.

Variable	Results
Maximum Vertical Deflection on Sheet Metal (δ_y)	22 mm
Maximum Horizontal Deflection on Sheet Metal (δ_x)	6.4 mm
Distributed Load on Sheet Metal (w)	3605.6 N/m

Under the assumed loading conditions, the design was able to consistently stay below the critical stress, buckling load, and pullout force on the bolt.

Variable	Critical	Results
Maximum Stress (σ)	502 Mpa	163.5 MPa
Buckling Load of Support (P_{cr})	131.3 kN	5.3 kN
Pullout Force on Bolt (F_P)	32.6 kN	3.1 kN

Acknowledgement and References

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