Food Enrichment Bag Handling Solution for Food Safety Testing

Andre Chacon • Oliver Kjellgren • Nicholas Jones • Rajat Singh • Maya Stuessi

Special Thanks to MilliporeSigma, Lisa John, Jordan Kestel, & Patty Buchanan

UNIVERSITY of WASHINGTON

Introduction/ Background

Project Description

Larger bag standards in the food sampling industry have resulted in less efficient and ergonomic working conditions for lab technicians

Goal Objectives

Increase Safety . Easy Ergonomics . Process Improvements

Our Problem

How can we improve the food sampling process, with particular emphasis on reducing the number of people involved and the effort required of the lab workers?

Narrowing the Scope

How can we reduce the number of people needed to lift the sample bags into the incubator and improve the ergonomics of this step in the process?

Our Solution

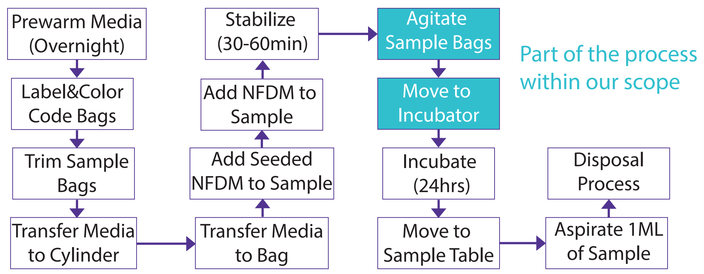
Why we chose to improve the current cart:
- Improve lifting process using hydraulics
- Change lifting motion to sliding motion using rollers
- Reduce labor and time for agitation process using rollers

Constraints

- Unable to visit the facility in person due to remodeling
- Shipping delays due to COVID-19

Process Flow Diagram

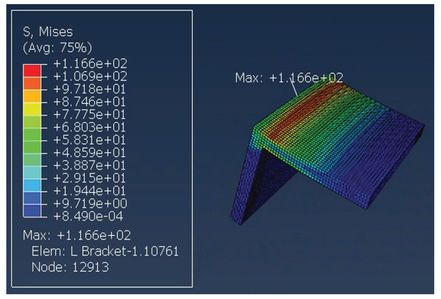
Food Safety Testing Process



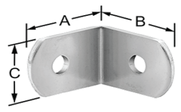
Finite Element Analysis (FEA)

Example: FEA for L-Brackets

FEA	Effect of length of max. stress						Effect of Width on max. stress		
Dimensions	Iteration 1	Iteration 2	Iteration 3	Iteration 4	Iteration 5	Iteration 6	Iteration 7	Iteration 8	Iteration 9
Length	0.875	1	1.125	1.25	1.5	1.875	0.875	0.875	0.875
Width	0.875	0.875	0.875	0.875	0.875	0.875	1	1.125	1.125
Height	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Thickness	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Max Stress	238.7	242	250	249.7	242	242.6	294.5	342.1	398.3
Max Deflection	0.424	0.422	0.422	0.422	0.422	0.42	0.638	0.925	1.268



Effect of Height		Effect of Thickness		
Iteration 10	Iteration 11	Iteration 12	Iteration 13	Iteration 15
0.875	0.875	0.875	0.875	0.875
0.875	0.875	0.875	0.875	0.875
0.625	0.75	1	1	1
0.1	0.1	0.08	0.15	0.25
190	157.5	172.1	59.4	23.8
0.336	0.279	0.418	0.05822	0.0122



Length (A) varies 0.875" - 1.875"
Width (B) Height (C)
Thickness(D) determined by FEA

Fig [1]: Excel Spreadsheet used for L-Brackets

Purpose

Ensure the equipment is safe

Load is transfered from the rollers to the cart top

Analysis

Assume total weight 500lbs
FOS of 1.5
Max load 750lbs
Load on each bracket = 412N

Conclusion

We want: Small (A)
Small (B)
Large (C)
Large (D)

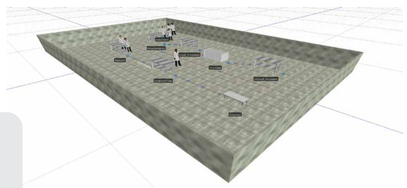
Simio Model

Current System

Prep Sample w/ Agitation :
3.631min +- 10%
Incubator Transfer in Time:
4 sec +- 10%
Worker Utilization:
19.21%

New System

Prep Sample w/ Agitation :
3.531min +- 10%
Incubator Transfer in Time:
6 sec +- 10%
Worker Utilization:
18.19%

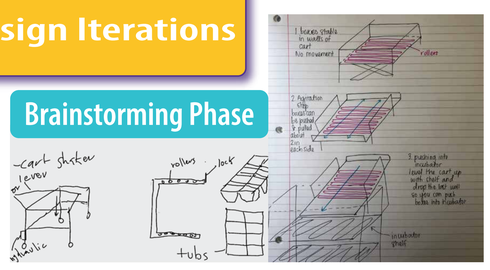


Resource Utilization of Lab Technicians

Decrease in resource utilization = lab techs time being used productively

Design Iterations

Brainstorming Phase



3D CAD Modeling

Original CAD Models
- Cart top modifications
- Opening and closing sidewall

Testing Roller Spacing with 3D Printing

- 3-D Printed Side Walls
- Tested Max Load

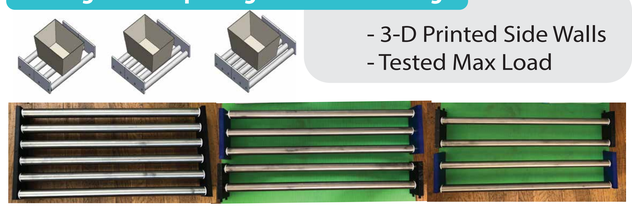
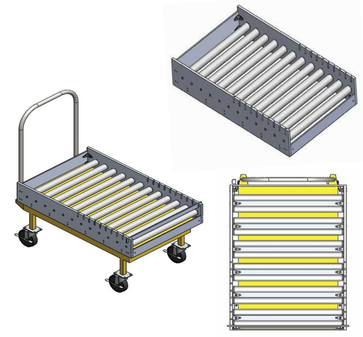


Fig [2]: Testing 5, 4, & 3 rollers per box

Finalized CAD Model

Key Features

- 12 rollers total
- L-Brackets used to elevate surface
- Locking bar sits in slits made 1/2in apart

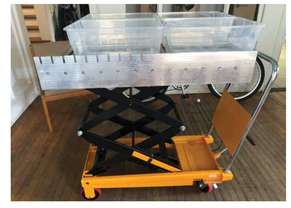


Final Solution & Impact

Final Deliverable

Hydraulic lifting Cart
Custom-built cart top modifications
- Stainless steel rollers
- Locking bar
  - Sits at very end slot for agitation
  - Sits against boxes to hold when moving

Physical Prototype



Final Impact

Utilization
- Only one technician needed for both lifting and agitating

Agitating Improvements
- Previously: approx. 100sec/batch
- Now: approx 20sec/batch (20 bags in one batch)

Increased safety when lifting boxes

Recommendations

Fig [3]: Example CAD Model Open/Closing Mechanism

Future Projects

Mechanism to open/close sample bags
- Increases safety
- Reduces lab tech needed to help keep bag open when taking 1ML sample

Automating the hydraulic cart