Food Enrichment Bag Handling Solution for Food Safety Testing

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

Introduction/Background

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?

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

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

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

Final Deliverable

- Only one technician needed for both lifting and agitating

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

Increased safety when lifting boxes

Worker Utilization:

- Incubator Transfer: 19.21%
- Agitation: 18.19%

Conclusion

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

Process Flow Diagram

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

Finite Element Analysis (FEA)

<table>
<thead>
<tr>
<th>FEAST</th>
<th>Effect of Length on max stress</th>
<th>Effect of Width on max stress</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Iteration 1</td>
<td>Iteration 2</td>
</tr>
<tr>
<td></td>
<td>Length 0.973</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Width   0.975</td>
<td>0.975</td>
</tr>
<tr>
<td></td>
<td>Height  0.975</td>
<td>0.975</td>
</tr>
</tbody>
</table>

Analysis

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

Example: FEA for L-Brackets

- Locking bar sits in slits
- Elevate surface

Testing Roller Spacing with 3D Printing

- 3-D Printed Side Walls
- Tested Max Load

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

Future Projects

Automating the hydraulic cart

Recommendaions

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