Project sponsored by: nanoString

Cost Efficient & Sustainable Alternatives to Consumable Reagent Containers

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Concept & Definition · Research & Brainstorm · Design & Prototypes · Testing & Results · Project Handoff

Project Objectives

The goal of our capstone was to **propose and design an alternative solution for multiple reagent containers** in NanoString's GeoMx® Digital Spatial Profiler (DSP) a microfluidic uptake device with an emphasis on **sustainability** and **affordability.**

- Reduce the final of Cost of Good Sold (COGS) of each container
- Create a more sustainable solution to current container
- Interfaces with NanoString's current device

Project Background

Reagent Bottles and Storage Bottles

- Containers that are intended for storing reagent solutions and chemicals, but primarily buffers
- Materials should not react with buffer solutions

Nanostring GeoMx® DSP

- Allows scientists and researchers to digitally profile protein expression RNA sequences in tissue with high throughput
- Digitally generates whole transcriptomes and data for 100s of proteins
- Consumes buffers from containers in the imaging process

Microfluidic Uptake Pump

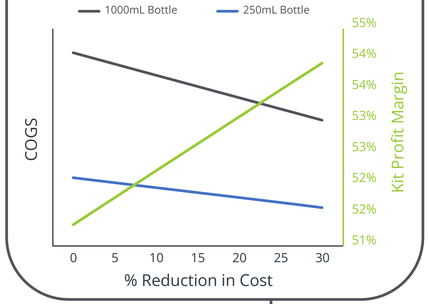
- Pump is sensitive to the suction of air, and bottom must be submerged to prevent suction of air into inner microfluidics

	Bag-Box	Covered Reagent Pouch	Narrow Bottom/ Thin-Wall Container
Pros	• Reduces reagent waste by collapsing as reagent depletes • Pre-existing design – No mold development costs • Low-cost materials and production method • Low waste volume – Easy to aggregate for recycling	• Reduces reagent waste by collapsing as reagent depletes and isolating uptake device • Widely standardized design • Low initial production costs • Low waste volume • Extremely thorough use of stored reagent	• Reduces reagent waste by reducing volume of reagent needed to submerge suction device • Reduced waste volume allows for reduced container surface area • Maintains rigidity • Made of easily recycled material
Cons	• Uses materials with poorly supported recycling • Requires formation of new business partnership • Inner lining has a surface coating that prevents recycling	• Low-cost materials and production method • Requires slight modifications to the machine's existing reagent uptake device • Utilizes coating that is extremely difficult to recycle	• Unique design requires extreme investment in mold and production line development • Rigid material results in high waste volume and difficulty collecting for recycling

Final Deliverables

- Manufacturer-based bottle designs using less material
- Bottle designs for 250 mL reagent container/bottle & 1 L reagent container /bottle
- Individual analysis and testing report
- Final group analysis report
- Project financial outlook (COGS, profit margin)

COGS and Kit Profit Margin Predictions

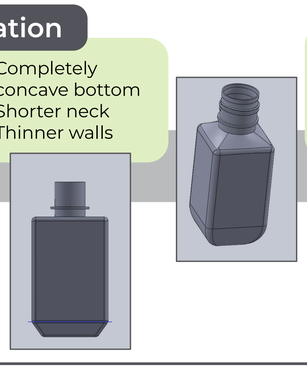


Design Constraints & User Requirements

User requirements	Target product requirements	Means of measurement (Units)
NGST COGS reduced	Cost less than current reagent container design (Goal: ↓ 33%)	Cost analysis ($)
Customer usability - ease of installation	Maintain or increase ease of use for placement of container	User satisfaction survey (rating)
Sustainability - reduction of waste	Reduce the amount of leftover reagent at end of use	Calculate remaining reagent post-use (mL)
	Reduce the amount of non-recyclable container waste	Life Cycle Assessment (report)
Safe transport	Must not leak reagent during product use	Shipping/drop/failure tests (%)
	Must withstand impact from shipping/handling	
	Must not react with the reagents within the container	Calculate remaining reagent post-use (mL)
No change to device functionality	Must not interfere with instrument function and processes	Measure flow rates (mL/min) & pressure (PSI)
Minimize cost of implementation	No change in required user equipment for new bulk container	Cost analysis ($)
	Should be no additional setup costs for the new containers	

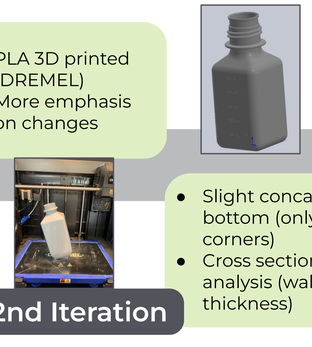
1st Iteration

- Completely concave bottom
- Shorter neck
- Thinner walls



2nd Iteration

- PLA 3D printed (DREMEL)
- More emphasis on changes



- Slight concave bottom (only corners)
- Cross sectional analysis (wall thickness)

3rd Iteration

- Shorter neck
- Thinner walls
- Resin printed (MARS-2) (more detailed)

Prototyping & Testing Process

- Test intake process of stainless steel mesh filter
- Measure of the current GeoMx® bottles design in-lab
- Meet with supplier to discuss design change ideas
- Review and edit current supplier's bottle design iterations
- Create 3D model of the Narrowed Bottom/Thin-Wall Container Design via SolidWorks
- 3D Print (Dremel PLA and Resin) Narrowed Bottom/Thin-Wall Container Design

Future Directions

- Supplier provides physical blow-molded prototype
- Physical fit, puncture, chemical, and shipping tests of Thin-Wall container design in the GeoMx® Mechanism Tray
- 2 iterations of testing by both supplier and NanoString