College of Engineering | School of Chemical, Biological, and Environmental Engineering

BIOE.01

CLEARVIEW MASKS

Phillip Hernandez[1], Christopher Yoon[1], Eugene Semenza[1], Conor Gwyn[1]
[1]Oregon State University, Corvallis, OR, USA

OPPORTUNITY & PROJECT CONCEPT

Mission Statement

The purpose of this project was to develop a face mask design that improves upon products already on the market and to characterize its performance using a series of prototypes. The COVID-19 pandemic led to a surge in demand for face masks by the general population and healthcare professionals. Additionally, there is a large global market for face masks that is increasing quickly. Many individuals around the world will be wearing face masks for the foreseeable future. Our team focused on three aspects of the face mask: visibility for individuals who wear glasses, foreign particle filtration, and mask comfortability. The goal of our team is to deliver a product that is uniquely useful and affordable for a majority of the general population.

Final Product Concept

Our final product included the following features:

- A double layer of high TPI cotton
- A silicon-based adhesive strip
- Elastic ear bands
- An aluminum nose wire

The unit price of our final product was set at $5.00.

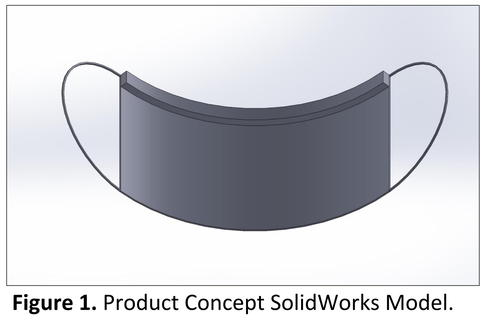

Figure 1. Product Concept SolidWorks Model.

Figure 2. Final Product Concept.

PROTOTYPE #1: SILICONE-BASED ADHESIVE STRIP

Purpose

To investigate what geometries provide the highest peel strength for the silicone adhesive strip.

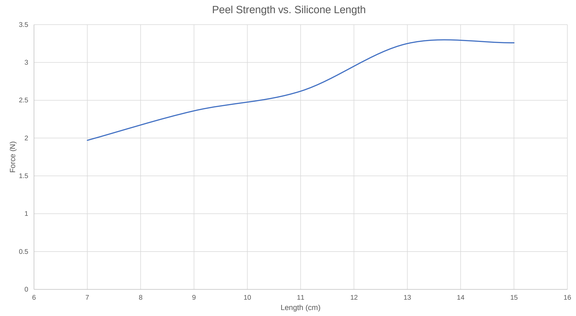

Figure 3. The force required to peel different lengths of silicone.

PROTOTYPE #2: MASK FABRIC

Purpose

To investigate the properties of mask fabrics and determine the optimal material, thread count, and number of layers.

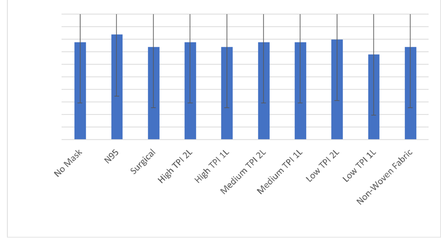

Figure 4. Average percent oxygen saturation of 10 users after wearing each mask for 60 seconds. There was no significant drop in any of the masks.

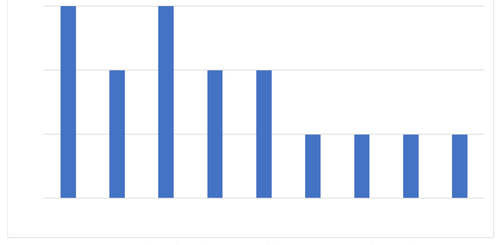

Figure 5. Level of relative filtration of each mask. This was determined using a candle test popularized by Bill Nye. The N95 and High TPI 2 Layer masks were the most effective.

PROTOTYPE #3: EAR LOOPS & COMFORTABILITY

Purpose

To determine what mask components and design are most efficient for attachment of the mask while still being comfortable.

Table 1. This shows the rankings for each mask component per category, ranked left to right from favorite (highlighted green) to least favorite.

Category	Component			
Ear loops	Elastic Bands (regular)	Elastic Bands (tied)	Nylon/Spandex Ear loops	Loops made of mask fabric
Fabric	High TPI cotton	Low TPI cotton	Mid TPI cotton	
Band	With metal band	Without metal band		
Strip	With silicon strip	Without silicon strip		

Table 2. This shows the rankings for each mask design with components included, ranked left to right from favorite to least favorite. Components marked green were the top picks in the table above.

Category	Mask Design			
Mask	1. Mask A (Final Design)	2. Mask B	3. Mask C	4. Mask D
Ear loops	Elastic Bands (regular)	Elastic Bands (regular)	Elastic Bands (tied)	Loops made of mask fabric
Fabric	High TPI cotton	Mid TPI cotton	High TPI cotton	Low TPI cotton
Band	With metal band	With metal band	Without metal band	Without metal band
Strip	With silicon strip	With silicon strip	With silicon strip	With silicon strip

ECONOMICS

Model Inputs	Model Values			
Quarterly Sales Profile	20%	25%	25%	30%
Sales Volume Growth	15%	per year		
Initial Sales Volume	500000	units/year		
Initial Retail Price	$5.00	per unit		
Distributor & Retail Margin	30.00%			
Retail Price Growth	-10.00%	per year		
Product Development	0.00020	$M over 1 year		
Equipment and Tooling	0.016	$M over 1/2 year		
Production Ramp-up	0.008	$M over 1/2 year		
Market Launch	0.050	$M over 1/2 year		
Marketing and Support	0.025	$M/year		
Production Cost	$1.26	per unit		
Production Overhead	0.5	$M/year		
Discount Rate	7%			

Figure 6. Economic model values based off assumptions made by our team.

CONCLUSION & FUTURE STEPS

Design Results

The ClearView mask is the obvious facemask of choice for visually impaired individuals. Its filtration efficiency is not only on par with other masks but performs better than most other masks in the market today. The addition of the anti fogging capabilities makes ClearView the obvious choice when considering which mask you should purchase.

Future Plans

Looking ahead, our team wants to scale up our manufacturing process. We are interested to see how scaling up could affect some of our costs and pricing of our product.

Acknowledgments

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Oregon State University