Element D

By Logan W, Felix M, Jason T, Henry M

Our intention:

We want to *reengineer* the single use plastic straw in a way that is familiar, cheap, and enjoyable for consumers.

Initial Ideas and feedback

Water

Soda

Weight

Taste

Biodegradability

Build Time

Peer Suggestions:

Do you have any other criteria you think we should test?

7 responses

- Transportable, can you easily take the straw with you and how much you can reuse it.
- How will it dissolve? Will it break off into the drink, or just become soggy and melted.
- Public appeal
- Compare and contrast the efficacy of the straw
- Price
- Maybe see how fast it would last in hot temperatures?
- Thickness of the beverage? Like testing the straws in smoothies too that may of chunks of fruit to see if the straw will break against something of that density.

Nathen Frey

MIT PHD Student

From: **Nathan C. Frey** <ncfrey@mit.edu>
Date: Thu, Jan 20, 2022 at 12:23 PM
Subject: Re: Materials For Our Straw
To: Henry Marks <henryesmarks@gmail.com>

Hi Henry,

Happy New Year! Some parameters that come to mind: usability (does it feel like a "regular" straw), compostability (related to biodegradability), shelf stability, temperature stability, diameter (does the structure hold up for milkshakes and boba!)

Some interesting materials to look at might be: plant fibers like cellulose, bamboo, or wheat. You might look at plastics/polymers that are not derived from fossil fuels or achieve net-zero emissions as well: https://www.technologynetworks.com/applied-sciences/news/making-plastic-without-fossil-fuels-339146

https://www.science.org/doi/10.1126/science.abg9853

Best,

Nathan C. Frey, PhD
Postdoctoral Associate
Lincoln Laboratory Supercomputing Center and AI Technology
Massachusetts Institute of Technology
ncfrey.mit.edu

James Shackelford

Professor emeritus UC Davis

Thank you Henry -

And, Happy New Year to you as well!

Your parameters are good ones. A corollary of "limiting lingering taste" could be "toxicity" in general.

Anyway, I would also look at two additional activities in your effort:

1) don't overlook the obvious of old-fashioned paper straws. I recall that some restaurants began using paper straws in their efforts to minimize plastic usage in recent years. A careful review of the pros an of paper would be appropriate as part of your project.

2) do an extensive Google search of what might already be on the market. I did a cursory search and came up with this initial example:

https://www.ecoproductsstore.com/compostable_straws

I am sure there are many more examples. Biobags and similar products can be role models as well. Many of these are, I believe, based on corn and potato starches. Getting detailed chemistries of such commercial (proprietary) products can be a challenge but could lead to some good detective work on your team's part.

I hope these comments are useful. I look forward to staying in close touch with you and your team as you move forward.

Best regards,
JFS

Tests

Liquid Test

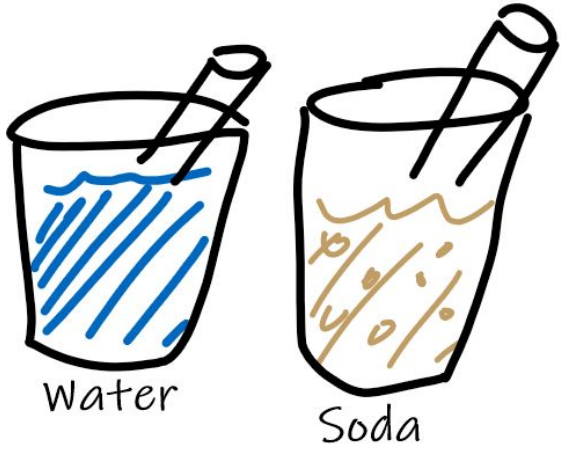
How long can the straw last in different liquids before it becomes unusable as a straw:

- Water
- Soda
- Coffee

at different temperatures: (F)

- Iced (~40)
- Room Temp.
- Hot (~120)

Total tests: 9



Shelf Life Test

Per our mentors recommendations, we want to look into shelf life of our straw.

- We want our product to last on the shelfs for near indefinite time.

Test:

- Recreate a “retail” setting and test how long it lasts
- Look for specific causes of degradation to product

Rough amount of tests: 2

Durability Test

How much force can the straw withstand before breaking. This test includes trying to suck thicker liquids through it.

Different fluids for testing:

- Thick Chunky Smoothie (50% ice cream/ice, 50% water/milk)
- Normal smoothie (30% ice/ ice cream, 70% water/milk)
- Light smoothie (15% ice/ice cream, 85% water/milk)

Total tests: ~15

Total tests

Taste Test

This is a more subjective test, but taste will play an important role.

Tests:

Group of 10 blindfolded people,

Let each person test each type of straw in 10 ten minute intervals and let them rank them each from best tasting to worst tasting.

Biodegradability Test

We will use the accelerated biodegradability test to roughly determine how quickly they will biodegrade.

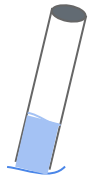
Capillary Test

Test how well the straw absorbs liquid by observing the time it takes to absorb a certain amount of liquid through capillary action.

Test: leave 5 of each type of straw in water, coffee and soda

Monitor the amount of liquid in the container 6 times over 30 mins

Total test~: 15

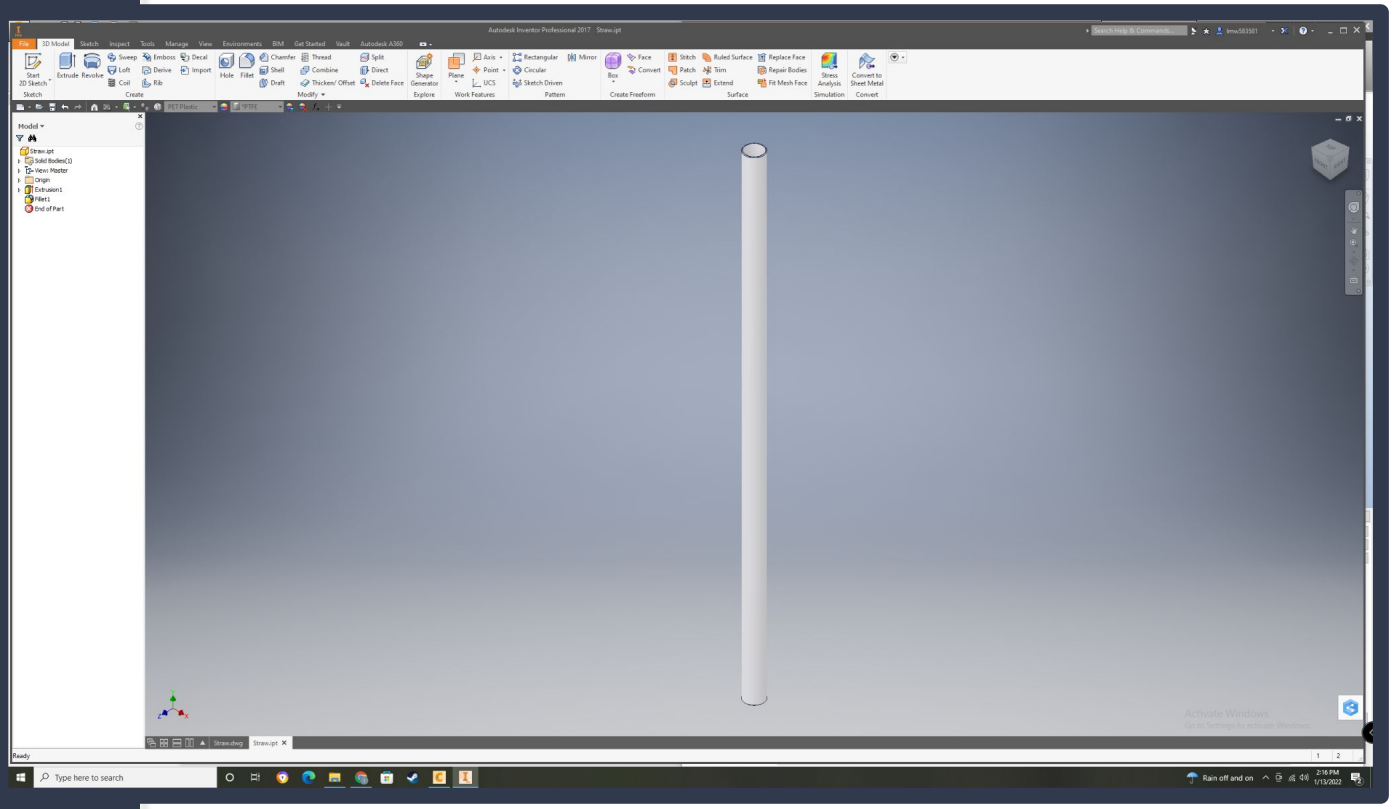


Other Tests

- Price
- Consumer aesthetics

Cad Files

3D Model: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Model
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Extrusion1
Fillet1
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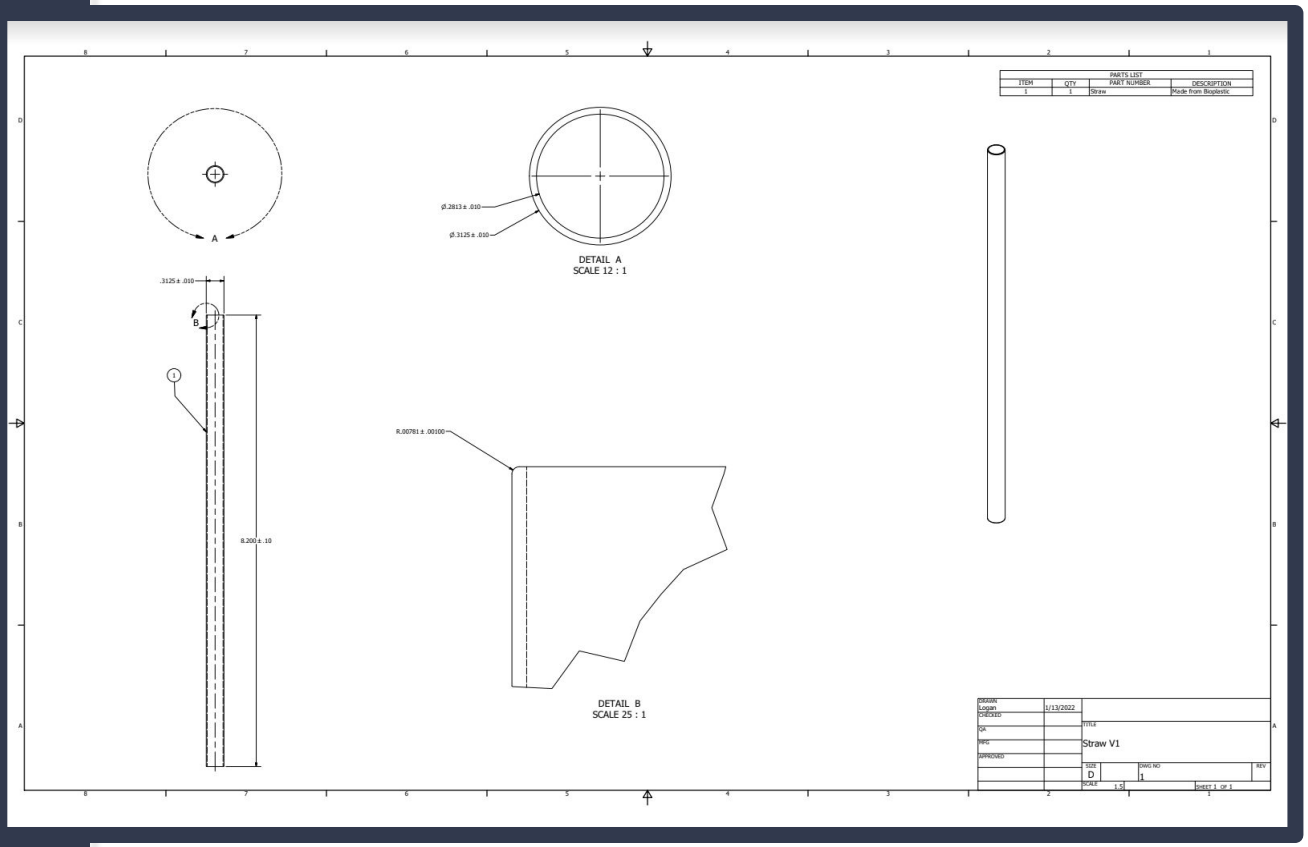
Annotated Drawing:



Potential Solution:

PCL Plastic:

Pros

- Insoluble in most liquids.
- Flexible and durable.
- Easily tweakable biodegradability.
- Is offered as a 3D printable filament.
- Very low glass transition temperature

Cons

- More expensive than other alternatives.
- Relatively low melting point (140 F; may be an issue for structural integrity.)

Any feedback?

We would love to hear it!!