Team Over Engineered

Microplastic Filtration using Tribo-Electric Phenomenon through recycled vehicular tyer waste

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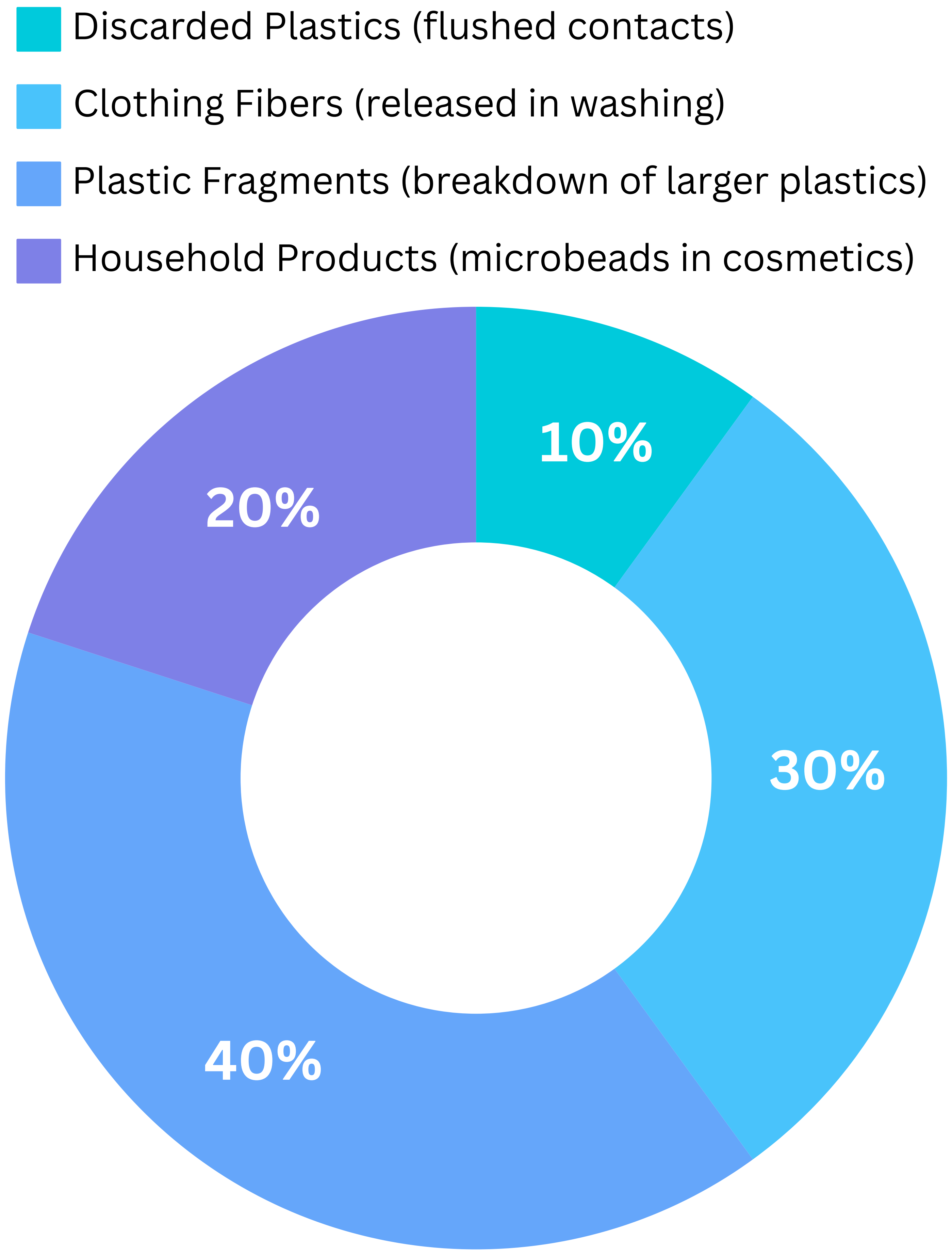
Problem

Household wastewater releases billions of microplastics daily, polluting aquatic ecosystems

- Synthetic Clothing fibres alone account for 30% of all microplastics derived from households. Fibres are much harder to filter than beads.
- Facial scrubs and toothpaste: Microbeads in these products, ranging from 1μm to 60μm easily slip through Water Treatment Plants
- 40% of all microplastics in waste are just tiny shards broken off from larger plastics.



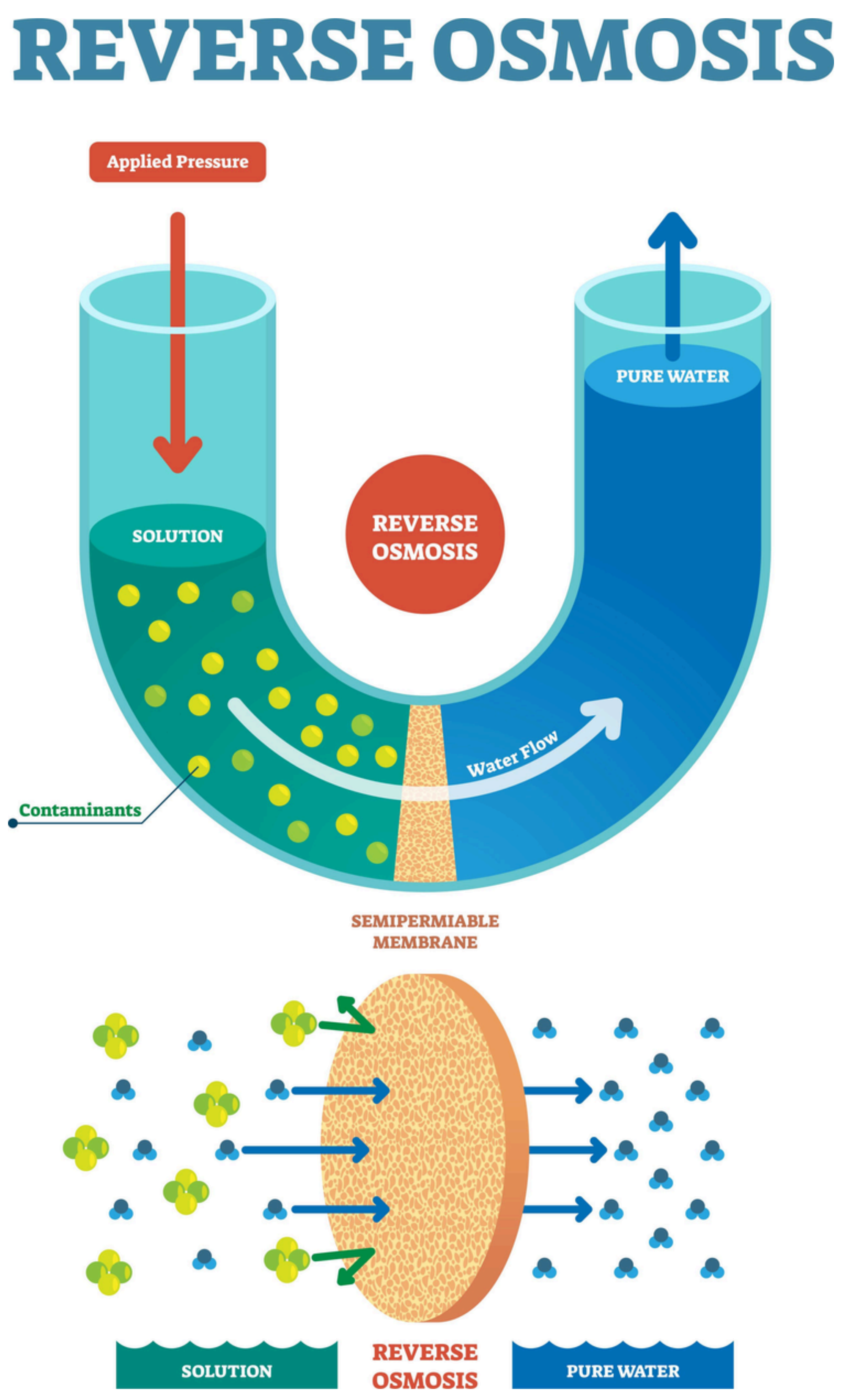
(Sources of microplastics, 2022)

Current Solutions

Water Treatment Plants are only able to filter microplastics <50μm in size.

- Reverse Osmosis, Distillation and UV Ultra filtration still cannot guarantee 100% removal of microplastics.
- Innovative Hydrogel and Synthetic Sponges can only remove 90% more of the microplastics

So how do we tackle the filtering of thin synthetic fibres and particles under 50μm?

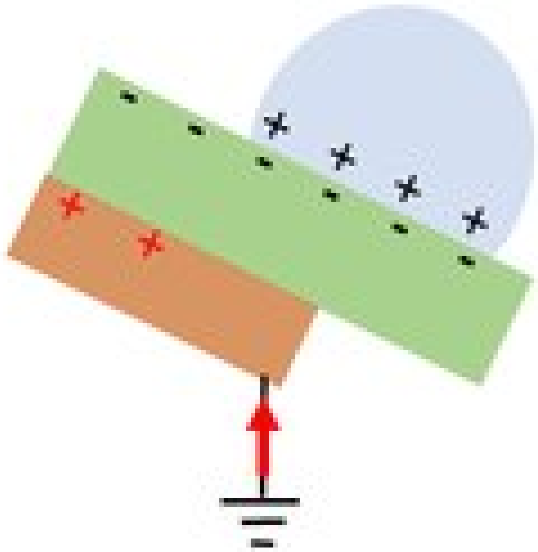


Our Big Idea - Overview

We invented a microplastic filter that clumps thin fibres, and super tiny shards together and seamlessly integrates into every home

- Innovative use of the Tribo-Electric Effect, Electro-Static Transfer
- Custom Designed sinkhole to ensure maximum surface contact with water thus increasing the maximum negative charge that will build up on the inner walls
- Postive/Neutrally charged microplastics will be attracted by the negative charges and clump together
- Cloth filter will sieve the microplastics that are now larger, leading to a much higher filtration %

Our Big Idea - How we used STEM



Science

- Understanding microplastic properties and behavior in water.
- Researching the Tribo-Electric Effect between plastic polymers and water.

Technology

- Fluid Dynamics for a custom sinkhole for enhanced water contact
- 3D Modelling to integrate the Tribo-Electric Effect

Engineering

- 3D Printing to prototype a sinkhole that can fit into most sinks diameter of 1 inch
- Application of laws of Thermo-Dynamics

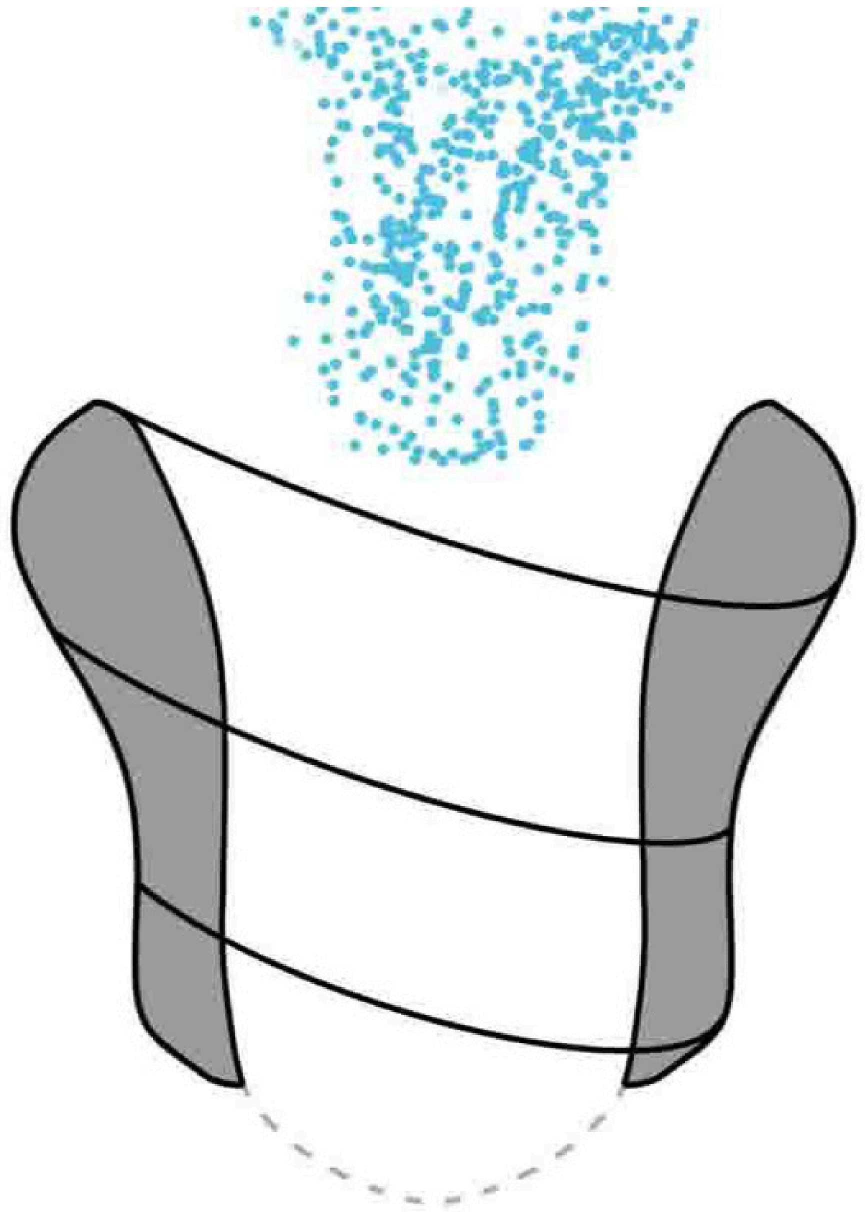
Math

- AI Optimization to gain maximum surface area for enhanced static charge build up, for better particle coagulation
- Data and Statistics were used to prove concept, backed by calculations

Our Big Idea - How does it work?

- Imagine a stream of water(🔵) falling from the tap onto the sinkhole

Our Big Idea - How does it work?



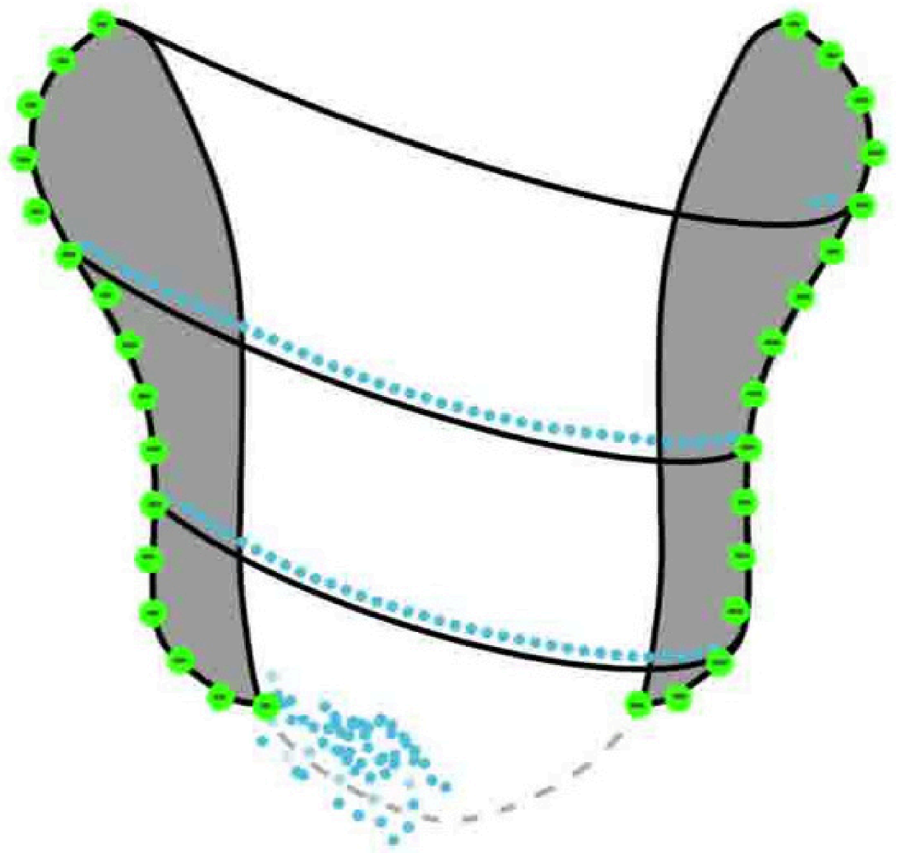
Legend

🔵: Water
🍏: Negative Charges
🔴: Positively Charged Micro-Plastics

- Imagine a stream of water(🔵) falling from the tap onto the sinkhole

Our Big Idea – How does it work?

- As the water particles travel down the sink hole and exits, it negatively charges the Teflon polymer of the sink hole (🟢)



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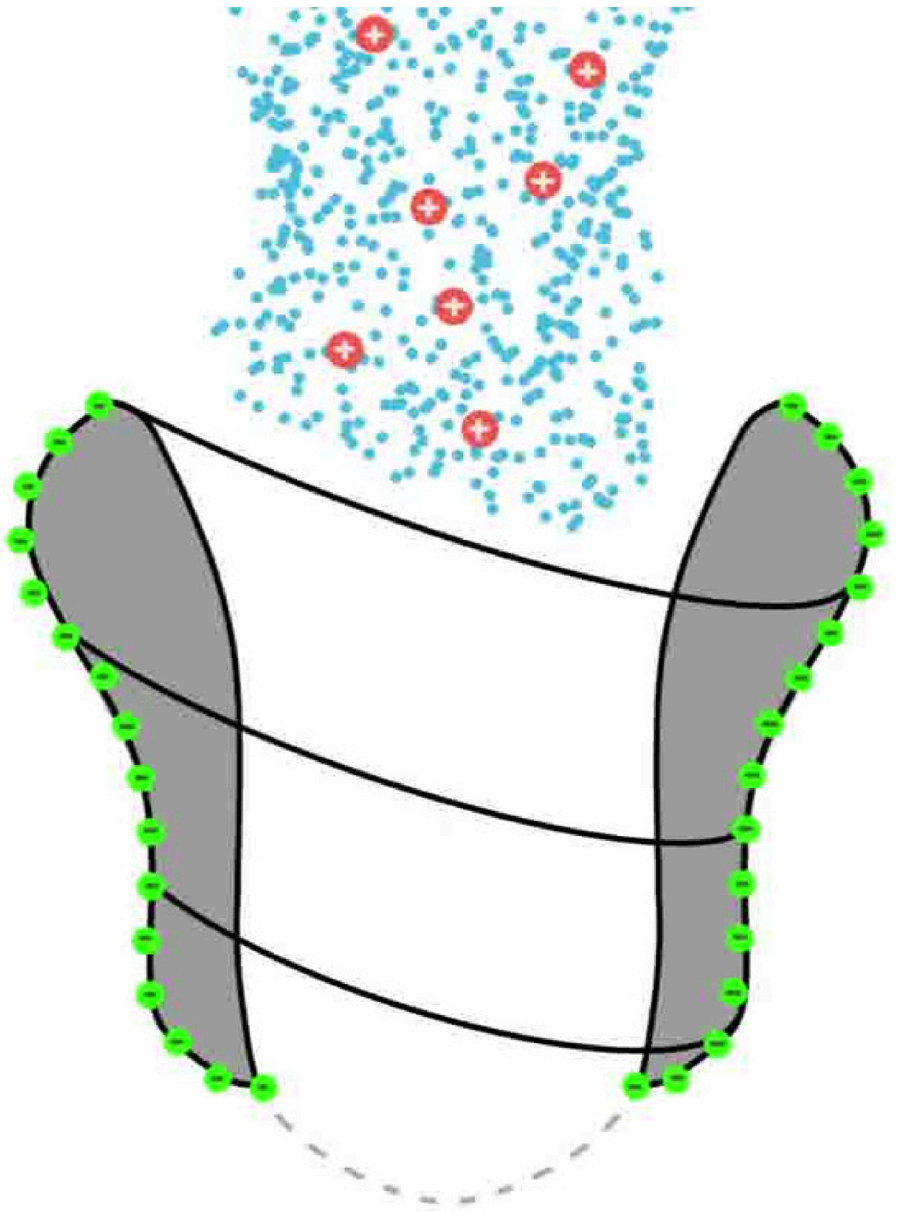
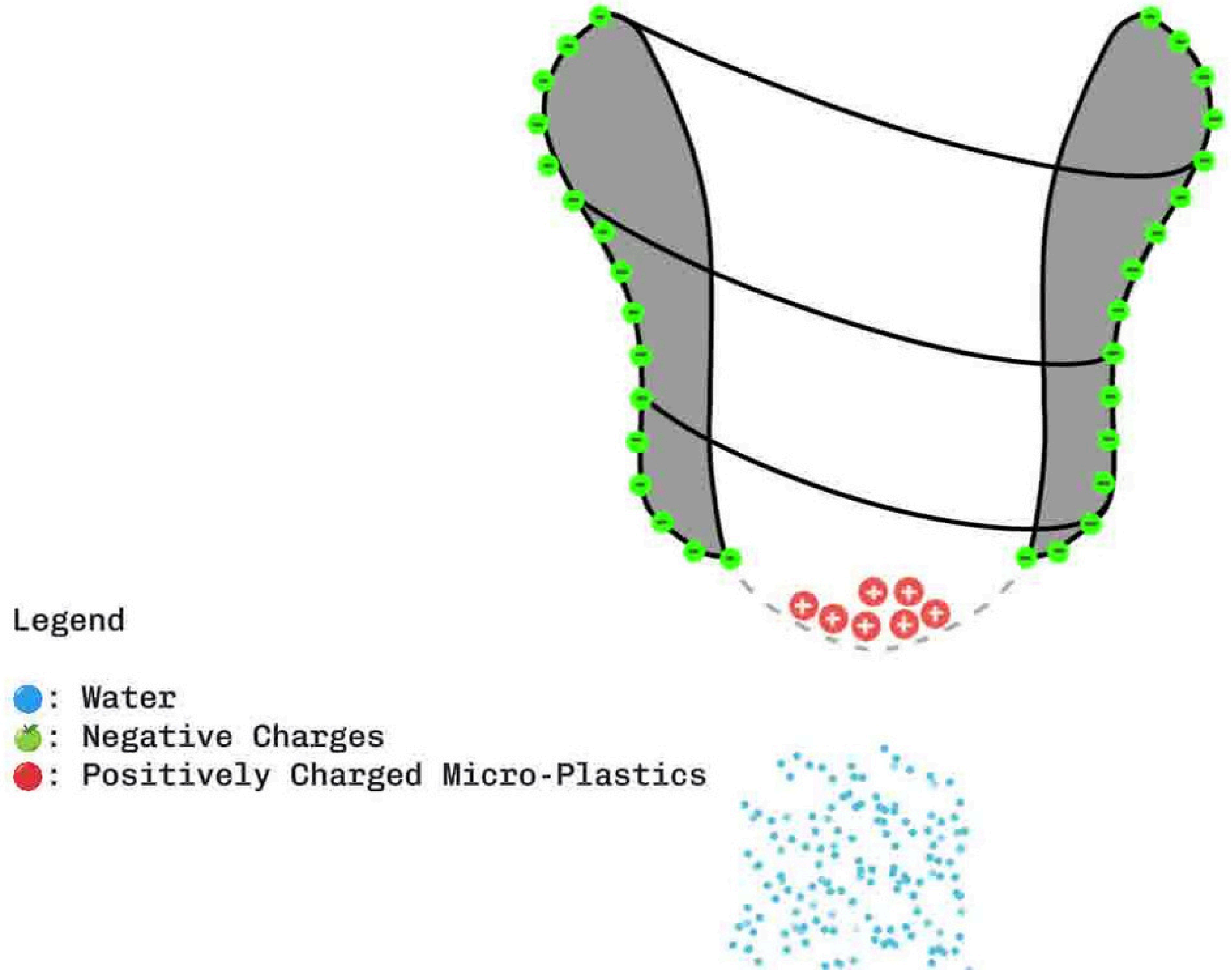


Legend

🔵: Water
🍏: Negative Charges
🔴: Positively Charged Micro-Plastics

- Micro-Plastics are generally positively or neutrally charged (🔴). They are attracted by the negative inner walls (🟢) of the sink hole, and clump together.

Our Big Idea - How does it work?



- A fine cloth filter ensures the now larger particles retain inside, hence reducing the pollution of micro-plastics by 80%!!

(Yes we did the math)

Our Big Idea - How does it work (Animation)

Scan to see our amazing animation

https://youtu.be/WiAYmmInX-o

- Imagine a stream of water( ) falling from the tap onto the sinkhole
- As the water particles travel down the sink hole and exits, it negatively charges the Teflon polymer of the sink hole ( )
- Micro-Plastics are generally positively or neutrally charged ( ). They are attracted by the negative inner walls of the sink hole, and clump together.
- A fine cloth filter ensures the now larger particles retain inside, hence reducing the pollution of micro-plastics by 80%!!

(Yes we did the math)

Our Big Idea – Does it actually work?

- Surface area of the Teflon sinkhole, $A = 18800\,\text{cm}^2$
- Microplastic particle sizes ranging from 1µm to 60µm

1. **Estimating the Number of Particles per Unit Area**:
   - Calculate the number of particles per square centimeter (N_p).
2. **Determine the Probability of Successful Transfer**:
   - Calculate the probability of successful transfer for each particle (P_p).
3. **Checking the Overall Success Rate**:
   - Evaluate the overall success rate based on the calculated P_p.

1. **Estimating the Number of Particles per Unit Area**:
   - Calculate the area occupied by each microplastic particle:
     $A_p = \pi r^2 = \pi \left(\frac{d}{2}\right)^2$
   - For particles ranging from 1µm to 60µm, let's consider the average diameter, which is $30.5\mu m = 0.00305\,\text{cm}$.
     $A_p = \pi \left(\frac{0.00305\,\text{cm}}{2}\right)^2$
   - Now, calculate the number of particles per square centimeter (N_p):
     $N_p = \frac{18800\,\text{cm}^2}{A_p}$

$$N_p \approx \frac{18800}{\pi \times (0.001525)^2}$$
$$N_p \approx \frac{18800}{\pi \times 2.325625 \times 10^{-6}}$$

2. **Determine the Probability of Successful Transfer**:
   - Calculate the probability of successful transfer for each particle (P_p) using the adjusted N_p:

$$P_p = \frac{1}{N_p} = \frac{1}{125}$$

$$P_p = 0.008$$

3. **Checking the Overall Success Rate**:
   - Evaluate the overall success rate based on the adjusted P_p:

$$\text{Success Rate} = P_p \times 100$$
$$\text{Success Rate} = 0.008 \times 100$$
$$\text{Success Rate} = 0.8 \times 10^2$$
$$\text{Success Rate} = 80\%$$

The calculated success rate is indeed 80%, as desired. This confirms that approximately 80 out of every 100 microplastic particles would successfully adhere to the Teflon surface through the triboelectric effect.

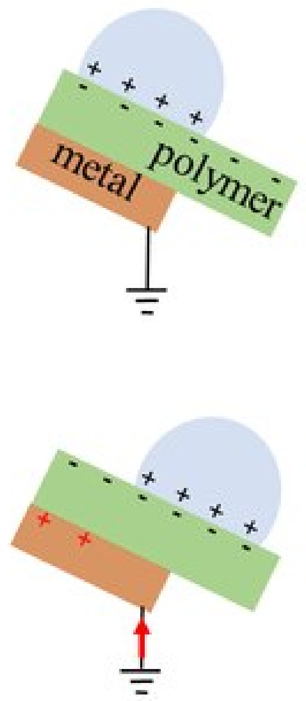
Theoretical Efficiency-> 80%

Our Big Idea – Feasibility

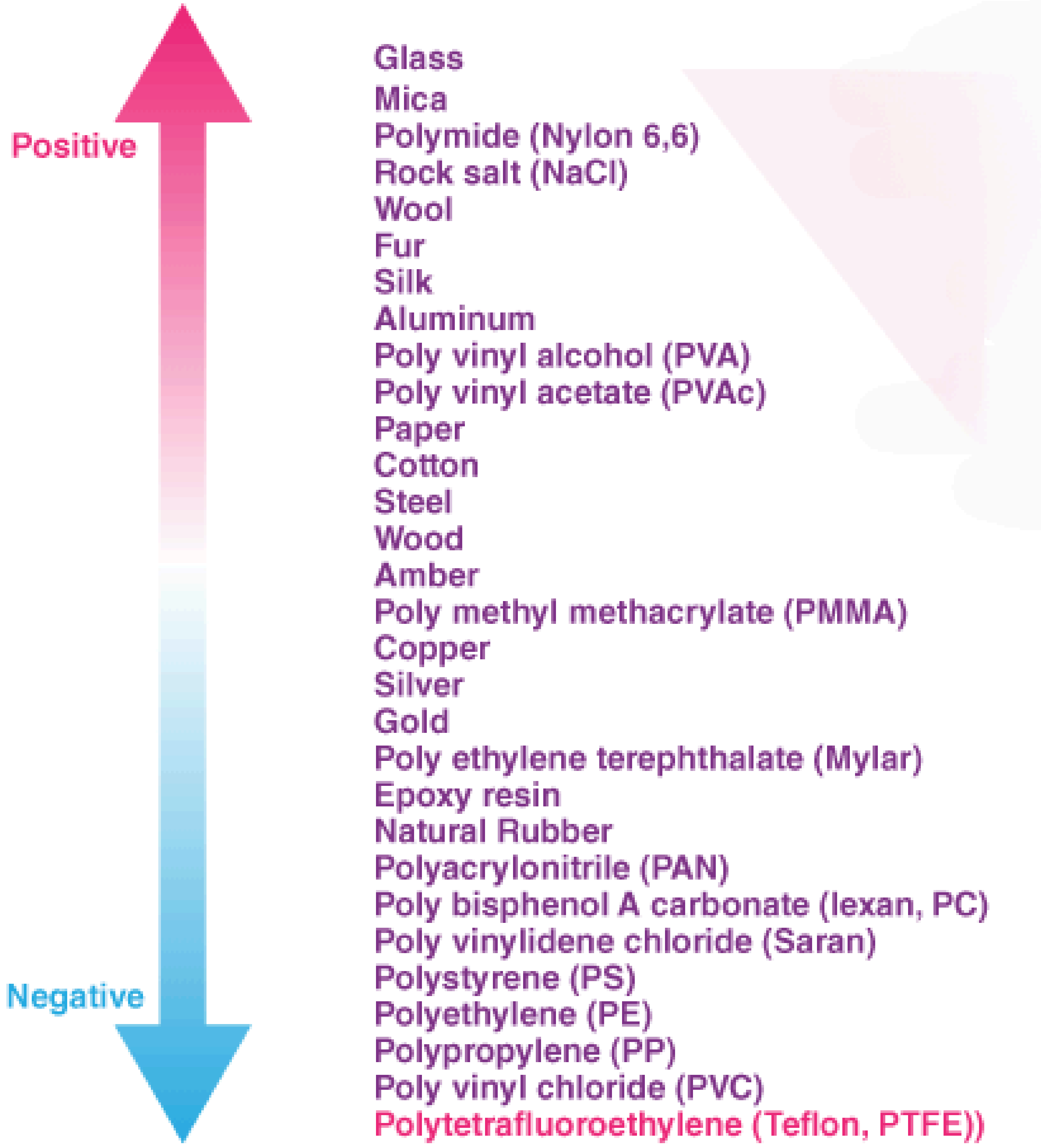
Tribo-Electric Effect

- This effect is the by-product of 2 materials in contact with each other, allowing transfer of static charges. (Electro-Static Transfer)

- Teflon, which is the most negative in the Tribo-Electric Series is the best material to generate the negative charges needed to attract, clump and filter out the tiny 1% of microplastics



(Physical Mockup)

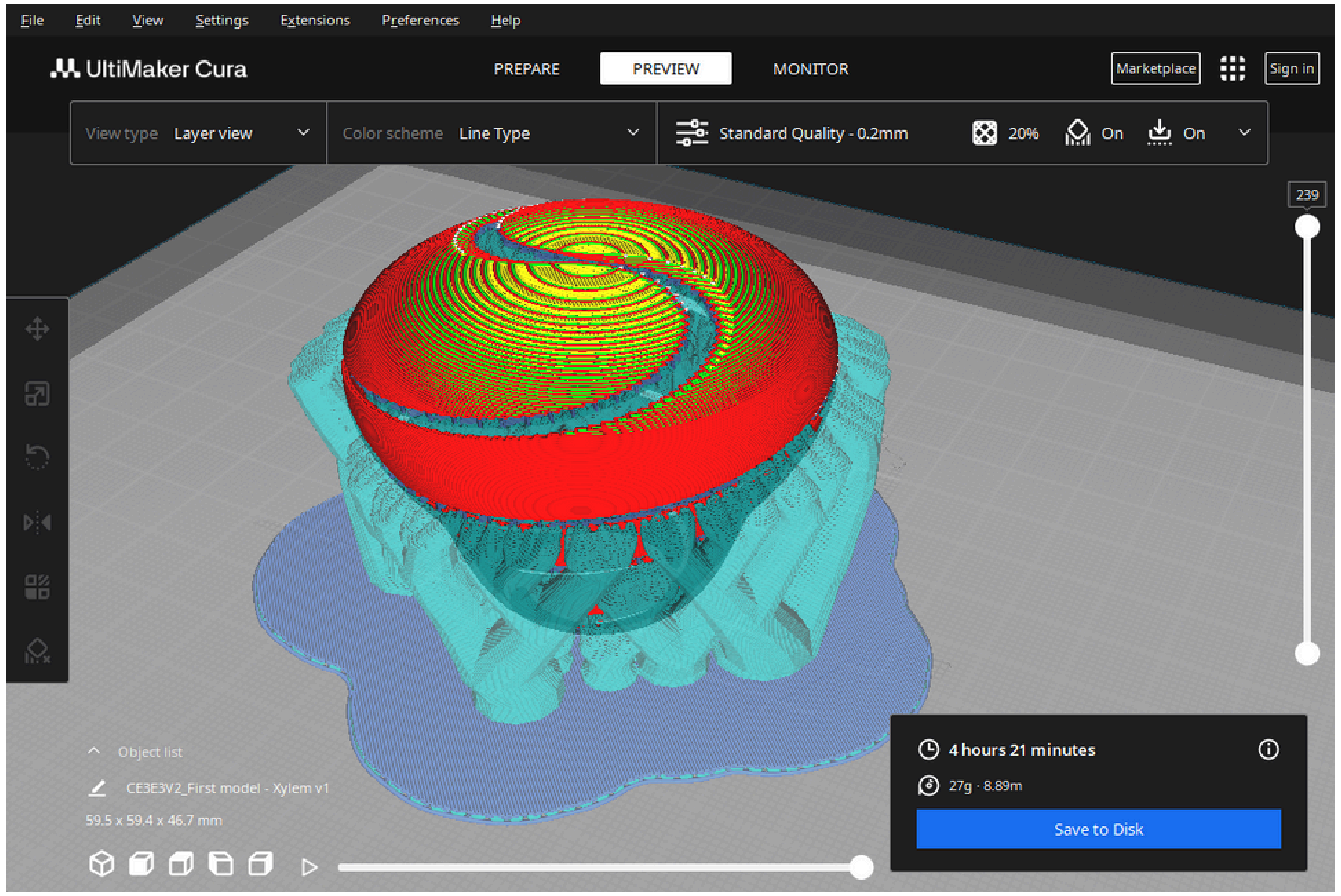


(Tribo-Electric Series)

Our Big Idea – Feasibility

Material Sourcing

- Teflon is sustainably sourced by recycling Vehicle Tyers
- Billions of Vehicular Tyers end up in landfills each year, they release toxic gases into atmosphere, are a fire hazard and a significant portion of toxic particles pollute the ocean
- We use waste, to prevent other forms of wastes from polluting the ocean! Free material!



Material Production

- 3D Printing is an affordable way to quickly produce complex designs. Our product would cost only about 1 dollar to build (Production Cost)

Our Big Idea - How is it better than existing solutions?

Builds on Existing Infrastructure

- "Plug and Play" type design, nothing new to learn

Easy to Source

- Recycling Waste Tyres

Super Scalable

- Technology can be implemented on a larger scale (E.g: Waste Water Treatments)

Easy to Manufacture

- 3D Printing to build product

Super Cheap (Only 1$)

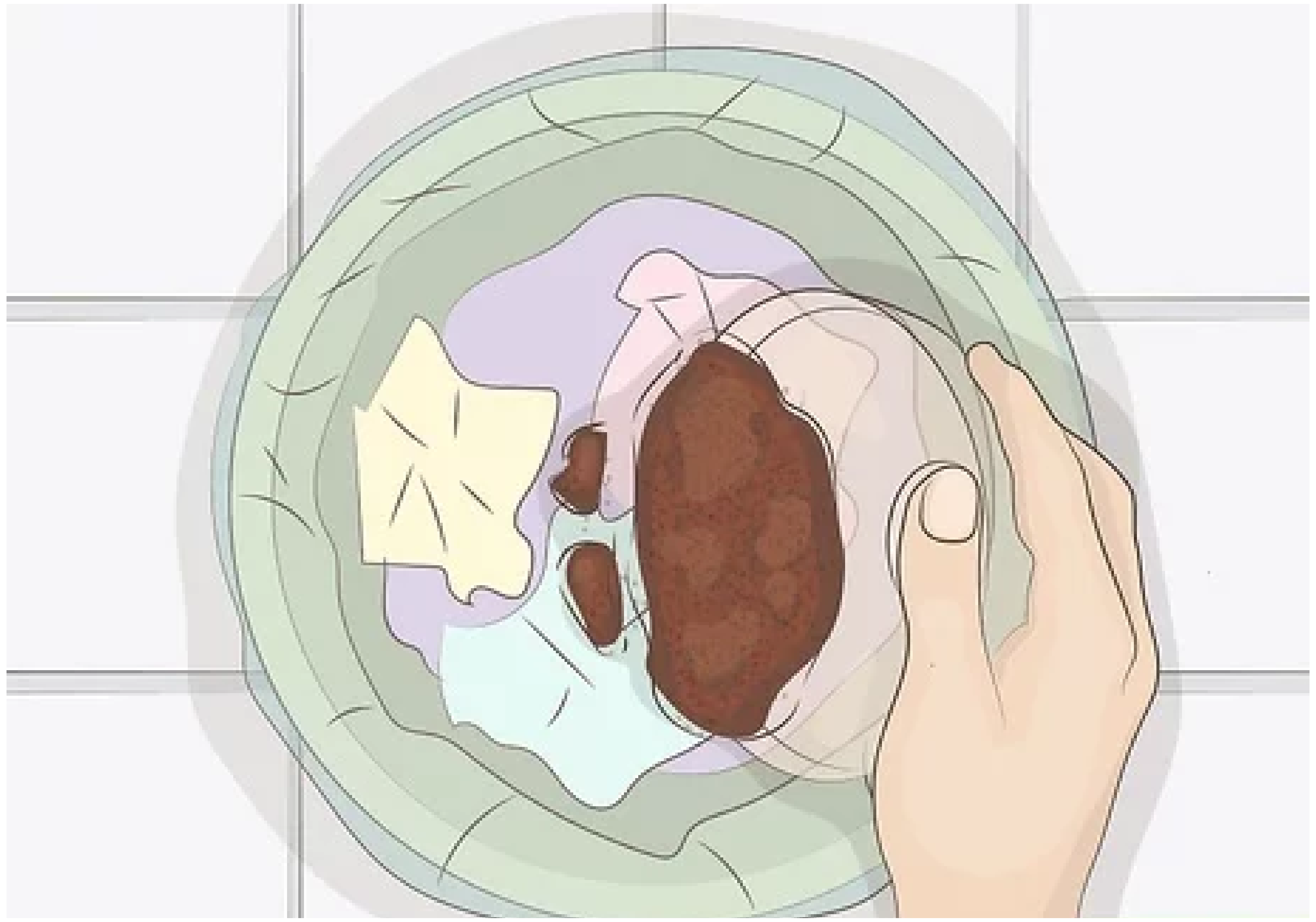
- Surplus of available raw material

Our Big Idea - Implementation

Our product uses many intricate concepts like Fluid and Thermo-Dynamics etc.
Yet, is Just an ORDINARY sinkhole for most folks. *Seamless integration without re-inventing the wheel* is the real innovation behind our product

Our Big Idea - Maintenence

Reusable Cloth Filter



Empty out collected micro-plastics into your bin for recycling every couple months

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Supreme Team

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Year 2

"We only have one Home, one Earth, lets all do our part in protecting it"

Thank you!