



Problem Statement

Arsenic-contaminated drinking water poses a threat to rural communities in Guatemala. The current household filtration solution, Ecofiltro, removes microbial and bacterial contaminants but does not target arsenic—a silent killer in this region.

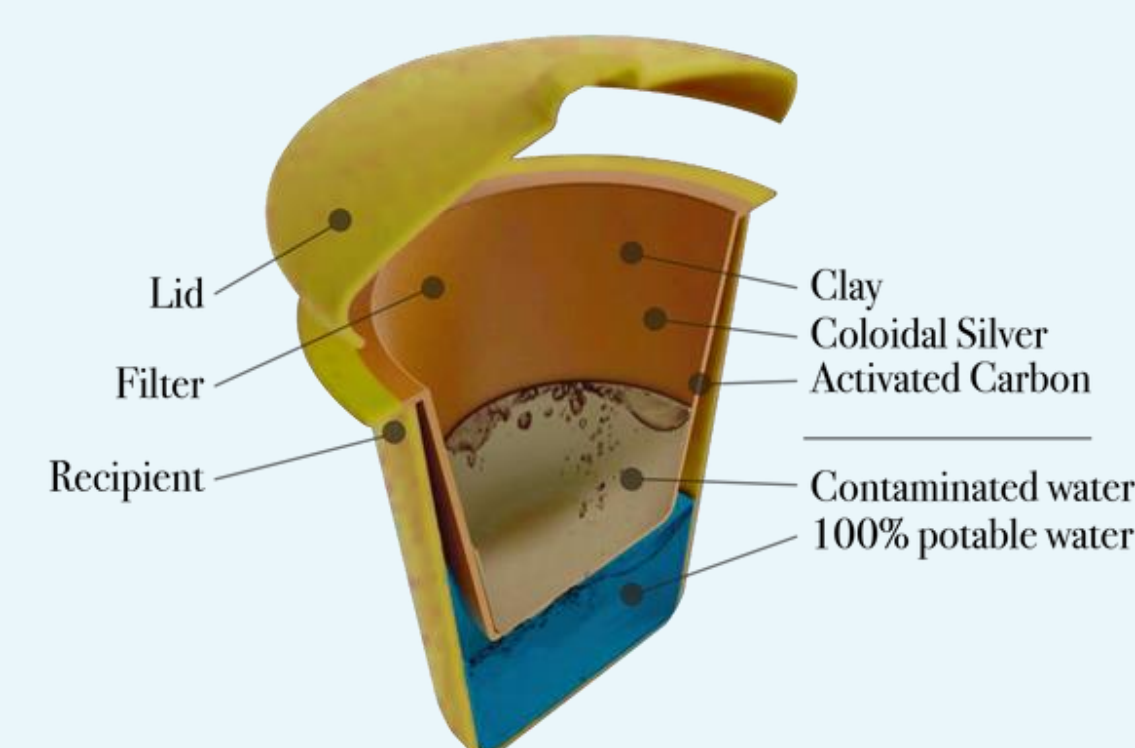
140 million people in at least 70 countries access arsenic-contaminated drinking water.

Short-term Impacts: vomiting, abdominal pain, diarrhea, numbness, muscle cramping

Long-term Impacts: skin lesions, skin and lung cancer, intellectual impairment, stunted growth

Arsenic is present in **33.6%** of urban/developed areas of Guatemala

Ecofiltro



- Designed to treat contaminated water in Guatemala
- User-friendly, gravity-fed design
- Crafted from natural materials, produced locally
- Affordable and widely adopted

Concept Ideation



DayCap In-Bottle Filter



Brita filter insert

Pristine Biochar



Adsorption capacity: ~3–11 mg/g

Arsenic removal: 92–100% removed from contaminated drinking water

pH performance: Removal peaks near 7-8 pH levels

Lower pyrolysis temps (~300–400 °C): produce biochars closer to pH ~7.2

PROJECT H₂O

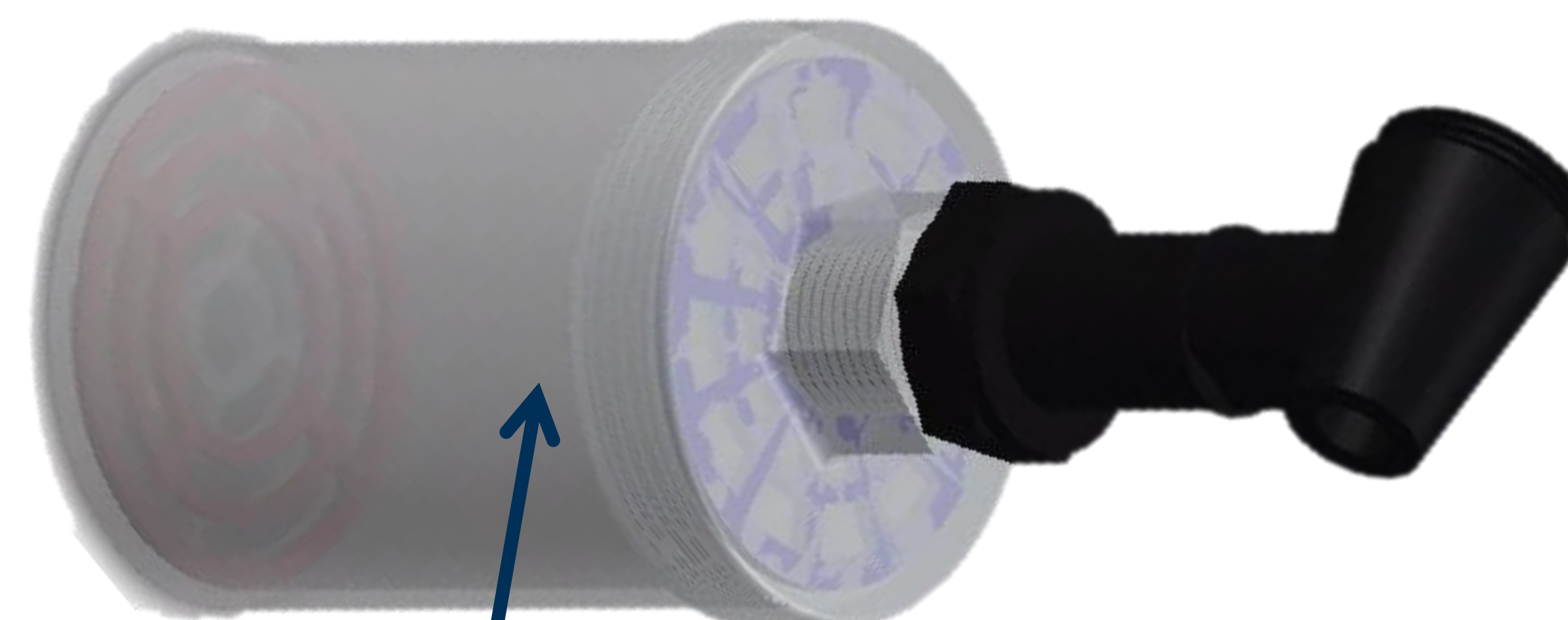
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Faculty Advisor: Mike Tinskey

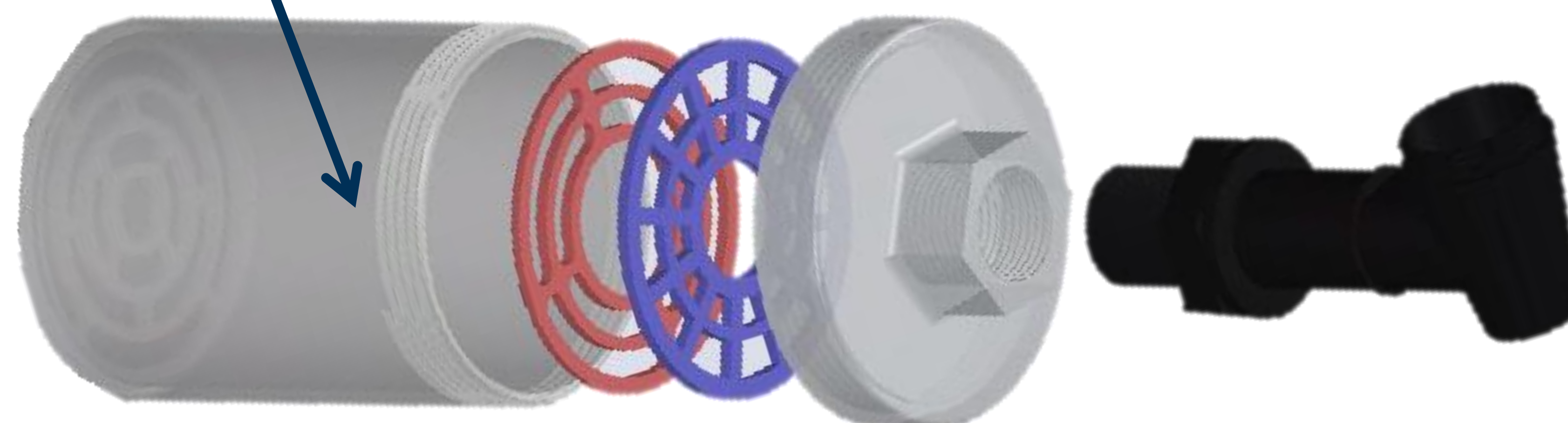
Made possible by: Design for Planet Impact & Ecofiltro

Objective: Produce a modular insert, compatible with the existing water filtration unit “Ecofiltro”, that adsorbs remaining arsenic particles in drinking water to promote the overall health of communities and families in Guatemala.

Prototype



Biochar as Filter Media



Specs & Constraints

- Lifetime (5000 liters)
- Flow rate (>2L/hr)
- Interface with Ecofiltro
- Arsenic removal (<10 µg/L)
- Easy use and replacement
- Low cost

Material Selection

- Resin
- 100-micron mesh
- Banana Peel
- Watermelon Rinds

Biochar Synthesis



Prep

- Rinse with distilled tap water
- Cut into pieces



Drying

- Air-dry pieces until dry
- Oven dry at 158 °F for 24h



Pyrolysis

- Fill ceramic crucible ½ to ¾ full
- Wrap the crucible in foil
- Place crucible into furnace
- Heat at a fast rate up to 400 °C
- Hold at 400 °C for 2 hr



Processing

- Weigh biochar
- Crush to desired particle size

Engineering Analysis

Internal cross-sectional area:

$$A = \pi \left(\frac{D}{2} \right)^2$$

Packed volume:

$$V = AH = \pi \left(\frac{D}{2} \right)^2 H$$

Flow rate is expressed as a volumetric rate Q and a velocity:

$$v = \frac{Q}{A}$$

Contact time:

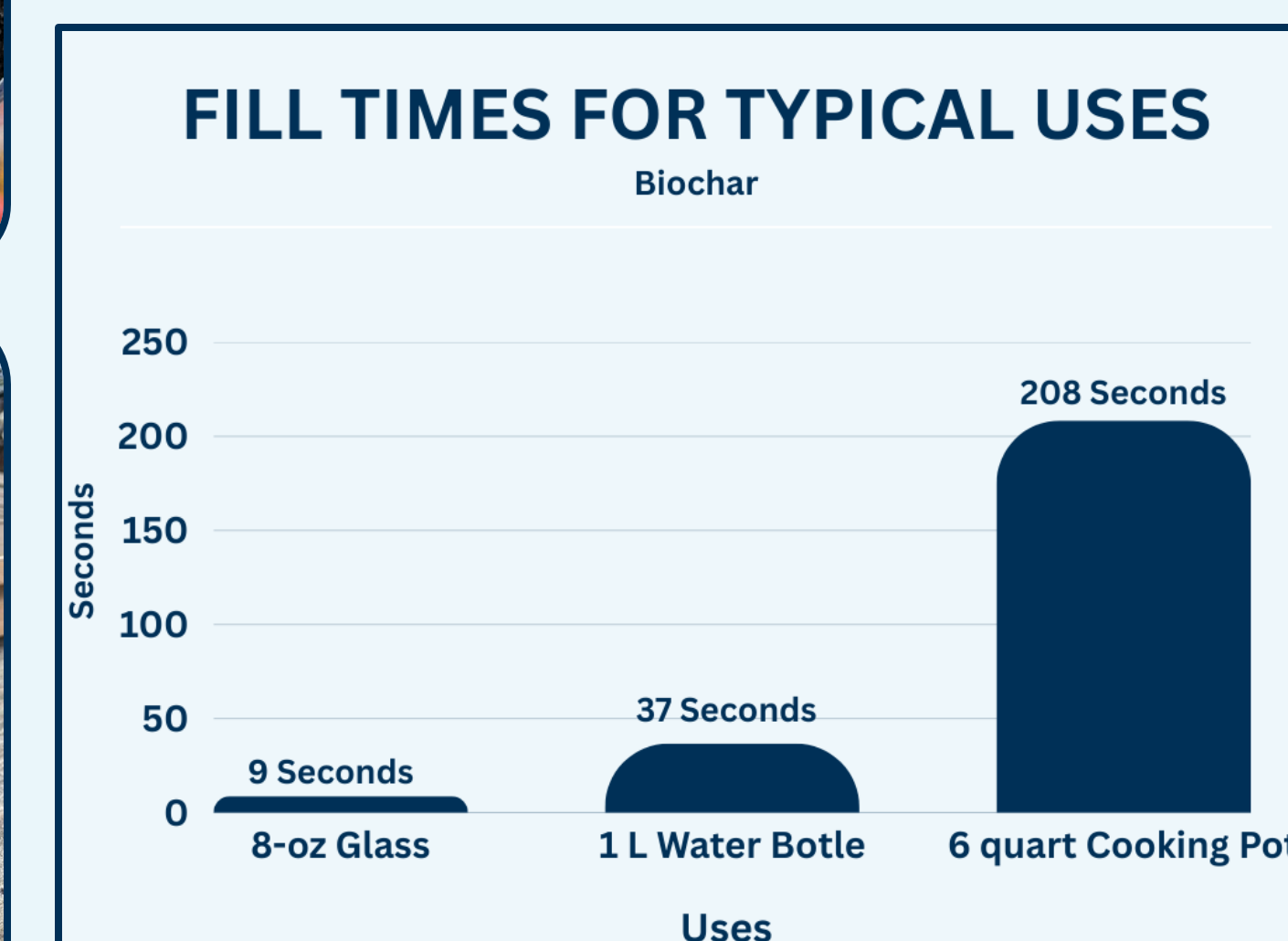
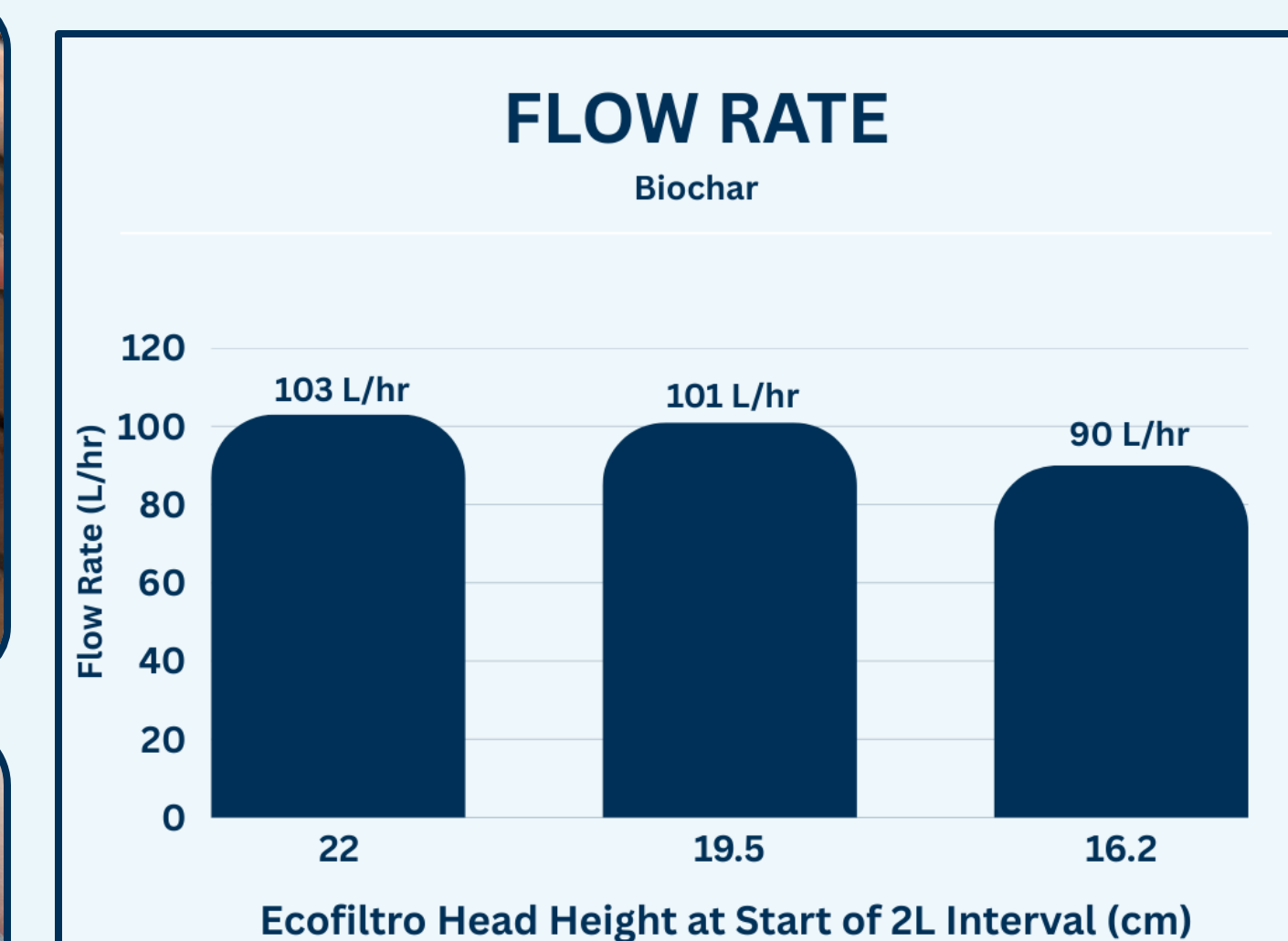
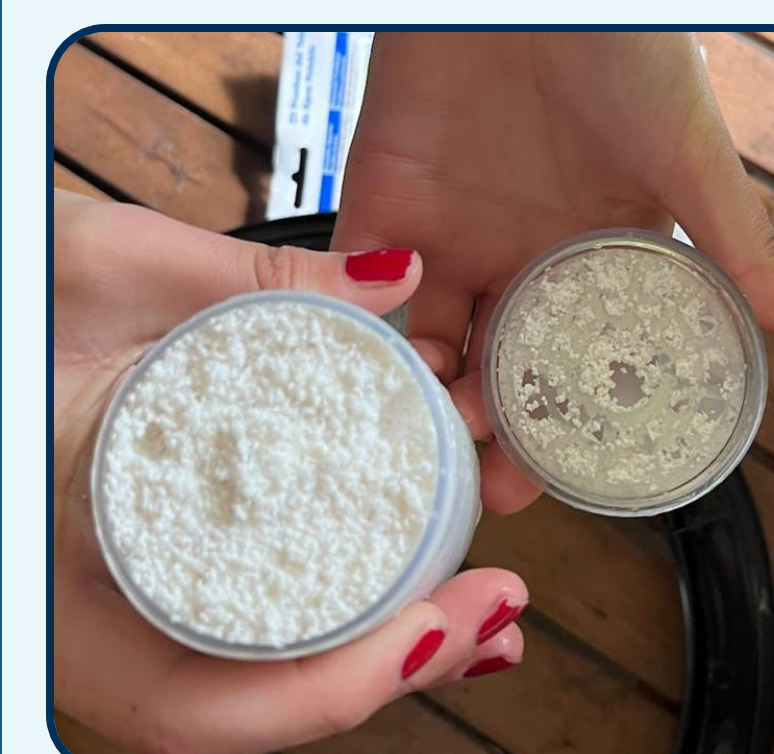
$$EBCT = \frac{V}{Q} = \frac{AH}{Q}$$

Target Life:

$$L_T = \frac{mq_d}{C_0 / 1000}$$

L_T [L] = Target Life
 C_0 [µg/L] = Influent As Level
 q_d [mg/g] = Field Capacity
 ρ_d [g/L] = Bulk Density
 Q [L/h] = Flow Rate
 D_i [m] = Internal Diameter
 H [m] = Packed Height

Testing



Future Steps

- Spectrophotometry testing on contaminated water samples to verify biochar's ability to remove arsenic
- Optimize contact time by adjusting filter size and flow time
- Modified Biochar
- Manufacture alongside Ecofiltro
- Modulate to treat contaminants in other regions