

# Water-Recycling Shower

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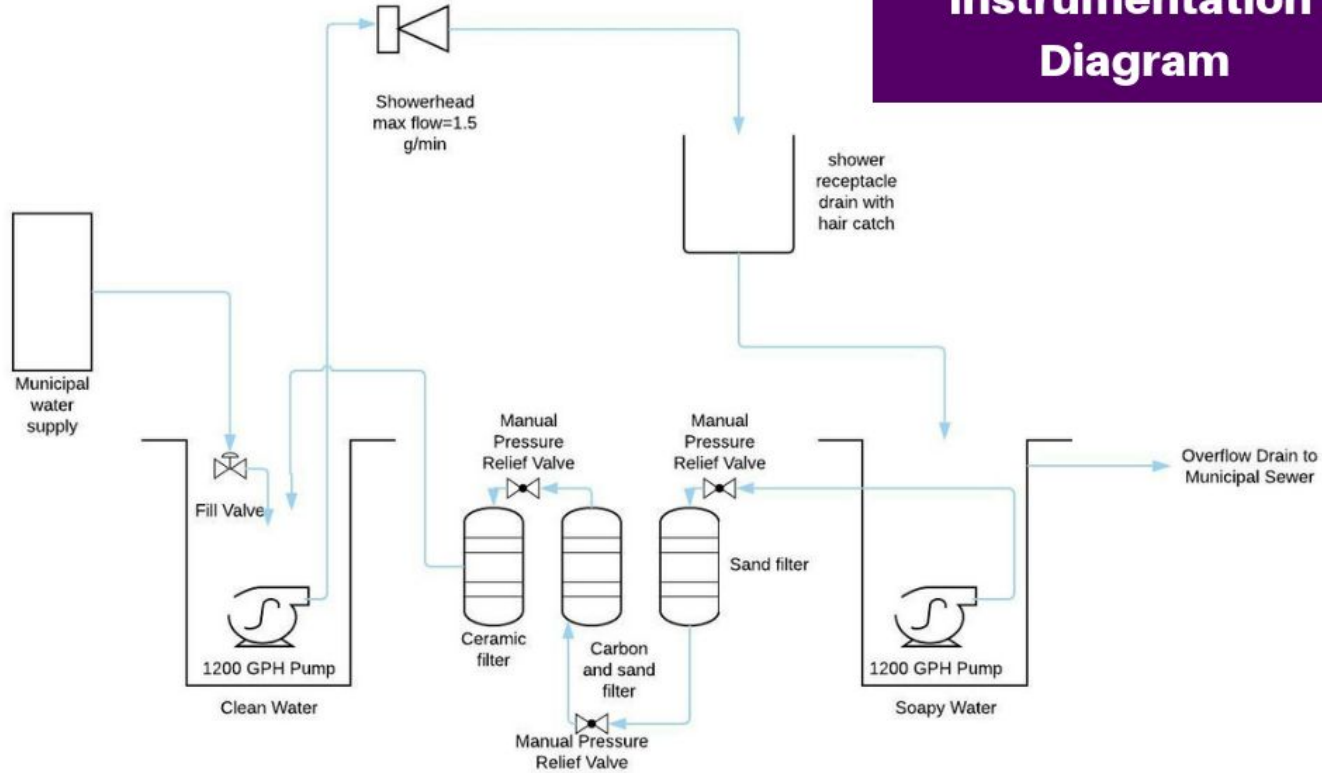




# Project Purpose

No one can predict the future, but we all agree that in the future, we will live in a water-scarce world where water is more expensive. In such a world, everyone will still want to shower. Introducing the shower that recycles water as you bathe to consume less water.

# Shower Piping and Instrumentation Diagram



# Videos of the Shower

This is a systems integration problem with several systems that work together simultaneously:



[https://youtu.be/xPqbcchjX\\_w](https://youtu.be/xPqbcchjX_w)

Content:

- Connection to municipal water
- Full system flow
- Air release valves

## Soap Filtration Challenge

# Critical Path Resolution

Chose a 3-Stage Filtration System:

1. Sand
2. 1/2 Sand plus 1/2 Activated Carbon
3. Ceramic



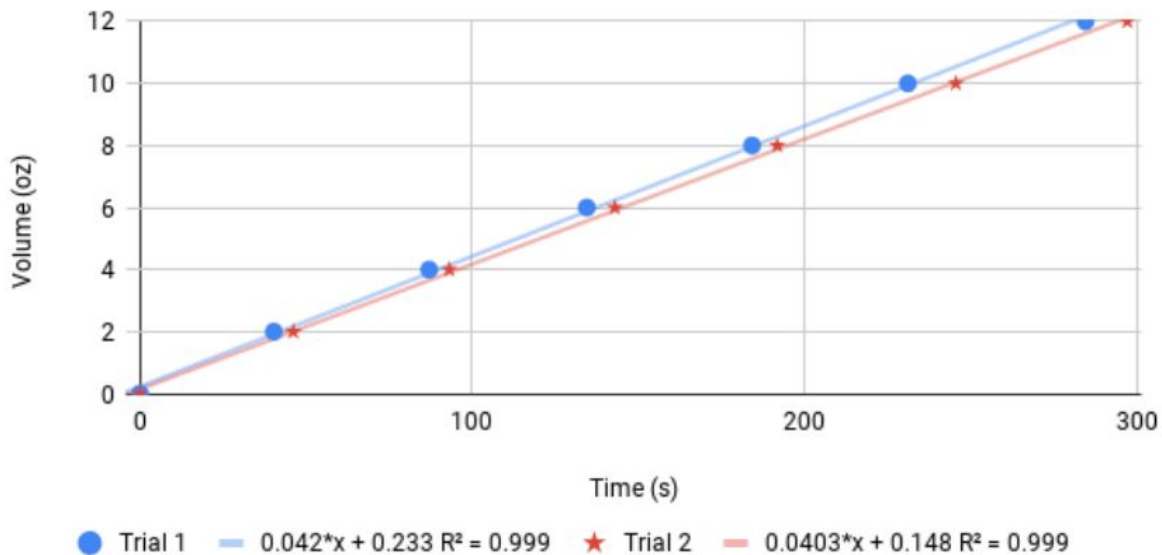
# Design Choices and Challenges



- **Ignored water temperature** because instant water heating technology exists already
- Used **aquarium pumps** for their versatility and price
- Conserved more water by using a **low-flow shower head**
- Installed a **toilet fill valve**, with anti-siphon capability, in the clean water reservoir to take in municipal tap water if the water level gets too low
- Connected the dirty water reservoir to the municipal drain in case the water level gets too high
- **Sealed leaking pipes** with PVC Purple Primer and Regular Clear PVC Cement
- **Prevented electrocution** by installing a ground fault circuit interrupter (GFCI)
- Installed three **decompression valves** before each stage of the filter to release air from the system and increase water pressure

# 0.02GPM

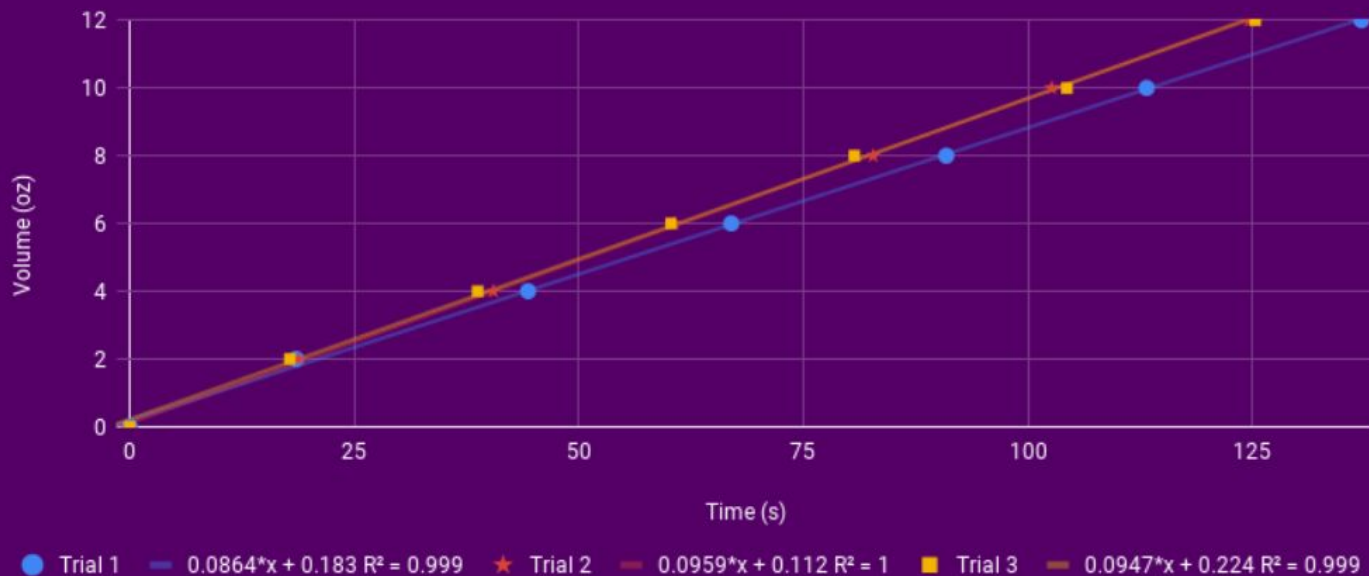
Volume (oz) vs. Time (s)  
small pump filter flow rate with tap water



## Filter Flow Rate with Large Pump

# 0.04GPM

Volume (oz) vs. Time (s)  
large pump filter flow rate with tap water



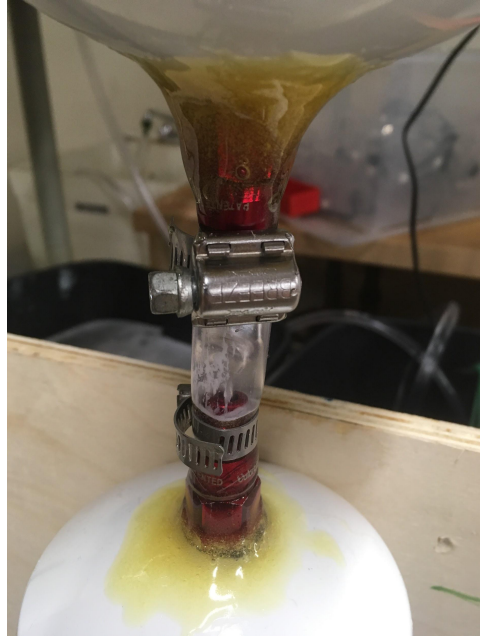
# Air Release Valve



Air trapped in the filter wasn't forced out by the water pressure of the pump. So we introduced three air release valves, one before each stage of filtration.



# Leaking in Joints



Substrate	Preparation	Adhesive strength	Failure mode
PVC	Lacquer thinner	444	Adhesion to surface
PVC	850 Solvent	485	Adhesion to surface
PVC	Sanded 32 grit	892	Adhesion to surface
PVC	Solvent wash and flame	1585	Substrate failure
PVC	PVC cleaner	485	Adhesion to surface
PVC	PVC cleaner and adhesive	1177	30% substrate failure

Resource from: <https://epoxyworks.com/index.php/bonding-pvc-plastic-with-epoxy/>

Note: We used 100 grit sandpaper

What's more, there are still other leakage that happened all the time. Thank for others help, we found the AB glue which showed above also fix the leakage among the other area/ At the beginning with, they were mix with two different glues with a certain ratio, then we put it in the critical area, waiting for 1 hours to become unmovable but still kind of porous. And after 24 hours, they can become stiffness and no water leaked at all.

# **Next Steps for a next generation prototype**

- Include a water temperature regulation method
- Improve the user interface for exchanging the filters
- Build out an enclosed shower prototype that can be tested with people
- Scale up the system to get a higher flow rate for the shower
- Higher flow shower head
- Stronger pumps
- Improve filter design to maximize efficiency and performance
- Run the filter system in parallel

