

# Environmental Fluid Mechanics at CSU



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# Background, Introduction, Motivation

- Small water treatment systems less able to meet safety regulations
  - Jet flow in the chemical stages of treatment can cause uneven mixing of water, creating dead zones that are too stagnant and short circuits that flow too quickly.
  - Undertreated/overtreated water can be unsafe or contain harmful byproducts
- Random Packing Material (RPM) for use in small water treatment systems
  - High porosity (amount of empty space) of RPM may help to standardize the flow of water and improve the mixing of water with chemicals

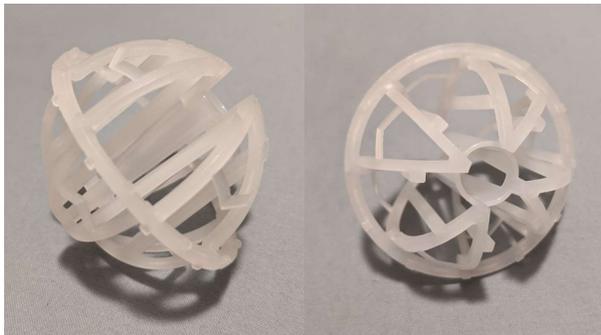


Figure 1 and 2. Random Packing Material

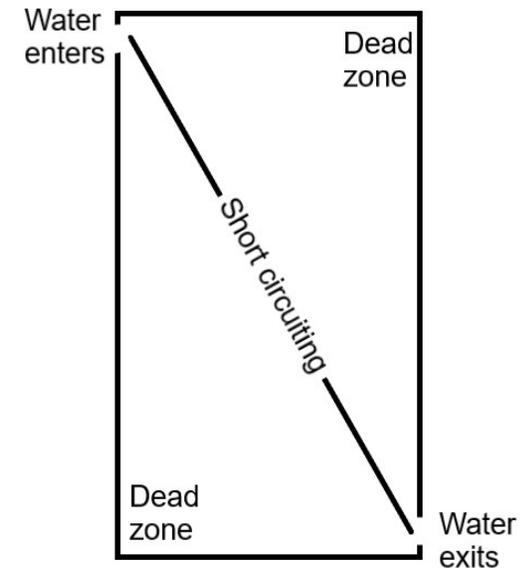
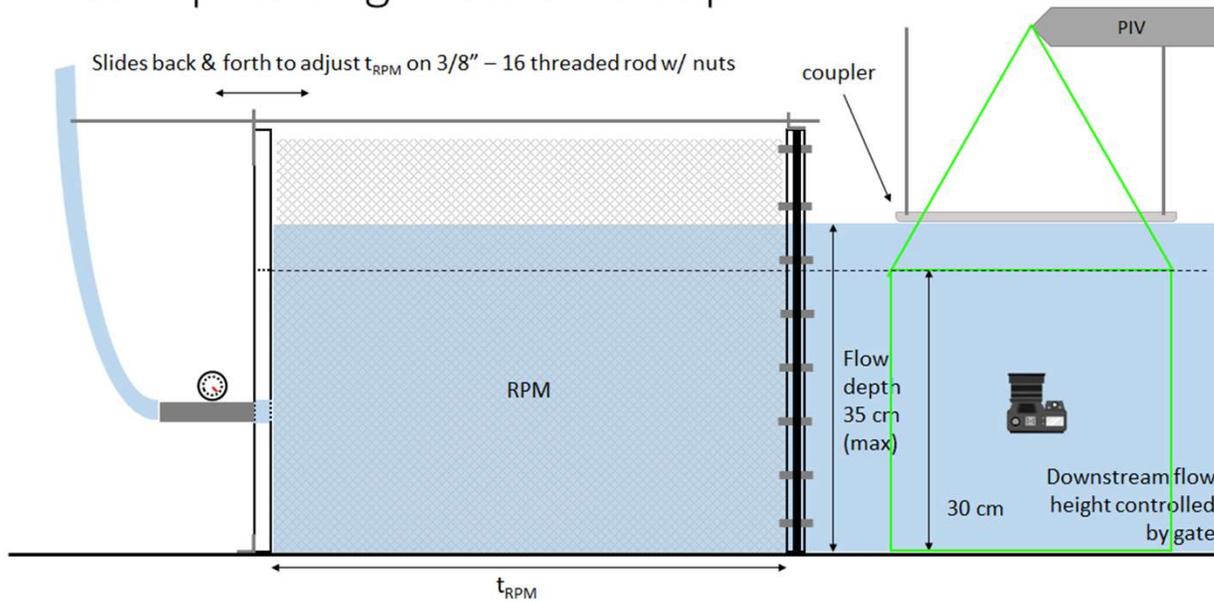


Figure 1 and 2. Short circuiting and dead zones



# Methods, Experimental Setup

## Jet Spreading – flume set up



**Figure 1.** Laser illuminates particles, allowing a high-speed camera (800 Hz) to track flow rates of water exiting RPM. Final design had an adjustable mesh wall as opposed to an adjustable jet wall. Image courtesy of Jessica Baker

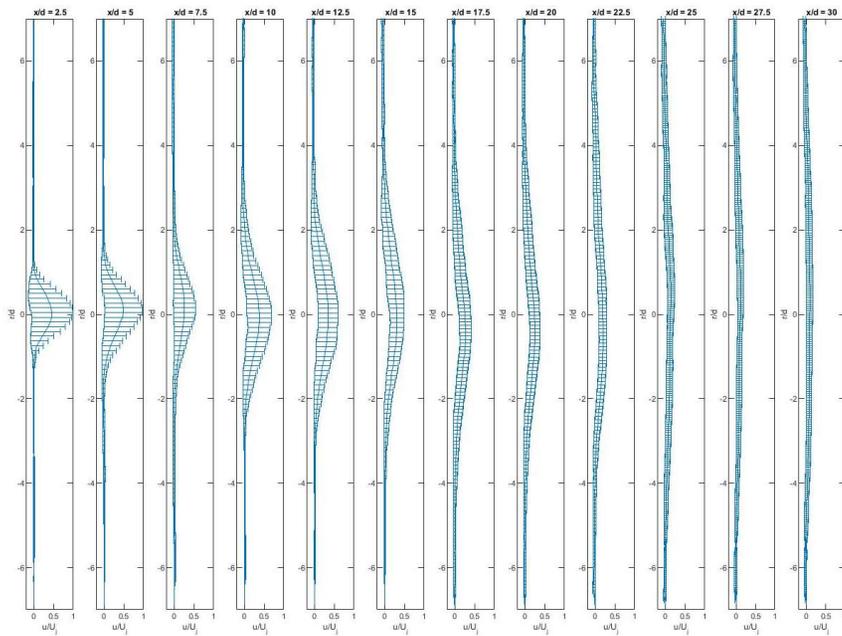


**Figure 2.** Mesh wall holds RPM in place, while allowing water to travel through with minimal effect on flow patterns.

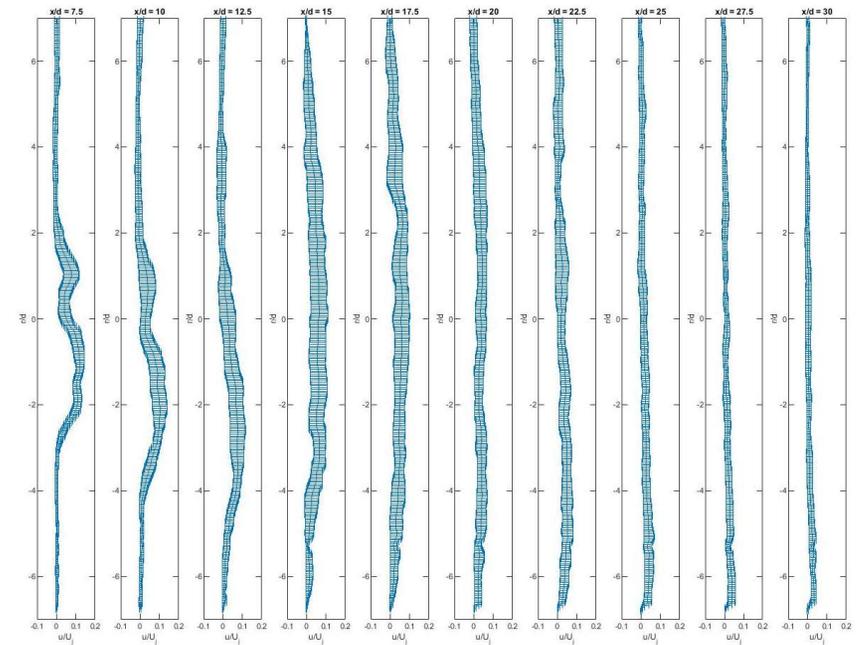


$r$  = radius,  $d$  = diameter,  $x$  = distance

# Results



**Figure 3.** Baseline velocities at different windows ( $x/d$ ).  $r/d$  ( $y$ -axis) defines position and  $u/U$  ( $x$ -axis) defines velocity. Flow becomes less turbulent as the window increases. Figure courtesy of Jessica Baker



**Figure 4.** Velocities with RPM at different windows (constant amount of RPM).  $r/d$  ( $y$ -axis) defines position and  $u/U$  ( $x$ -axis) defines velocity. Flow is less symmetrical and more turbulent for all windows than the baseline. Figure courtesy of Jessica Baker



## Conclusions

RPM increases the turbulence of water coming from a jet, thus increases the amount of mixing expected to take place with chemicals in water treatment. RPM is a viable option for improving the efficacy of small water treatment systems.

## Discussion, Next Steps

- Even with zero slope, the particles had a slight downward trend in the presence of RPM. Is this a feature of RPM spreading?
- Is more testing (such as replacing particles with chemicals/reactants) necessary to validate the use of RPM in the chemical treatment of water?



## What benefits did you get from you SURE experience?

- Learned how engineering research is conducted in a professional setting
- Weekly seminars by student researchers at the EFML to expand understanding
- Insight and advice on coursework, career plans, and software to learn; mentorship
- Improved soft skills

## References & Acknowledgements

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# Thank you



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