DYE TRANSPORT ACROSS THE SEDIMENT WATER INTERFACE: PRELIMINARY EXPERIMENTS

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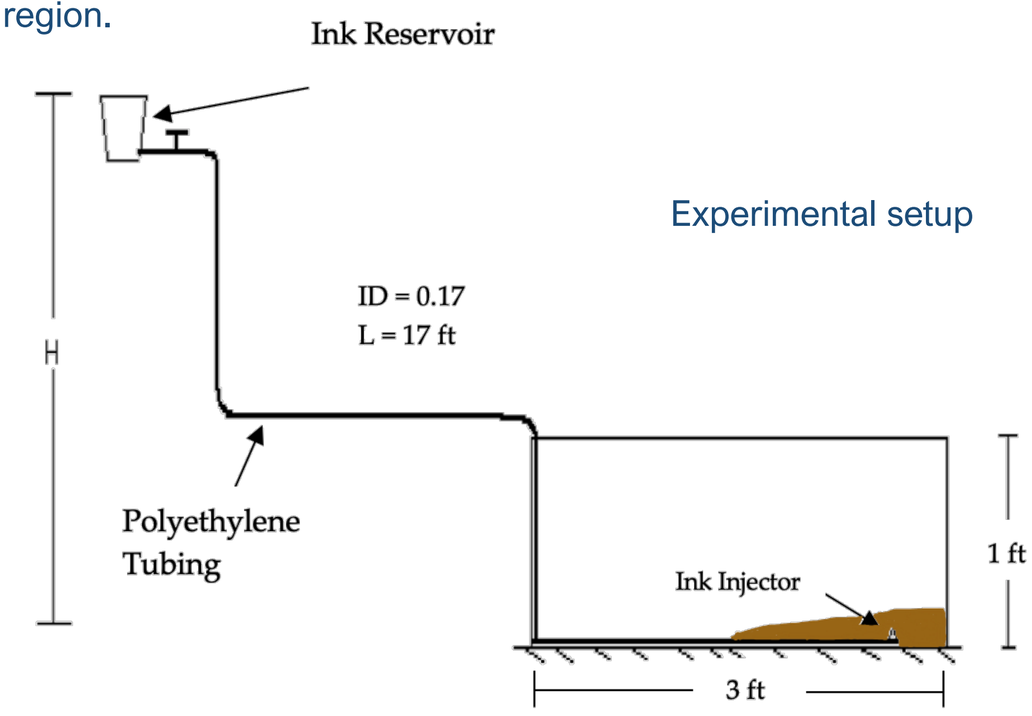
Introduction

Motivation: Several transport processes occur at sediment-water interface with direct impact to benthic ecosystems. Flow across this interface can potentially transport contaminants, nutrients, food sources, among other. The physics become more complicated when the interface is irregular in shape (ripples and bedforms). This preliminary experiments will help in the design of a full-scale laboratory study to better understand this phenomena.

Goal: To experimentally simulate dye transport across a small-scale sediment-water interface without free-stream flow. The idea is to quantify the momentum and pressure forcing necessary to produce a series of plume heights. These preliminary experiments will serve to design the injectors to be used in the full-scale experiments.

Experimental Methodology

Flow through porous media, unlike pipe flow, cannot be directly measured by conventional means due to its complicated nature. The less porous the medium, the more energy is required for the fluid to flow through it, since it decelerates when it enters said region.



- The tank was partially filled with sand grains from Steps beach and then with tap water.
- Plume heights were evaluated for different pressures, flow rates and injector depth.
- The same procedure was repeated for various sediment types.

Conclusions and Future Work

In general, it was observed that for the same pressure and injector depth, flowrates for D50=0.44mm can be almost 6 times higher than those for sediments with D50=0.24mm, due to bed porosity. These results will be used to design an optimal injection system that will be integrated into the full-scale oscillating boundary layer apparatus currently being assembled at UPRM. This experimental setup will be employed to obtain data of scalar transport at sediment-water interface.

Results

Different injector depths produce different plume heights at the same pressure values. This is due to the energy losses associated with Darcy flow within the sediment bed. The finer the sediment grains, the slower flowrates for the same supplied pressure (0.97 psi). For the future injector design, an external pump will be needed to produce higher plume heights at finer grain sizes to compensate for the energy loss due to reduced porosity.