ABSTRACT

TITLE:	Sediment Exclusion in Small Water Systems Using a Coanda Effect Device
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ABSTRACT: The purpose of this project is to develop a sediment exclusion device for use with village-scale water systems in developing countries. Reducing sediment mitigates abrasion and deposition in system components, leading to increased system life. Using the engineering down select process, a device that uses a Coanda effect screen was determined to best meet the project objectives and constraints. The device was tested in a laboratory set-up and in a field prototype. Laboratory tests were used to determine the hydraulic performance for five Coanda effect screens, each with unique geometry. The field prototype was completed to confirm the constructability and sustainability of the design. The design parameters include sediment concentration, sediment size distribution, flow rate, dimensions of the Coanda effect screen (slot width, wire tilt angle, and wire width), and geometry of the spillway structure. Performance was assessed by measuring the fraction of sediment removed by the screen and the change in flowrate through the screen during a 10 minute batch trial with a sediment concentration of 20,000 mg/l. Analysis of sediment size distributions showed that of the screens tested, a 1.0 mm slot width screen with a 3/16" wire width and a 10 degree wire tilt angle was the most effective at removing sediment, with 48.5% of the material in the 0.5-0.85 mm range being removed and 65% of material from the 0.85-1 mm range being removed, compared with the 0.5 mm screen (tilt angle and wire width identical to 1.0 mm slot width) which removed 87% of material in the 0.5mm - 0.85mm range and removed 100% of material from 0.85 - 1.0 mm. Flow testing indicated that screen blockage by sediment particles reduced the flow through the screen by 3% during the trial run for a screen with a 1.0 mm slot width, whereas a screen with a 0.5 mm slot width resulted in a decrease in through flow capacity of 46% from initial flow rate of 13gpm. Based on the target flow rate and the laboratory test results, a Coanda effect screen of 1.0 mm slot width (geometry listed previously) can be used to efficiently remove sediment down to 0.5 mm, while also maintaining an adequate flow rate, throughout system use, because 49% of material between 0.5 - 0.85 mm was removed while only losing 3% of the Coanda effect screen's initial through flow capacity. Field testing showed that the spillway section can be built using locally available materials and tools, except the Coanda Effect screen itself, while meeting the 4 work days for 4 workers constraint. The design team concludes that the Coanda Effect screen can be used to reliably remove sediment from sediment laden flows.