

# Linear Chemical Dose Controller

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## Abstract

The linear chemical dose controller, LCDC, is a key technology for AguaClara. The LCDC makes it possible for the plant operator to directly set the chemical dose for the chemical feeds without requiring any electricity. Creating a linear chemical dose controller that can be directly controlled by the plant flow rate has been a major accomplishment of the AguaClara team. This invention is now ready for deployment. To scale up it will be necessary to provide detailed instructions for obtaining parts, fabricating the components, placing the unit in a water treatment plant, calibrating the doser, and using the doser. A peer reviewed publication documenting the theory and design of the dose controller will also help speed adoption of this technology.

students 3

skills fluid mechanics, fabrication, documentation, videography

## 1 Introduction

The LCDC performance has been improved by reducing minor losses. The current recommendation is that the dosing tube have an inside diameter of  $3.175\text{ mm}$  and a maximum flow rate of  $2\frac{\text{mL}}{\text{s}}$ . The dose control tubing must be kept straight to eliminate losses due to curvature. The flexible connection to the slider on the lever arm is made with a larger diameter tube that has negligible head loss.

The next challenge is to create a central chemical feed unit for the AguaClara plants that doses coagulant to the flocculator, coagulant to the filter, and chlorine 1.

Tasks for the LCDC team are:

1. Test the entire system for chlorine resistance. The dosers that are used for chlorine all look terrible in Honduras because of small chlorine leaks. Propose improve plumbing connections that will completely eliminate leaks and be easy to clean and maintain (see Linear flow controller design Word Doc attached to your wiki page for suggestions).

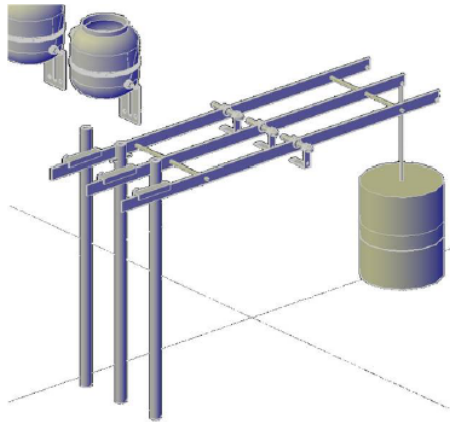


Figure 1: Proposed triple slider LCDC.

2. Test the screw that fastens the slider to the lever. Will this screw wear out over time? Will it be damaged if alum, PACl, or chlorine is spilled on it?
3. Add the calibration device, a turnbuckle, that connects the float to the lever arms. The turnbuckle can adjust the distance between the lever and the float to set levers level at zero flow (see Summer 2011 CDC Final Report: Figure 10).
4. Devise a method to generate labels for the lever arm using AutoCAD or some other method that can be automated and included with the design files (coordinate with the design team).
5. Test and document the calibration method of a new LCDC so that it produces the design chemical dosages on all three chemical feeds. Be sure to incorporate our new knowledge of chemical viscosity as a function of concentration (see Summer 2011 CDC Final Report: Figure 8).
6. Create extensive videos showing fabrication methods for the entire system. Provide fabrication details including embedded videos on the wiki so that the LCDC can easily be built without requiring assistance from the Cornell team.
7. Evaluate best methods of distributing the LCDC technology. Should the LCDC be built by a small company and distributed globally, built by small companies in global regions, or built by local implementation partners?
8. Write an article for submission to Journal of Environmental Engineering that details the design of the LCDC including both theoretical and practical constraints. Accuracy studies need to be done for the full range of flows reporting total percent error of dose to the plant as a function of plant flow rate and also dose.

## References

- [1] A. K. Mohanty and S. B. L. Asthana, *Journal of Fluid Mechanics* / Volume 90 / Issue 03, pp 433 - 447, 1978. Published online: 19 April 2006 DOI: 10.1017/S0022112079002330
- [2] Zhou, Y., & Shah, S. (2006). New Friction-Factor Corrections for Non-Newtonian Fluid Flow in Coiled Tubing. *SPE Drilling and Completion* , 68-76 (DOI: 10.1017/S0022112079002330).