Fall 2010 CDC Development

Chemical Dose Controller Fall 2010

Semester Overview

During the Fall 2010 semester the CDC team has focused on redesigning the mounting and arrangement of the dose controller in order to make it more accessible and aesthetically pleasing. Instead of being positioned directly above the entrance tank, the team envisions the system's components being mounted on a plywood board on the wall of the plant. The lever arm of the dose controller would then be connected to the float in the entrance tank by a simple pulley system in order to couple the elevations of the orifice and the entrance tank water level. The team has selected parts for the design and constructed a prototype in the lab.

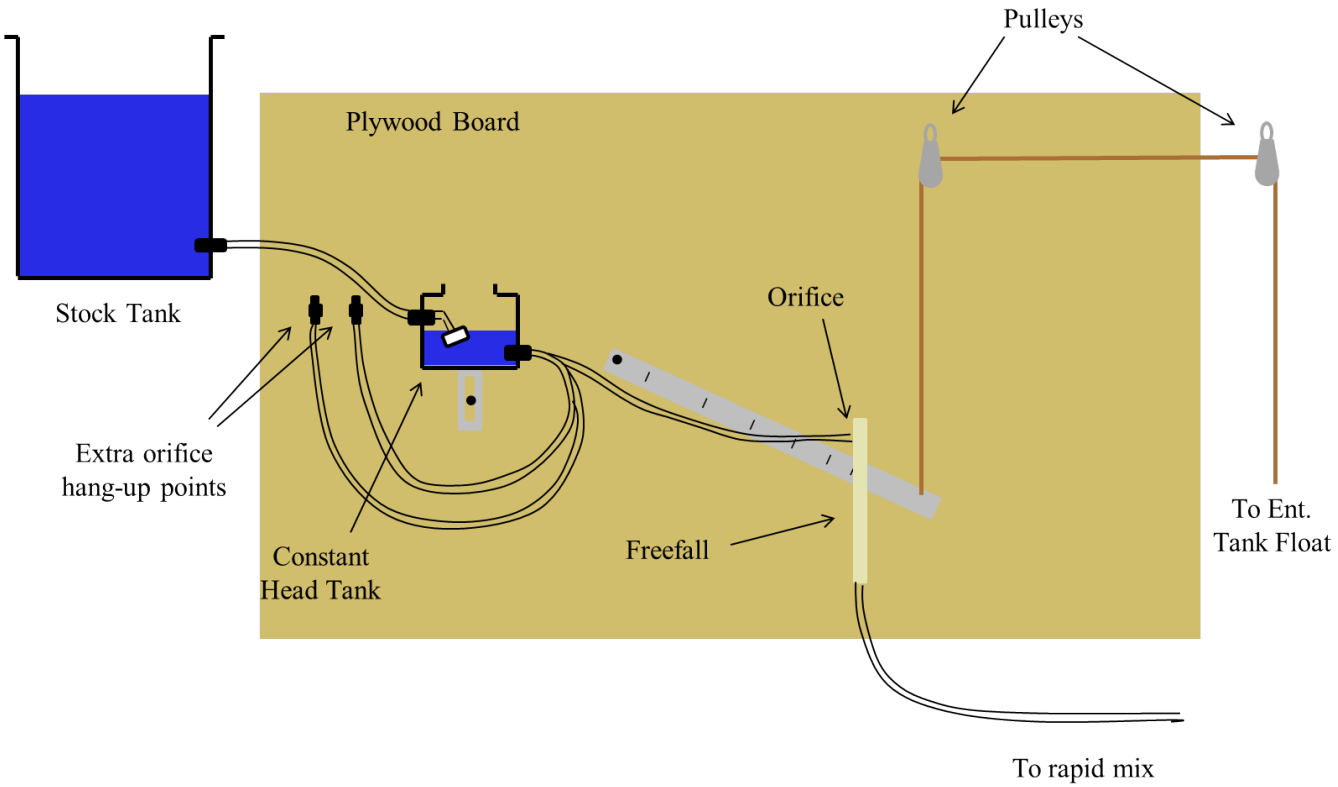

Figure 1. The new CDC will be mounted on a plywood board to make it visually accessible. Note that this schematic does not show the details of the slider assembly or the flow measurement column.

Linear vs. Nonlinear

The team has received feedback from Honduras indicating a preference for the linear chemical dose controller for low flow plants instead of the nonlinear doser which was meant to supersede it for all plant designs, big and small. Although the linear doser does not work for high flow rates because the linear relationship between flow rate and head loss breaks down when flow through the dosing tube becomes turbulent, it still offers several advantages over its nonlinear counterpart.

First, with the original design which uses a Linear Flow Orifice Meter in the entrance tank followed by a freefall, the head loss in the entrance tank is hydraulically isolated from the rest of the plant. For the newer designs in which head loss in the entrance tank is not hydraulically isolated from the rest of the plant, unexpected effects downstream can alter the carefully calibrated water elevation-flow rate relationship on which the dosing system is dependent. In the case of the plant at Agalteca, a build-up of settled grit in one of the flocculator ports has increased the plant head loss and thrown off the CDC's calibration. It should be noted that the head loss in the entrance tank can be isolated from downstream effects through freefall in the case of a nonlinear system. Connection with downstream flow is not inherently a part of the nonlinear design.

In addition, the linear dose controller has a wider range of flow rates which it can accomodate with a single tube than the orifice-based non-linear doser does. The same principle carries over to the entrance tank, where the LFOM has a wider range of flow rates for which it can provide accurate head loss measurement, so the plant has more flexibility in varying its flow rate. The wider dynamic range of the system and the linear scale between tube elevation and flow rate eliminate the need for multiple tubes, simplifying the system for the plant operator. Finally, the linear system does not suffer from the effects of surface tension at low flow rates.

The design of the mounted system which was the focus of the Fall 2010 team is not changed dramatically by a switch between nonlinear and linear systems. The major differences are a change in the scale on the level arm and the use of a single, small-diamter flexible tube instead of three tubes which end in orifice caps. All other components function the same. It seems likely that AguaClara will proceed in the direction of using both systems, choosing between them based on the size of the plant to be designed.

Fall 2010 Design Details

The majority of the team's time was focused on selecting parts for the proposed CDC design and constructing a prototype. Details of the design process as well as listings of part details and McMaster-Carr item numbers for all of the relevant components can be found here.

Pre-semester Context and Goals

The Summer 2010 CDC team provided a detailed discussion of the goals of the Fall 2010 semester. The page also provides background and context for the new design features.

Fall 2010 Task List and Reports

A Detailed Task List was created to lay out the planned research for the CDC team for Fall 2010.

Reflection Report I provides a detailed description of the planned research.
Reflection Report II provides a sketch of what the improved CDC apparatus will look like (using two chemicals and pulleys to control the entrance tank float)
The Final Report details the design process including specific components used, contains the results of the flow test run with the new orifice cap, and makes suggestions for future work.