FC Linearization and Calibration

Flow Controller

Linearization and Calibration

Introduction

The Flow Controller device is used to maintain a constant level of water in a source, a constant head tank, which is refilled by a stock tank. By adjusting the constant head tank, different flow rates of Alum may be sent to the plant for the flocculation process. Field use of this device, however, is consistently inaccurate, diverging in direction relation to flow rate as well as tubing length. However, the majority of the data seems to indicate that there are in fact more confounding variables which make flow predictions nearly impossible. This dependence on faulty information, namely the inapplicable equations, may cause miss-dosing in the plant or a wasteful situation of using too much Alum for the plant.

Divergence specifically occurs to cause under delivery of alum to the plant, which decreases the efficacy of flocculation and has an adverse affect on effluent turbidity. This section of the Flow Control Module Team is conducting tests to identify confounding variables to more accurately parameterize the equations to provide for more efficient flocculation in the plant.

Goals

This team is working specifically with the constant head tank as a distribution system with known parameters and an adjustable arm for dosing providing a known head loss from elevation. First it is important to verify that the tubes in use, do in fact, meet the specifications of smoothness and diameter. Once we are sure that the material is regular, and if not, once we may correct for this difference, it is important to see what the trend is in divergence from the Hagen-Poiseuille equation. Graphing of flow rate vs. Head loss allows for a simply relationship between the experimental and theoretical. Once these have been parameterized for the purposes of calculation, it will be useful to continue looking into possible sources of head loss through the system or any factors that may deter flow.

These goals will be realized by the utilization of the depicted apparatus. The constant head tank was constructed using two elevated buckets. The storage was significantly larger and with a larger diameter than the actual constant head bottle. They were connected by a single tube which went from the base of the stock tank and into the top portion of the bottle where the float was located. From the bottom of the bottle was a from which the dosing tube was attached. This tube is adjustable to allow for different lengths. A PVC pipe was procured and sealed on the bottom and placed in a wooden base to stabilize it. In this, along the top 26 centimeters, 26 7 mm holes were drilled. The top hole had its center line leveled with the water level in the constant head bottle so that ever additional hole below was another centimeter of head loss.

Additional Documentation

The Linearization and Calibration Quiz- find out how much you really know about this flow controller sub team.
Linearization and Calibration team goals and meeting minutes.

Methods and Results from Specific Experiments

Flow Rate vs. Headloss for Variable Tube Lengths

- Taking the new apparatus, flow rates were calculated relative to head loss and plotted again the Hagen-Poiseuille equation to analyze divergence from the mathematical model

Verification of Tubing Inner Diameter

- Calculate the inner diameter of the black tube used for dosing to ensure accuracy in dosing

Float valve corrosion test

- A simple test where float valve parts were left in alum and chlorine for extended periods of time to determine corrosion effects

Flow controller body design and selection

- Includes notes on the brainstorming that went into FCM parts selection and design

Flow versus head loss data collection in the turbulent range

- Experiments were conducted to establish a model for the relationship between FCM outflow and head loss associated with outflow tube position

Determining the maximum inlet shut-off pressure

- The maximum inlet pressure that the float valve can shut off was investigated in order to determine how much head there can be between the chemical stock tanks and the flow controllers

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- Background on previous research

Conclusions

It may be concluded that there are definitely variables that are causing significant distortion between experimental and theoretical results. Possibly due to un-considered sources of head loss, experimental results are producing dramatically lower flow rates than are predicted theoretically. This may be attributed to manufacturing error, specifically in the diameter or roughness of the dosing tube; the corrective abilities of these terms on the equations are note worth. Additional challenges as they relate to future topics may be found here.