Low Flow Flocculator

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Abstract

Low flow vertical flow baffled flocculators are inefficient because the energy dissipation zones caused by the 180 degree bends are very small compared with the depth of the flocculator. The result is a requirement for very high number of baffles. The objective of this project is to develop an alternate design for low flow flocculators that is more economical to build and yet is easy to maintain.

students 2

skills CEE 4540/fabrication

1 Introduction

A high priority goal for the spring semester is to design several ultra low flow AguaClara facilities. The target flow range is between 3 L/s and 0.3 L/s. Typical per capita demand is approximately 3 mL/s and thus a village with 100 people would need 0.3 L/s. Thus the flow range of 0.3 L/s to 3 L/s corresponds to populations between 100 and 1000 people.

The flocculator baffles are currently make of corrugated plastic sheeting and PVC pipes (figure 1). For low flow plants the baffle spacing becomes very close and the H/S ratio (depth to spacing ratio) becomes very high. The result is an inefficient use of the plastic baffle material. An alternate design is needed for low flow plants. See the CEE 4540 Capstone Design Project: TapTrustfor several alternative designs for a low flow flocculator.

The residence time required in the flocculator may be reduced if the floc recycle experiments prove successful. Thus it may be possible to design for a collision potential of much less than $100\,m^{\frac{2}{3}}$. One possible design is a pipe flocculator with obstacles inserted into the pipe or strung in the pipe on a nylon string or stainless steel cable. For example a $4\,in$ diameter PVC pipe might be a reasonable flocculator for a flow of $1\,\frac{L}{s}$. Perhaps the PVC pipe would be buried to protect it from the sun and arranged as a U or W to keep the ditch from being excessively long. The pipe flocculator would need to be designed so that it can be flushed to remove any settled sediment. The obstacles should be

Figure 1: Floc baffle construction using corrugated plastic sheets and PVC pipes.

removable and should be easily reinserted when water is flowing through the pipe flocculator.

Another possible design is to add additional obstacles to a vertical flow flocculator. However, the human width requirement for the channel width results in very small spacing between baffles and thus this approach seems flawed. It would be better if the flow geometry had a more equal dimensions normal to the direction of flow. Thus the pipe option appears to be the preferred geometry. The pipe system should also be easy to assemble and thus labor costs will be much lower than for the concrete channel options.

2 Strategy

Design and build a low flow pipe flocculator to test the concept of obstacles on a string in a pipe. Create the design algorithms for the size and spacing of the obstacles using the CEE 4540 course notes. One possibility would be to use 2 inch diameter PVC pipe with each 6 m long section of pipe connected to the next pipe with 2 street elbows (male on one end, female on the other) so that all of the pipes can be stacked neatly in a tight bundle. Ideally design the system so that the obstacles can be inserted or removed while water is flowing through the flocculator. Test the method of inserting and removing the obstacles on a string. Use our proposed Hydraulic Test Facility to provide flow for the flocculator. The

Hydraulic Test Facility will be able to provide flows up to 3 L/s.