Virginia Military Institute

Mechanical Engineering Department

Cooperative Engineering Center (CEC)

Maury Service Authority Tube Settler Implementation

16 April 2001

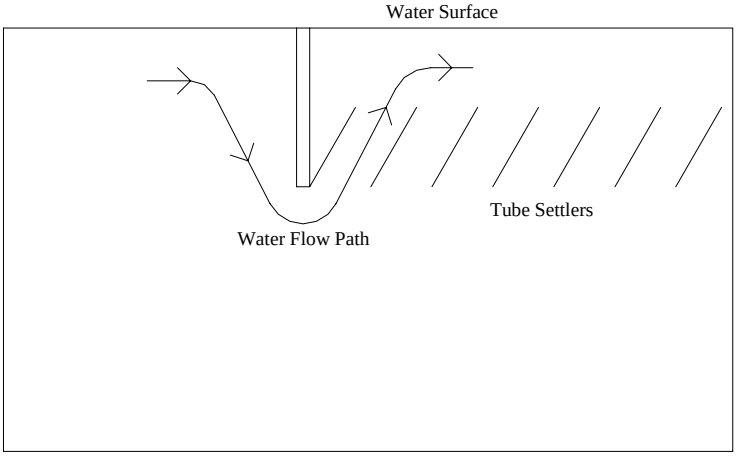
Greg L. Martin - Team Leader

Stephen A. Wiegel - Engineer

John J. Dempsey - Engineer

Col. Charles Morgan PhD, P.E. - Faculty Advisor

Maury Service Authority has tasked the Virginia Military Institute Cooperative Engineering Center with devising a way to install tube settlers into their water treatment plant. Tube settlers have been used for many years in water treatment plants to help remove particles from water. This design revolves around a series of honeycombed plastic tubes arranged on a 60° angle. This orientation results in efficient removal of particles. Operation of tube settlers are based on the idea of slowing the water flow to give the dense particles more time to settle inside the tubes. This is accomplished by allowing the water to flow under a wall and up through the 60° inclined tubes. As the water flows head-on into this wall, the path is redirected to go underneath it. At this point, water is forced to travel through the base of the tube settlers. While water travels through each tube, flow is slowed, thus causing the dense particles to also slow and collect on the tube walls. This can be seen below in the diagram. It is essential that laminar flow takes place in order to maintain the collection of particles. If the flow through the tube becomes turbulent, disruption of the particle formation will take place and decrease the tube settlers efficiency. Tube settlers are extremely beneficial because they enhance the sedimentation of dense particles. To help understand this entire process of making particles settle and produce clean water, a brief description is needed. When raw water is brought into the plant, it is treated by two different processes: coagulation and flocculation. In the flocculation process, floc particles are created and subsequently settle out of the water. This particular



process removes all the large particles, but allows the dense ones to pass through. Traditional methods, which Maury Service Authority practices, allow the dense particles to flow through the settling basin and then into a series of filters. One problem is that these dense particles take an extremely long period of time to settle out. If tube settlers are placed between the flocculator and filters, then more particles can be removed before ever entering the filters. As a result, the filters can be left in longer and save Maury Service Authority money. After running several calculations to determine how efficient this installation could be, it was found that the settling rate was five times greater with the tube settlers in place.

To successfully complete this project, Maury Service Authority specified that a complete cost analysis be done to determine what vendor, method of installation, and design a complete frame to support the tube settlers. This cost analysis was analyzed two ways:

a) with a vendor doing everything from purchasing to installation of the frame
b) with Maury Service Authority purchasing tube settlers from a vendor and manufacturing their own frame.

First, a vendor had to be selected to supply the tube settlers. After an extensive search a list was complied and eventually narrowed down to two manufacturers: Brentwood Industries and Enviropax. After contacting them, a rough estimate was provided stating the cost of tube settlers, frames, and installation fees. With this complete, our group was now responsible for devising a frame design to support the tube settlers. After many calculations analyzing Aluminum and Stainless Steel I-Beams and Channel through the use of MathCAD and ALGOR, the size was determined and the cost for each material was completed. By using these two programs, an in-depth frame analysis was completed showing an acceptable factor of safety value and acceptable amounts of stress and deflection in the beams. The cost analysis based on this design showed that it was more cost effective for the Maury Service Authority to do the installation themselves.

The picture to the left is how the completed installation will appear in the water basin at Maury Service Authority. This photo was taken at the Radford water treatment plant, which we modeled this project after. If proper installation is completed at Maury Service Authority, there is no doubt that acceptable results will be obtained.