Coagulant Stock Tank Design Program

Coagulant Tanks

The goal of the chemical storage project is to redefine and add to existing code in order to make calculations regarding the way tank sizes are selected and variables are assigned more efficient. The existing code serves as a base to create new code that eliminates assumptions and draws pieces that have never been coded into MathCAD. Ultimately, this project allows the chemical storage tanks to be properly integrated into the final AguaClara plant drawings.

Our code allows users of the Design Tool to see the appropriate size and placement of the tanks along with the pieces and pipes leading out from the tanks. This eliminates any user confusion about the chemical storage tanks and facilitates easier understanding about materials needed for construction.

To explain how the code was created, several formulas that were used in order to calculate the appropriate volume of the chemical storage tanks are included below. The maximum flow rate through the plant is calculated based on user inputs according to the following formula relating plant flow rate and concentration of coag:

$$Q_{CoagStockMax} = \frac{Q_{Plant} \times C_{CoagDoseMax}}{C_{CoagStock}}$$

With this calculated flow rate, the necessary volume of the tank is calculated:

$$V_{CoagTank} = Q_{CoagStockMax} \times Ti_{StockMin}$$

The coagulant is referred to as "alum" in previous files. However, since PAC is now used instead of alum in some AguaClara plants, we refer to the coagulant as "coag" in our files, and all variables related to the tanks include "coag" in the subscript instead of "alum."
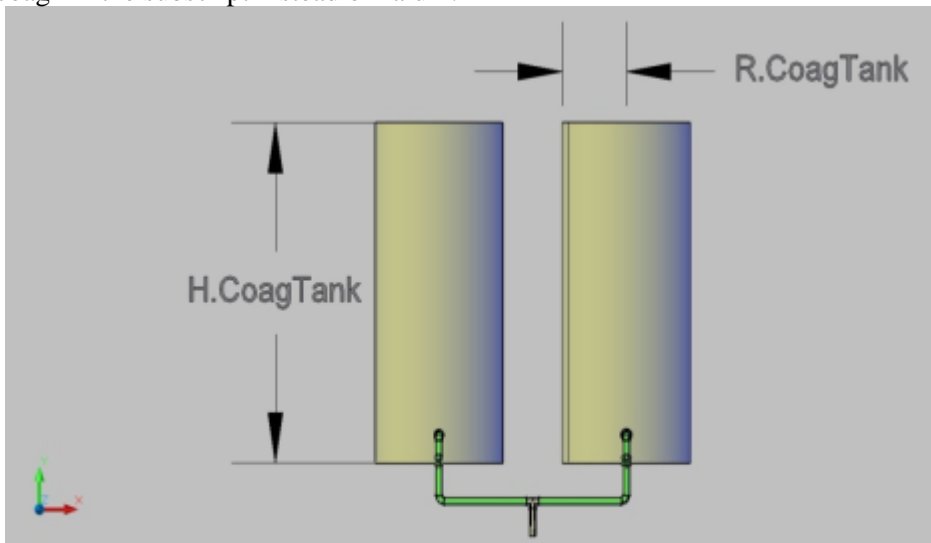

Figure 1. This drawing shows how the radius and the height of the chemical storage tanks are properly assigned to the corresponding dimensions of the tanks

Based on the available tank sizes from Rotoplast's supply information (http://www.rotoplast.com.co/cajones-y-canecas-industriales/) a database has been compiled relating the volume of each tank to its specific height and radius. Once the volume necessary for the plant is calculated, it is multiplied by a ratio in order to create a practical range of calculated volumes for each supplier tank volume. Using this range allows plants that would, hypothetically, require a tank size by a marginal amount to round down to the closer tank volume in order to be efficient and reduce cost.

Once the correct tank size is selected from this index, the corresponding height and radius of the tank are reassigned as $H_{CoagTank}$ and $R_{CoagTank}$ respectively (Figure 1). These variables are used in the AutoCAD script that draws one of the storage tanks and then mirrors it to accurately depict the two standard storage tanks used in each of the plants.

The chemical storage tank coding efficiently chooses and draws the appropriate chemical storage tank for a given plant. Rotoplast will be the supplier for future plants in Honduras, as the company is based in Latin America. Previously, the tanks had received little attention in the Design Tool, causing confusion about the size and placement of the the chemical storage tanks. The tanks were drawn according to the necessary volume calculated from basic inputs and the assumption that the tanks' height to radius ratio is 1.5. With our newly created database, the tanks drawn in the Design Tool accurately represent tanks that can be supplied to AguaClara plants by Rotoplast.
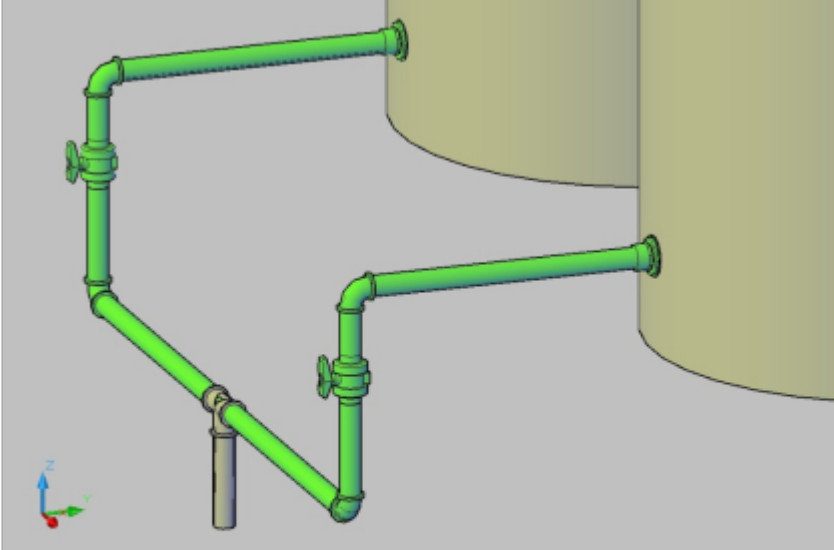
Additionally, the accompanying MathCAD code had not been created to show how the tanks are connected to the constant head tank before, but now pipes and connecting pieces are drawn leading out from the chemical storage tank (Figure 2). The bulkhead fitting and male adaptor that lead out of the chemical storage tanks have been redrawn in AutoCAD. An outlet is drawn in the chemical storage tank were a bulkhead fitting is attached in order to seal the tank. From this fitting, a male adaptor is attached so that ½" PVC piping can be connected from the storage tanks. This piping is connected at an elbow to piping where a ball valve is attached, and ultimately joins at a T that leads to a pipe that will be connected to the constant head tank with a flexible tube. The pipes and pieces leading out from the tanks are not yet connected to the constant head tank because we are unable to draw flexible tubing in AutoCAD to attach to the end of our final pipe. Once AguaClara team members discover how flexible tubing can be drawn, this can be added to our AutoCAD script in order to have the tanks completely connected to the rest of the plant.

Figure 2. This drawing illustrates how the connecting pieces are drawn from the chemical storage tanks leading to the constant head tank.

The final portion of our code contains a mirror function executed when an odd number of channels in the flocculator results from the basic inputs. This is because the entrance tank is mirrored in this case, and the chemical storage tanks must be on the side of the entrance tank containing the constant head tank in the final drawing.

With the completion of our code, the chemical storage tanks are now in their proper location with respect to the rest of the plant and of the proper dimensions as dictated by the basic inputs and the database of tanks that can be provided by Rotoplast.