Marcala El Chiflador 2 parallel plant design

Marcala El Chiflador plant

Our goal is to make the operation of two parallel water treatment plants as easy as possible for a single operator and to make design and construction of the facility possible.

Guiding principles

- Flows through the plants must be easy to control and easy to measure
- Operator must have easy access to the control and critical observation points (flow measurement, flow control, alum addition, floc tanks, sed tanks, chlorination point) of both facilities
- Controls should be intuitive and should not require trial and error adjustment.
- AguaClara needs to move to standard designs so technicians who support the various plant operators don't have to maintain many different technologies. Our goal in developing the dose controller technology is to create a system that doesn't require the operator to refer to tables when setting chemical dosages. The dose controller technology is also designed to work over the full range of plant flow rates from a few liters per second to the largest plants that can be built. Of course the plumbing in the dose controller will need to increase in size as the flow rates increase, but the basic technology can be the same for all of our plants.

Pseudo Independent Plant Flow Control (option 1)

With a single plant it is relatively easy to adjust the valve on the transmission line to regulate the flow of water into the plant. With two plants sharing the same transmission line it will be a bit cumbersome to regulate the flow through each plant. If we Tee the transmission line and then have control valves at both plants then closing down one plant will increase the flow through the other plant because as the flow rate in the transmission line is decreased the pressure available to push water through the regulating valve increases. Thus it will be necessary to adjust both valves in order to turn one plant off and maintain the same flow through the other plant.

Easy to design and build
Operator has to run two plants
Easy to shut down one plant for maintenance

Independent Plant Flow Control (option 2)

Add a small control box before the entrance tanks that is a pressure break with an overflow. The incoming transmission line could have a valve on it or it could be wide open so that no one ever pressurizes the transmission line. Excess flow will go across an overflow sharp crested weir to a drain and be returned to a local stream.

Install an LFOM or a single orifice for each plant in this control box so that the flow will automatically divide between the plants correctly.

Each plant will be completely independent. The pipes coming from the raw water control box to each entrance tank will have a valve at the entrance tank to allow flow regulation to each plant.

Two LFOMs in the existing entrance tank (option 3)

Use two LFOMs in the existing entrance tank to divide the flow proportionally between the plants based on their design capacity. The existing LFOM remains unchanged. Add a second LFOM that sends water to the new plant. Size the new LFOM so that the flow is divided in proportion to the capacity of each plant. The LFOM for the new plant will send its water to the entrance tank of the new plant and that plant will use a dose controller so that the operator doesn't need to adjust the chemical flow as the plant flow varies. A disadvantage of this system is that the flow division is automatic (a potential advantage) but that the operator can't easily change the flow division. If we want the operator to have the ability to change the flow division we would need to build several LFOMs (this would be easy) with different flow ratings and then the operator could swap LFOMs to change the flow division.

This system would have two independent dosing systems for alum.

Use a dose controller for the new plant. Use the existing flow control at the current plant. This will allow a side by side comparison of the two technologies. The goal would be to eventually move to whichever dosing system is best for both plants.

The flow through a plant would be shut off by sliding a plastic sleeve or a Fenco fitting around the LFOM to close the orifices.

Single Alum addition point (option 4)

In this option the water would all flow into the existing entrance tank. A dividing wall would be added to the entrance tank to separate the raw water pipe from the two LFOMS. The dividing wall would have an on orifice plate sized to generate about 5 or 10 cm of head loss at 55 L/s. The alum would be added at the orifice plate. The volume of the section of the tank containing the LFOMs would be kept as small as possible.

This design would need to have free fall of water after the alum addition in the two LFOMS in order to divide the flow. The free fall is necessary to eliminate the influence of head loss through the plants on the flow through the LFOMs. This design will create lots of foam in both plants.

It would be possible to use the water level in the entrance tank to drive a linear dose controller. This would require using perhaps 4 flow control tubes in parallel. We could use a single large float valve to control the alum level in the constant head tank.

If we want to switch to the nonlinear orifice design for a dose controller that would be possible. We would use single orifices instead of LFOMs.

This system would be difficult to make work right when one plant is shut off. The relationship between Q and h in the entrance tank would change based on which of the treatment trains was in operation. Thus the dose controller would probably need to have two orifices, one for each treatment train. When turning off a treatment train the corresponding dosing orifice would need to be turned off too. If we need to have two dosing orifices in any case, then we may as well have two independent dosing systems.

One large plant (option 5)

Build one giant flocculator and add sed tanks.
We would need to take plant off line for construction.

This is not a viable option

Conclusions

The best option is #2.

Entrance Tank improvements

Consider sloping the bottom of the entrance tank at 60 degrees like a cone to the drain. Or add a drain system that is similar to the drain system in the bottom of a sed tank. This drain would be opened daily to flush out accumulated solids

Use a minimum of 3” drain valve (the 2” drain valve at Marcala clogs). However, clogging might not be as big of a problem if this is purged at least every day. Perhaps the drain valve should be large enough to handle the entire plant flow so that the purge velocities are high and the large sediment can be scoured out of the tank.

Consider adding

- inlet manifold - (to eliminate short circuiting). The inlet manifold would be directly connected to the LFOM that is in the Raw Water Control Box. In this case the bottom of the Entrance Tank would be a valley identical to a sedimentation tank bay.
- plate settlers - It would be good to test this in a facility. It wouldn’t take many plate settlers in an entrance tank and we could determine if they make any difference in water quality. Their effectiveness would depend on the raw water composition.
- launder – how would this connect to the rapid mix pipe and alum dosing line.

The alum feed line must be installed securely because it can’t be easily checked during operation.

Eliminate the macro/micro mix orifices and replace with a single orifice that generates 1 W/kg of energy dissipation. This will eliminate or significantly reduce clogging problems. Design the rapid mix orifice/alum feed line so that it can easily be accessed and removed for inspection.

Raw Water Control Box

All of our plants should be designed so that the transmission line is allowed to run continuously even when the plant is shut off. This way when there is dirty water coming to the plant the plant can be turned off and the transmission line will eventually clear itself of the very dirty water. This will be accomplished with a raw water control box. In the case of parallel treatment trains the raw water control box will have an LFOM for each of the treatment trains to split the flow according to the flow capacity of each train. Approximately 20 cm of head loss will be used to divide the flow with the LFOMs. The overflow will be across a sharp crested weir. This will make it impossible to send more flow to a plant than it can handle. The LFOMs will be removable so that the design flows can be changed if necessary.

The raw water control box will be a small shallow tank inside the entrance tank. The raw water control box should contain the screen that is used to catch large debris to protect the control orifices from clogging. It must be easily accessible to the operator because the screen will need to be cleaned.

Water will exit the RWCB through a pipe that goes through the bottom of the RWCB. This pipe will serve as an inlet manifold into the entrance tank.