The flocculator causes colloids (small particles) to collide and stick together to form larger aggregates (flocs) that can settle out more easily in the sedimentation tank. Particles collide more frequently in turbulent flow. Since the AguaClara plants use no electricity, the turbulence is generated by controlling the flow of the water around sharp bends. The water flows around a series of baffles. The baffles are in several channels to create a compact plant footprint and to minimize construction costs by maximizing shared wall space. The flocculation tank is also designed to have the same length as the sedimentation tank so the two unit processes can share a common wall. There are N.FlocChannels channels in the flocculator and each channel is W.FlocChannel wide (inner width, not including walls).

The particles must collide a certain number of times for them be large enough to settle out in the sedimentation tank but not prematurely in the flocculation tank. The target collision potential (a measure of the opportunities for collisions provided by the flocculator) that was set for the flocculator was CP.Floc. The actual total collision potential was CP.FlocTotal. Note that the design value for the collision potential can be significantly higher than the target because the number of flocculator channels must be an integer. The equation for the collision potential in each space between baffles is



The height of the floc tank wall was calculated by adding the head loss of the water through the flocculator to the height of the water in the inlet channel of the sedimentation tank and a freeboard height that was set as H.PlantFreeboard. The height of each floc tank wall measured from the inside bottom (i.e. not including the thickness of the slab ) of the flocculator is H.Floc.

The total width of the floc tank (measured perpendicular to the direction of the channels), including the thickness of all the walls except the one shared with the sedimentation tank is W.FlocWithWalls. The total length of the floc tank is the same as the total length of the sedimentation tank. The total length of the floc tank including the thickness of the walls is L.FlocWithWalls. The floor of the flocculator (from the inside, not including the thickness of the bottom wall) is elevated Z.FlocTank from the floor of the sedimentation tank (from the inside, i.e. not including the thickness of the bottom wall).

The residence time in the flocculator is Ti.Floc. The average velocity in the flocculator is V.Floc.**Vertical Flocculator (will only display for vertical)**

**Rigid (Will display only for rigid baffles):**

The baffle type for the plant you designed is BaffleType. The thickness of the baffle, which you specified, is T.FlocBaffle. The space between baffles is designed to be larger than a minimum human width, S.FlocBaffleMin, so that a human can enter the flocculator for maintenance. The space between baffles in all the channels except the last is S.FlocBaffleFirst. The spacing between baffles in the last channel (except in the first and last spaces of the channel) is S.FlocBaffleLast. The spacing in the last channel is slightly different to maintain the flow pattern and accommodate the width of the inlet channel to the sedimentation tank. The center to center spacing (which includes the baffle thickness) in all the channels except the last is B.FlocBaffleFirst. The center to center spacing in the last channel (except in the first and last spaces of the channel) is B.FlocBaffleLast.

The number of baffles in the all the channels except the last is N.FlocChannelBafflesFirst. The number of baffles in the last channel is N.FlocChannelBafflesLast. The total number of baffles in the flocculator is N.FlocBaffles.

In a vertical flocculator the baffles are staggered up and down. The lower baffles start from the floor of the flocculator. They have a length of L.FlocBaffleLower. There are N.FlocBaffleLowerTotalV lower baffles.The upper baffles start a distance that is the same as the spacing between the baffles (S.FlocBaffleFirst) higher than the floor. They have a length of L.FlocBaffleUpper. There are N.FlocBaffleUpperTotalV upper baffles. The width of all the baffles is W.FlocBaffle. The baffles are wider than the channels so they can be held in place by slots in the channel walls. The baffle width should be confirmed from field measurements after the channel walls are completed.

To keep the baffles in place, slots of depth L.Slot into the wall of the channel should be constructed. They have the same width, T.FlocBaffle plus some tolerance for fabrication variability, as the baffles. The slots extend to the floor of the flocculator for the lower baffles. They start a distance S.FlocBaffle above the slab for upper baffles. These slots can be created by attaching a piece of wood with the dimensions of the slot to the wall before adding the final layers of mortar. Then the piece of wood is removed to reveal the slot.

Baffles can be constructed using reinforced concrete. The baffles can be made in several pieces to facilitate construction and installation. The baffles must be designed to withstand the hydrostatic force of water that occurs during tank draining. We recommend that the baffles be designed to withstand the hydrostatic force that results when one side of a lower baffle is fully submerged in water and the other side is completely drained.

Ports need to be placed in the lower baffles of rigid vertical flocculators in order to prevent water from being trapped between them during draining. The ports are cast into alternating sides of the lower baffles to ensure that there is no short circuit path for water to flow through the flocculator. The port and valve sizes are chosen based on the desired drain time, Ti.FlocDrain.

The port height is L.BafflePort. The horizontal dimension of the port has an additional T.ConcreteMin to account for the fact that part of the port will be blocked because it will be in the slot that supports the baffle.

One of the design goals is to achieve the correct energy dissipation so that the particles collide frequently without breaking up from too much mixing. The target maximum energy dissipation rate at the design plant flow rate that was set for the flocculator was ED.Floc. The actual maximum energy dissipation in all channels except the last was ED.FlocChannelFirst. The maximum energy dissipation in the last channel is ED.FlocChannelLast.

where

**Plastic (will display only for plastic baffles):**

The flocculator baffles are made from polycarbonate sheeting that is L.SedPlateSheet long, W.SedPlate wide, and T.SedPlate thick. We recommend using transparent corrugated polycarbonate sheeting. These sheets are cut in half to obtain the W.FlocBaffle width of the flocculator channels. The spacing between baffles in all the channels except the last is S.FlocBaffleFirst. The spacing in the last channel (except in the first and last spaces of the channel) is S.FlocBaffleLast. The spacing in the last channel is slightly different to maintain the flow pattern and accommodate the width of the inlet channel to the sedimentation tank. The center to center spacing (which includes the baffle thickness) in all the channels except the last is B.FlocBaffleFirst. The center to center spacing in the last channel (except in the first and last spaces of the channel) is B.FlocBaffleLast.

The number of baffles in the all the channels except the last is N.FlocChannelBafflesFirst. The number of baffles in the last channel is N.FlocChannelBafflesLast. The total number of baffles in the flocculator is N.FlocBaffles.

In a vertical flocculator the baffles are staggered up and down. The lower baffles start from the floor of the flocculator. They have a length of L.FlocBaffleLower. There are N.FlocBaffleLower lower baffles. The upper baffles start a distance that is the same as the spacing between the baffles higher than the floor. They have a length of L.FlocBaffleUpper. There are N.FlocBaffleUpperTotalV upper baffles. The width of all the baffles is W.FlocBaffle.

**Display for both types of baffles:**

There are ports in the bottom of the walls connecting channels that maintain the vertical flow pattern. The width of the port opening is W.FlocPort0. The height of the port opening is H.FlocPort0. The ports are flush with the bottom of the flocculator tank.

**Horizontal Flocculator (will only display for horizontal)**

In a horizontal flocculator, the baffles are staggered from side to side. The length (from side to side) of the baffles is L.FlocBaffle Lower. The width of the baffles (from top to bottom) is W.FlocBaffle. The width is shorter than the height of the floc tank to allow a path for water flow in case the plant becomes accidentally overloaded with water.The thickness of the floc baffles is T.FlocBaffle. If the thickness of the baffles is not the desired thickness, the facility should be redesigned with the correct baffle thickness.

The baffles must be made of a rigid water proof material. They must containing sufficient reinforcement so they withstand normal maintenance activities. They could be built as integral sections of the channel walls and could even be built using the same construction technique as the channel walls.

The spacing between baffles (not including the baffle thickness) in all the channels except the last is S.FlocBaffleFirst. The spacing in the last channel (except in the first and last spaces of the channel) is S.FlocBaffleLast. The spacing in the last channel is slightly different to maintain the flow pattern and accommodate the width of the inlet channel to the sedimentation tank. The center to center spacing (which includes the baffle thickness) in all the channels except the last is B.FlocBaffleFirst. The center to center spacing in the last channel (except in the first and last spaces of the channel) is B.FlocBaffleLast.

The number of baffles in the all the channels except the last is N.FlocChannelBafflesFirst. The number of baffles in the last channel is N.FlocChannelBafflesLast. The total number of baffles in the flocculator is N.FlocBaffles.

The width of each channel (not including wall thickness) is W.FlocChannel. It was calculated by multiplying the space between the baffles by Pi.JSOptimal.

The channels are connected by an open space that has the same width as the space between baffles, W.FlocPort0.

**Display for all 3 types**

Gate valves are placed at the base of every other channel in the flocculator (both horizontal and vertical) at-grade to allow for draining. Additionally, the design requires a drain in the first and last channel of the flocculator, so if there is an even number of channels, the first two channels (the ones closest to the entrance tank) will each have a valve. The nominal diameter of the valve, ND.FlocValve, is calculated so that the flocculator tank can be drained in less than Ti.FlocDrain. The valves that need to handle the highest flow rates are the valves that drain two channels. All of the valves are then set to that size. The equation for the minimum valve diameter is given by

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where

This design requires N.FlocValves. An ND.FlocValve diameter coupling is embedded in the flocculator wall. A short nipple and an adaptor are used to connect to the valve. We recommend connecting a elbow to the effluent of the valve to deflect the water into the drain canal.

Since the center of the valve is aligned with the floor of the flocculator, slopes are required in the floor of the tank. The slopes have a width equal to the diameter of the valve, ND.FlocValve, and a depth equal to half the diameter, H.FlocSlope. Thus, the valve is placed at-grade with a slope of 30 degrees. In the event that a 30 degree slope causes the slope to be longer than the space between baffles, the length of the slope is set to be 5 cm away from the nearest baffle. If the distance the slope extends into the channel is longer than the spacing between baffles, the slope would extend through a baffle.  To correct this problem, the distance the slope extends into the channel will be set to a distance of 5 cm from the nearest baffle.