Floating Flocs Summer 2009 Set-up

Floating Flocs Team Experimental Set-up (Summer 2009)

System Modifications

The experimental setup used in Spring 2009 was modified at the beginning of the summer to include a taller pressurized aerator in order to increase the residence time of the bubbles and to establish more consistent supersaturation in the water going to the sand filter. The new aerator includes a valve to release water to maintain the appropriate water level. The hot and cold water valves present in the original set-up have been omitted in the new one, and the water source has been changed to a container with water whose temperature is maintained at 20 degrees Celsius. Since the aerator is pressured throughout the experiments, a pump was added before the aerator to force water into the system. The PID flow accumulator used in the previous set up was effectively replaced by a pump that now controls the flow rate through the sand filter. While the flow accumulator no longer controls the flow rate of the system, it has been kept as part of the setup in order to even out flow rate fluctuations from the pump and also to collect any bubbles coming through the line into the sand filter. A temperature probe is used just to confirm that the water temperature is 20 degrees Celsius. From there, the water flows up through the sand filter, and then to the bubble collector, as in the Spring 2009 setup.

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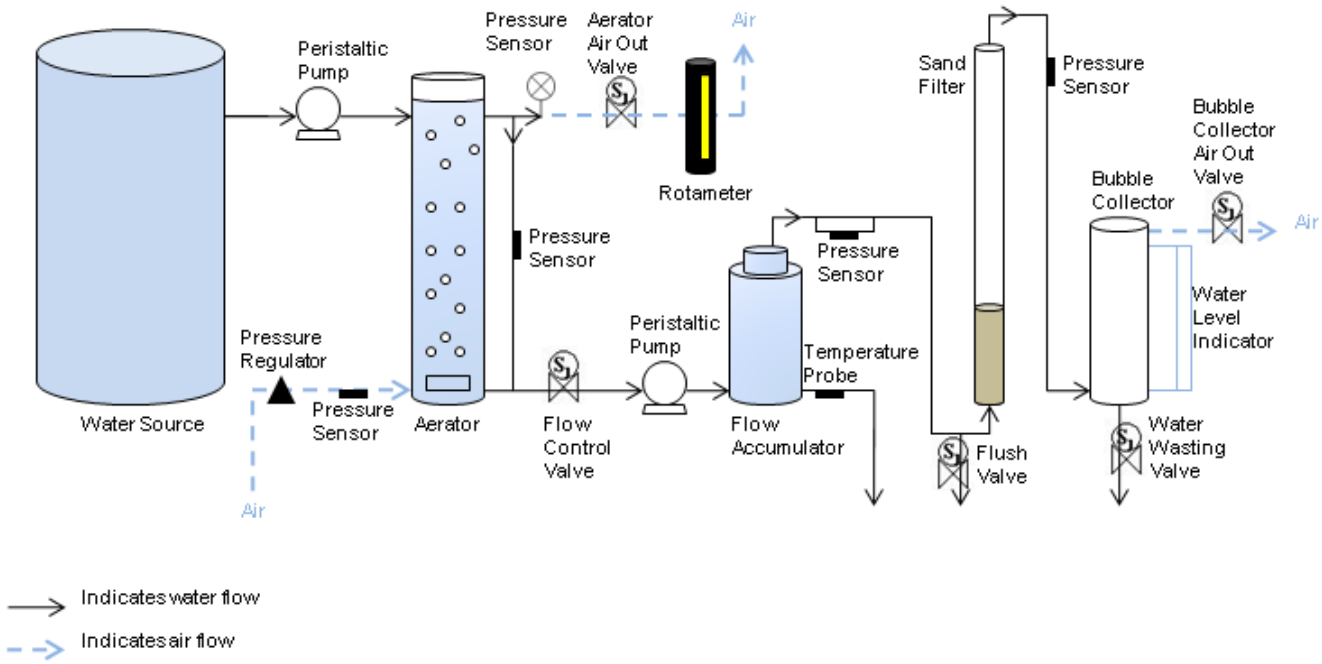

Figure 1: Current experimental apparatus (Summer 2009)

The Process Controller software is used to automate experiments and record data on Microsoft Excel spreadsheets. Two states have been developed for the experimental setup - an "On" and an "Off" state. Generally, experiments will be run with the system on the "On" state. However, as experiments are conducted, it may be necessary to increase the number of states. A rough draft of the *Process Controller* configuration file to be used can be found here.

In the "On" state, water from the temperature-regulated source flows into the aerator until the water level reaches a certain height that is yet to be established. This maximum height (set point: Aerator Max Water Level) is limited by the water level indicator system on the aerator, which measures the difference between the air pressure in the system and the water pressure. The water level should not reach the tube connecting the headspace of the aerator to the pressure sensor. If the maximum water level is exceeded, a valve is opened to release the excess water until a minimum set water level (set point: Aerator Min Water Level) is reached. (See set point: Aerator Water Wasting Control for method governing the water release valve.)

During experiments, the aerator is kept in the range of 100 kPa - 102 kPa gage pressure in order to achieve consistent dissolved gas concentrations. The air pressure regulator valve functions much like the water level regulating valve control for the aerator mentioned above. (See set point: Aerator Air Release Control for method governing the air release valve.) When the pressure is below the maximum set pressure (set point: Aerator Max Air Pressure - 102 kPa), the valve will remain closed. Once the maximum pressure is reached, the valve will open until the minimum set pressure (set point: Aerator Min Air Pressure - 100 kPa) is reached. To control the flow of air leaving the system, a rotameter is connected after the air release valve.

The flow of supersaturated water exiting the aerator is regulated by a valve that is controlled by the PID flow accumulator. The flow rate can be adjusted in Process Controller by editing the set point "Flow Rate", which is the target value of the PID control algorithm.

The water leaving the aerator is then sent up through the sand filter and out to the bubble collector, which measures the amount of gas removed by the sand filter. The bubble collector has two valves - a water outflow valve and an air valve. At the start of each experiment, the bubble collector is filled with water to a level that will be determined experimentally (set point: Bubble C. Max Water Level). The bubble collector uses the same sort of water level indicator system as the aerator; the water level in the bubble collector is limited by the location of the tube connecting the headspace to the pressure sensor. During the process of filling the bubble collector, the air valve is opened and the water outflow valve is closed, allowing for natural refilling of the apparatus. When the maximum water level is reached, the air valve is shut and the water outflow valve is opened, causing a partial vacuum at the top of the collector that holds the column of water up. As water flows through the bubble collector, gas bubbles in the influent water slowly increase the pressure in the bubble collector, causing the water level to decrease to a minimum level (set point: Bubble C. Min Water Level). Once this minimum level is reached, the system refills by the same process. (See set points: Bubble C. Water Outflow Valve and Bubble C. Air Valve for methods governing the water outflow valve.)

In the "Off" state, the water release valve and the air valve in the aerator are opened to prevent the build-up of pressure. The flow valve that allows water out of the aerator and into the sand filter is closed and the air valve and water-out valve in the bubble collector is opened to drain the bubble collector.