Laminar Tube Flocculator

FReTA can't accurately measure low turbidities due to recirculation caused by pressure and velocity fluctuations during flow deceleration. This recirculation makes it impossible to measure low turbidity where floc break up is expected to be significant. Thus it is time to abandon FReTA and switch to a continuous flow system that uses a tube settler. This settled water turbidity (**SWaT**) measurement system will be identical to the system that will be used by the Turbulent Flow Flocculator. SWaT will consist of a sample line from the effluent of the flocculator that connects to a single tube settler, a turbidimeter, and finally a variable speed peristaltic pump. The flocculator effluent that doesn't pass through SWaT will go directly to the drain. This drain line will carry the flocs that settle out of the tube settler. SWaT should be designed to not be affected by floc roll up (this will set minimum tube diameter) and to have a capture velocity that can be varied between 0.1 mm/s and approximately 0.5 mm/s. The critical design for floc rollup will be at the maximum capture velocity. The maximum flow of SWaT should be limited to about 90% of the flocculator flow to allow for sufficient waste flow. The minimum flow for turbidimeters is approximately 1 mL/s to reduce sedimentation in the turbidimeter sample vial. This sets the minimum flow that can be used for SWaT.

Repeat the clamp experiments after SWaT is installed and compare with results obtained with FReTA. If there is no evidence that clamps enhance flocculation, then conduct experiments over a range of clamp induced energy dissipation rates. Consider using a single variable clamp positioned near the middle of the flocculator. Gradually decrease the clamp opening size and monitor the resulting performance. Given that the flow is continuous it should be possible to manually adjust the clamp over a period of perhaps 30 minutes. Use head loss measurements to calculate the energy dissipation rate as a function of time. The head loss due to the clamp should vary from 0 cm to approximately 1 m. Plot SWaT as a function of the energy dissipation rate taking into account the residence time between the clamp and the turbidimeter. Determine next research steps based on these results.

If floc breakup doesn’t reduce residual turbidity, then we need to develop an alternative explanation for the poor efficiency of residual turbidity reduction after initial flocculation. Tapered flocculation would be worth exploring to see if that gives us any more insights. If we use tapered flocculation we might consider using a wide range of energy dissipation rates starting from 1000 mW/kg.