BAFFLE BASICS ... A BRIEF TUTORIAL

"Density currents" and "density current baffles" have become common terms in the lexicon of clarifier design over the past several years, with the baffle becoming a standard element in clarifier design. Here are some "Baffle Basics" to keep in mind when designing the baffle into the next project.

1. Density currents form in all activated sludge clarifiers and cause short-circuiting of the main clarification volume of the tank. This increases effluent suspended solids and reduces the tanks actual hydraulic capacity. In fact, the hydraulic performance of all center-fed clarifiers is the same, regardless of the process type, i.e. activated sludge, trickling filter, etc. In each case the magnitude of the density currents will vary depending upon flow, the configuration of the tank, the configuration of the feedwell and the operation of the clarifier.

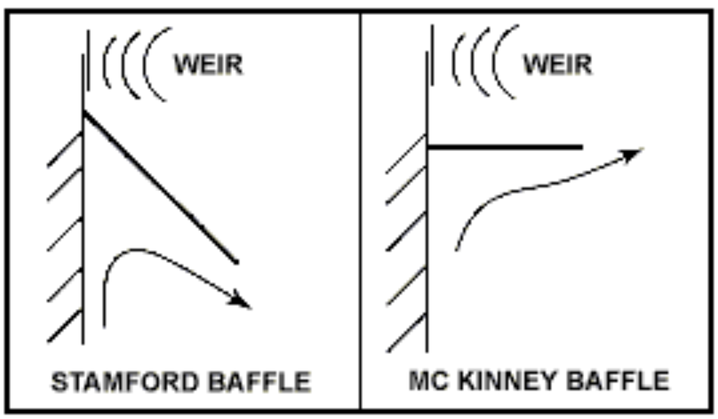
2. The principal cause of density currents in center-feed tanks is the downward flow of the dense input mixed liquor at the feedwell, although temperature differentials and internal tank hydraulics may also introduce currents which disrupt settling. Because the hydraulic flow within the tank tends to spiral slowly from the center outward toward the walls, the currents acting within the tank contribute to the movement of solids toward the weirs.

3. Density currents affect deep tanks as well as shallow tanks. In deep tanks, the input liquor cascades downward over a greater distance and may reach significant velocity. Tanks with 12 to 15 foot SWD commonly exhibit short-circuiting, as do those with less SWD. Density currents also occur irrespective of tank diameter, with short-circuiting common in both 25 foot and 200 foot diameter clarifiers.

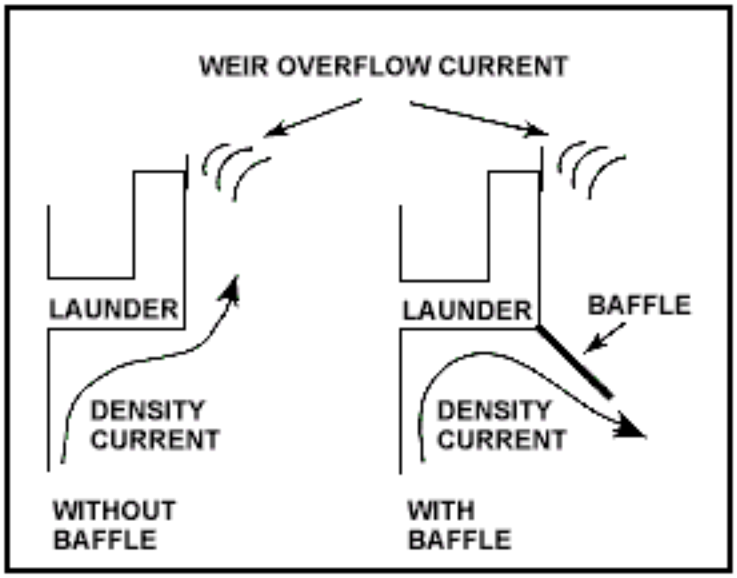
4. Density currents tend to move along the top of the blanket, where MLSS are in the 2000 range, and carry the lighter solids to the outer wall and upward toward the weir. If there is insufficient distance between the bottom of the inlet feedwell and the top of the blanket, the currents may be sufficient to cause scouring of the tank.

5. The action of the Density Current Baffle is two-fold: 1) it directly impedes the current (and solids) flowing up the tank wall and diverts it back into the center of the tank, and 2) it produces a hydraulic barrier around the tip of the baffle which causes those currents in the vicinity of the baffle to flow around and toward the tank center without ever reaching the wall.

6. The Stamford, or Inclined, Baffle offers several advantages over the McKinney, or Horizontal, Baffle: 1) because it is inclined away from the weir, the Stamford Baffle keeps the lighter solids at a greater distance from the weir overflow current, 2) the incline allows solids which build up on the upper surface of the baffle to slide off periodically ... the horizontal baffle is known to collect solids and cause maintenance problems, 3) the inclined design is easier to retrofit in an existing tank than is a horizontal design.



7. Tanks with internal launders also require density current baffles. Although the bottom of the launder does act as part of the baffle, solids emerging from beneath the launder are easily drawn into the localized current of the overflow weir. A baffle cantilevered out and downward from the lower inboard comer of the launder will deflect solids away from the weir and back into the main clarification volume of the tank, just as in the case of a wall mounted baffle.



8. Baffle size varies as a function of tank diameter, depth and configuration. For inboard launders, we recommend a 24" to 36" long baffle mounted at the lower inboard corner of the launder and inclined at a 45° angle. Larger baffles may be required in larger tanks. For outboard launders and dual weir configurations, we recommend a baffle mounted to the tank wall at a 45° angle. The size of this baffle can range from 24" to as large as 68".

9. The proper depth of the baffle in the tank is a function of tank depth and the height of the blanket. Ideally, the baffle should be positioned such that the lowest point of the baffle will be in the clear zone above the blanket. This usually means that the baffle should be mounted three to four feet below the weir. This height can vary somewhat to avoid pipes, supports and other obstructions in the tank, but the bottom of the baffle should be positioned low enough to be effective, yet as far above the blanket as possible. It may be necessary to reduce the inclination angle of the baffle to obtain the desired horizontal projection and keep the baffle above the blanket.

10. At a minimum, the baffle must be designed to withstand the upward buoyancy force of the liquid in the tank. This force varies as a function of the density of the mixed liquor. Assuming that the liquid has the density of water, this force can be 3000 pounds or more under an eight-foot baffle section. Some form of venting is required to allow gas that can collect beneath the baffle to escape. These conditions require a rugged baffle that is firmly attached to the tank wall. Thin baffles, and those that simply cantilever from the wall without benefit of a triangular support bracket, cannot withstand the forces at work in the tank.

11. Density current baffles are most effective when the clarifier is operating in the average to peak flow ranges. TSS reductions in the range of 25% to 35% are routinely reported under average flow conditions, and 40% to 50% improvements are not uncommon at peak flow. Clarifiers that are operated below design flow may not benefit from the use of a Density Current Baffle.