Theory of Settling System Design

Settling system design is controlled by four important elements:

1) Flow rate of the water through the settling system
2) Time that the water is in the system
3) Size/design of the system
4) Ability to remove the sludge

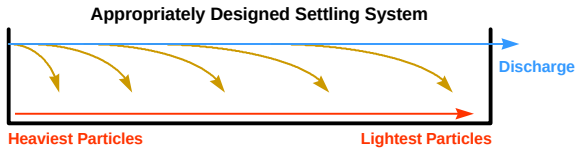
1) Water flow rate needs to be slow enough to allow particles to settle out. If the water flow is too rapid particles will not settle out and will be discharged. A properly designed tank or baffle system will reduce the water flow and allow particles to settle out.

2) The water needs to remain in the system long enough to allow the particles to settle. This 'residence time' is directly related to the first element. A properly designed tank or baffle system will reduce the water flow, but turbulence will reduce particle settling and may disturb settled sludge. If you disturb settled sludge the system will not work as well since the system must re-settle the disturbed particles.

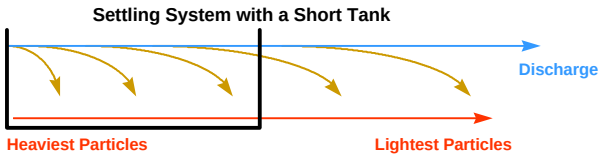
3) Size/design of the system needs to allow number one and two to occur. If the system is too small the water flow will likely be too rapid and the residence time too little. Proper design will also minimize sludge disturbance. What needs to be considered is particle size (smaller particles take longer to settle out), tank length, width and depth (must be long enough for appropriate retention time, wide enough to hold the water, and deep enough to not allow sludge disturbance), and baffle design (improper baffling can cause poor settling and sludge disturbance).

4) Sludge removal should occur easily and in a manner that allows production to continue if needed. A regular sludge removal schedule should be used to keep the system running properly. Allowing sludge to build up will reduce the effectiveness of the settling system. Using a consistent schedule will also minimize sludge disturbance.

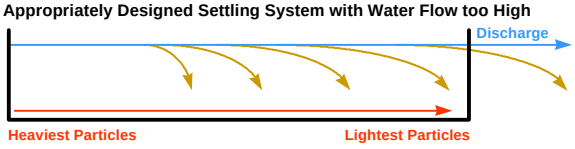
You should carefully consider your system materials. Metal tanks can be used but due to corrosion they may be prone to tank failure. Plastics are the preferred materials since they will not corrode and are lightweight. Yet, the materials you use should take into consideration your needs and finances.



Heaviest and lightest particles settle out



Heaviest Particles may settle out but most lighter particles are discharged



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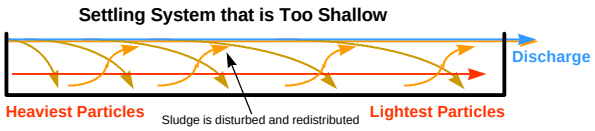
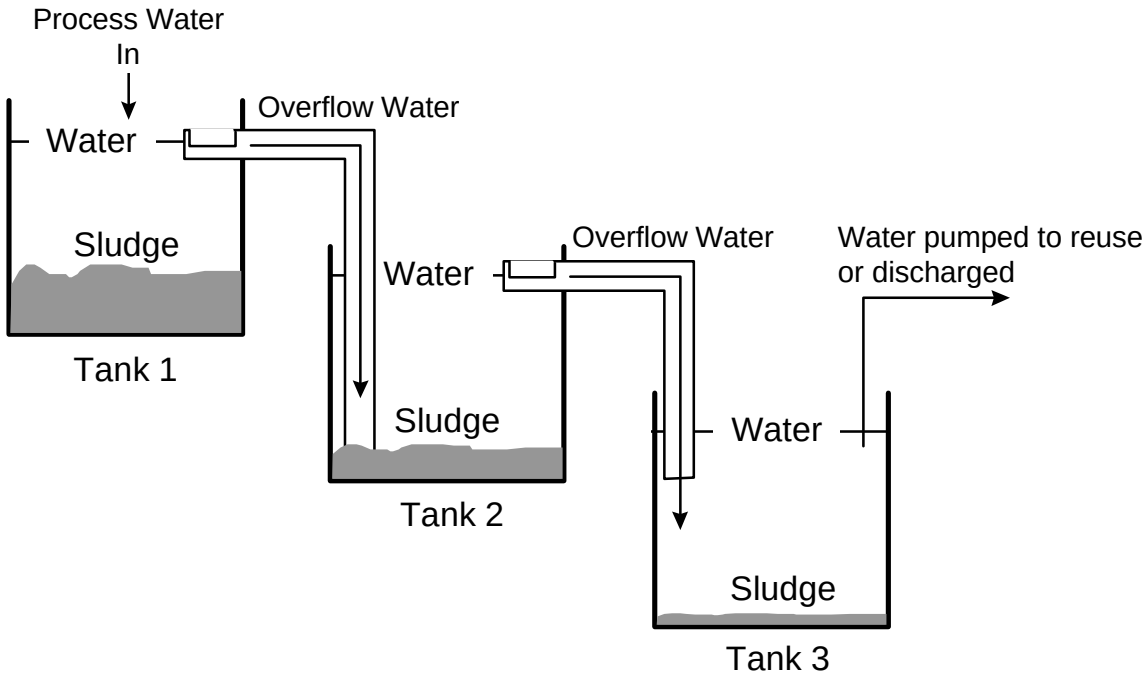


Particles may settle but will be redistributed due to water turbulence and may be discharged

Source: abcwua.org

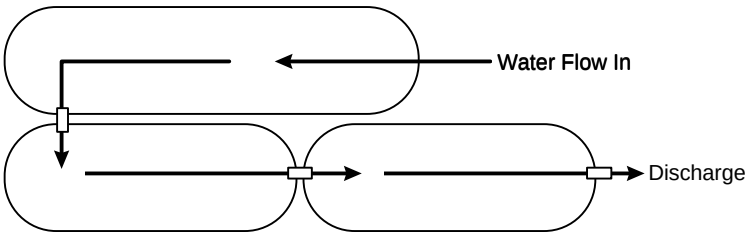
Holding/Settling Tank System

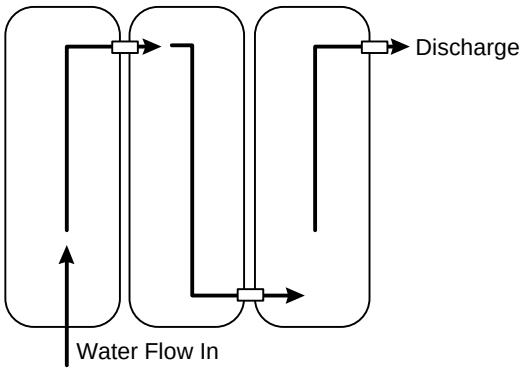
In this system the water is pumped into a holding tank and then slowly overflowed into a second and third tank (see diagram below). The water spends a significant amount of time ponded in each tank. During these periods the metal particles settle to the bottom of the tank for easy removal. As the water moves from tank to tank there is a gradual reduction in metal content. By the time the water is discharged (or reused) it has a lower metal concentration. If the final concentration is still too high the water can be slowed down in the tanks or filtration can be used.



Tank System. Process water is allowed to flow through several settling tanks. This is effective for settling sludge and fine metal particles. If enough metal exists the sludge can be refined and the metals recovered for reuse. Water from tank 3 may be clean enough to reuse.

Below are a couple examples of water flow through three tank systems.



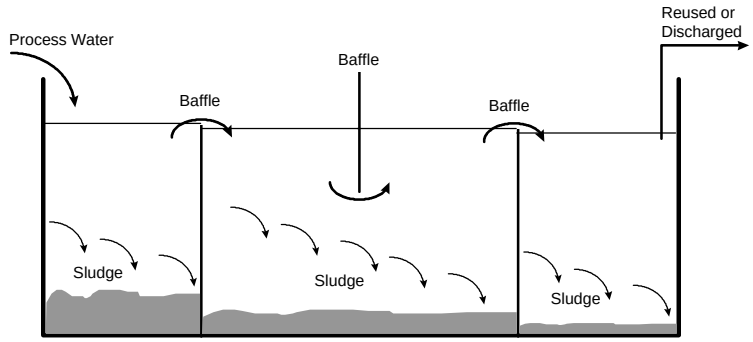


Source: abcwua.org

Baffled Tank System

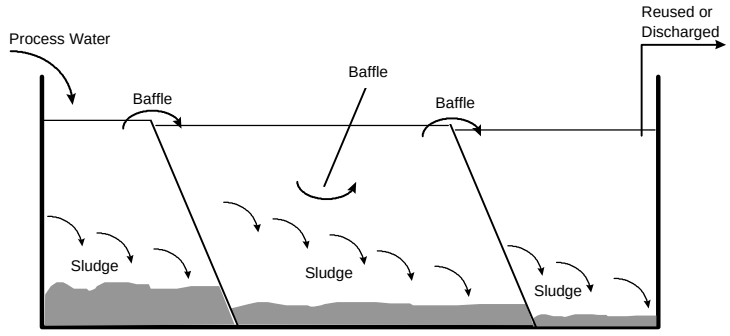
In this system a single tank is divided into several compartments using a number of perpendicular plates or baffles (see diagrams below). The baffles slow the water down by forcing the water to flow over, under or around. There are two primary baffle systems:

1) Designs where the water flows over and/or over the baffles
2) Designs where the water flows to the left and right of the baffles
   (Designs that may combine the different elements in numerous ways)



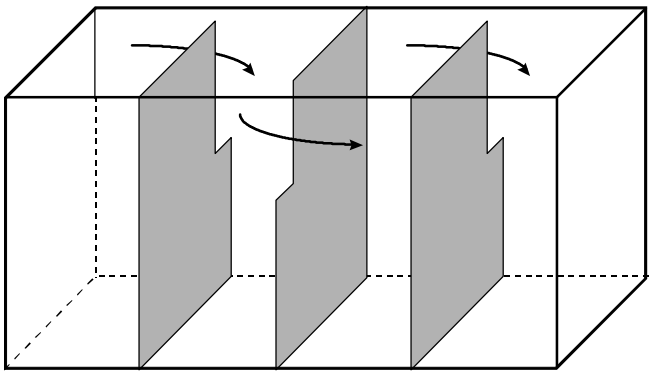
In design style 1 the water moves over and under the baffles. If the tank is too shallow the sludge will be disturbed.

Design Style 1



One alternative to design style 1 is design style 1a. Here the baffles have been angled, but this may interfere with sludge removal unless removable baffles are used.

Design Style 1a



The second baffled style allows the water to flow to the left and right of the baffles. Holes have been used instead of open areas.

Design Style 2

There are numerous variations in tank and baffle designs. One important note is that more baffles, or more tanks, does not make a more effective system. A proper design will consider water flow, retention time, size/design, and sludge removal to make the settling system more effective.

Source: abcwua.org