Clarifier Performance Evaluations, Inc.

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An Evaluation of Circular Clarifier Sludge Collection Equipment

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1. Draft Tube (RSR) Suction Devices

Advantages / Claims	Disadvantages
1. Multiple tube arrangement can remove sludge where it settles, esp. a sludge with a high SVI!	a. Creates some stirring, which may keep the sludge blanket in suspension. b. RAS tubes often interfere with the flow from the centerfeed inlet ports.
2. Can minimize denitrification and P-release by removing sludge rapidly.	
3. Creates a stirring motion, which may enhance flocculation	Creates a stirring motion, which may prevent the blanket from compacting and reduce RAS concentration.
4. Creates a stirring motion which may enhance the release of denite bubbles, thereby reducing rising sludge.	
5. Provides for sludge removal control for each "ring" area of the clarifier floor.	Practically speaking, many operators do not take advantage of the individual control of the RAS tubes.
6. Individual terminal control valves allow optimizing control of each RAS tube flow.	a. Practically speaking, control of tube flow rate is often determined by the setting that minimizes tube plugging. b. Some types of control valves are not operator-friendly for varying flows.
7. Selective sizing of tubes provides for sludge removal in proportion to the area of floor covered.	a. Use of large tubes at the outside may lead to plugging at low velocities. b. Use of small diameter tube near center almost always leads to plugging due to small diameter.
8. Surface sight well provides for observation and sampling of RAS tubes and total RAS flow.	a. RAS well box has seal that can wear and leak, causing a dilution of the RAS. b. RAS well depth lowers inlet feed location, should require deeper c-well or EDI.
9. RAS tube configuration makes it amenable for use of a Crosby cylindrical baffle	
10. Minimum floor slope required.	
11. Use of long-radius elbows minimizes head loss.	Use of multiple 90 degree elbows increases head loss.

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2. Uni-Tube (Manifold) Suction Devices

Advantages / Claims	Disadvantages
1. Removes sludge where it settles without channeling it to multiple draw-off tubes; allows total floor area to be used.	a. Improperly designed orifices can defeat suction advantages. b. The smaller inner holes tend to plug
	Probably should not be considered without primary treatment and excellent pre-screening
2. "Sucks" its way through the blanket, creating little disturbance.	This motion would not enhance flocculation, but a truss on the opposite side does.
3. The lower "profile" creates less disturbance moving through the sludge blanket.	A suction header has been known to develop an internal air pocket, causing the header to rise slightly, and the skimmer to dip proportionately.
4. Less disturbance of the blanket may lead to a more concentrated RAS	
5. A more concentrated RAS reduces the power cost for RAS pumping.	
6. An increased RAS concentration permits higher MLSS concentration.	May require a certain RAS flow rate or periodic reverse pumping to keep the header from clogging with sludge.
7. Direct connection to RAS pumps simplifies RAS control.	The operator can't tell whether or not it's drawing from the entire area because the orifices are hidden from view.
8. A properly designed tapered header maintains scouring velocity in header which should minimize header clogging.	a. An improperly designed header will contribute to clogging. b. lower RAS rates lead to plugging of the outer section
9. Minimum floor slope required; reduces construction costs.	a. Some minimum slope is required for dewatering. b. Requires a <u>much</u> deeper blanket in clarifiers with a standard sloped floor.
10. Suction plus squeegee action can maintain a lower blanket and rapid total removal, reducing opportunities for P-release and denitrification.	The suction header top and bottom seals <u>always</u> need maintenance or replacement in order to maintain good suction. Denitrification may occur more often with the blanket well over the outer orifice. (Note: Maintenance people tend to overlook the bottom seal.)

3. Standard Scraper Blade / Plow Blade Collectors

Advantages	Disadvantages
1. Conventional, best known technology	Because of the perception that this is "old technology", it has fallen into disfavor.
2. Squeegee blades system permits clean scraping of the floor.	Sludge blanket is somewhat re-suspended as the blades pass thru it, esp. near the perimeter even due to normal 10-12 fpm tip speed.
3. Plow collectors move sludge continuously toward the hopper" (….. however, the settled activated sludge will move to the hopper as a flowing fluid with the standard 1" in 12" floor slope)	a. It's claimed that this plowing action takes several revolutions of the mechanism to move solids to the center sludge hopper. b. However, at higher tip speeds, the blades should plow thru the sludge. c. Scraper collection should utilize steeper floor slopes; deeper center depths.
4. Plow collectors are claimed to eliminate the jetting action of the RAS drawn along the collector arm by RSR suction technologies, leading to a "trailing wave of solids" loss at the weirs.	Note: We have not been able to locate signs of any "jetting" along a suction collector arm. In fact, we have shown by field experiment that this phenomenon is not present.
5. Use of a sludge hopper permits thickening of the RAS prior to pumping.	a. Some "innovative" sludge rings have been promoted to try to replace the valuable central sludge hopper. b. Central sludge hopper is in the zone where inlet-related blanket scour may take place.
6. Proponents claim that the use of a "sludge ring" leads to a more uniform RAS draw-off.	a. Use of a "sludge ring" may cause drawing a more dilute sludge from the ports opposed to and behind the scraper blades …. unless there's sufficient sludge blanket over it. b. Carrying a "sufficient" sludge blanket reduces the effective clarifier volume and may increase solids carry-over.

4. Spiral Scraper Mechanisms

Advantages / Claims	Disadvantages
1. Perceived as the "latest" collector technology	It's been around Europe/UK since the early 1900's, fell into disfavor; has now been “rediscovered”.
2. Can be used with a simple center sludge hopper.	a. Standard hopper design leads to a minor fluctuation of RAS concentrations as collectors pass over and beyond the hopper. b. Central sludge hopper location can be subject to scouring action.
3. Claimed that "…. deep scraper blade effectively moves solids to the hopper in one revolution or less."	a. But, the sludge doesn’t have to be scraped to the hopper; it flows like a thick "soup"! b. A deep scraper blade is required to prevent overloading the collector with solids. c. A deep scraper blade probably promotes fluffing of the sludge blanket, esp. at elevated (20-30 fpm) tip speeds. d. Multiple blades that are required for larger clarifiers may exacerbate fluffing of the blanket. e. The deep blade profile may increase torque; definitely does on primaries! f. The deep spiral blade may induce a concentrated outward density current. g. Scraper collection should require steep floor slopes; deeper center depths. h. Sludge removal deteriorates with higher SVI's.
4. Claimed that "….. coupled with a sludge ring, provides for effective removal of the sludge."	a. Use of some sludge rings should cause drawing a more dilute sludge from the ports opposed to and behind the scraper blades …. unless there's sufficient sludge blanket over it. b. Carrying a "sufficient" sludge blanket reduces the effective clarifier volume and may increase solids carryover. c. Carrying a deep sludge blanket increases the likelihood of denitrification and P-release.