Lowering The Total Cost Of Operation

The system removes more solids than conventional clarification, so filters can run longer between backwash cycles. Fewer backwash cycles means less backwash water, less media breakdown, less filter-to-waste on filter start-up, and lower energy cost.

By ITT Corporation India Pvt. Ltd.

The Leopold Clari-DAF system is a proven, highly effective method of removing turbidity, insoluble metals (iron, manganese, arsenic), algae, color, taste and odor, Giardia, Cryptosporidium, and other low-density particulates from water. Its performance is superior to gravity sedimentation in providing consistent quality effluent, producing consistently high sludge solids, and operating at high loading rates (gpm/sf, m/hr)– results that can lower the total cost of operation.

How The System Works

1. The Clari-DAF process starts with raw water being dosed with a coagulant in a rapid mix chamber, much like that of conventional sedimentation. Alum, ferric, and polyaluminum chloride are typical choices for coagulant. Lower doses than sedimentation are used because a pin floc is desired instead of a sweep floc.

2. Good coagulation is the most important factor affecting flotation. Two-stage tapered flocculation is standard. G values of 30 to 70 are typical for full-scale operations. Low tip speeds prevent the fragile floc from being sheared. Flocculation time is usually 10 minutes in each chamber but can be less, depending on the raw water quality.

3. Hydraulic loading rates normally range from 4 to 8 gpm/sf (9.68 to 19.36 m/hr), although pilot testing has shown that rates up to 10 gpm/sf (24.20 m/hr) are not unusual. As a result, the DAF requires a smaller footprint than sedimentation.

4. After a pin floc is formed, the raw water stream is injected with water that has been saturated with air at 60 to 90 psi. The saturation process is accomplished by taking a fraction of the throughput, typically 10% of design flow, and recycling it back to a pressure vessel. VFDs control the recycle pumps to maintain a balance in the saturator. A compressor provides a constant pressure of oil-free air to the saturator.

5. The saturator, a packed tower for water or unpacked tower for wastewater, mixes the water and air.

6. The aerated water is delivered to a distribution header that spans the width of the DAF cell. This distribution header has a series of specially designed orifices or nozzles. As the pressurized water exits the nozzles, the pressure drop produces a cloud of hundreds of millions of microbubbles that are 20 to 100 microns in size.

7. The contact zone is given a milky appearance like that of a whitewater blanket. The tiny air bubbles rise through the coagulated water, capturing floc as they ascend to the surface. The tiny spherical bubbles rise under laminar flow at a rate following a modified Stokes Equation.

8. A blanket of sludge forms on the surface of the DAF cell. The blanket is supported from beneath by the tiny air bubbles.

9. The sludge blanket that forms on the top of the DAF cell is removed periodically by either a mechanical scraper or by hydraulic means. Under certain conditions scum removal can be achieved using a combination of both mechanical and hydraulic processes.

10. The clarified effluent water is drawn off the bottom of the tank by a series of lateral draw-off pipes that allow for uniform distribution along the bottom of the DAF cell.

Features

Polymer Or Flocculant Elimination

Formation of large, rapidly settling floc is not required, saving money. In addition to the chemical cost savings, typical Clari-DAF system effluent has greater compatibility with other subsequent treatment steps, such as membrane or gravity filtration.

Effective Operation In Low-Temperature Raw Water

The system process is unaffected by low-temperature raw water. The presence of large numbers of bubbles increases the chance of bubbles attaching themselves to suspended floc. In fact, at an 8% recycle flow and 70 psi saturation pressure, the system creates 681 million 40-micron bubbles per gallon at 40°F (4.4°C). At 68°F (20°C) the number of bubbles per gallon is 530 million.

With conventional clarification, increased chemical addition –at increased expense– is necessary to achieve larger, heavier floc that will settle in dense, low-temperature raw water.

Rapid Start-Up

Good-quality effluent can be achieved within 45 minutes of start-up. Other high-rate processes can take several days to form a stable floc blanket during start-up. Rapid start-up is ideal where daily flow variations occur and continuous operation of full plant capacity is not needed. Rapid start-up plants are ideal, too, for automatic start-up and shut-down without an operator –and associated labor costs.

High Percentage Sludge Solids & Low Loss of Process Water
Solids content of the floating sludge at the time of discharge is 3% to 5%, compared to 0.5% to 1.0% for conventional clarification. This results in increasing the efficiency of sludge handling equipment and a reduction in the cost for sludge processing.

Longer Filter Runs

Because the system removes more solids than conventional clarification, filters can run longer between backwash cycles. Fewer backwash cycles means less backwash water, less media breakdown, less filter-to-waste on filter start-up, and lower energy cost.

High Sludge Concentration

Dewatering can occur without additional thickening, eliminating expensive sludge thickeners. There is less volume of sludge to handle, less chemical conditioning, less time to dewater and lower energy costs. And because cake solids are higher, disposal costs are reduced.

High Loading Rates

The system can accommodate loading rates of up to 10 gpm/sf (24.20 m/hr). This not only contributes to its compact design, but also means that flow-through can be increased by as much as 8 to 20 times that of conventional clarification tanks.

Compact Design

Because of its high loading rate, the area needed for a Leopold Clari-DAF system is approximately 15% of that required for conventional clarification. The small footprint of the system improves land use, especially in existing plants with no room for expansion. Its compact design also means that it can be retrofit in existing conventional clarification tanks.

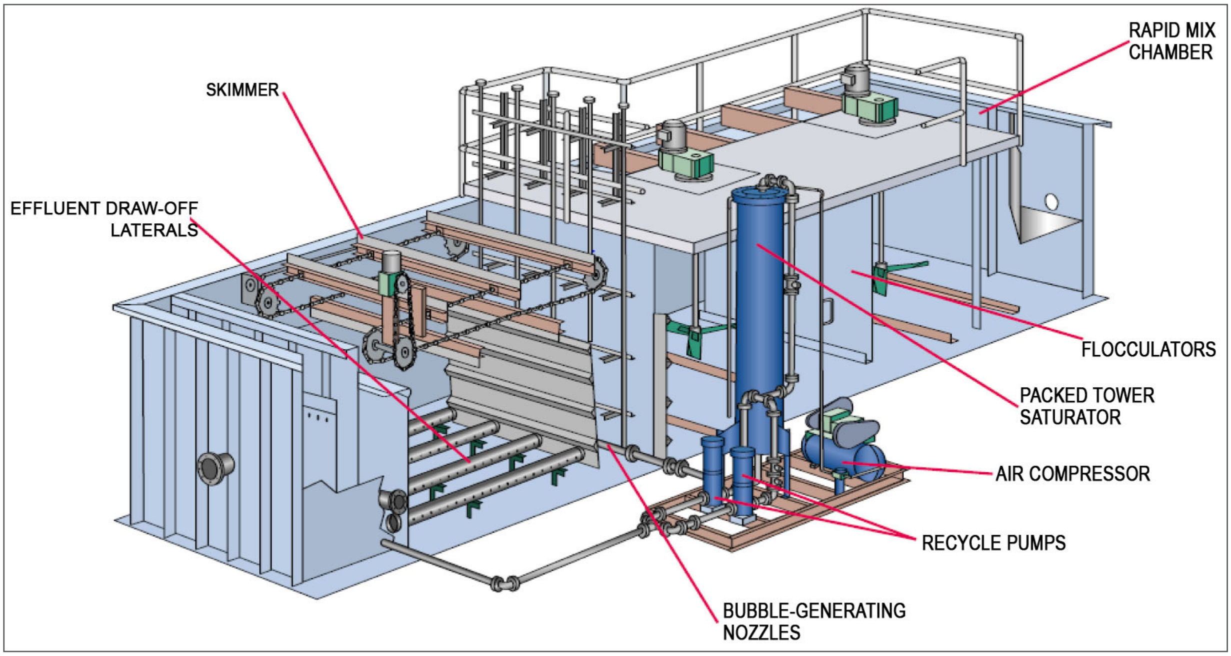

Figure 1: The Leopold Clari-DAF System

Steel Or Concrete Tank Installation

The system can be constructed above-ground using a steel tank when the design flow rates are low (0.25 to 1.0 MGD) or in-ground using a concrete tank for larger units. This flexibility contributes to keeping capital costs low.

The Principle Of Buoyancy Flotation

The system employs a physical process whereby very fine air bubbles (micro-bubbles) attach themselves to low-density particles suspended in the water and float them to the surface where they form a floating sludge blanket that is easily removed. Good-quality water can be produced within 45 minutes from start-up.

Conventional gravity sedimentation requires chemicals–inorganic coagulants and polymers–to precipitate low-density particles out of solution. But these particles typically have a density close to that of water, which means low settling velocity.

Applicable For A Variety Of Source Waters

The system process is versatile enough to be used for potable water applications or wastewater lagoon applications. For filter backwash water treatment, the Clari-DAF system typically can remove Giardia, Cryptosporidium cysts, and oocysts by >3.0 log.

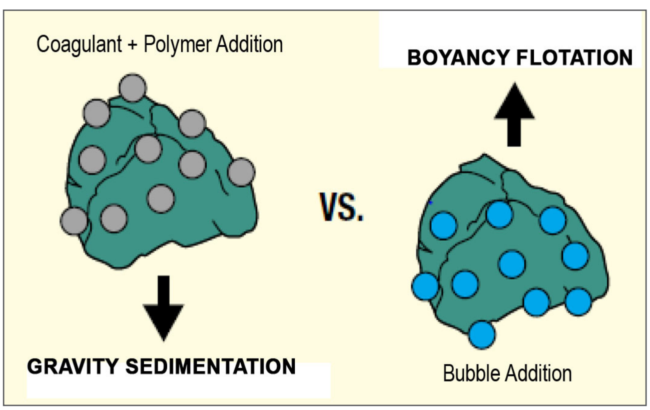

Figure 2: Gravity Sedimentation Vs. Buoyancy Flotation

Lower The Total Cost Of Operation With:

Improved Water Quality

- Longer filter runs
- Less backwash water
- Less media breakdown
- Lower energy cost
- Less filter-to-waste
- Reduces or eliminates filter aids

Improved Solids Handling

- Less volume of sludge to handle
- Less time to dewater
- Lower energy cost
- Lower chemical cost
- Higher cake solids
- Lower disposal costs

Lagoon Treatment System

The Leopold Clari-DAF LT (Lagoon Treatment) system is a clarification technology for the removal of algae, colloidal and suspended solids, precipitated dissolved solids, and BOD (Biochemical Oxygen Demand) associated with suspended solids from wastewater lagoon treatment systems. It is a proven, and effective technology for providing consistent effluent water quality and lowering the total cost of operation.

Helps Meet Effluent Permit Requirements

Installing a LT system after a wastewater lagoon settlement pond and before discharge to creeks, streams, rivers, or lakes can help wastewater treatment plants stay within effluent permit requirements by removing low-density solids that have not settled out. The Clari-DAF LT system can help wastewater plants stay within permit requirements during summer months when seasonal algae blooms can lead to regulatory issues.

Additional Benefits

Creating hundreds of millions of microbubbles of air to float suspended low-density particles out of the effluent, the Clari-DAF LT system increases the dissolved oxygen content in the discharged water. By adding small amounts of iron or aluminum coagulants, the Clari-DAF LT system can effectively remove phosphates, too.

Results Prove The System Effective

Prior to the installation of a Clari-DAF LT system as the final process step at a 0.4 MGD wastewater treatment plant in Johnstown, Colorado, the average effluent TSS achieved by sedimentation was 25 ppm (versus an average 195 ppm influent TSS) and the average effluent BOD achieved by sedimentation was 9.6 ppm (versus an average 227 ppm influent BOD). This was within the plant's U.S. EPA National Pollutant Discharge Elimination System (NPDES) permit for effluent of <75 ppm TSS and <30 ppm BOD. However, the plant routinely exceeded its permit limits due to algae bloom in the summer.

After installation of a Clari-DAF LT system to handle the algae and additional TSS and BOD from a moving bed biofilm reactor that had been installed to remove ammonia, not only were permit excursions due to algae growth eliminated, but also further reductions in TSS and BOD resulted. Average TSS dropped from 25 ppm to 8.1 ppm and average BOD dropped from 9.6 to 1.2 ppm. In addition, the coliforms previously

The Clari-DAF System Creates a milky solution of hundreds of millions of microbubbles 20 to 100 microns in size that rapidly float suspended particles to the surface for removal

The floating sludge blanket-a mass of solids formed by the microbubbles that have captured and floated the pin floc to the surface-is easily removed with a mechanical skimmer or by hydraulic overflow

The next step for this sludge produced by a Clari-DAF System is dewatering equipment.

The floating Sludge blanket-a mass of solids formed by the microbubbles that have captured and surface-is easily removed with a mechanical skimmer or by hydraulic overflow.

Figure 3: The Process

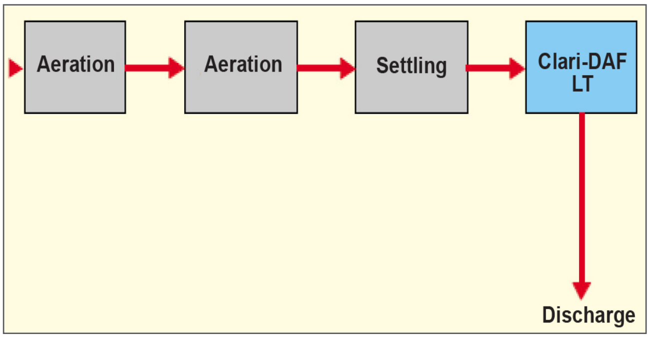

Figure 4: The Clari-DAF Lagoon Treatment System

leaving the settling pond decreased from 5,000 cfu/100 ml to 250 cfu/100 ml leaving the system.

Potential to Process Increased Flow-Through

The Johnstown, Colorado wastewater treatment plant with the Clari-DAF LT system installed is presently operating at 4 gpm/sf. But pilot tests show that it can operate at 8 gpm/sf. This means that the plant can handle increased flow-through without having to add additional capacity–a capital cost savings.

Improved Sludge Solids Lowers Cost

With the system, the solids content that can be achieved is 3% to 5% compared to 0.5% to 1% for gravity sedimentation. This results in increasing the efficiency of sludge handling equipment and reduction in the cost for sludge processing. Dewatering can occur without additional thickening, eliminating expensive sludge thickeners. There is less volume of sludge to handle, less chemical conditioning, less time to dewater, and lower energy costs. Because cake solids are higher, disposal costs are reduced.

About The Article

This article has been contributed by ITT Corporation India Pvt. Ltd. Mr. Shashi Shankar Naik is the Director of Sales for ITT India. ITT Water & Wastewater Leopold, Inc. is a global leader in the water and wastewater industry, having pioneered and acquired a number of innovative technologies aimed at improving the quality of water. www.fbleopold.com