

Advanced Filtration Approach for Treating High-Solids Wastewater



Managing high solids loading is a critical aspect of water and wastewater treatment in nearly every industrial process. From power generation and pharmaceuticals to food and beverage processing, elevated or seasonally erratic levels of total suspended solids (TSS), biological oxygen demand (BOD), or fats, oils and greases (FOG) in process water, wastewater or backwash water, for example, can wreak havoc on conventional filtration and separation approaches, causing blockages, fouling and unplanned downtime that disrupt operations.

For industrial processes discharging wastewater to downstream waters or municipal treatment facilities, addressing high solids loading is also critical for meeting local, state and federal regulations. Failure to do so can result in expensive service fees and surcharges — or worse, exorbitant fines for non-compliance.

Furthermore, with a growing focus on water conservation, many industries are looking to reuse as much water as possible by redirecting treated wastewater back into their processes. Conventional filtration methods like sand or multimedia struggle to purify high-solids wastewater to a level that is fit for reuse.

Self-cleaning filter technology offers a viable and cost-effective alternative for treating difficult, particulate-heavy process and wastewaters. Although this technology has existed for decades, until recently it had proven unable to handle high solids loading for an extended period without blinding off. To address this, Spiral Water Technologies (SWT) has developed a liquid/solid separator and automatic self-cleaning filter designed to remove ultra-high and variable TSS (15,000 mg/L and more) from a fluid stream while simultaneously concentrating solids for low-volume discharge. SWT offers operators of variable TSS process streams (e.g., oceans, rivers, lakes and ponds) less downtime due to natural upset conditions. Many end users who install Spiral Water systems in their natural cooling water processes see increased protection and uptime of their bearings, compressors, equipment and systems.

How It Works

Different from standard backwash filters, the Spiral Water filter is a mechanical cleaning system. And unlike scraper filters or strainers using low rpm metal scraping blades, SWT's patented distributor/cleaning assembly spins off tip vortices creating a unique hydrodynamic agitation that more effectively keeps the filter clean while maintaining a constant differential pressure (DP) across the filter. Backwash filters build up DP and waste more energy in the process.

Each Spiral Water advanced filtration and concentration unit contains a motor-driven, spiral-shaped brush that continuously cleans collected debris from inside the filter element. Each unit can filter upwards of 100 gallons per minute (gpm) at 15 to 25 microns, and units can be combined for higher flow rates. Solids collect at the bottom of the filter housing and are expelled through an automatic purge valve. An agitator inside the purge chamber keeps the collected and concentrated solids fluidized to prevent clogging and caking.

The SWT system, which is patented in 14 countries, does not require high inlet pressures to operate (10-30 psi) and is rated up to 150 psi. It also performs at very low differential pressures of less than 2 psi. Since the filter units do not use a backwash to clean the filter screen, they can concentrate solids to a high degree. Collected solids can be purged as a slurry ready for dewatering.

Compared to other filtration approaches, Spiral Water's advanced filtration and concentration technology offers significant advantages for addressing typical industrial processing challenges. When introduced to existing process solutions, operators can achieve filtration results (<25 microns) not possible with traditional methods like drum screens and screw presses, supporting companies' water reuse objectives.

Spiral Water in Action: Case Study #1



A pomegranate grower/producer in Stockton, California, was experiencing high operating expenses from trucking its raw pomegranate juice to an off-site centrifugal separation system — not to mention, because of the centrifugal separation process, 400 gallons of product were lost for every 3,000 gallon batch processed. On top of that, the severe centrifugal forces applied to the juice had an adverse effect on its flavor.

The producer purchased Spiral Water's Model 810 single-filter skid. With the ability to filter down to 15 microns, the producer was able to reduce the pomegranate juice from 8% solids to 1% solids, reducing the amount of product lost from 400 gallons per batch (a 13% loss) to just 85 gallons (a 1.7% loss).

Further, the concentrated pomegranate solids — a former “waste product” — contain nutrients and texture that are of value in other industries such as agriculture and cosmetics, giving the producer another revenue stream to target for further return on investment.



Water Consumption

With traditional filtration approaches, backwashing can last up to 15 minutes and require three times the normal flow rate. For example, a 100 gpm sand or multimedia filter will send nearly 300 gpm to waste in a single backwash cycle. If the cycle lasts 15 minutes, that means over 4,000 gallons of water is wasted. Unlike sand or screen filters, Spiral Water advanced filtration and concentration units clean themselves mechanically; they do not require a backwash cycle. When a purge event is triggered in the Spiral Water unit, it lasts only 2-3 seconds and discharges about 3 gallons. This reduces backwash water to waste by 90%, resulting in substantial water savings.

Because they can filter down to 15 microns, Spiral Water filters are also ideal for supporting water reuse and recovery initiatives. Placed after existing backwash systems in the treatment train, for example, Spiral Water filters can enable otherwise wasted water to be redirected for use elsewhere in the process, such as in rinsing applications.

Footprint

Space is an important consideration with traditional filtration systems. Multimedia filters, for example, often require holding tanks and circulating pumps to handle large volumes of both clean and dirty backwash water. Sand filters use thousands of pounds sand, taking up valuable space on the plant floor. Spiral Water advanced filtration and concentration units are compact

and lightweight. The Model 850, for example, has a 7-inch diameter and weighs about 90 pounds — compared to a 100 gpm backwash filter that could weigh over 5,000 pounds. This is especially important in applications like offshore oil and gas processing where weight matters. The Spiral Water unit is also modular and compatible with standard industrial equipment power requirements, making it scalable and easily retrofittable into existing plant footprints.

Maintenance and Labor

Spiral Water filtration and concentration systems are built with longevity in mind. Engineered with corrosion-resistant wetted parts, the units will not succumb to the effects of harsh wastewaters or process waters such as seawater. Continuous cleaning of the filter screen keeps it free of clogging debris and the agitator in the purge chamber means solids won't cake. All of this results in very little maintenance and no downtime.

In industrial process trains that include ultrafine filtration such as membranes, a Spiral Water unit placed ahead of this sensitive downstream equipment can protect it from damage and wear that could require expensive repairs.



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Spiral Water in Action: Case Study #2

Brewery wastewater contains significant amounts of organic matter consisting of hops, spent grains and yeast. As such, many breweries are installing onsite wastewater pre-treatment systems – which often include membrane bioreactors – to remediate wastewater before discharge to a municipal wastewater treatment plant, septic system or surface water source.

At a brewery in Northern California, the wastewater operator was struggling to successfully remove suspended solids prior to the bioreactor, which was reducing the efficiency of the process by decreasing the liquid fraction of the bioreactor and impacting the volume of wastewater that could be treated. Less wastewater means less beer; less beer means less revenue.

Analysis of the particle distribution size (PSD) indicated that 80% of the particles were smaller than 50 microns, explaining why it was so difficult for the system's existing automatic backflushing filter to reduce TSS. A Spiral Water Model 1000 filter unit, with a 25 micron screen, was installed and operated. Six sets of grab samples were analyzed for total COD (insoluble COD correlates to TSS). The 25 micron filter screen produced an average reduction in total COD of 13%, illustrating its ability to remove suspended solids from brewery wastewater and provide effective pretreatment for bioreactors.



Conclusion

When it comes to industrial water and wastewater treatment, there is no silver bullet. Oftentimes, achieving a particular objective – whether it's reducing water consumption, supporting reuse, or protecting sensitive downstream equipment – requires complementary solutions working together. To that end, the filtration capability, mechanical cleaning, low pressure, low discharge, and concentrating abilities of Spiral Water's filtration technology is enabling many industries to rethink the way they address and approach water treatment.

Additionally, new trials and repeat unit sales have proven SWT systems to be very effective in new market applications such as a biogas pre-digester for improved gas production, for hemp separation, and others.

About Spiral Water Technologies

Spiral Water Technologies develops and markets high performance products for advanced high solids filtration and concentration applications. Sophisticated in engineering yet elegantly simple to use, these products utilize our patented technology to deliver superior results while reducing CapEx and OpEx to deliver low Total Lifecycle Cost. Learn more at www.spiralwater.com.