SmartFlow Technologies

Concentrating Nature's Bioactivity™

WHITE PAPER

PRODUCT/WATER RECOVERY FROM IN-PROCESS WASTE STREAMS

USING SMARTFLOW TECHNOLOGIES HSTFF™

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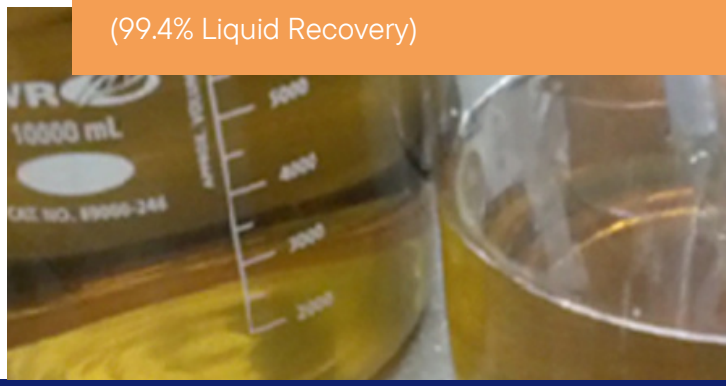
EXECUTIVE SUMMARY

Food, beverage, and ingredient manufacturers routinely lose valuable product and water down the drain. Each wash-down, separator overflow, or rinse cycle carries suspended solids, sugars, proteins, and other organics that drive up BOD/COD charges and wastewater volume.

SmartFlow Technologies' High-Solids Tangential Flow Filtration (HSTFF™) systems recover both product and clean water from these streams—producing concentrated, reusable solids and a clear, low-TDS permeate suitable for reuse or discharge.

GRAPE LEES CONCENTRATE
(99.4% Liquid Recovery)



By combining proprietary ultrafiltration (UF) and reverse osmosis (RO) modules in a continuous system, SmartFlow captures valuable material, reduces load on wastewater treatment, and dramatically cuts water consumption.

Benefits:

- Up to 95 % Water Recovery → Reduced discharge volumes
- 30–40 ° Brix Product Concentrates → Saleable by-product streams
- Permeate < 200 µS → Clean water for reuse or discharge
- Lower BOD/COD fines → Fast ROI (< 12 months typical)

Up to 95%
Water Recovery → Reduced discharge volumes

30–40 °
Brix Product Concentrates → Saleable by-product streams

FAST ROI
Lower BOD/COD fines contribute to possible ROI < 12 months

WASTEWATER STARCH RECOVERY
(L TO R: STARTING, CONCENTRATE, PERMEATE)

THE CHALLENGE:
WASTE STREAMS = LOST VALUE

Traditional food-processing lines wash away product solids and sugars that still contain commercial value. Typical “waste” from fruit, dairy, or beverage plants measures 20,000–40,000 ppm TDS and hundreds of mg/L BOD, requiring costly hauling or pretreatment.

Conventional recovery approaches rely on settling tanks or centrifuges that only separate coarse material and cannot reclaim dissolved constituents or clean water. As a result:

- Valuable ingredients are discarded instead of reused.
- High organic loading drives up municipal surcharges.
- Plants purchase and heat fresh water that could have been recovered.
- Sustainability targets remain unmet.

NOTE

- “Waste” streams often contain 2–4 % solids and sugars that can be captured and reused.

SMARTFLOW SOLUTION: INTEGRATED UF + RO RECOVERY

SmartFlow's HSTFF™ technology which integrates their patented ConSep® II filter modules allows for sequential membrane operations:

1.) Ultrafiltration Stage (UF)

- Removes suspended solids and pulp
- Concentrates to 3 × solids (~12–15 % dry matter)
- Produces a sugar-rich permeate

2.) Reverse Osmosis Stage (RO)

- Concentrates dissolved sugars/proteins to 30–40 ° Brix
- Generates clear permeate (< 200 µS conductivity)
- Suitable for in-plant reuse (wash-down, CIP make-up)

Automated Monitoring & Control

- Continuous conductivity and flow tracking
- 24/7 modular operation (1–5 000 gpm feed range)

< 200 µS

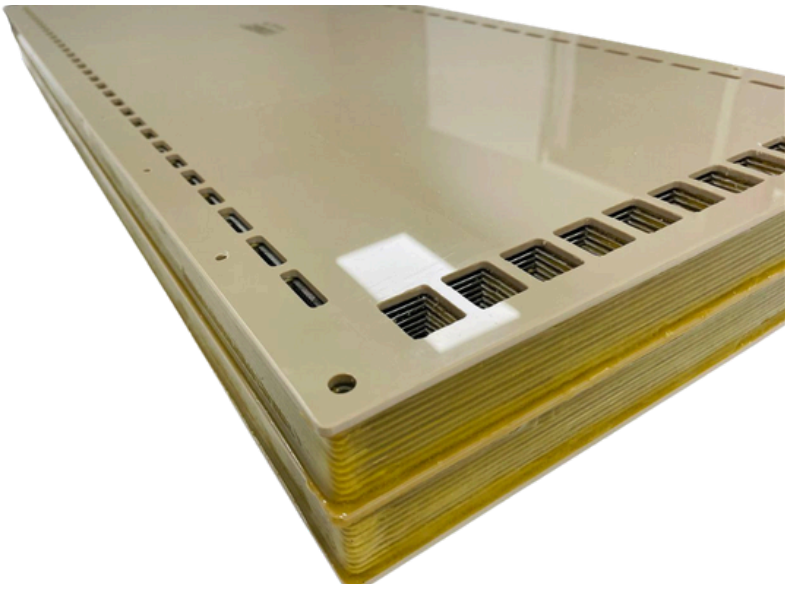
Clean water permeate for reuse or lower cost discharge.

MODULAR

Scalable from Pilot to Full Plant

120 PPM TDS

Final Water = 120 ppm TDS typically, within "tap water" range



SmartFlow Technologies ConSep® II Filter Module

BUSINESS IMPACT

Economic Performance

- Recovered media can be reused or sold as high value products.
- Reduced fresh-water purchase = lower utility bills.
- Avoided BOD/COD surcharges and haul-off costs.
- Significantly shortened ROI period.

Operational Benefits

- Continuous, closed-loop operation = higher throughput
- Automated membrane monitoring ensures stable quality output.
- Optimized for CIP and high-temp sanitation (up to 85 °C, 90 °C peak).

Sustainability Impact

- Up to 70 % overall water reuse rate possible.
- Reduced carbon footprint via lower energy for pumping and heating fresh water.
- Supports corporate ESG and zero-liquid-discharge initiatives.

TECHNICAL DISCUSSION

SmartFlow Technologies develops integrated systems to capture the waste from food processing lines to produce concentrated solids, concentrated liquid, and clean water streams. The clean water stream eliminates fines or fees for excess BOD/COD in wastewater experienced in many production settings

The systems utilize proprietary ultrafiltration and reverse osmosis stages to capture the solids and serum from food processing lines and process waste streams. The systems produce three outputs; a concentrated pulp, a high brix water stream, and a clean water for discharge or reuse stream. The concentrated pulp and high brix streams are able to be recombined at client selectable ratios to produce salable product lines. The clean water stream, with conductivity typically under 200 µS which is in the range of tap water (50-800 µS), can be discharged or reused within the plant.

SmartFlow Technologies ConSep® II Stacked Filter Design

COMMERCIAL PROCESS

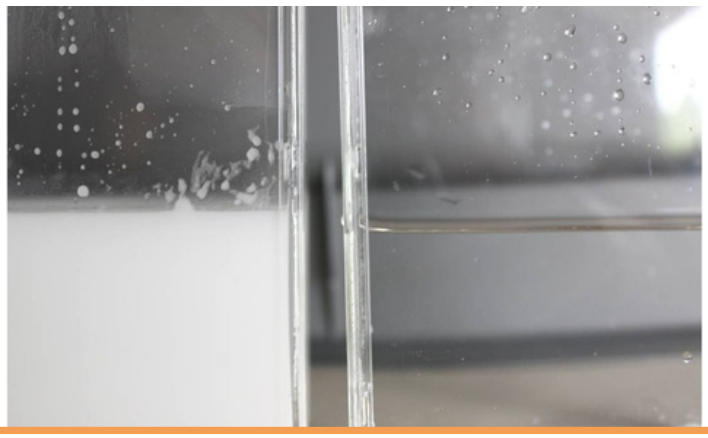
Large scale fruit processing facilities operate at maximum capacity during the harvest season. A typical process entails the fruit being unloaded from semi-trailers into wash troughs and transported via automated lines to further processing zones, sorting, peeling, slicing, cooking, packaging. Each step of the way, a portion of the fruit is broken and the pulp and serum of the broken fruit can be captured in waste collection points and directed to waste treatment.

Figure 1: SmartFlow's 6-Stage Project Development Program

SmartFlow Technologies' solution: Through it's 6-Stage Project Development Program, SmartFlow demonstrates the feasibility of concentrating the fruit solids into a paste consistency while processing the permeate from the fruit solids concentration to capture and recover the sugars, proteins, and macromolecules in a reverse osmosis process stage. The permeate from the sugar's recovery step has been shown to be suitable for in plant wash down use, saving fresh well water from being utilized for the process.

Once the membranes, process conditions, and instrumentation to monitor and document the process performance are determined, the system can be demonstrated at pilot scale using continuous processing design to enable 24/7 operation in production.

Separating Crisco from Waste Water



With customer concurrence that the process is meeting their target objectives, a production scale system is designed, built and installed. SmartFlow has designed modular production systems that accept input streams of 1 to over 5,000 gallons per minute. Typical input streams in fruit processing applications contain approximately 2-4% fruit pulp solids and/or 2-4% dissolved sugars, proteins, and natural organic acids in a watery slurry.

The ultrafiltration stage can concentrate the fruit pulp approximately 3X or more to produce a typical paste containing 12-15% dry matter. This material is continuously bled off the concentration stage and can be directed to be reincorporated to product. The sugar rich permeate from the ultrafiltration stage can be concentrated utilizing our specialty RO system. With the ultrafiltration system designed to remove suspended solids (pulp) primarily, incoming RO streams are in the same dissolved solids (sugars, salts, small proteins) range as the incoming feed stream to the ultrafiltration system and measures approximately 3- 5,000 µS in conductivity.

In the sugar recovery stage, the concentrate is typically increased to approximately 30-40 degrees Brix in the RO system. For reference 1% sugar is 1 degree Brix. During continuous processing, the concentrate bleed from the RO stage can be directed to storage tanks for subsequent recombination with products elsewhere in process or sold as inputs to processes requiring high sugar inputs. The permeate in this sugar recovery and concentration stage is produced at a rate that is proportional to the input volume and has a typical conductivity of under 200 µS which corelates to approximately 120 ppm TDS and sugar is no longer detectable. The dissolved components that account for the conductivity of the permeate are salts and low molecular weight compounds that pass through the RO membrane.

BOD DISCUSSION

The rate and degree that organic matter in wastewater is decomposed (or oxidized) by the normal bacteria present in a sample is largely dependent on the characteristics of the organic matter. For example, some organic matter (like sugars or starches) are oxidized very easily and rapidly, and will almost always result in measurable "BOD". Other organic matter, however, is sometimes resistant to biological oxidation, and may require special "acclimated" bacteria to oxidize the material and to show a "BOD". Although this is what actually happens in nature, it causes significant variation in BOD results from sample to sample.

Some common ranges of BOD results are as follows, in mg/L:

Influent	**150-400**
Primary Effluent	**60-160**
Secondary Effluent	**10-60**
Digester Supernatant	**1000-4000+**
Industrial Wastes	**100-3000+**

Pennsylvania department of environmental protection biochemical oxygen demand

Acceptable influent BOD levels are set locally. For example, the Cape Fear Public Utility Authority in eastern North Carolina has set an influent action level of 200 mg/L BOD for their water treatment plant. Industrial waste streams measuring higher than 200 mg/L are required to be pretreated. If treatment is not available, the waste is required to be hauled away to a different treatment facility. Due to the high water table in the area, no waste is accepted above the regulatory influent action level.

ANALYSIS

Each of the system's multiple stages eliminates components from the process wastewater and solid land fill volumes generated by the plant. Typically, the system reduces the dissolved solids in the wastewater from an estimated 20,000- 40,000 ppm in the influent to about 120 ppm in the final water effluent. Conductivity of the final water effluent was measured in-line continuously and the typical value was in the range of 200 µS.

With the final RO permeate water quality, the water is typically reused in the plants for washdown or other operations. This eliminates the volume of water from immediate discharge to the local wastewater treatment facility. The typical 120 ppm TDS of the final water effluent is within with the range of tap water (50-800 ppm) and therefore expected to be acceptable for wastewater disposal without fines or fees due to high BOD levels.

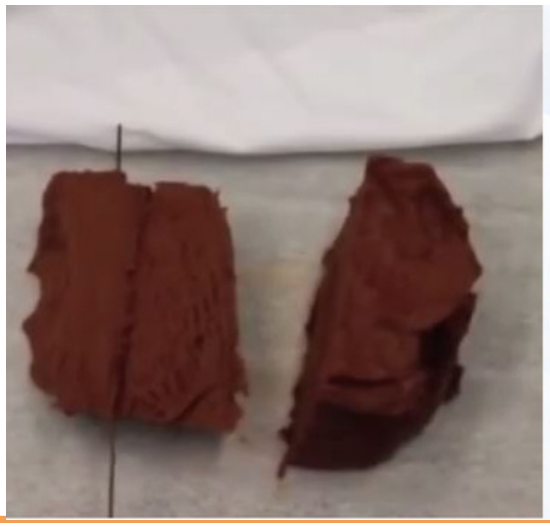
Significant positive economic benefits can be achieved by the system through the capture of fruit pulp and sugars prior to entering the wastewater drain system. By capturing them before entering into the wastewater they can be directed for recombination into salable products, eliminating these streams from being lost to waste disposal.

Mushroom

Enzyme Recovery

Tomato Juice Processing

Concentrate



Permeate

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