



FilmTec™ Hypershell™ Elements – Dairy Wastewater Management in a Reverse Osmosis Whey Concentration System

Membrane filtration is an essential part of producing milk, cheese, whey, lactose, and many other valuable dairy ingredients. Reverse Osmosis (RO) and Nanofiltration (NF) membranes maintain all nutrients while removing water, and are widely used for the concentration, demineralization and separation of dairy ingredients derived from milk and whey.

DuPont Water Solutions and Tetra Pak work together to help dairy processors, like Arla Foods, create high-quality and high-value dairy products that are economically feasible and enable people to thrive around the world. In addition to enabling dairy ingredients, membrane filtration facilitates water reuse. This case study demonstrates how technology expertise and commitment to sustainability goals can help dairy processors achieve 100% wastewater reuse.

Background

According to the United Nations World Water Development Report, 80% of the global wastewater produced is released to the environment without adequate treatment. In the dairy industry, wastewater management is one of the main environmental challenges. The dairy industry consumes high amount of process water to maintain the required hygiene and cleanliness standards, generating highly contaminated wastewater streams. For wastewater treatment, significant amounts of water need to be removed through membrane filtration or evaporation processes.

Fast Facts

Location: Denmark - EU

Commissioning: 2020 – Operational period of 2 years

Application: Whey Concentration

Water type: Dairy Wastewater

OEM/End User: Tetra Pak / Arla Foods

Technology: Reverse Osmosis and Nanofiltration

Plant Capacity: 65 tons Whey/h

Product: FilmTec™ Hypershell™

The Challenge

Arla Foods' dairy factory in Denmark produces around 1,450 tons per week of mozzarella. The wastewater from the production was being treated and discharged into the environment.

The effluent contained dairy residues and resulted in an organic-rich effluent characterized by high concentrations of COD and biological oxygen demand (BOD), which presented regulatory challenges for wastewater disposal or reuse.



The Solution

Arla Foods is committed to ensuring environmentally friendly dairy processing and using the latest water treatment technologies. It is taking an active role in water reuse and wastewater discharge reduction through its collaboration with DuPont Water Solutions and TetraPak.

The principal constituent of milk and whey is water. In milk processing, water represents 87% of the content, while in whey it is 94%. Development of newer membranes with high flux and rejection characteristics have increased the success rate of water reuse in dairy processing. With water being a crucial and limited resources on-site treatment and reuse can decrease the wastewater treatment costs for dairy factories, reducing the demand for fresh cleaning water while positively impacting the quality of the aquatic environment.

Arla's main on-site process currently includes a series of wastewater reverse osmosis polishers using FilmTec™ Hypershell™ elements that reduce the COD to values below 25 mg/L, so that the recovered water can be reused for cleaning water throughout the site.

Customer Feedback

"Now we reuse all RO water, where before we dumped 1,000 m³/week."



Case Study

The expected increase in worldwide milk and dairy ingredient production, in addition to the effluent characteristics, have led to a global concern around dairy wastewater (DWW) management. Cheese whey COD can range from 50,000-80,000 mg/L and the typical dairy process wastewater has a COD of around 100-500 mg/L after being treated with RO and 2000-5000 mg/L after being treated with NF. The measured concentration of the wastewater may vary between different dairy manufacturing sites due to the production mix of dairy products that are produced at each location as well as the different processing methods applied.

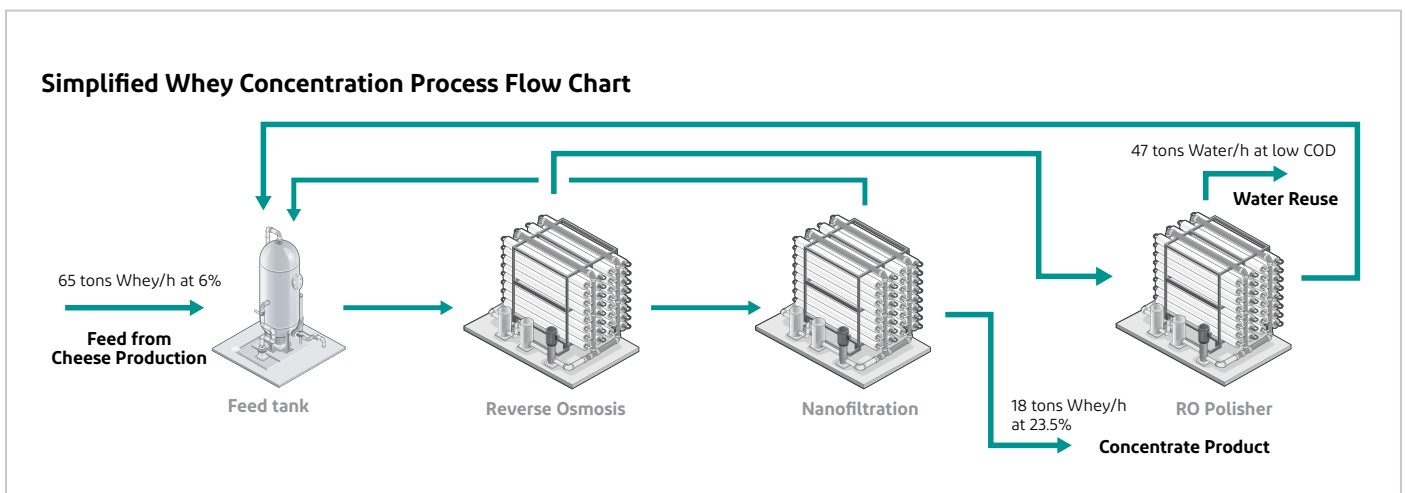
There is also a lack of knowledge on the amount of DWW produced in different countries, the existing legislation, the cost of the available management practices and the future challenges for achieving sustainable dairy wastewater management. Therefore, the main challenge for companies like DuPont and Tetra Pak, who provide filtration solutions to the dairy industry, is to deliver innovative membrane technologies and processes, pointing to water savings and a circular economy.

In this case study, advanced on-site treatment methods such as reverse osmosis and uv-light for wastewater reuse has been chosen as an option for DWW management. This information has been collected from Arla Foods' dairy factory in Denmark, that produces around 1450 tons/week of mozzarella. The collected retentate is then moved to a whey concentration RO plant, where on-site wastewater treatment, consisting of a final reverse osmosis step plus uv-light, is applied for water reuse.

According to the results, Arla Foods' plant has reduced its wastewater discharge from 1,000 m³ water/week to 100% wastewater reuse by using on-site treatment with FilmTec™ Hypershell™ RO-polisher membranes, resulting in a total cost savings of approximately \$113,500/year.

Tetra Pak, as a system provider, improves the efficiency, quality, and safety for dairy processing and production. DuPont as membrane technology supplier provides technical expertise and strongly supports the wastewater reuse project. 65 tons of whey per hour are concentrated using DuPont™ FilmTec™ Hypershell™ RO-8038/30 and NF-8038/30, producing 18 tons per hour of concentrated product at 23.5% total solids (TS). Approximate, 47 tons of water per hour is recovered using FilmTec™ Hypershell™ elements as a final polishing step and reused as cleaning water.

The entire dairy plant represents a multi-technology membrane system using reverse osmosis, nanofiltration and a RO-polisher to achieve a process with zero discharge. In this case, the NF permeate and RO polisher retentate are recycled back to the feed tank with only RO/NF concentrate product and RO-polisher permeate water for reuse. This is an ideal process set-up where the combination of different membranes leaves no by-products, so that all process streams can be reused or sold as valuable products.



Using the on-site DWW treatment with the adoption of a multi-technology membrane combination in full-scale supports water reuse and concentration of valuable dairy ingredients, such as whey, generating additional profits for the dairy industry.

DuPont Life Sciences and Specialties

DuPont advances nutrition with sophisticated science-based technologies enabling the manufacturing of traditional caloric sweeteners and dairy products to low and no calorie sweeteners and specialty health solutions. With more than 40 years of experience in the dairy industry, we provide full-fit sanitary spiral wound elements, FimTec™ Hypershell™ rigid outer shell technology, ion exchange resins, and continuing innovation in quality and design to help you process milk into the essential foods and ingredients we use every day. Our comprehensive product line, technical expertise, manufacturing excellence, continuous innovation and global reach provide you with solutions to solve your application and process challenges and enable economical, high-performance, enduring operations. Our broad range of Life Sciences products improve the quality of life for humans, plants, and animals in our world.



Water Solutions

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