

CASE STUDY: Reverse Osmosis Filter System

Reverse osmosis filter system saves natural gas, electricity, water and money at Maryland balancing plant.

BEST PRACTICE

Replace evaporators with reverse osmosis systems for more efficient milk balancing operations.

The Maryland & Virginia Milk Producers Cooperative (Maryland & Virginia) processes approximately 767 million pounds of milk into cream, and condensed and powdered milk each year at its balancing plant in Laurel, Md. Balancing plants require a lot of energy to evaporate water from milk, so related energy-savings initiatives can have an immediate and significant effect for processors.

In late 2009, Maryland & Virginia's Laurel plant replaced two outdated milk evaporators with one reverse osmosis (RO) filter system. The old evaporators used steam to bring the incoming milk to 36 percent total solids – an energy-intensive process. The new RO system uses a semipermeable membrane to separate much of the milk's liquid without applying any heat. The RO system brings the incoming milk to 32 percent total solids, with the remaining 4 percent reduction of total solids being accomplished in the finisher condenser. The new process is expected to significantly reduce the plant's steam and save 528,000 therms and an estimated 82,290 kWh of electricity per year, saving on utility costs while significantly reducing greenhouse gas (GHG) emissions.

Instead of using steam, the most energy-intensive part of the milk drying process, the RO system functions

as a selective membrane. Cold milk goes through a series of tubes, where most of the water is removed. The remaining liquid is then evaporated through a spray dryer system, which turns condensed milk into powdered and evaporated milk.

In addition to saving the gas needed to produce steam, this new system also enables water recycling. Remaining milk liquids that are left over after the RO process now pass through the finisher filter and can be used to wash plant equipment. This has reduced excess water runoff at the Laurel plant, making the new RO system even more sustainable.

The \$2,202,000 RO system is expected to save approximately \$490,000 in energy costs annually. With the help of a \$65,150 incentive from the Maryland Farm Energy Audit Program, operated by EnSave, Inc., the system has an anticipated payback period of less than 4½ years. It is a solid investment that will continue to make the plant more cost- and energy-efficient for years to come.

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Key benefits.

Annual Energy Reduction: 82,290 kWh per year and 528,000 therms per year, representing an estimated annual cost savings of \$490,000.*

Payback: The plant will realize a return on its investment in 4.4 years. Investment dollars include the Maryland Farm Energy Audit Program incentive.**

Greenhouse Gas (GHG) Reduction: The current savings in electricity use represent the equivalent of 59.1 metric tons of CO₂ per year, equivalent to the GHG emissions avoided by recycling 19.9 tons of

waste instead of sending it to the landfill. The current savings in natural gas represents the equivalent of 2,638 metric tons of CO₂ per year, equivalent to the annual GHG emissions from 504 passenger vehicles.

Source: EPA Greenhouse Gas Equivalencies Calculator (www.epa.gov/cleanenergy/energy-resources/calculator.html).

Lowered Maintenance: The RO system requires less cleaning than the evaporator system because there is no buildup from heating elements. Because it is a low-temperature operation, the RO system does not require insulation for steam lines, resulting in lower plumbing installation and maintenance costs.

Farmer-owned milk cooperative balances surplus milk and energy savings.

CHALLENGE AREA

Reducing energy required to remove water from fluid milk.

The old steam evaporator system was effective but energy-intensive. The new RO system removes most of the fluid from the milk without the need to generate heat in the process, saving significant energy. Additionally, excess waste water is now filtered after the RO process and used to clean plant equipment, for further environmental and cost benefits. While increased horsepower is required for the new RO system, the reduction in total chilling load makes the increase negligible in terms of total energy use.

PLANT PROFILE

Maryland & Virginia Milk Producers Cooperative, Laurel, Md., Balancing Plant.

Maryland & Virginia's Laurel balancing plant processes 767 million pounds of milk from its nearly 1,500 farm families throughout the region. They specialize in processing powdered and condensed milk.

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FINANCIAL INFORMATION

Investment	\$2,202,000
System includes	A reverse osmosis filtering system with a series of tubes for processing cold milk through a membrane
System life expectancy	Ten years, after which new membranes may be required
Offsetting incentives	\$65,150 from the Maryland Farm Energy Audit Program**
Payback period	4.4 years with a savings of 82,290 kWh and 528,000 therms per year*

*Energy cost savings were calculated at the time of project completion, based upon the regional cost of energy for the plant's location. Energy costs may fluctuate over time and by geographic region.

**State and federal incentives will vary by plant.

QUICK FACTS

- Balancing plants play a crucial role in stabilizing the milk market by turning seasonal excess milk supplies into evaporated or powdered milk. Without balancing plants, surplus milk would be disposed of and wasted – a loss to producers.
- The new RO system at the Laurel plant is capable of processing 730,000,000 pounds of milk annually.
- Using the filtered “cow water” from the RO process to wash equipment dramatically reduces the environmental impact of excess water runoff.

TOOLS AND RESOURCES

EnSave can help farms and food processors identify ways to save energy. Contact EnSave at 800-732-1399 for more information, or visit www.EnSave.com.

THE DAIRY PLANT SMART project is designed to increase U.S. milk processor awareness of and confidence in the economic feasibility of energy management practices. Dairy Plant Smart is one of 10 projects endorsed by the Innovation Center for U.S. Dairy™ to help reduce greenhouse gas emissions and increase business value across the dairy industry.

This is one in a series of validated case studies that have been proven to be economically viable in fluid milk processing plants. Together, these case studies help identify critical control points for energy management best practices for improving efficiency and profit opportunities.

For more information about Dairy Plant Smart, or to join our mailing list, e-mail innovationcenter@usdairy.com.

The Innovation Center aligns the collective resources of the dairy industry to offer consumers nutritious dairy products and ingredients, and promote the health of people, communities, the planet and the industry.