Membrane TECHNOLOGY FORUM®

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Dairy FOODS

ADPI AMERICAN Dairy Products INSTITUTE

New energy-savings membrane element: **Optum RO**

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Veolia's Optum RO Element

Product Overview

What is the Optum RO Element?

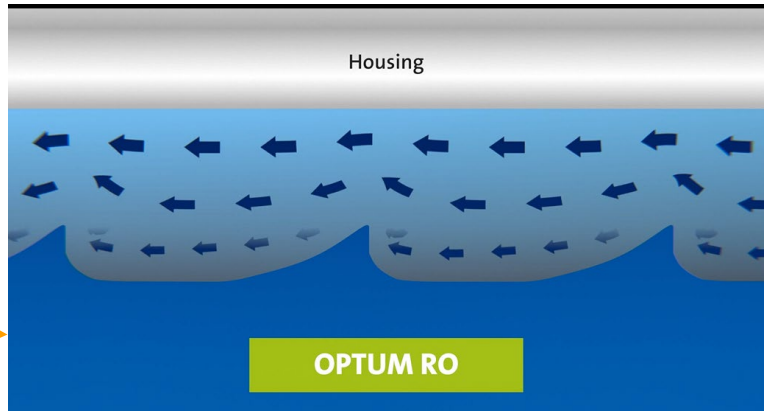
- A new energy efficient element designed with engineered sleeves on both ends of the element to reduce OPEX and deliver against multiple health and safety concerns in food processing applications
  - Significantly reduces fluid bypass while maintaining 3A sanitary standards
  - Reduces pump energy spent on excessive fluid bypass
  - Offers a 20% reduction in force required for installation and removal
  - Blister-free construction
  - Reduction in plastic waste
  - Strict Product Compliance

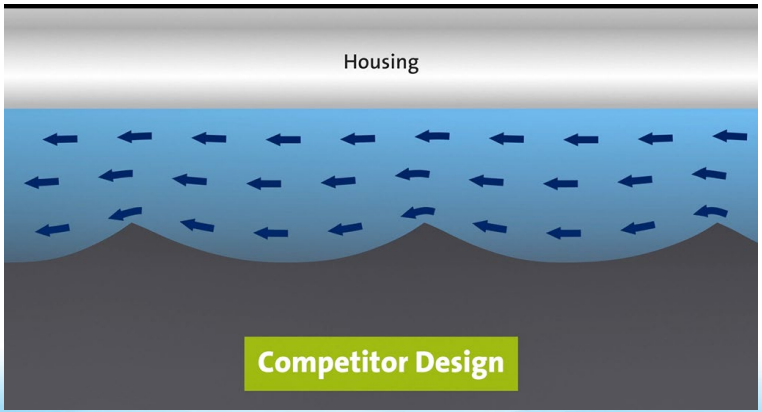
Targeted Applications

- Lactose Recovery
- Whey and milk protein concentration
- Sugar and juice concentration
- Protein and sugar isolation
- Polishing of permeates and COW water for recovery and reuse

Veolia's Optum Series Elements

Energy Efficient Sleeve Design

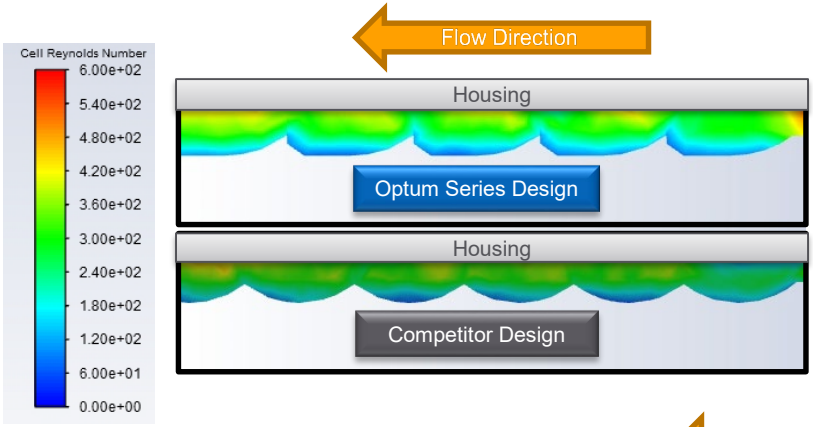


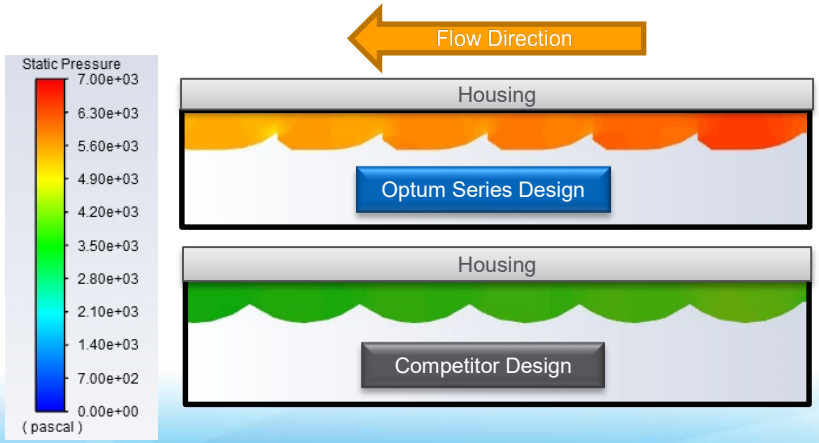


Innovative sanitary geometry creates turbulence and static pressure to minimize fluid bypass compared to competitor shelled elements and standard cage-wrapped elements

CFD Modelling of Flow

Annular space between outer shell and housing wall

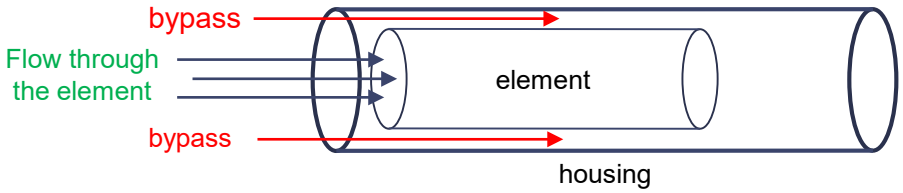




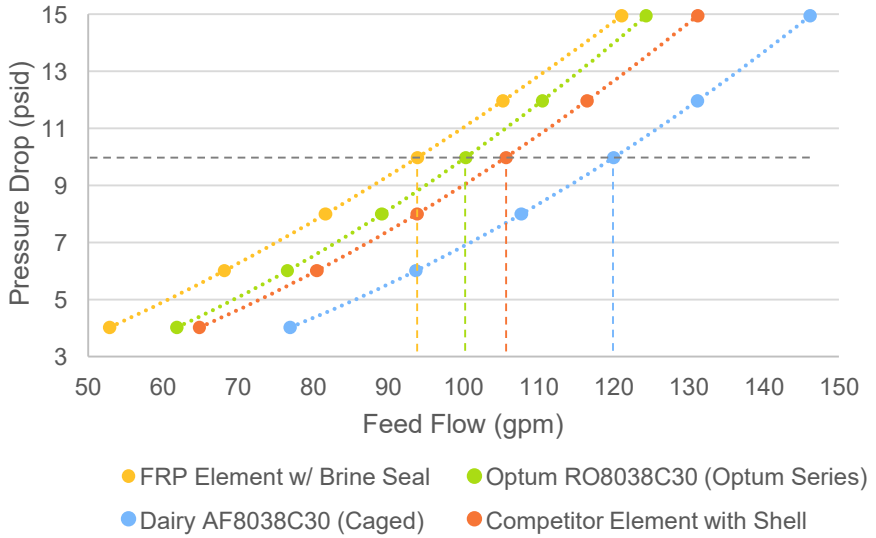
- Increased Reynolds number with Optum design
  - Increased turbulence within annular space
- Increased static pressure with Optum design
  - Lower fluid velocity within annular space

Lab Testing of Various Element Designs

Quantifying bypass flow and pressure drops



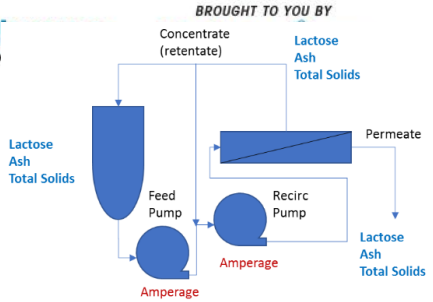
Feed Flow = Flow through element + Bypass Flow



Pressure Drop Across Single Element (psid)	FRP Element w/ Brine Seal				Dairy AF8038C30 (Caged)				Optum RO8038C30 (Optum Series)			
	Feed Flow (gpm)	Flow Through Element (gpm)	Bypass Flow (gpm)	% Bypass	Feed Flow (gpm)	Flow Through Element (gpm)	Bypass Flow (gpm)	% Bypass	Feed Flow (gpm)	Flow Through Element (gpm)	Bypass Flow (gpm)	% Bypass
4	52.6	52.6	0	0	76.7	52.6	24.1	31%	61.6	52.6	9.0	15%
6	67.9	67.9	0	0	93.4	67.9	25.5	27%	76.3	67.9	8.4	11%
8	81.4	81.4	0	0	107.4	81.4	26.0	24%	88.9	81.4	7.5	8%
10	**93.6**	**93.6**	**0**	**0**	**119.8**	**93.6**	**26.2**	**22%**	**100.1**	**93.6**	**6.5**	**6%**
12	105.0	105.0	0	0	130.9	105.0	25.9	20%	110.2	105.0	5.2	5%
15	120.8	120.8	0	0	145.9	120.8	25.1	17%	124.1	120.8	3.3	3%

Small Scale Pilot Testing

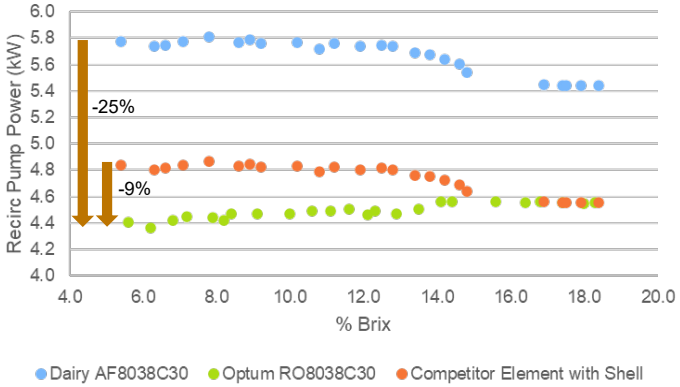
Quantifying recirculation flow and power consumption

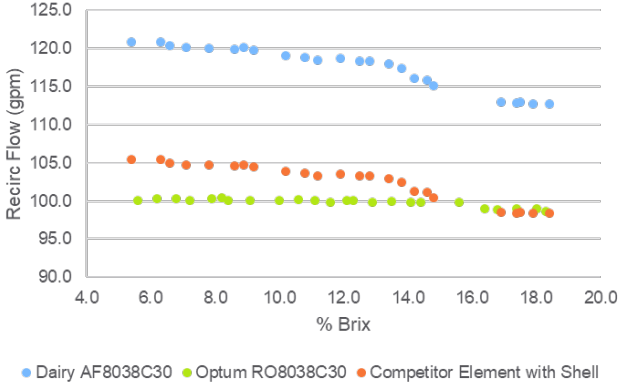


Davis Dairy Plant, South Dakota State University

Recirculation pump 5HP Fristam FPHP722-145

- **Feed:** Sweet Whey UF Permeate – Lactose Recovery
- **Element Pressure Drop:** 10 psid across element
- Fixed flux & Recovery
- Batch processed 140 gal – concentrated up to 19% Brix





Less Power (kW) consumption required with Optum RO compared to caged or competitor shelled elements when operated at similar pressure drops and recoveries

Case Study: Optum RO vs Competitor Shelled Element

Quantifying total savings in full scale, commercialized dairy plant

Application: Lactose Recovery

System Design: Three stage Feed & Bleed system with six 5-long vessels per stage
- 30 elements per stage

Operating Parameters:
- Pressure drop per stage: 60 psid
- System Recovery: 82%
- Concentrated up from 5% → 22% Brix
- 6,000 hrs uptime per year
- Baseline power consumption with competitor shelled element in stage 1 was 125 kW

Results: **4.6% reduction** in total power consumption of RO system after replacing competitor shelled elements with Optum RO in stage 1

	Competitor Element with Shell	Optum RO8038C30	Optum RO Savings
Total Annual Energy Consumption	750,000 kWh	715,500 kWh	34,500 kWh/yr
Energy Cost (United States, WI)	$0.08 USD/kWh		
Annual Energy Cost	$60,000	$57,240	$2,760/yr
Energy Credit	-	$1,610	$1,610
Carbon Footprint Reduction	374.97 tCO_2e/yr	357.72 tCO_2e/yr	17,250 $kgCO_2e$/yr

$4,370 Savings in one year by switching first stage elements from Competitor element with shell to **Optum RO** element!!

Optum RO: first in its class to receive **custom energy saving incentives** from Wisconsin's **Focus on Energy** Program.

focus on energy® Partnering with Wisconsin utilities

Optum RO vs Standard Caged Elements

Quantifying total savings

Application: Lactose Recovery

System Design: Three stage Feed & Bleed system with six 5-long vessels per stage

- 30 elements per stage

Operating Parameters:

- Pressure drop per stage: 60 psid
- System Recovery: 82%
- Concentrate up from 5% → 22% Brix
- 6,000 hrs uptime per year
- Baseline power consumption with standard cage-wrap element in stage 1 was 140 kW

Results: **15% reduction** in total power consumption of RO system after replacing standard caged elements with Optum RO in stage 1

	Standard Cage	Optum RO8038C30	Optum RO Savings
Total Annual Energy Consumption	840,000 kWh	715,500 kWh	124,500 kWh/yr
Energy Cost (United States, WI)	$0.08 USD/kWh		
Annual Energy Cost	$67,200	$57,240	$9,960/yr
Energy Credit	-	$3,920	$3,920
Carbon Footprint Reduction	419.97 tCO_2e/yr	357.72 tCO_2e/yr	62,250 $kgCO_2e$/yr

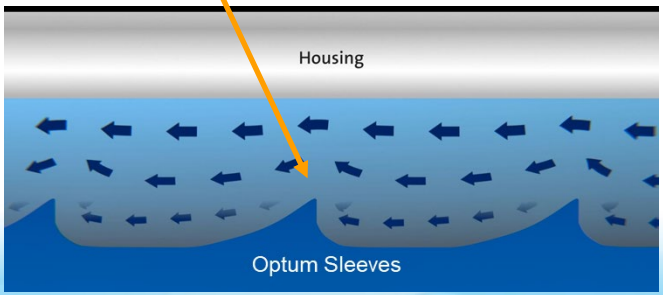
$13,880 Savings in one year by switching first stage elements from standard caged elements to **Optum RO** elements!!

New Optum Series Elements

Ergonomic Benefits of the Shell Improve Employee Health & Safety

- Less surface contact between element and housing wall
- 20% reduction in force required during installation and removal compared to standard caged elements
- Sleeves help maintain element scroll integrity for improved lifetime, performance, and easier removal

Fewer points of vessel wall contact during installation and removal from both a necked middle and sleeve peaks



Veolia's Optum NF Element

Newest Optum Series Product Offering

Membrane products continue to evolve and improve.

We strive to put your needs first in those evolutions.

New products like Optum RO and Optum NF are designed to meet your needs… give them a try!

Thank You

Back-up

Case Studies

Davis Dairy Plant, South Dakota State University

Recirculation pump 5HP Fristam FPHP722-145

- **Feed:** Sweet Whey UF Permeate – Lactose Recovery
- **Element Pressure Drop:** 10 psid across element
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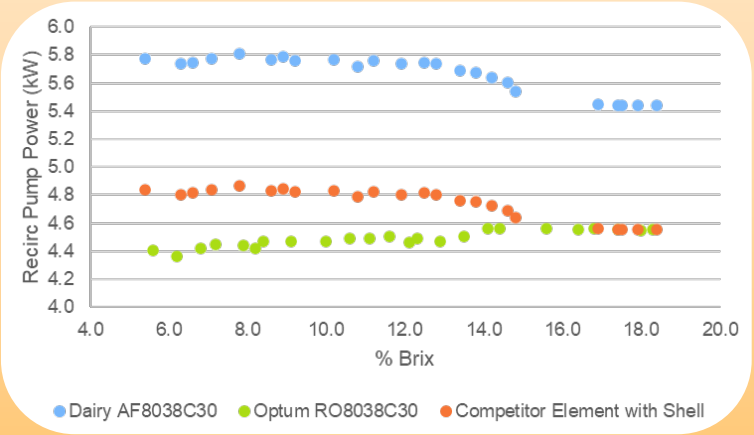
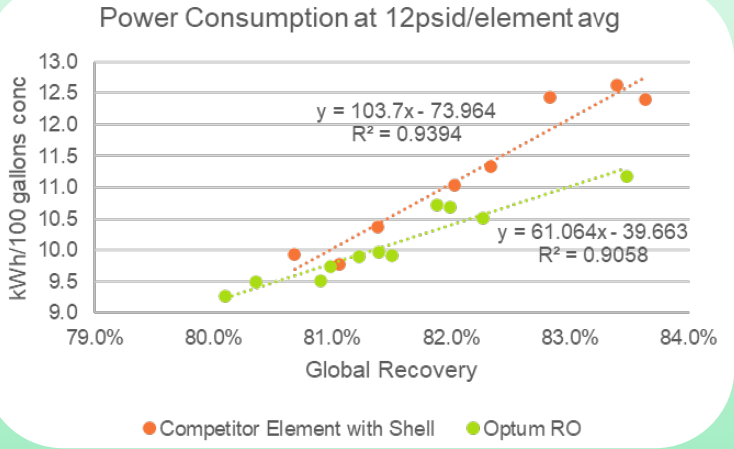


Dairy Powder Plant in Wisconsin

Wisconsin's Focus on Energy Measurement & Verification Study

- Sweet Whey UF Permeate – Lactose Recovery
- Baselined competitor element first – 82.2% Global Recovery
- Replaced Competitor elements with Optum elements in Loop 1



Less Power (kW) consumption required with Optum RO compared to caged or competitor shelled elements when operated at similar pressure drops and recoveries

Energy Savings and WI FOE Rebate Calculations

Known Values:

- Trial site had an RO System that uses 125 kW of power (power factor 0.9 and voltage of 480)
  - kW = (Volts × Amps × Power Factor × 1.732) ÷ 1,000
    - 1.732 is the constant used when calculating kW for a three phase
- This site switched from **competitor shelled element to Optum** in first stage of a 3-stage system - so will use **4.6% energy savings assumption**
- Trial site operates 6,000 hrs/year

Calculations:

1. Power Savings = 125 kW * 4.6% = 5.75 kW
2. 5.75 kW power savings * 6,000hrs annual operation = 40,250 kWh/year savings
3. **Energy Credit = (Total kWh Savings * $0.03/kWh) + (Total power savings * 100)**
   a. (34,500kWh * $0.03/kWh)+(5.75kW*100) = $1,610 energy credit
      i. If they buy 1 stage (30 elements), then energy credit would be $53.66/element
      ii. If they buy 2 stages (60 elements), then energy credit would be $26.83/element
      iii. If they buy 3 stages (90 elements), then energy credit would be $17.89/element

Example 2:

If the same site were to switch from a **Cage design to Optum**, then there would be a **10% energy savings assumption** with the following calculations:

1. Power Savings = 140 kW * 10% = 14 kW
2. 14 kW power savings * 6,000hrs annual operation = 84,000 kWh/year savings
3. Energy Credit = (Total kWh Savings * $0.03/kWh) + (Total power savings * 100)
   a. (84,000kWh*$0.03/kWh)+(14kW*100) = $3,920 energy credit
      i. If they buy 1 stage (30 elements), then energy credit would be $130.67/element
      ii. If they buy 2 stages (60 elements), then energy credit would be $65.33/element
      iii. If they buy 3 stages (90 elements), then energy credit would be $43.56/element

WI FOE Rebate Process

RO PROCESS VARIABLES	INPUT	NOTES
Annual hours of RO processing (not cleaning)		
Stage 1 Existing Element Brand and Specific Product		
Stage 2 Existing Element Brand and Specific Product		
Stage 3 Existing Element Brand and Specific Product		
Stage 1 Proposed Element Brand and Specific Product		
Stage 2 Proposed Element Brand and Specific Product		
Stage 3 Proposed Element Brand and Specific Product		
Stage 1 Boost Pump Power (KW)		
Stage 2 Boost Pump Power (KW)		
Stage 3 Boost Pump Power (KW)		
Stage 1 Circulation Pump Power (KW)		
Stage 2 Circulation Pump Power (KW)		
Stage 3 Circulation Pump Power (KW)		

Note:

- If pump motor power draw information is not available, use motor nameplate horsepower and add “HP” in the notes column
- For the Focus on Energy incentive application, please provide your utility representative permission to give your Focus Energy Advisor the last 12 months of electrical use (KWH) and cost ($) information.

Caged vs Optum Elements

Optum sleeve reduces annular space and element bypass