

North America's First Full Scale Nutrient Recovery



- By Rob Baur
- Senior Operations Analyst
- Clean Water Services

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Ostara Pilot

- 1 lpm pilot, 6 meters tall



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Precipitation Reaction

- $\text{NH}_3 + \text{PO}_4 + \text{Mg} + 6 \text{H}_2\text{O} \rightarrow \downarrow \text{NH}_3\text{PO}_4\text{Mg} * 6 \text{H}_2\text{O}$
- pH dependent. $\text{CO}_2 \uparrow = \text{pH} \uparrow = \text{struvite} \downarrow$
- Struvite, MAGamp, MAP
- Mg usually limiting nutrient.
- Supplied as Dust Guard in summer and De-icer in winter.

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Pilot Results

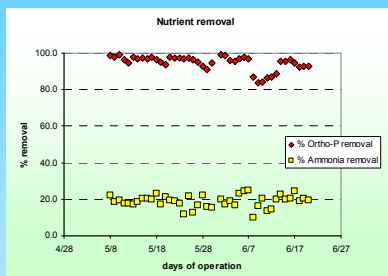
- 90% P removal
- 20% ammonia
- No caustic used
- CO_2 off gassing in supply tanks
- No reactor scaling
- Stable operation



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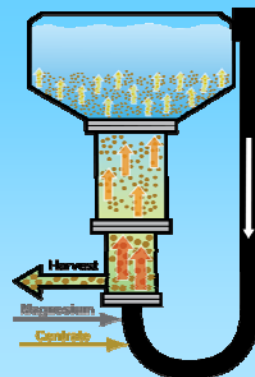
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Removal Graph



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Edmonton Full Scale Reactor

- Sludge lagoon return. Prills harder, more dense and smoother than pilot.



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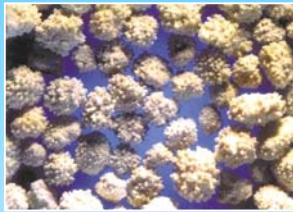
Pilot vs. Full Scale Prills



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Shimane Prefecture sewage works. Osaka, Japan



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Crystal Green™

- 5-28-0 10% Mg fertilizer.
- 5% N - 28% P₂O₅ (12.6% P) – 0% Potassium (K)
- Slow release 6 to 9 months on surface, 3 months in soil, 1 month in a river. Larger prills slower, smaller faster.
- Container plants & golf courses.
- Low nutrient headwater river fertilization in BC to provide nutrients for salmon fry.
- NOT A BIOSOLID. Licensed by Dept. of Ag. As a fertilizer manufacturer. Not waste derived.

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Decision

- + Chemistry works.
- + Pilot works.
- + Full scale works better than pilot.
- + US\$ 1,000,000,000 container nursery industry nearby.
- - No struvite problem at plant.
- - Low metal salt dose.

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Decision

- + Innovative public/private partnering.
- + Growing revenue stream.
- + Larger influent phosphorus reduction than phosphate detergent ban.
- + Sustainably produced fertilizer.
- + Process stability by reducing MLSS P%.
- + Potential carbon credits.

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Contract

- No risk, turnkey, “fee for removal” option not chosen.
- Outright purchase, revenue from struvite.
- Saved US\$ 1.1 million by using decommissioned pump station building.
- Incentives to meet 7 year payback and be the first full plant scale system.

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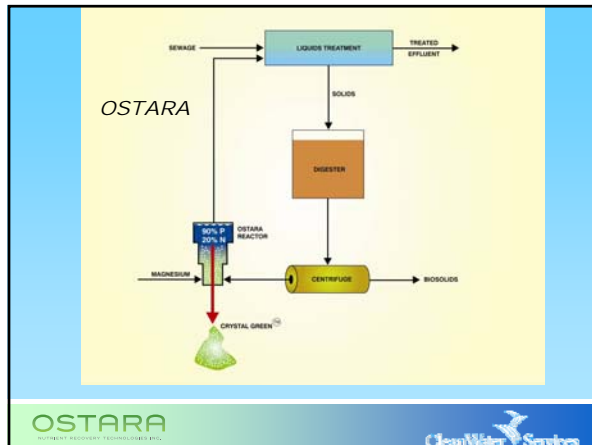
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Design Build

- Existing building issues.
- Startup goal spring of 2009.
- Ostara as design/build contractor.
- HDR mechanical layout.
- CWS performed construction management.

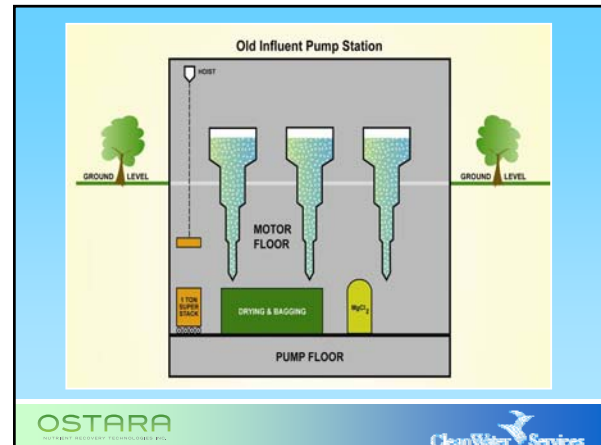
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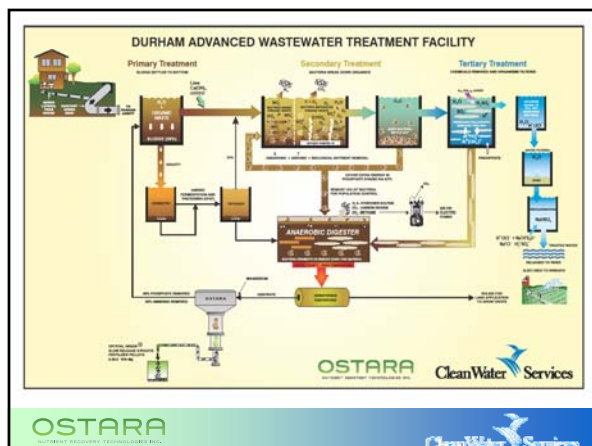
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8,000 lb SS Reactor Top



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Very Tight Fit



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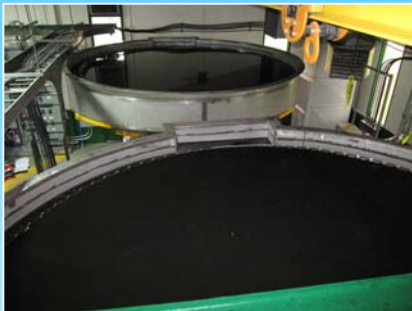
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Odor Control Covers



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Seeding



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Reactor Recycle and Waste



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Recirculation Pump



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Dryer Heater



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Water Separation



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Water Removal, Drying and Sorting



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Dryer Exhaust



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Silos, bagging and hoist



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Startup

- April 16 -- Seeding each reactor 1 tonne Edmonton material.
- April 27 -- 24 hour operation of 3 reactors at reduced rate.
- May 11 -- first harvest!
- Mike Mengelkoch, Operations Control Analyst, "It's like having another aeration train on line removing phosphorus".
- Initial poor quality centrate did not affect prill quality.

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Public/Private Partnership

- Both parties able to make decisions rapidly.
- Risk sharing with common goal of optimizing production which benefits both parties.
- CWS under no obligation to produce product.
- Ostara remotely controls chemical feed, flow rates and harvest setpoints.
- CWS does material handling and maintenance.

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20 ton celebration



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Savings Accrued

- 11.8% reduction in dry tons biosolids hauled
- More than reduction in phosphorus
- 23% reduction in alum use due to lower P inventory and ongoing improvements in EBPR stability
- Synergistic improvements, Ostarate reduces P = better EBPR = less alum = more P to Ostarate = lower alum cost + increased revenue
- Opposite is true, EBPR upset = more alum \$ = less struvite revenue

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Conclusion

- Nutrient recovery is no longer an idea, it is a reality.
- We are commercially generating a sustainably produced fertilizer.
- Significant lowering of plant influent nutrient loading from recycle streams via side stream treatment.
- Finishes the goal of EBPR to remove nutrients.
- Provides positive feedback to EBPR by reducing recycle.

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Optimization

- WASSTRIP Patent #7,604,740
- Strips P and Mg from WAS.
- Digester feed reduced P & Mg.
- Centrate/filtrate high in P & Mg, no ammonia.
- Add to NH₃ rich digester centrate/filtrate in Ostarate reactor.
- Increase struvite production and supply part of Mg needed.
- Reduced struvite potential in digester.
- Reduce payback to 5 years.

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Phosphorus imports

- Local high tech has phosphoric acid waste.
- Currently trucked to traditional fertilizer plant.
- Enough for 1 reactor.
- Added to centrate to lower pH & prevent struvite there.
- Removes additional ammonia from centrate.
- Increases revenue and shortens payback period.

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Ammonia capture

- Ostarate still has 1,000 mg/l ammonia.
- Several new technologies to remove 90%.
- Converted to ammonium sulfate.
- \$46 per ton?
- Requires concentrated sulfuric acid!

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Ostara requirements

- Bio-P intentionally or even with anaerobic selector zones incidental Bio-P.
- High phosphorus in centrate.
- 10 mgd.
- Better without alum addition.
- 1 pound of alum reduces struvite production potential by 8 pounds.

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Additional Installations

- Edmonton AB, full scale reactor pilot
- Signed contracts:
- York PA, 2 reactors, fee for service
- Hampton Roads Sanitation District VA, 3 reactors installed, startup in spring
- Clean Water Services evaluating for the Rock Creek plant. 5+ reactors

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Questions?

Thanks to:

- Ostara
- CWS Board of Directors
- Stettler Construction
- Marks Bros. reactor fabrication
- Plasti-Fab odor covers
- Oregon Electric
- Durham Operation & Maintenance staff
- CWS Water Quality Lab

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