A Division of
COLUMBIA RIVER CARBONATES

MICRONA™ AquaCal

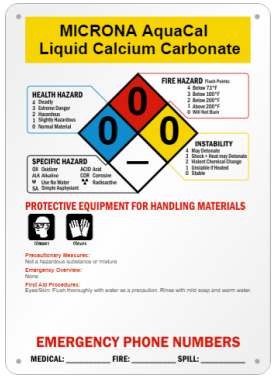
Micronized Calcium Carbonate for Optimized pH / Alkalinity Control in WWTFs

Presentation to SW WA Section, PNCWA Meeting
Three Rivers Wastewater Authority – Longview, WA
March 20, 2025

Overview of Presentation

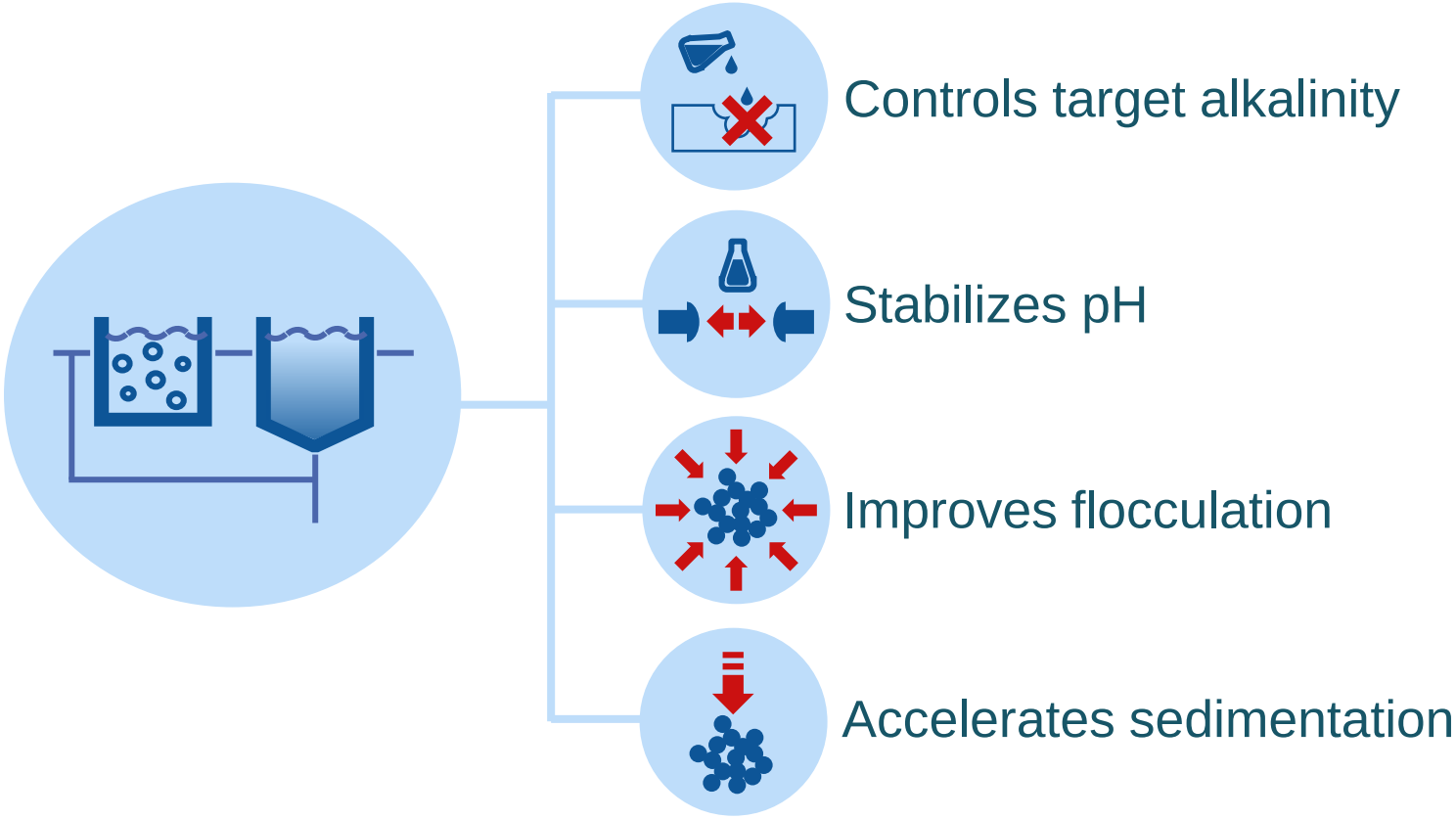
- **Introduction: MICRONA™ AquaCal – Liquid $CaCO_3$ in a nutshell**
- Pilot Studies and Commercialization at Municipal WWTFs
- MICRONA™ AquaCal products for wastewater and/or biosolids alkalinity and pH control at municipal wastewater treatment and reuse facilities
- Summary

MICRONA™ AquaCal in a nutshell



Safe and easy handling

Natural raw material no energy intensive conversion process



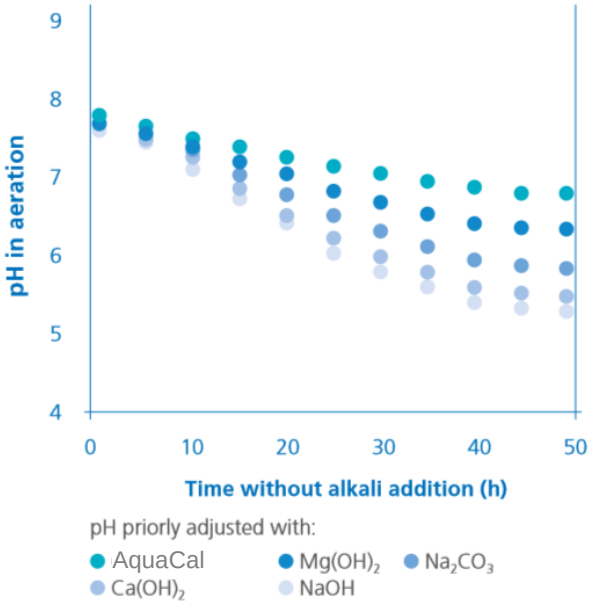
CRC MICRONA™ INDUSTRIAL

MICRONA™ AquaCal Handling and Dosing

- AquaCal is not corrosive , does not for scale and is stabilized for easy handling:
  - Clogging of pipes ruled out
  - Maintenance costs and man hours significantly reduced
  - Process onstream time is increased
  - Product stays in suspension for long periods of time without agitation
  - Pilots can be conducted with unagitated totes or bulk Baker tanks*

* Agitation recommended for permanent storage

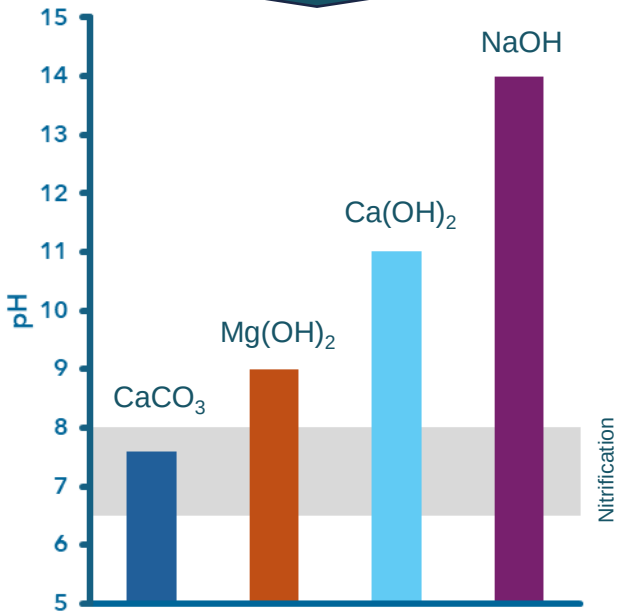
- Ease of Dosing:
  - Overdosing with AquaCal is not possible
  - Provides longest lasting buffer affect on the market



CRC MICRONA™ INDUSTRIAL

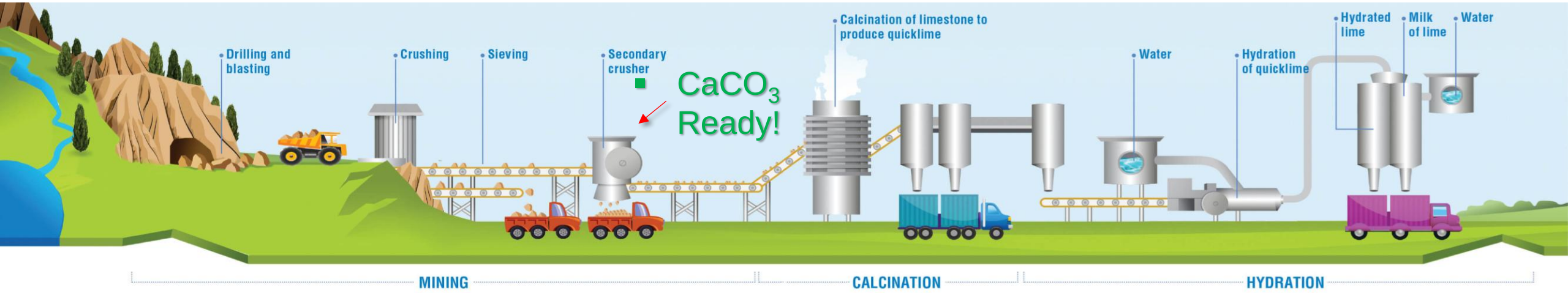
Alkali Comparison

1 Gallon 76% MICRONA AquaCal Slurry		pH Adjustment Range
50% NaOH	→	1.5 Gallons
25% NaOH	→	3.9 Gallons
60% $Mg(OH)_2$	→	0.9 Gallons
45% $Ca(OH)_2$	→	1.6 Gallons

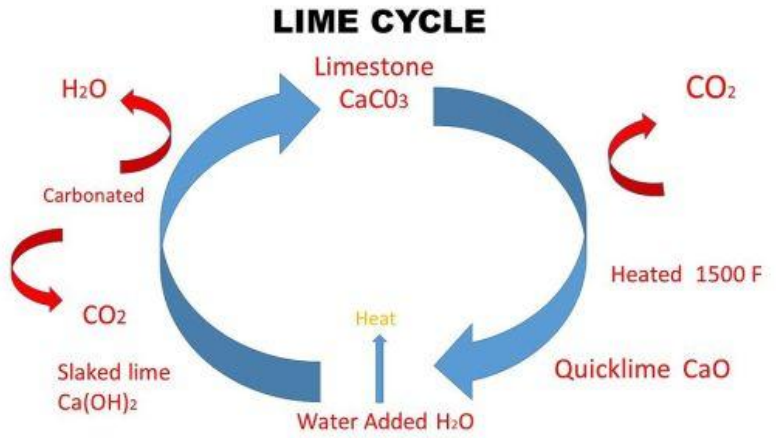


CRC MICRONA™ INDUSTRIAL

Alkali Production Comparison

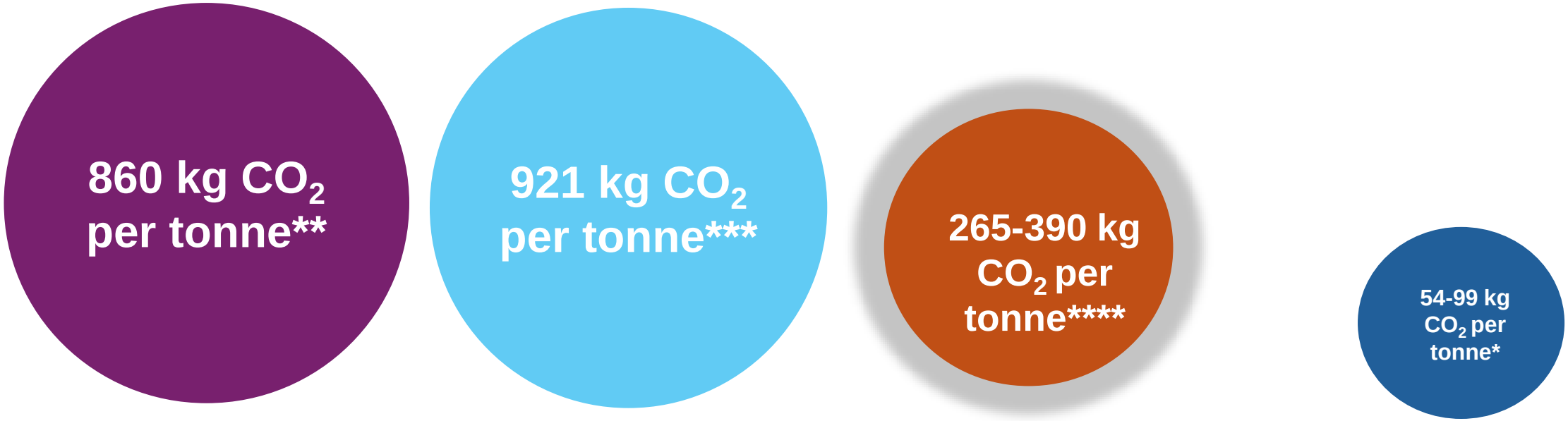


- The Lime Cycle
  - $CaCO_3$: Mined, Quarried, Ground – then…
    - $CaCO_3 + Heat\ (900C) \rightarrow CaO + CO_2$
      - $CaO + H_2O \rightarrow Ca(OH)_2 + Heat$ = ~ 1 kg eq CO_2/kg
- $Mg(OH)_2$ has energy intensive production cycle + CaO addition
- The Calcium Carbonate Cycle
  - $CaCO_3$ – Mined, Quarried, Ground – Done! = ~0.06 kg eq CO_2/kg



CRC MICRONA™ INDUSTRIAL

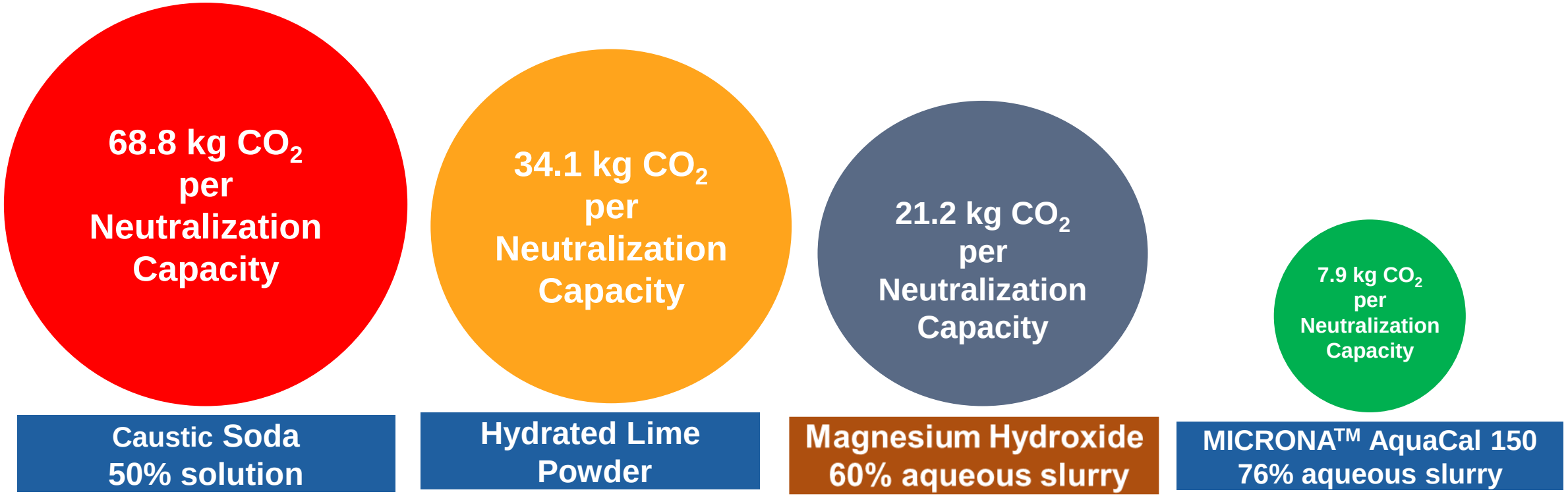
Carbon Footprint (during production)



* *LCA for Calcium Carbonate* (2021) CCA-Europe, Version 1, in accordance with ISO 14040-14044, from cradle to gate – includes carbon released during use
** *Chlorine Environmental Product Declaration (The chlor-alkali process)* (2013) Euro-Chlor
*** *Life Cycle Inventory (LCI) of Hydrated Lime* (2019) EuLA, Version 1, in accordance with ISO 14040-14044, from cradle to gate
**** Journal of Cleaner Production 202, August, 2018

CRC MICRONA™ INDUSTRIAL

Carbon Footprint (during usage for acidity neutralization)

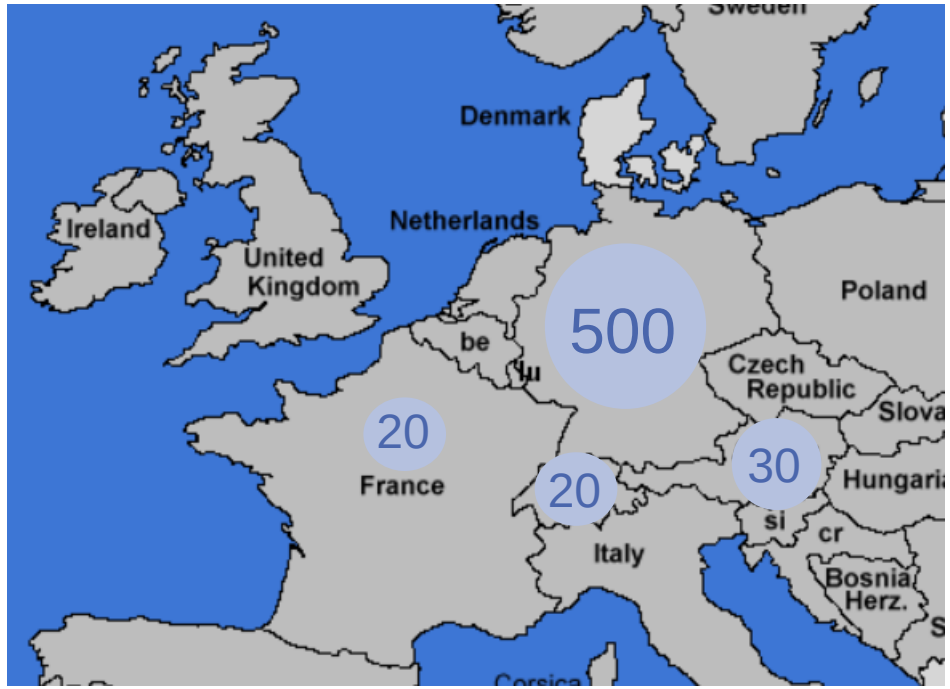


Neutralization Capacity = the relative product required to neutralize 1 kmol H^+ in a liquid stream

Market Success

These product features have led to a rapid market growth of $CaCO_3$ in Europe for alkalinity and pH control in wastewater treatment plants:

- First trials with $CaCO_3$ for pH/alkalinity adjustment in wastewater treatment in Germany date back to 2005.
- Nowadays, with more than 500 customers, $CaCO_3$ is a fully established product for wastewater treatment in the German speaking countries.
- First initiatives for further market development are currently underway in many countries in Europe and beyond.
- United States customers and pilots:
  - Spokane County Regional Water Reclamation Facility – replaced NaOH, chosen over $Mg(OH)_2$
  - Lake Stevens Sewer District - replaced NaOH, chosen over $Mg(OH)_2$
  - Sunriver Utilities - new membrane facility
  - City of Gresham (replaced lime addition in digester)
  - City of Bend, OR (trialed and commercialized AquaCal for improved settling of sludge in secondary stage clarifier) – replaced $Mg(OH)_2$
  - 100 MGD Suffolk County, New York – replaced $Mg(OH)_2$
  - Evaluations (pilot and full scale) beginning in WA, OR, ID and CA over next 3 years



Wastewater treatment plants using $CaCO_3$ in European wastewater plants

CRC MICRONA™ INDUSTRIAL

Benefits Of Using MICRONA™ AquaCal

- Helps to stabilize flocs = increased settling in clarifiers (commercially verified)
  - Reduced turbidity
  - Increased capacity
- Highly reactive – ultrafine liquid $CaCO_3$
- Safe - Easy handling with no risk of pH spike
- Reduced cost with reduction in chemical usage
- Significantly reduced maintenance compared to $Mg(OH)_2$ and $Ca(OH)_2$
- Greener product compared to NaOH, $Ca(OH)_2$, $Mg(OH)_2$

CRC MICRONA™ INDUSTRIAL

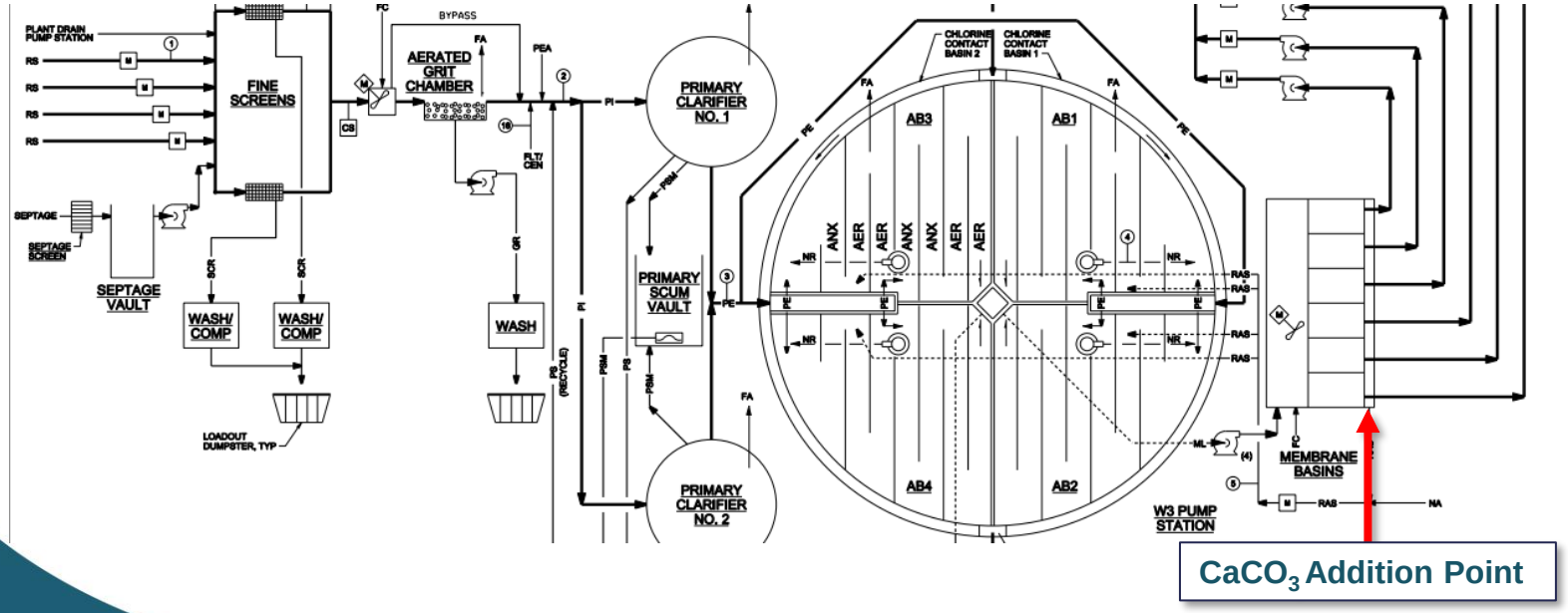
Overview of Presentation

- Introduction: MICRONA™ AquaCal – Liquid $CaCO_3$ in a nutshell
- **Pilot Studies and Commercialization of MICRONA™ AquaCal at municipal wastewater treatment and reuse facilities**
- MICRONA™ AquaCal products for wastewater and/or biosolids alkalinity and pH control at municipal and industrial wastewater treatment and reuse facilities
- Summary

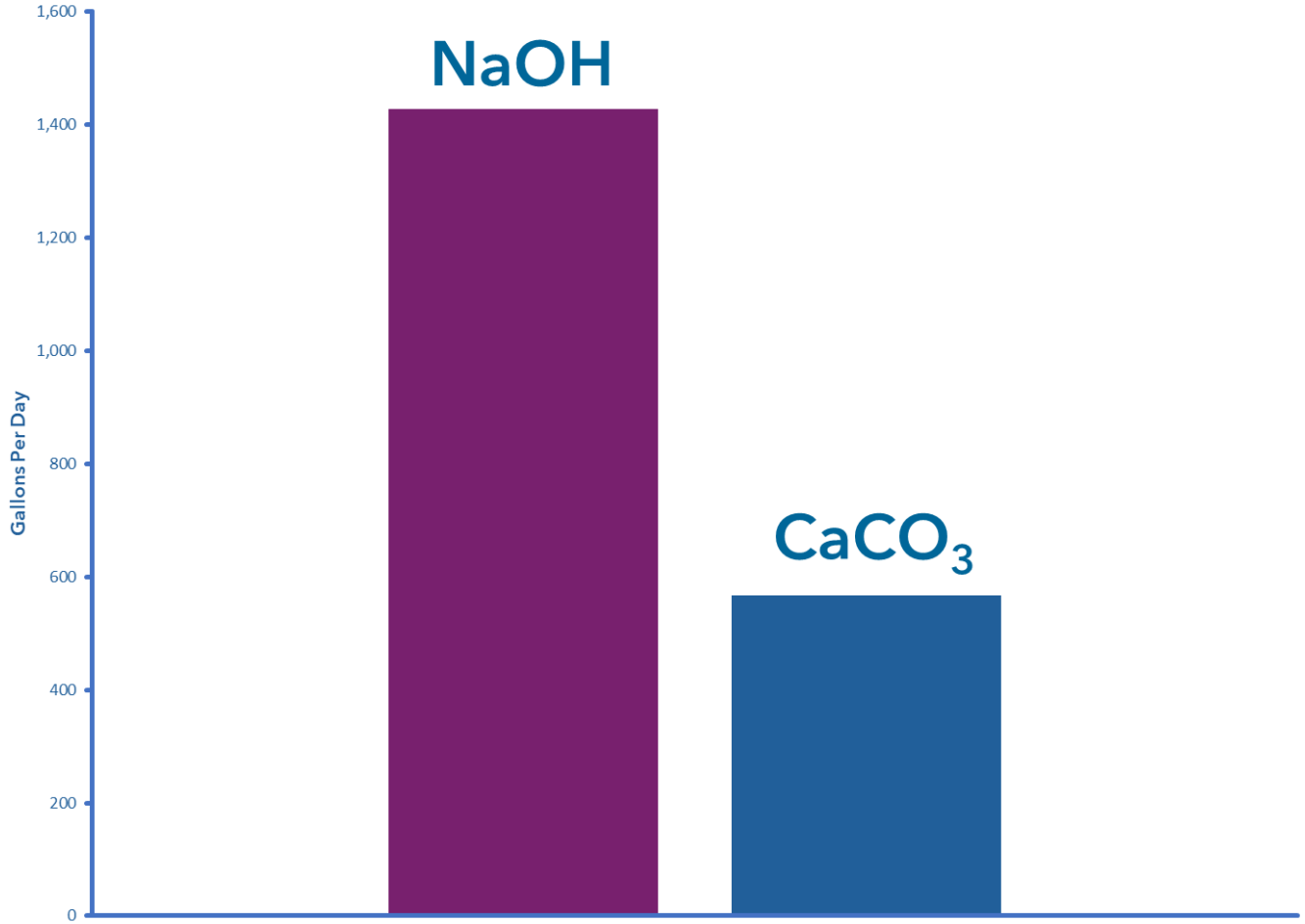
Demonstration Trial and Commercialization of AquaCal at Spokane County Regional WRF

Seasonal Water Permit Requirements

- ☑ 50 µg/L Total Phosphorus
- ☑ 0.25 mg/L Ammonia
- ☑ S.U. Effluent pH 7-9 – Changed to 6.5-9
- ☑ 10 MGD

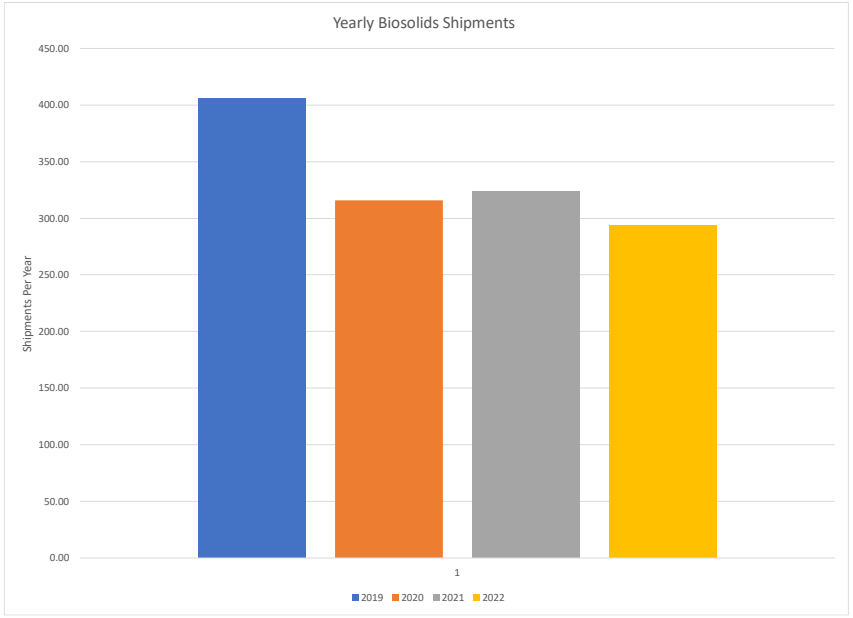


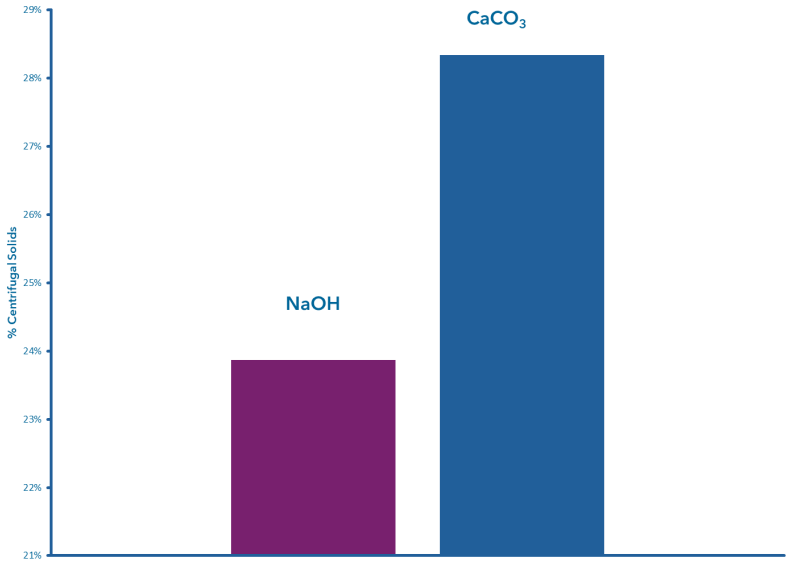
Operational Stability – Treatment Chemicals – Primary/Secondary Addition at SCRWRF



Alkali demand changes due to seasonal permit limits on phosphorus and $NH4^+$
NaOH ranged from 1200-1900 gpd
$CaCO_3$ ranges from 460-650 gpd
Add $FeCl_3$ for P control in Primary Clarifiers

Increase in Sludge Solids Concentration at SCRWRF

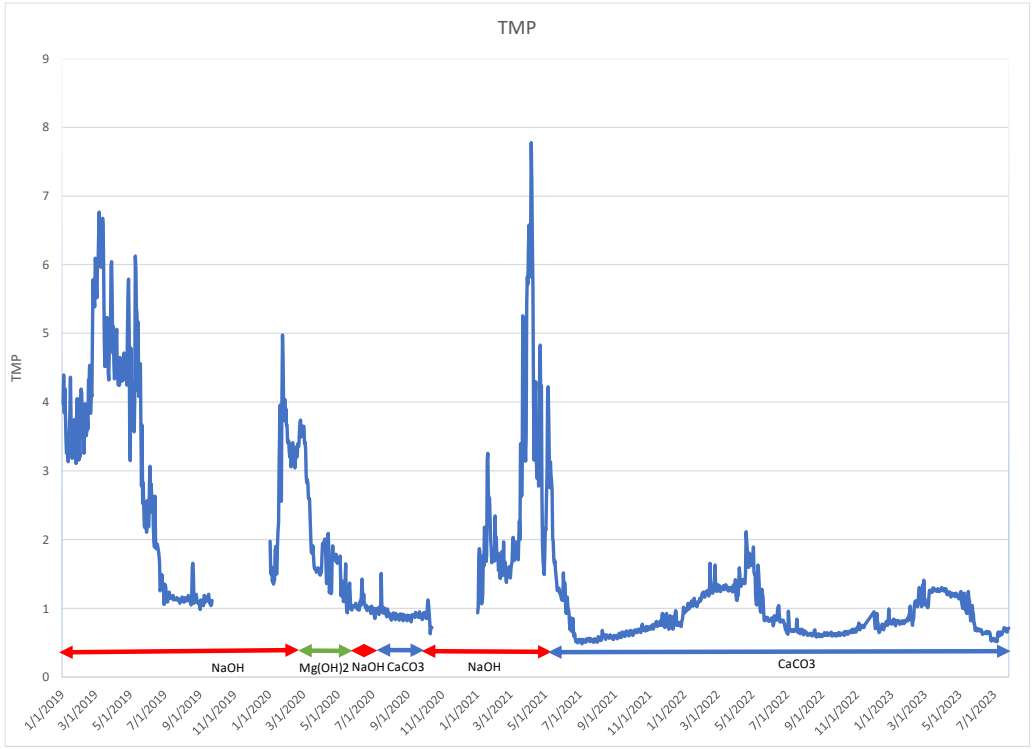


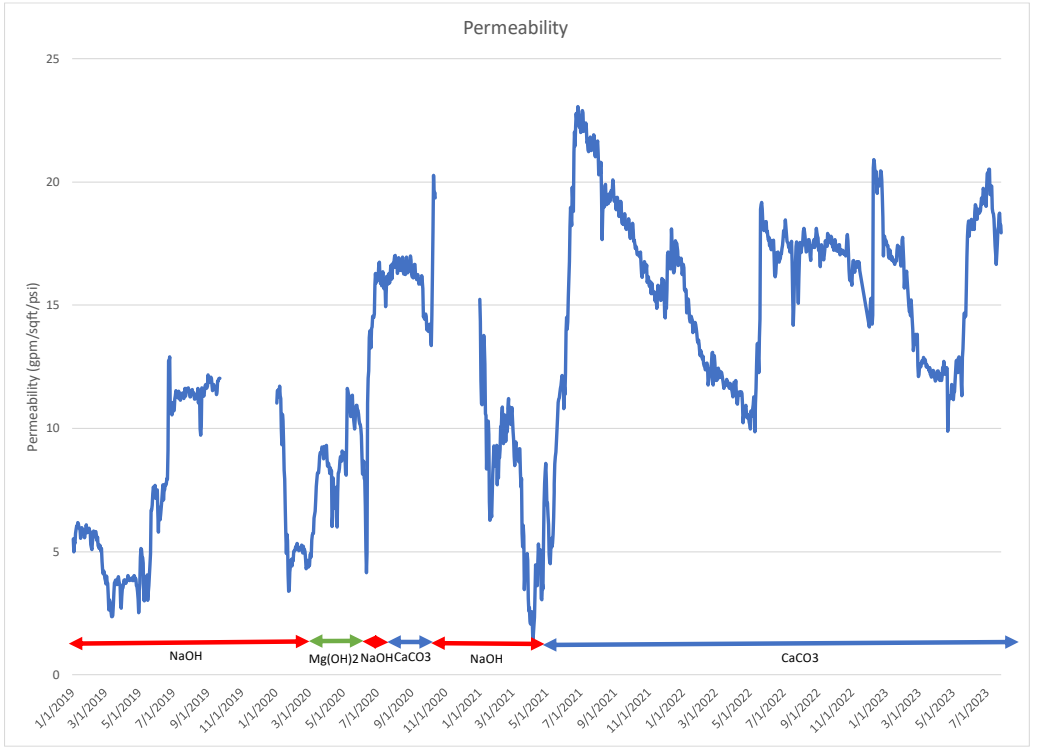


- ➔Sludge dewaterability greatly improved
- ➔The increase from 23.3% to 28% in 2020 initial trial would result in a decrease of 1,500 tons of dewatered sludge per year
- ➔2021data showed the same comparative increase in solids production through the centrifuges
- ➔Realized in 2022 a reduction in 17 truckloads per year vs. 2021 of sludge hauled in water weight alone to landfill site

CRC MICRONA™ INDUSTRIAL

Membrane TMP and Permeability – 2019-2023





- A significant decrease in TMP coincided during the trial period of MICRONA™ AquaCal Calcium Carbonate usage
- A significant increase in Permeability coincided during trial periods of MICRONA™ AquaCal Calcium Carbonate usage
- Calcium is known to bind dissolved microbial substances which may reduce organic fouling
- Ferric chloride usage as well as seasonally warmer wastewater is known to lead to higher permeability

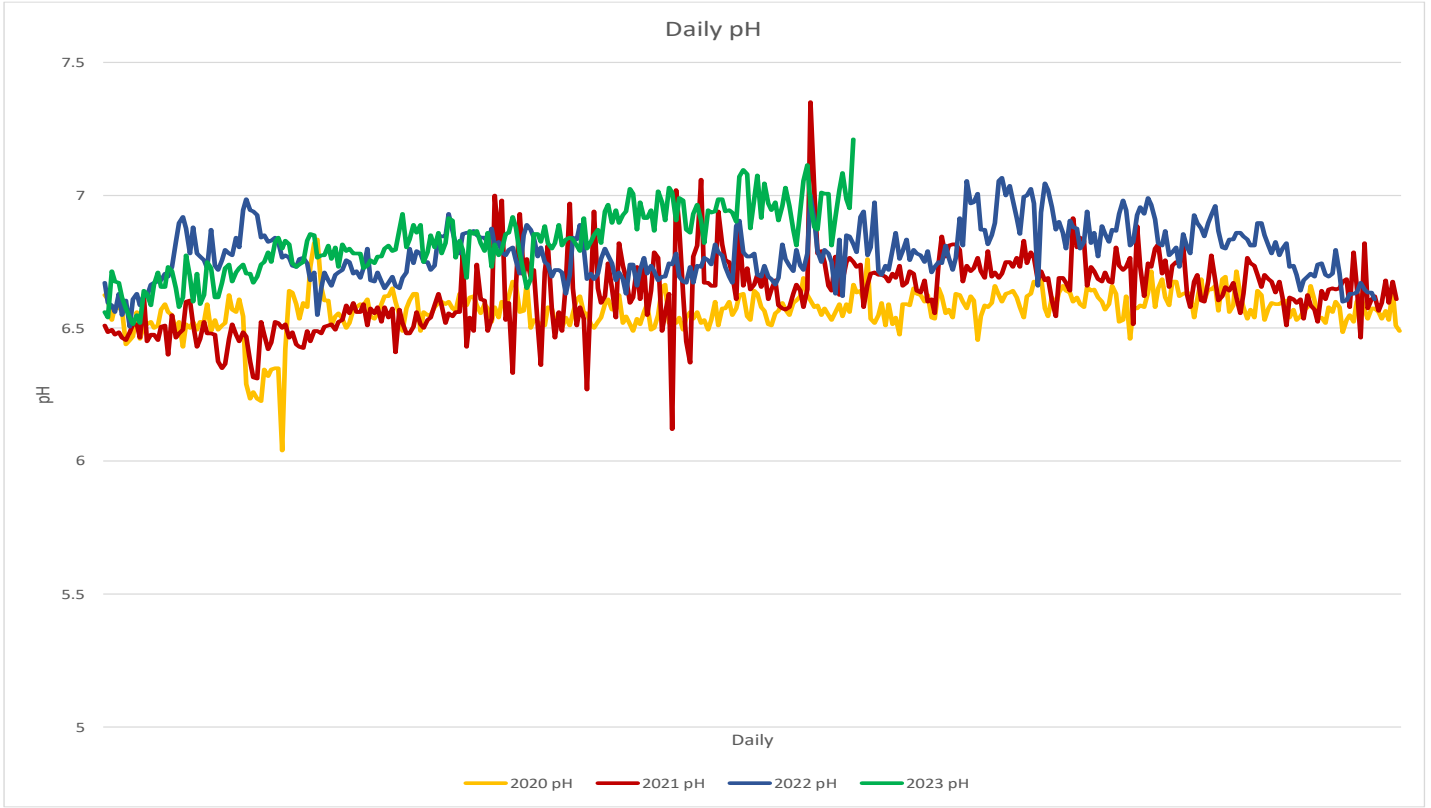
CRC MICRONA™ INDUSTRIAL

Demonstration of AquaCal 70 Benefits at LSSD Sunnyside WWTP

pH Performance and benefits

- MICRONA™ AquaCal 70 full-scale pilot began in Mid-February 2022 and completed one year later; Commercialized in Mid-Februay 2023
- pH set points have changed between 2020 and 2023
- Using $CaCO_3$ has allowed NaOH consumption to be drastically(e.g., by more than 80%) decreased

Daily Effluent pH

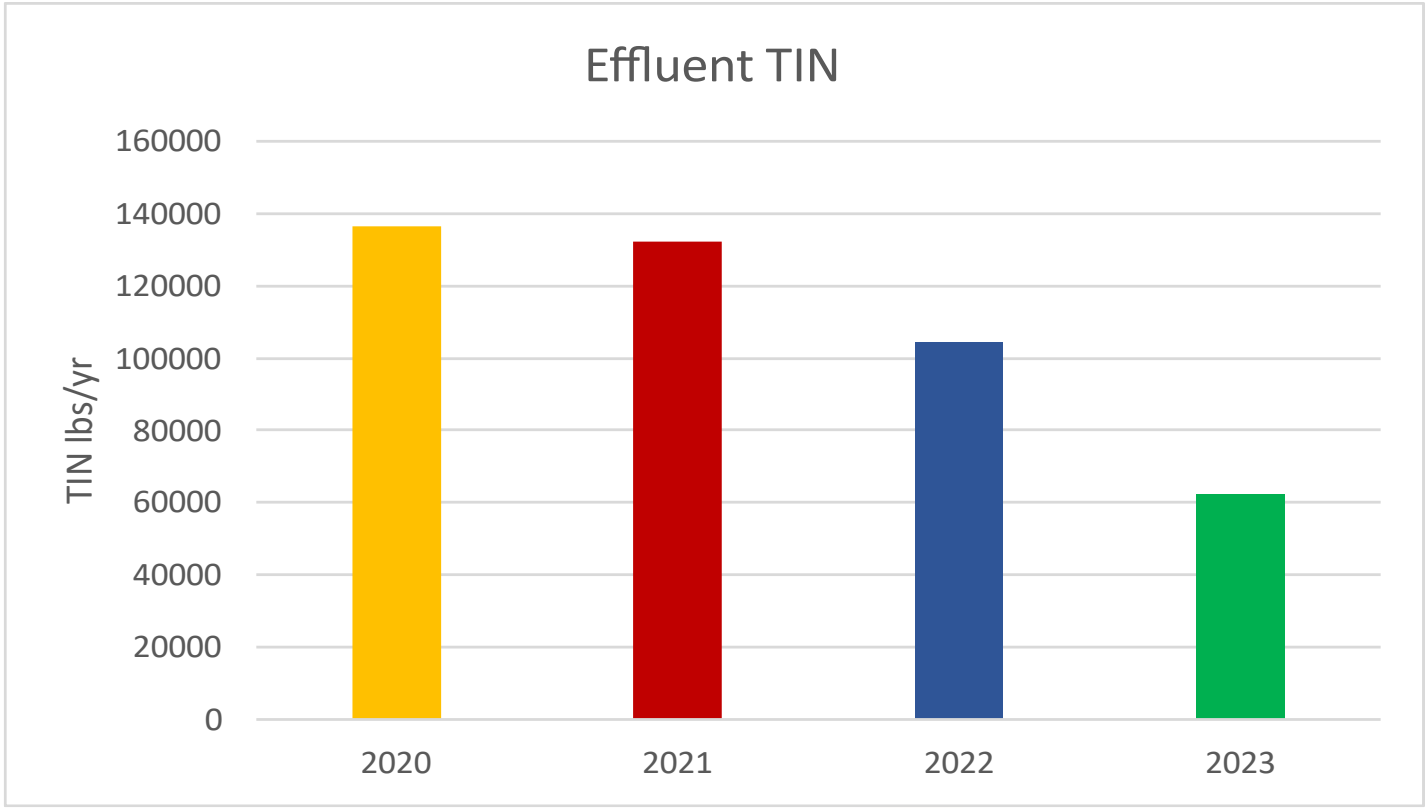


Demonstration of AquaCal 70 Benefits at LSSD Sunnyside WWTP

Total Yearly TIN Reduction

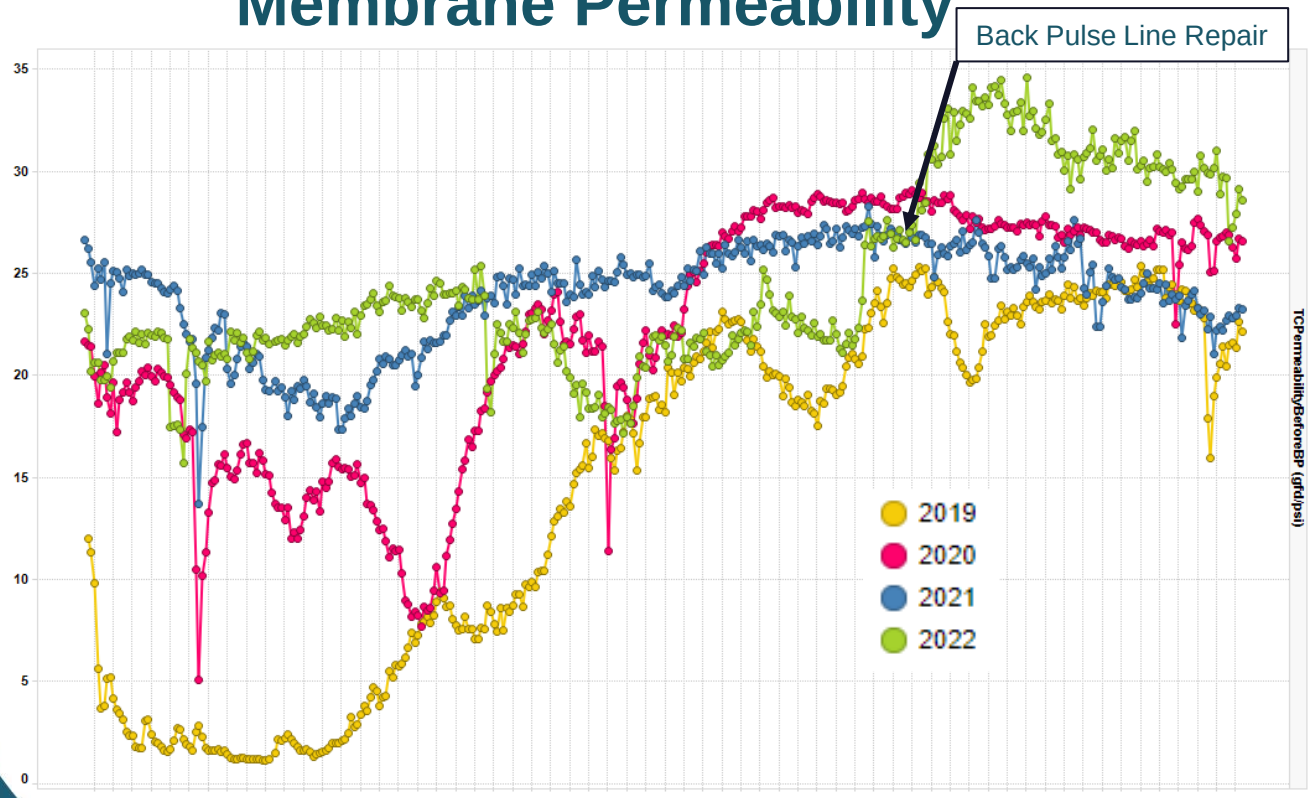
- Annual Total Inorganic Nitrogen (TIN) discharged in effluent, 2020 – July 2023
  - 2020 – 136,527 lbs. (only NaOH used as alkali in secondary treatment stage operating with nitrification only)
  - 2021 – 132,553 lbs. (only NaOH used January-March and NaOH+$Mg(OH)_2$ used April-December, operating with nitrification only)
  - 2022 – 104,577 lbs. ($NaOH+Mg(OH)_2$ used January-February and $NaOH+CaCO_3$ used March-December, operating with nitrification only)
    - New permit limits went in place in 2022
    - Plant operations changes increased denitification and decreased effluent TIN
  - 2023 – 62,551 lbs. (partial year total from January through July ($NaOH+CaCO_3$ used during nitrification to attain desired pH to supplement alkalinity from denitrification)

Effluent TIN



Demonstration of AquaCal 70 Benefits at LSSD Sunnyside WWTP

Membrane Permeability



Membrane Performance

- Last 4 months of 2022 operation resulted in the best membrane Permeability than any of the previous 3 operating years of the LSSD MBR
  - Back Pulse line was repaired in 2022 which allowed for significant membrane cleaning improvment and large jump in permeability
- End of year TCPermeability has been in the 20-26 gfd/psi range over the previous 3 years, increasing to an average of 27 in 2022
- Flux of the membranes has remained consistent over the last 4 years
- Membrane performance has remained stable through 2023 and 2024

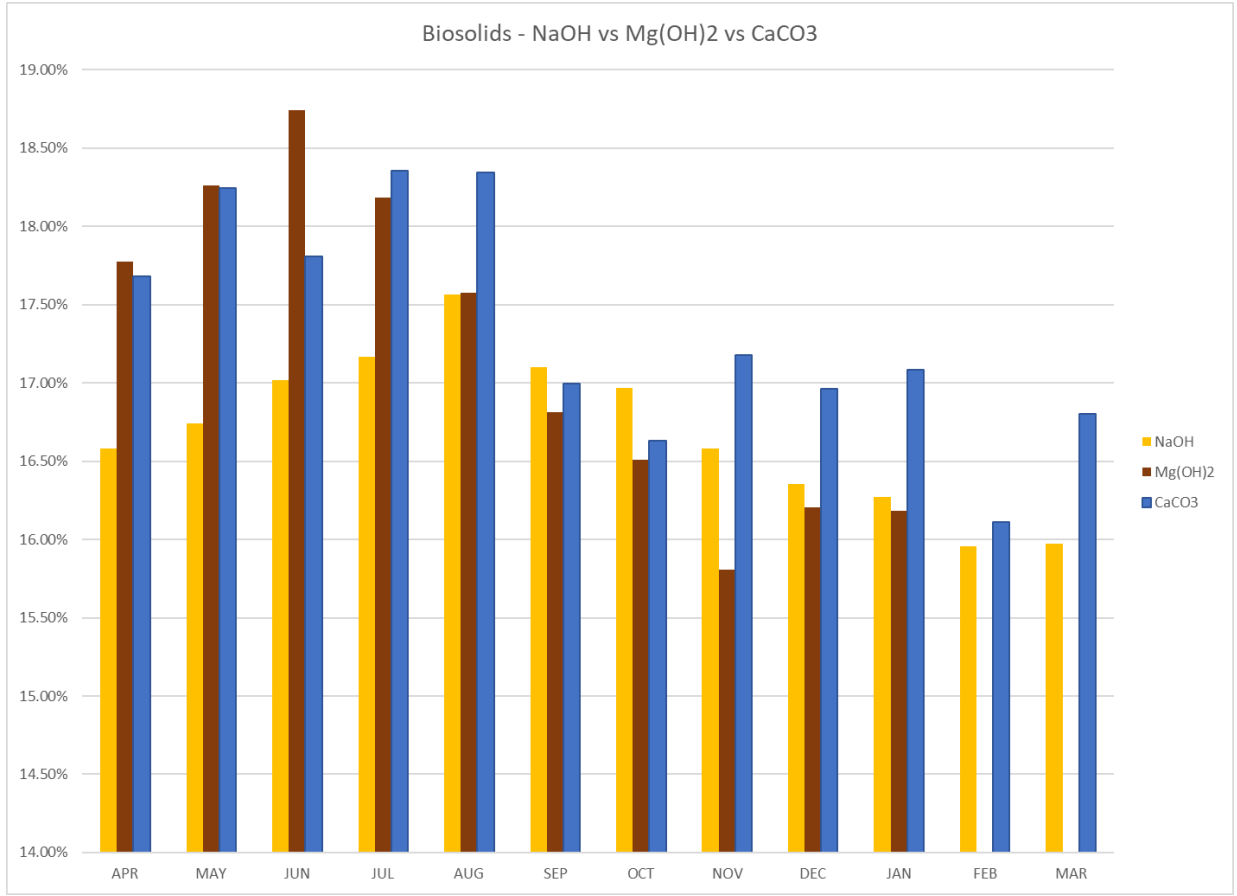
Demonstration of AquaCal 70 Benefits at LSSD Sunnyside WWTP

Dewatering Performance

- 10 out of 12 months had a higher concentraion of solids coming out of centrifuge
  - Jan 2023 – Weir adjustments have increased dewatering performance
- An average increase of 0.7% solids was observed when using $CaCO_3$ compared to same time period using only NaOH

	Average Apr-Mar % Solids		
	NaOH	$Mg(OH)_2$	CaCO3
2020-2021	16.69%	0	0
2021-2022	0	17.09%	0
2022-2023	0	0	17.35%

Biosolids – Centrifuge solids



Demonstration of AquaCal 70 Benefits at LSSD Sunnyside WWTP

Summary of pilot

- Dosing $CaCO_3$ slurry (connected to SCADA) from a horizontal, skid mounted, unagitated bulk storage tank above aeration basin
    - Aquacal 70 application in full SCADA control with 100-150 mg/l dosage rate and pH set points of 6.5 to 6.8 – system regularly stops dosing due to achieving high set point until alkalinity addition is once again required due to nitrification process
- $Mg(OH)_2$ 11 month demonstration trial completed in Feb 2022
- NaOH purchasing decreased significantly with both $Mg(OH)_2$ and to a greater extent with $CaCO_3$
- Total chemical spend decreased 28% using $CaCO_3$ when compared to the same period using $Mg(OH)_2$
- TCPermeability remained stable during use of $CaCO_3$
- Total yearly TIN decreased during use of $CaCO_3$ due to permit limits and increased denitification
- Centrifugal solids increased during use of $CaCO_3$

Chemical consumption and cost

	April-December		
	2020	2021	2022
NaOH Consumption	70842	30067	25817
NaOH Usage Decrease	0%	58%	64%
Total Chemical Spend			<28%
pH Target	6.3-6.5		6.5-6.8

CRC MICRONA™ INDUSTRIAL

Replacement of Lime in Biosolids Digester at 10 MGD City of Gresham, OR WWTP

- MICRONA™ AquaCal has Replaced Lime Addition into an Anaerobic Biosolids Digester to control optimal alkalinity that receives 15,000 gallons/day of FOG collected in the community.
- Biogas produced goes to a Caterpillar cogeneration plant that generates about 10% more electricity than the WWTP requires for its operations that is then sold back into the electrical power grid in the region.
- Replacement of Lime with MICRONA™ AquaCal reduces maintenance due to elimination of scaling in piping, valves, etc. and this is achieved at an equivalent or slightly lower spend for alkalinity.

CRC MICRONA™ INDUSTRIAL

MICRONA™ AquaCal Use For Digestion of Biosolids

Pros and Cons of Aerobic vs. Anaerobic Digestion of Municipal Biosolids

Aerobic Digestion	Anaerobic Digestion
Pros	Pros
• Faster decomposition – ready in a few weeks • Lower structural CAPEX – smaller footprint • Less complex management of control • Larger impact on OPEX based on alkali choice	• Biogas production – co-gen lower fossil fuel use • Higher structural CAPEX • Cost-efficient for lower-COD/BOD waste streams • Can have lower maintenance OPEX /CAPEX
Cons	Cons
• Higher operating OPEX – blower electrical $ • No generation of biogas – no energy produced • More limited in waste types accepted • Can have higher maintenance OPEX / CAPEX	• Slower decomposition – ready in 2-3 months • Higher structural CAPEX – larger footprint • More complex management of control • Smaller impact OPEX based on alkali choice

CRC MICRONA™ INDUSTRIAL

The Role of Alkalinity in Biosolids Digestion

Alkalinity plays a crucial role in the aerobic digestion of wastewater biosolids.

Here's a step-by-step breakdown:

1. **pH Balance**: Alkalinity helps maintain a stable pH level, which is essential for the survival and activity of aerobic bacteria. A pH range of 6.5 to 8.5 is generally optimal for these microorganisms.

2. **Microbial Activity**: Proper alkalinity supports the metabolic processes of bacteria, enhancing their ability to break down organic matter effectively. This leads to more efficient digestion and reduced sludge volume.

3. **Nutrient Availability**: Alkaline conditions can improve the solubility of nutrients, making them more accessible to bacteria, which is vital for their growth and reproduction.

4. **Optimal Levels**: While specific optimal alkalinity levels can vary, maintaining a total alkalinity of around 1,000 to 3,000 mg/L as $CaCO_3$ is often beneficial for aerobic digestion processes.

5. **Monitoring**: Regular monitoring of alkalinity is essential to ensure that it remains within the optimal range, allowing for adjustments as necessary to support bacterial health and digestion efficiency.

In summary, **maintaining the right alkalinity is key to optimizing the aerobic and anerobic digestion of wastewater Biosolids, ensuring effective treatment and resource recovery.**

CRC MICRONA™ INDUSTRIAL

Overview of Presentation

- Introduction: MICRONA™ AquaCal – Liquid $CaCO_3$ in a nutshell
- Pilot Studies and Commercialization at Municipal WWTFs
- **MICRONA™ AquaCal products for alkalinity and pH control at municipal wastewater treatment and reuse facilities**
- Summary

MICRONA™ AquaCal Products and Equipment

- Powder:
  - MICRONA™ AquaCal 300
    - Ultrafine dry ground powder
  - MICRONA™ AquaCal 1800
    - Fine dry ground powder
- Aqueous Slurry:
  - MICRONA™ AquaCal 150
    - Ultrafine wet ground 76% solids suspension
    - Available via: Tote / Bulk
  - MICRONA™ AquaCal 70
    - Finest wet ground 71% solids stable suspension
  - MICRONA™ AquaCal SS 70
    - 6 month+ 65% solids stable suspension
    - Ideal where no agitation possible and low use expected

Pilot equipment based on availability

- 2 bulk storage tanks
- Seepex progressive cavity pumps
- Totes w/manifold

CRC MICRONA™ INDUSTRIAL

Overview of Presentation

- Introduction: MICRONA™ AquaCal – Liquid $CaCO_3$ in a nutshell
- Pilot Studies and Commercialization at Municipal WWTFs
- MICRONA™ AquaCal products for alkalinity and pH control at municipal wastewater treatment and reuse facilities
- **Summary**

Summary

- MICRONA™ AquaCal can be used to optimize akalinity and pH control of wastewater and biosolids.
- Product consumption is ideally based on stoichiometry (e.g., equivalent (OH^-) and verified by pilot trial).
- Sludge dewatering can significantly improve after replacement of NaOH.
- MICRONA™ AquaCal can result in significant membrane performance improvement at MBR facilities (verified by pilot trial and commercialization data).
- Significant improvement of material handling and decrease in operating and maintenance OPEX compared to Magnesium Hydroxide, Quick (Calcined) Lime or Slaked (Hydrated) Quick Lime.
- Significant decrease of carbon footprint (manufacturing and use) compared to other Alkaline additives.
- MICRONA™ AquaCal optimally buffers to pH 6.5-8.5 that is ideal for peak performance of aerobic and anerobic bacteria utilized in municipal wastewater and biosolids facilities, both conventional and membrane bioreactor based.

CRC MICRONA™ INDUSTRIAL