

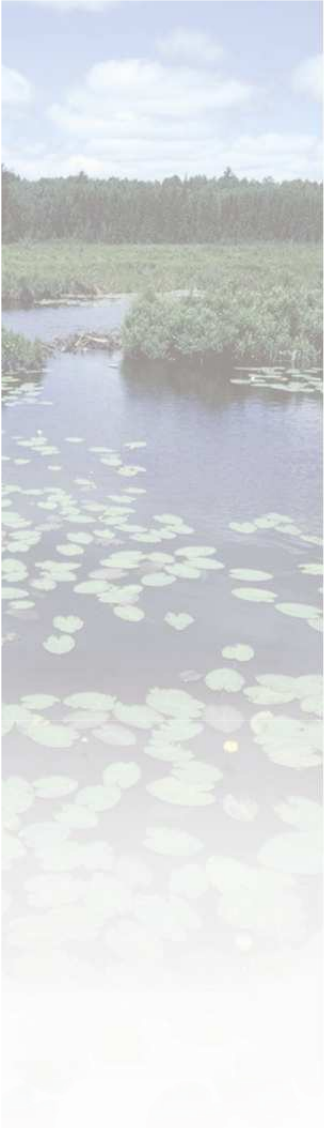


# ***Peracetic Acid A New Disinfection Approach***

*PNCWA 2009  
September 15, 2008*

Kelly Dancey, P.E.





## Overview

- Status Quo
- What is Peracetic Acid?
- Physical Characteristics
- PAA Suppliers
- Pros/Cons of PAA
- Dosage Requirements
- Design Issues
- Performance
- Economics
- PAA and UV
- Summary



## Status Quo

- Chlorine
- Sodium hypochlorite
- Ultraviolet light
- Ozone

# Chlorine

- Disinfectant of choice for decades
- Cause of concern due to:
  - Gas leaks
  - Chlorine toxic to aquatic life
  - Formation of potentially harmful byproducts
- Code requirements
  - EPA, OSHA, CFATS
- Community concerns
- Need to dechlorinate



# Sodium Hypochlorite

- Used extensively
- Safer than chlorine gas
- Breaks down to  $\text{Cl}^-$ 
  - Toxic to aquatic life
  - Formation of potentially harmful byproducts
- Code requirements
  - CERCLA, OSFM
- Limited community concerns
- Need to dechlorinate
- Decomposes rapidly, especially in high heat
- Freeze protection required
- Off-gassing issues





## Ultraviolet Light

- Becoming increasingly popular
- Reliability has greatly increased over past 10 years
- No chemicals
- No harmful residuals
- High capital cost
- Operator safety is a key concern



## Ozone

- Not widely used
- More complex than chlorine or UV, resulting in more complicated equipment
- Highly corrosive and reactive
- Not economical for plants with high TSS, BOD or TOC
- Worker safety is a concern as ozone is very strong irritant
- No harmful residuals



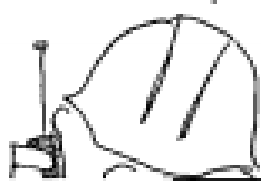
# What is Peracetic Acid?

**GRANTLAND®**

HOW DO YOU KNOW THAT SPILL IS SO SERIOUS IF YOU DON'T KNOW WHAT CHEMICAL WAS INVOLVED?



I CAN TELL BY LOOKING AT THE PLACE WHERE IT HIT THE GROUND.



WHY? WHAT DO YOU SEE?



DAYLIGHT.



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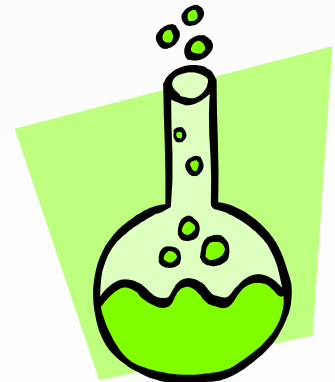
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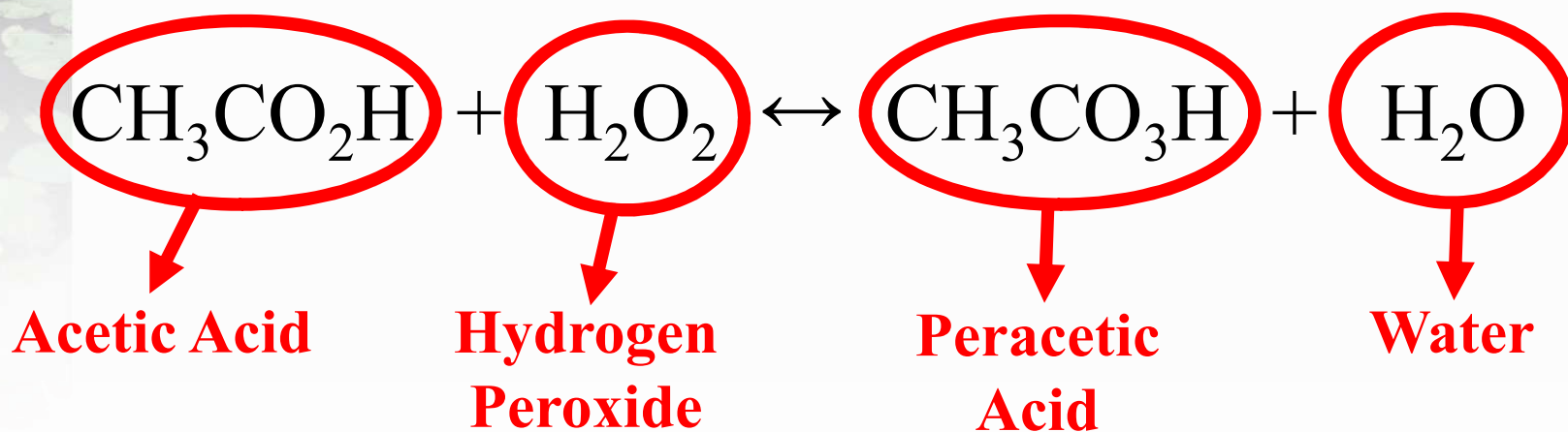
## What is Peracetic Acid?

- Strong oxidizer
- Broad spectrum of antimicrobial activity
  - effective bactericide, fungicide, and sporicide
- Used in food processing, beverage, medical, pharmaceutical, textile and pulp and paper
- Liquid sanitizer
- Widely used in Europe for wastewater disinfection



# What is Peracetic Acid?

- Commercially available as an equilibrium mixture of:
  - Peracetic acid 12-15%
  - Hydrogen peroxide 18.5 – 23%
  - Inert ingredients
    - acetic acid ~18%
    - water ~51%



- PAA, Peroxyactic Acid, Ethaneperoxoic acid, Peroxide of Acetic Acid



## Physical Characteristics

- Clear, colorless liquid
- Pungent acetic acid odor (i.e. vinegar)
- pH <2
- Soluble in water in all proportions
- 12% Solution:
  - 1.1 lbs of PAA/gallon solution
  - Weighs 9.2 lbs/gallon
  - Freezing Point ~-40°C
  - Very stable – less than 1% loss of active ingredients per year



## PAA Suppliers

- FMC Corporation, Envirotech Chemical Services and Solvay Chemicals
- Solvay: Proxitane WW-12, 12% PAA
- FMC: VigorOX WWT II, 15% PAA
- Both FMC and Solvay are US EPA approved
- Proxitane bulk manufactured in Chicago, IL
- Solvay also has a peroxide manufacturing facility in Longview, WA.
- FMC bulk manufactured in Tonawanda, NY and in the future, Bayport, TX

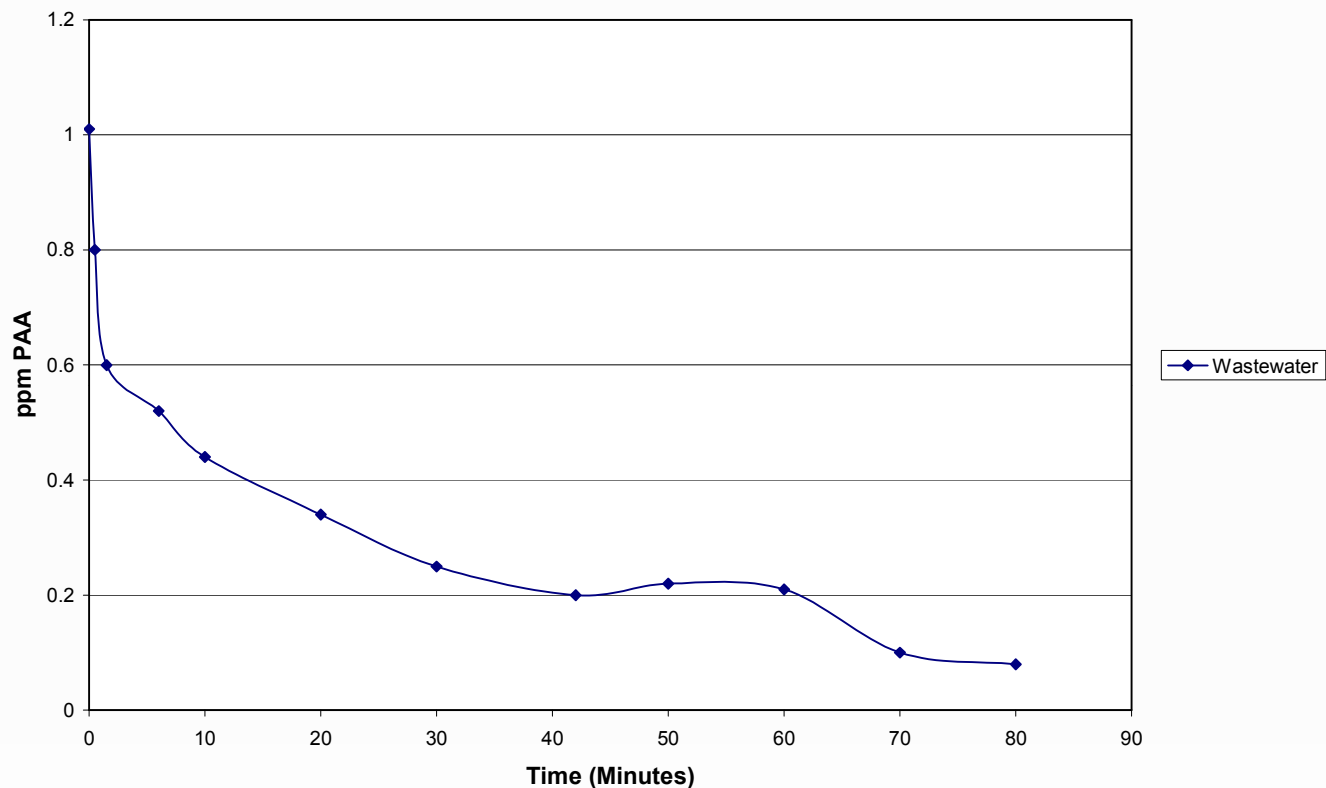


## Pro's and Con's of PAA

- Advantages:
  - Highly effective bactericide
  - No formation of harmful DBP's
  - Quenching not required
  - Low freezing point
  - Long shelf life
  - Ease of implementation (no extensive capital improvements required)
  - Small footprint
  - Minimal pH dependence
  - No residual

# PAA Decomposes Rapidly

PAA Rundown Secondary Effluent at Huron Basin



Results from Bench-Scale Testing at Huron Basin Plant,  
OH indicating rapid decomposition of PAA *Courtesy of Solvay*

# Solvay Pilot Study



Frankfort, KY

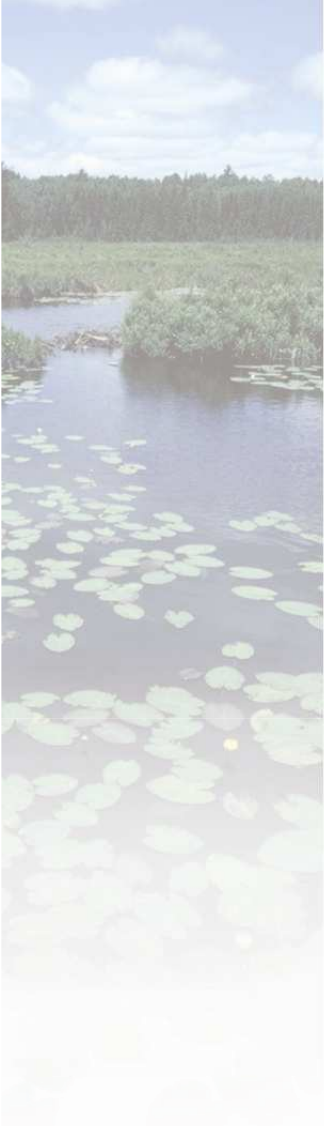
*Courtesy of Solvay*



## Pro's and Con's of PAA

- Disadvantages:
  - While USEPA approved, still requires local DEQ approval
  - No proven applications in N. America
  - No buried piping
  - Logistical and market risks as there is no bulk manufacturing in the NW
  - Does not maintain a residual





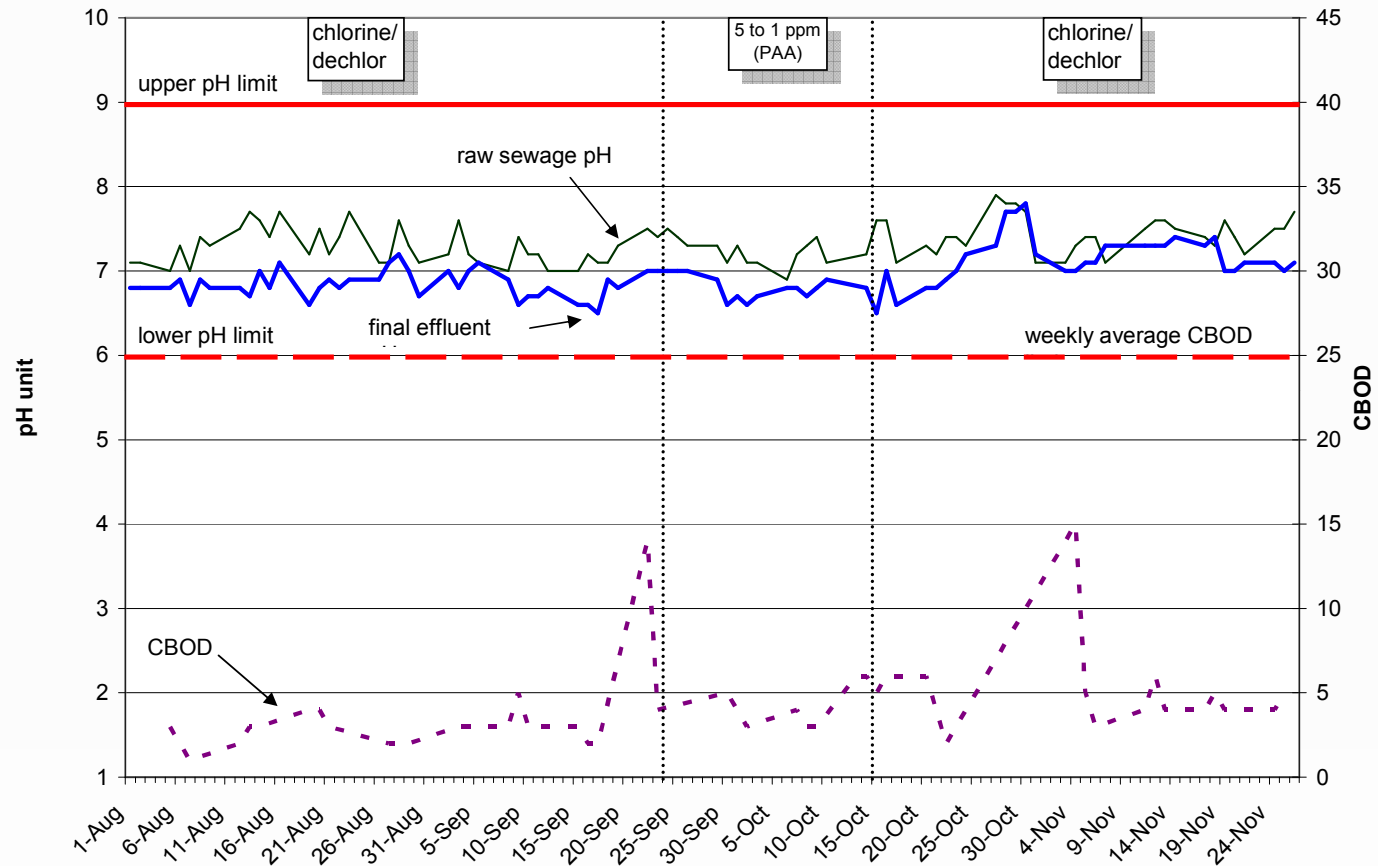
## Pro's and Con's of PAA

- Some articles note:
  - Increased effluent organic content due to the acetic acid
    - CBOD testing has shown this to be untrue.
  - Highly explosive
    - Higher concentrations of PAA are unstable, 12% and 15% have no explosive characteristics



# Studies Show PAA has no Effect on CBOD or pH

Effect of PAA on pH and CBOD



Results from Pilot Testing at Huron Basin Plant, OH  
Indicating no effect of PAA on CBOD or pH *Courtesy of Solvay*



## Dosage Requirements

- Studies have been performed to determine dosage requirements.
- Actual dosage is dependent on contact time, bacteria count, and permit limits
- Recommend jar testing to determine dosage
- Typically,
  - Secondary Effluent: 0.50 to 2 mg/L PAA
  - Enhanced Primary: 5-10 mg/L PAA
  - Raw Wastewater: 10-20 mg/L PAA
- Contact time varies. Typically 10 to 30 minutes. Majority of rxn occurs within first 10 minutes



## Design Issues

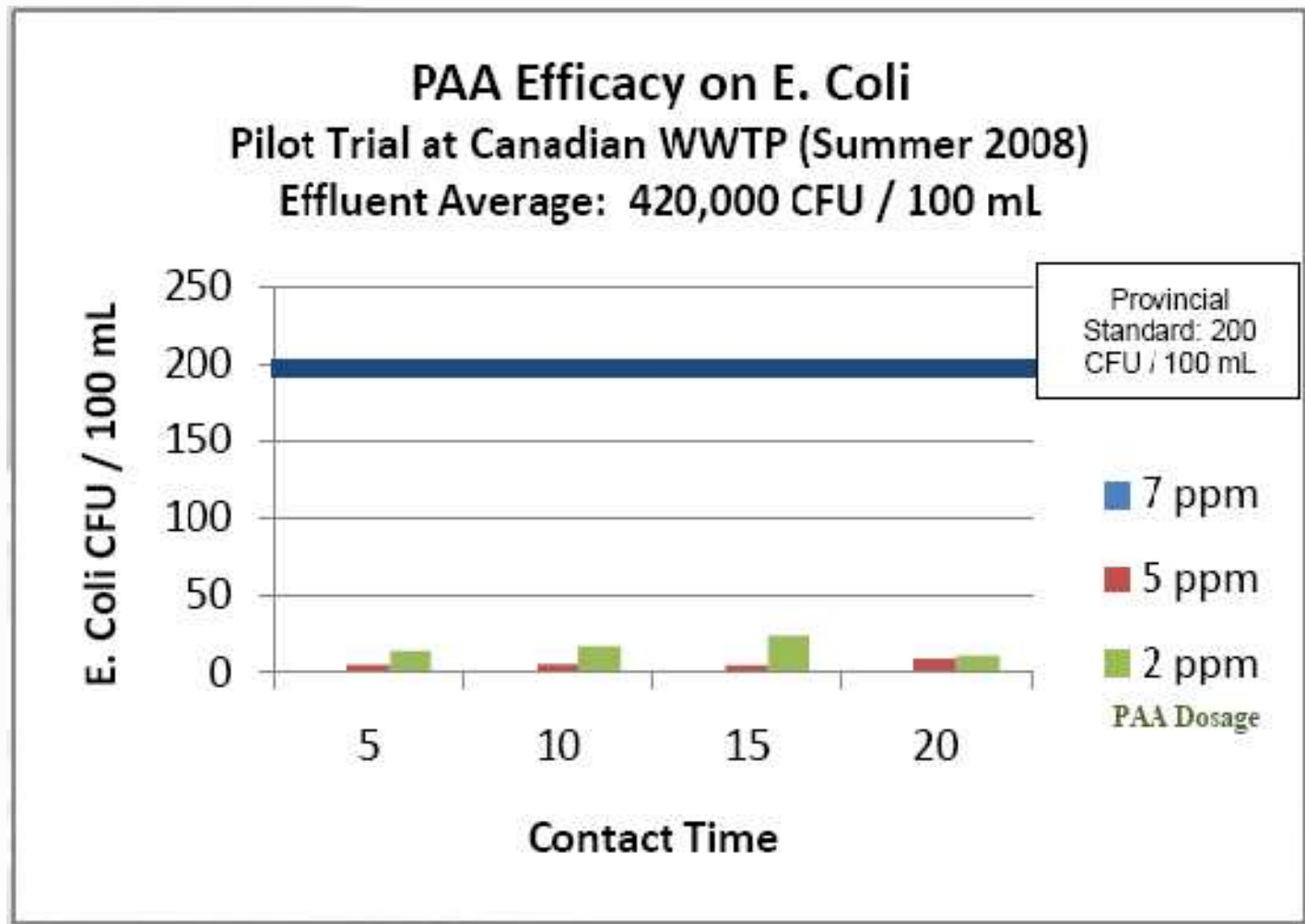
- Available in 330 gallon totes and in bulk
- 304L Stainless steel tubing/piping
  - Piping must be pickled and passivated
  - For temporary applications, PVC can be used
- Elastomers: Teflon/PVDF/HDPE/LLDEPE
- Venting is required. Valves must be vented back to system.
- Chemical equipment must be placed close to the point of use. No buried piping.
- Solvay recommends ProMinent Pumps. Peristaltic not recommended
- Add PAA at a turbulent location or use a paddle mixer



## Performance

- Solvay
  - PAA used in Milan, Italy since 2003
    - 114 MGD plant
    - treated water used for irrigation of edible crops
    - 2 ppm resulting in <10 cfu/100 mL *E. coli*
  - Louisville and Jefferson County, KY
  - Erie County, OH
- FMC
  - Niagara Falls, ON, Canada
  - Gainesville, FL
  - Buffalo, NY
  - Mississippi
  - Great Lakes Basin
- Many tests and trials on-going – Looking for volunteers

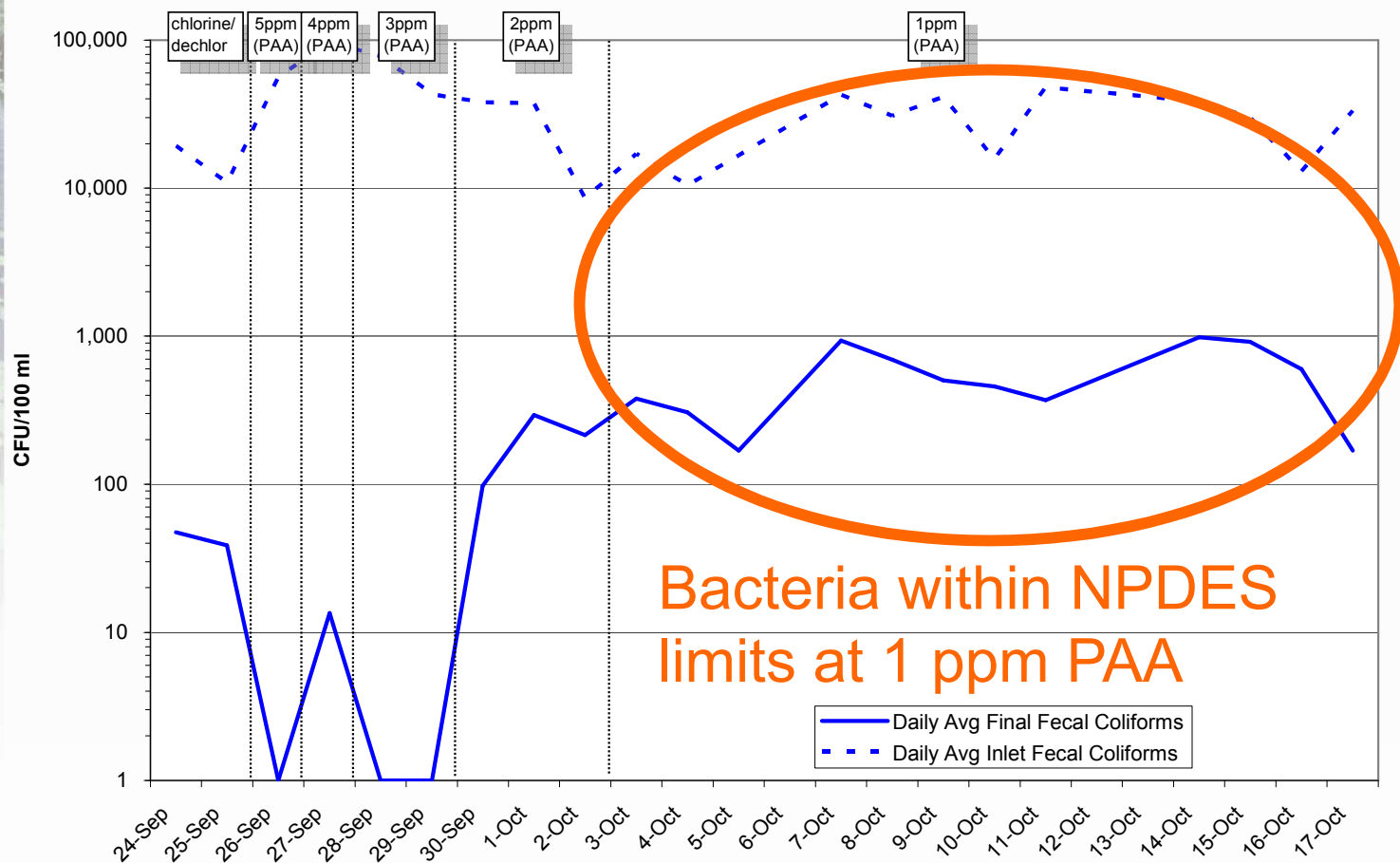
# FMC Pilot Testing



Courtesy of FMC

# Solvay Pilot Testing

Disinfection Performance of PROXITANE WW12 Dosage (as PAA)  
Daily Avg. Fecal Coliforms Before and After Disinfection



Results from Solvay Pilot Testing at Huron Basin Plant, OH  
indicating Fecal Coliform Levels *Courtesy of Solvay*

## Economics

- Sodium hypochlorite and bisulfite
  - Hypochlorite (12.5%) \$1.25/gallon
  - Bisulfite (38%) \$1.55/gallon
  - Typical dosage for hypochlorite is 4 to 6 ppm for secondary effluent.
  - Bisulfite requires 1.5x chlorine residual
- PAA
  - Solvay: \$0.50 to 0.70/lb
    - \$5.50/gallon (assuming \$0.60/lb)
  - Typical dosage is 1 ppm for secondary effluent.







## Economics

- Assume a 10MGD plant disinfecting secondary effluent
  - Sodium hypochlorite
    - Dosage of 4 ppm with a 0.5 ppm Cl<sup>-</sup> residual
    - 335 gal/day NaOCl and 18 gal/day NaHSO<sub>3</sub> required
    - Sodium hypochlorite      \$420/day
    - Sodium bisulfite              \$27/day
    - *TOTAL COST* : ~\$450 per day
  - PAA
    - Typical dosage of 1 ppm
    - 76 gallons/day PAA required
    - *TOTAL COST* : ~\$420 per day



## PAA and UV

- PAA has shown to enhance the effectiveness of UV when added upstream.
  - reduction in power intensity
    - FMC: 47% reduction in UV light power intensity based on pilot trial data
  - less frequent and easier lamp cleaning
- Adding PAA to an at-capacity UV system could extend life of system
- Solvay interested in doing additional testing with UV systems



## Summary

- PAA is effective for WWT disinfection
- PAA is a viable and cost comparable alternative to sodium hypochlorite and bisulfite

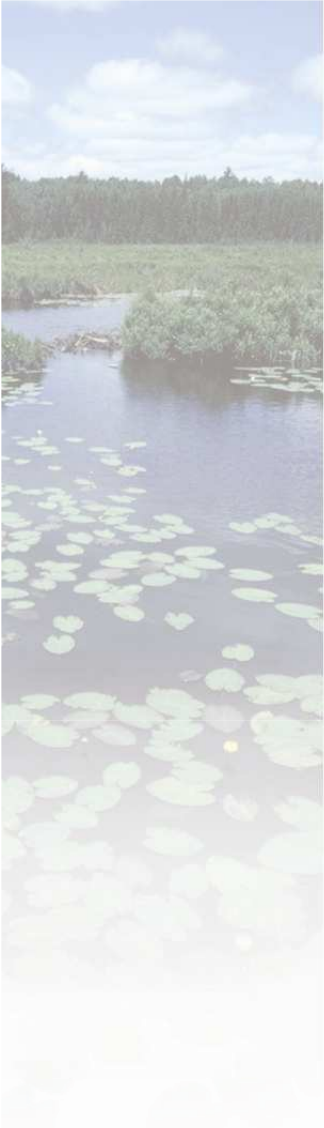
### **Benefits:**

No DBP's  
No dechlorination  
Very stable  
Low freeze point

### **Disadvantages:**

Permitting issues  
Logistical risks  
No buried piping

- Applicability of PAA is project dependent and should be evaluated on a case by case basis



## Special Thanks To:

- Solvay Chemicals:
  - Jason Muessig [jason.muessig@solvay.com](mailto:jason.muessig@solvay.com)
  - John Maziuk [john.maziuk@solvay.com](mailto:john.maziuk@solvay.com)
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  - Frank Sessa [frank.sessa@fmc.com](mailto:frank.sessa@fmc.com)



# Questions?

