



Peroxyacetic Acid 101

Liz Sutton

Jonathan Howarth

Enviro Tech Chemical Services, Inc.

Outline

- **Properties of Peroxyacetic Acid (PAA)**
 - What makes PAA a “GREEN” chemistry?
- **PAA in zero liquid discharge systems**
 - Case Study: Corn-to-Bioethanol Plant
- **Safety and Handling**
- **Summary: Reasons to Consider PAA**

What is Peroxyacetic Acid?

- **Common names: peracetic acid, peroxyacetic acid, PAA.**
- **Stable equilibrium solutions of PAA, H_2O_2 , and acetic acid**
- **Prepared by reacting acetic acid + H_2O_2 with acid catalyst. “Cure” for 3-5 days.**
- **Typical solution is 15% PAA with 22% H_2O_2**
- **EPA registered biocide.**
 - EPA Reg. No. 63838-2

General Characteristics

- **Clear, colorless liquid with a pungent vinegar-like smell.**
- **pH of 10% solution: <1**
- **Freezing point: -23°F**
- **Flash Point: 207°F**

What Makes PAA a Green Chemistry?

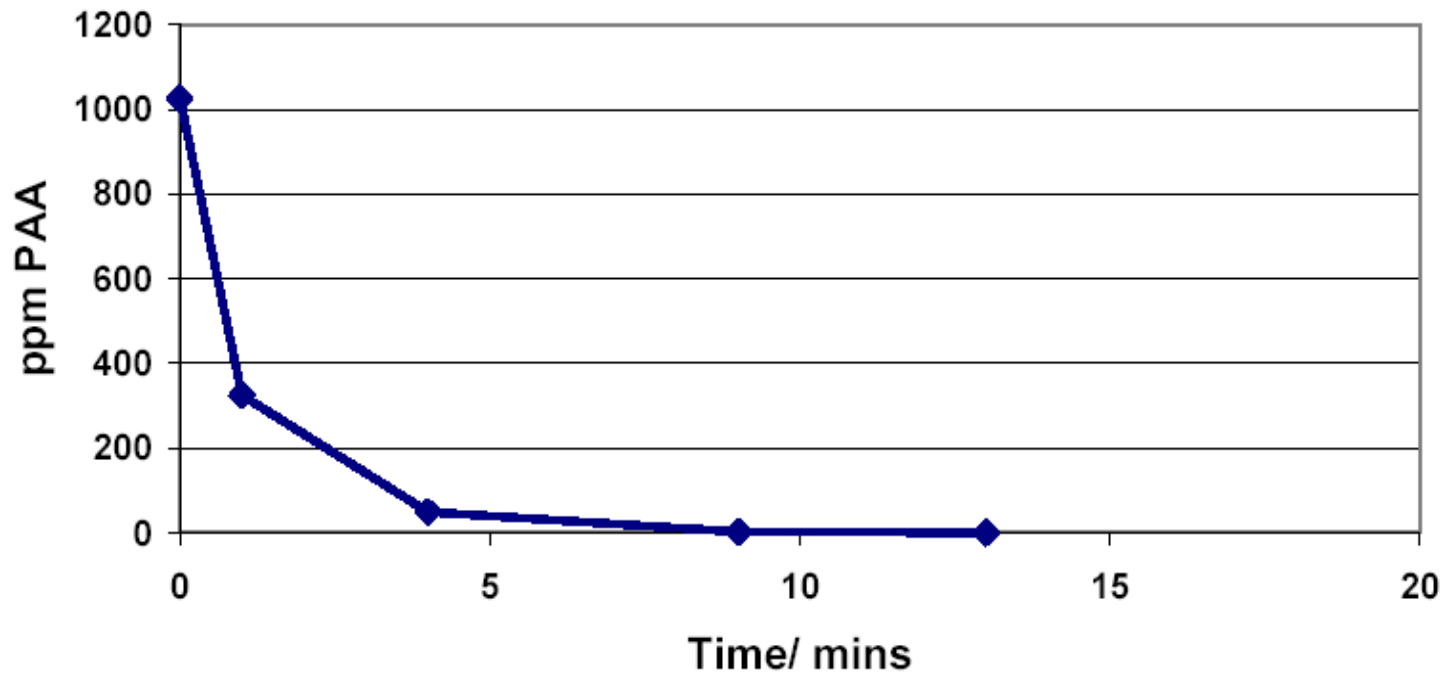
- Breaks down to CO_2 and H_2O
 - Non-persistent in the environment.
- No toxic by-products associated with its use.
- Approved for discharge to land.
- NPDES Permit for discharge to surface waters.
- NOP Certified organic (7 CFR 205.601)

Comparison with Sodium Hypochlorite (NaOCl) Bleach

	<u>PAA</u>	<u>NaOCl</u>
Efficacy	High	High
Efficacy pH >8, NH₃	High	Lower
Degraded by UV	Slight	T_{1/2} =45 mins
Contributes Na+, EC	No	1.8 lb NaCl/gallon
Field test kit	Yes	Yes
Shelf-life	> 1 year	Weeks
Aquatic toxicity	Low	High
Cost	Higher	Low

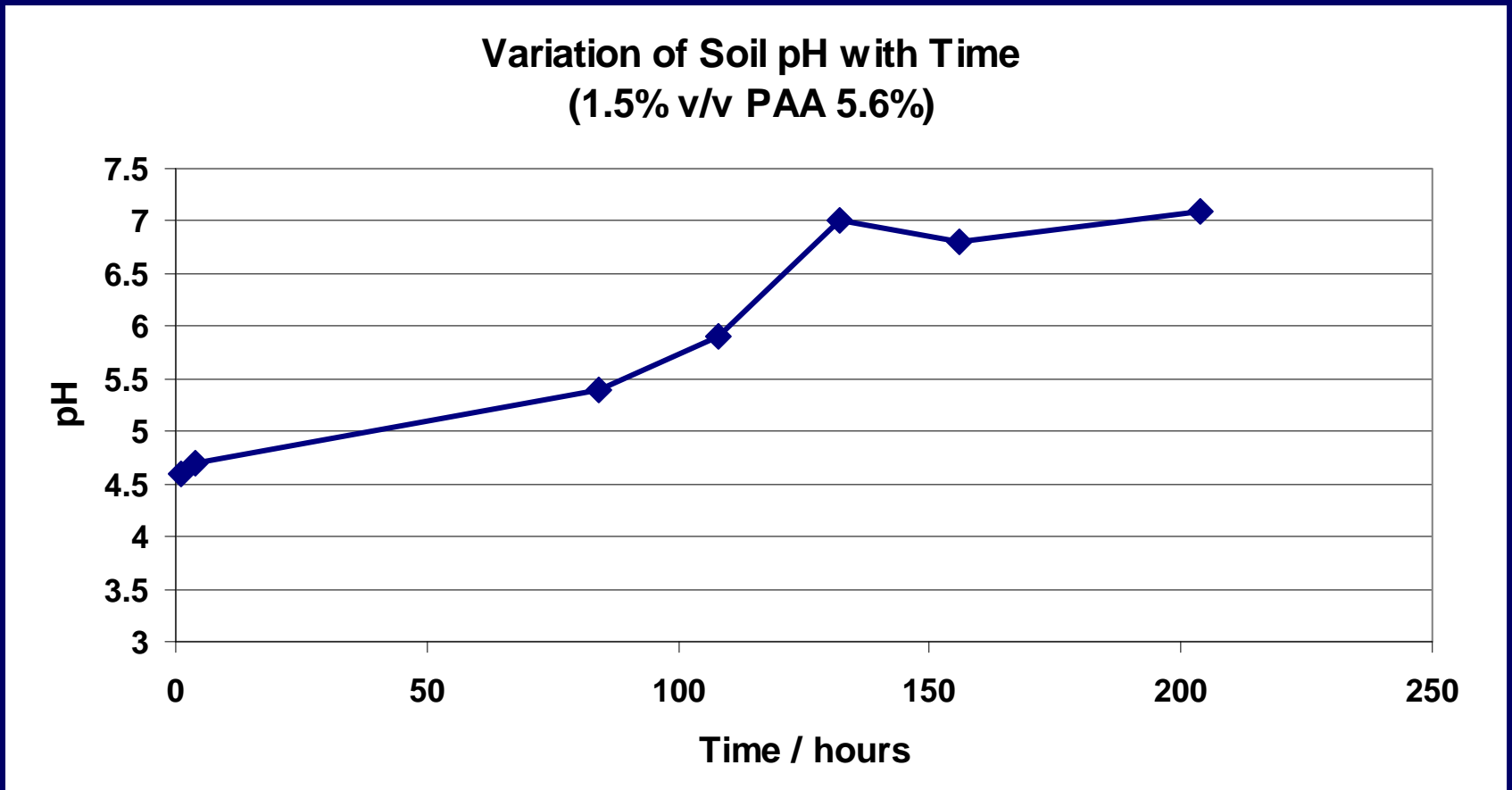
PAA Fate in Soil

Figure 1: Degradation of PAA in Soil
(1027 ppm PAA from Perasan 15)



Both PAA and H₂O₂ were depleted 20 min. after contact.

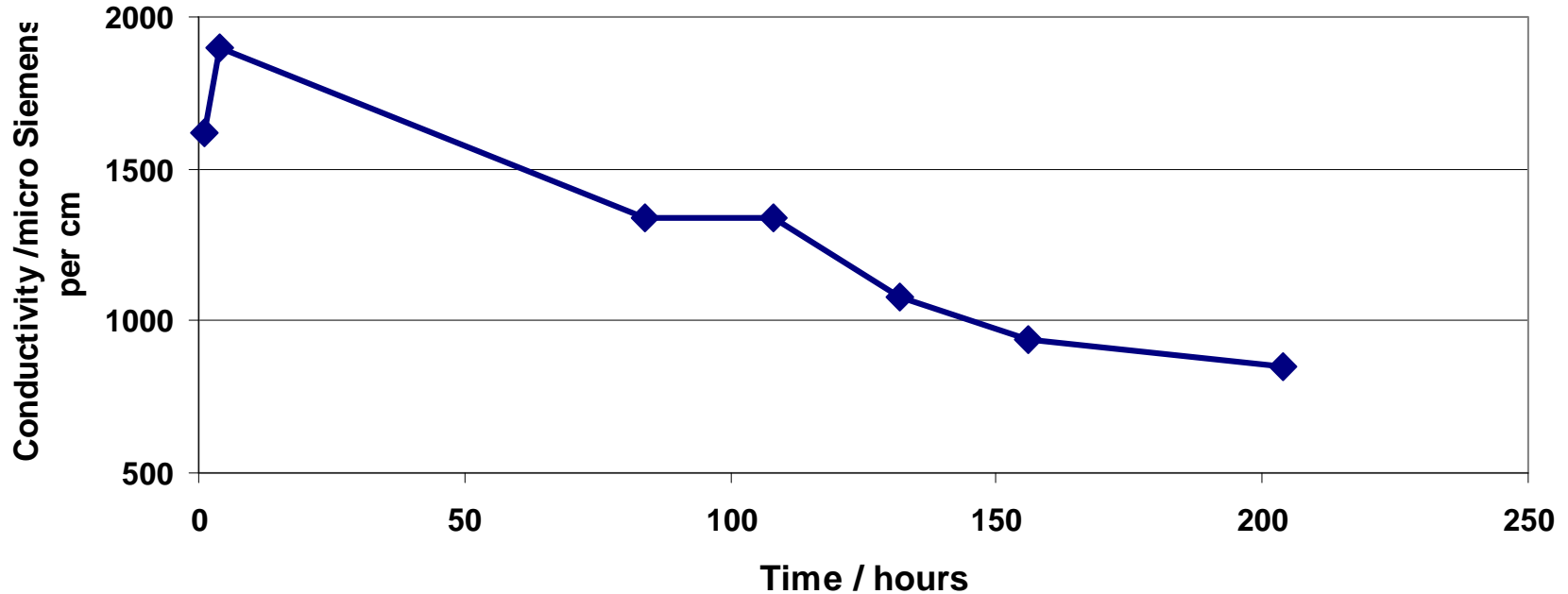
Soil pH Rebound



Soil pH neutral in just over 8 days

Effect on Soil Conductivity

Variation of Soil Conductivity with Time
(1.5% v/v PAA 5.6%)



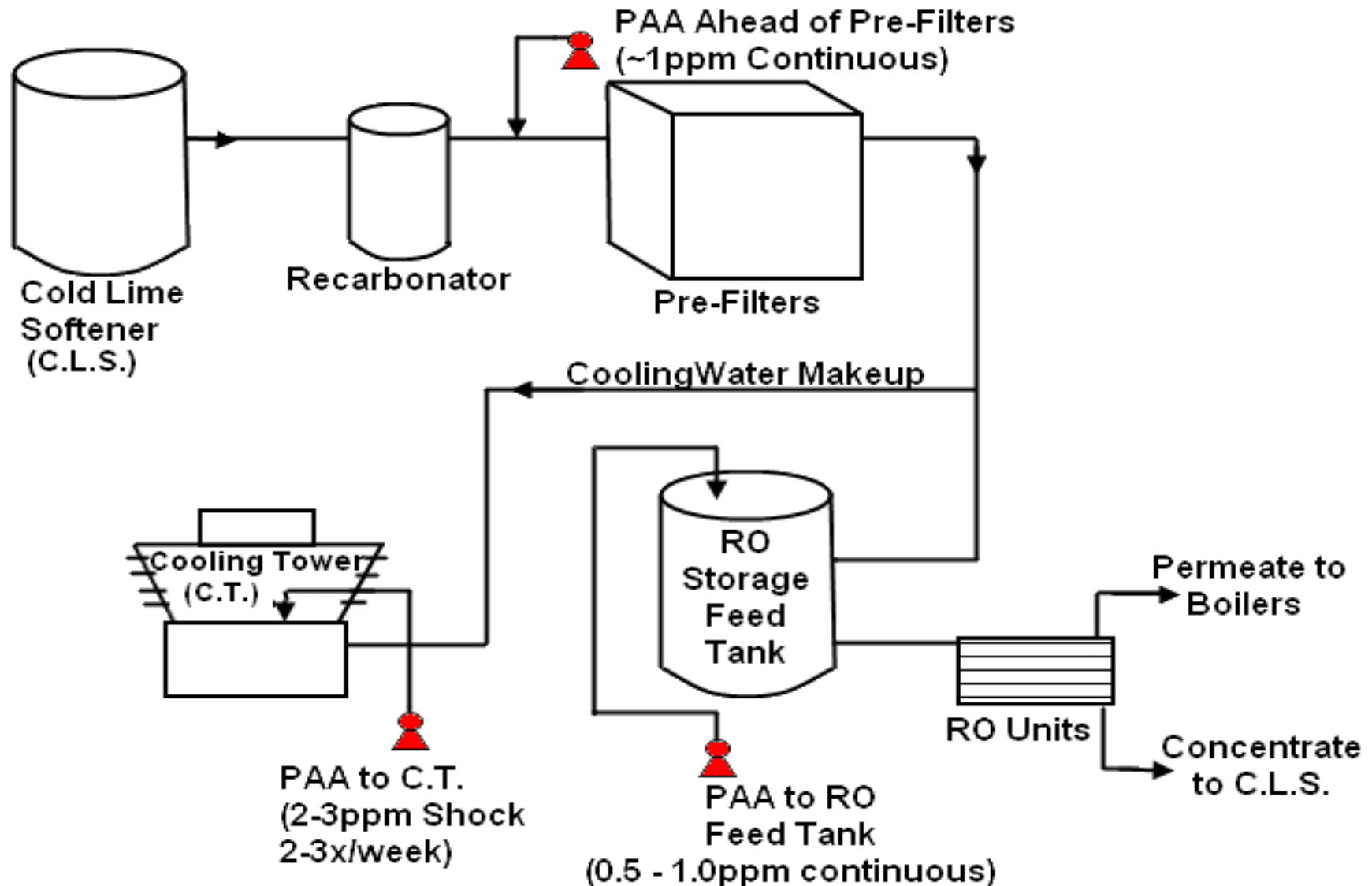
Soil conductivity rebounded to normal in 8 days.

Use of PAA in Zero Liquid Discharge Environments

Why PAA for this application?

- PAA contributes NO anions or cations that would accumulate in system.

PAA in Z.L.D. BioEthanol Plant

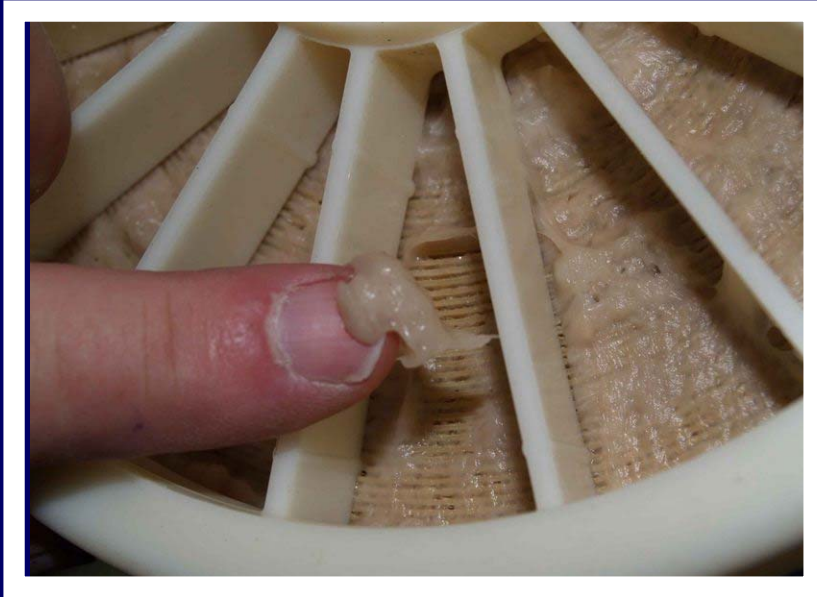


Fouled Pre-Filters



- Typical bio-fouling observed in pre-filters at bioethanol plant.

Spiral Wound RO Membranes



- Accumulation of biomass causes reduced RO flux.

Safety & Handling



- PAA is a safe to use acid.
- Wear gloves, safety glasses, or face shield, and other appropriate chemical resistant gear when handling PAA products.
- Be certain of all materials of construction that are contacting PAA.
 - Pumps, tubing, tanks, etc.

Compatible Materials - Pumps

- Teflon diaphragms and Teflon, polypropylene, or kynar liquid contacting parts.
- Double seated check valve and de-gassing head.
- Peristaltic pumps can be used.
 - Santoprene™ squeeze tubes (Stenner Pump)
 - Check integrity of squeeze tube regularly.

Compatible Materials - Elastomers

- Teflon
- Ethylene Propylene Diene Monomer (EPDM)
 - Least Expensive Option.
- Gore-Tex
 - Fluorinated.
- Kalrez
 - Very Expensive

Compatible Materials - Tubing

- Teflon
 - Excellent tolerance to PAA, wear, pressure, and UV, expensive.
- High density polyethylene (HDPE)
 - Relatively good tolerance to PAA but will become brittle with time.
- Low density polyethylene tubing is not recommended.

Storage & Handling (cont.)

- Store in original container in upright position.
- Storage area should be well ventilated and protected from sunlight and sources of radiant heat.
- Avoid freezing conditions.

Storage & Handling (cont.)

- Avoid contamination of the product, especially transition metal ions (Cu, Fe, Zn).
- Only add PAA to water. Never return product to original container.
 - Never mix PAA with any chemicals.

Effects of PAA on Skin



- Irritation and skin bleaching
- Rinse immediately with water.
- Skin returns to normal < 3 hours.

Safe-T-Feed System

- Inexpensive engineering control for PAA containers.
- Eliminate potential for worker exposure.
- Simplifies installation and use.

Safe-T-Feed System



Drum arrives with internal system installed, white shipping cap easily removed with screw driver.

Safe-T-Feed System



- Twist adaptor onto drum.
- Attach feed tube to adaptor.



Summary: Reasons to Consider PAA

- **Electrical conductivity limits/ Na⁺ ion limits on plant discharges or Z.L.D.**
- **Clean RO membranes**
 - **PAA unreactive to polyamide membranes**
- **Avoid a dechlorination step**
 - **No chlorinated DBP's**
- **Large amount of stainless steel equipment.**

Peroxyacetic acid is the
“Greenest” EPA registered
biocide available.

Acknowledgements

- Charlie Kroeger, US Water Services
- Tina Rodrigues, Enviro Tech Chemical Services