
LEADING THE WAY
CampusEnergy2022
Feb. 15-18 | Westin Boston Seaport District Hotel | Boston, Mass.
INTERNATIONAL DISTRICT ENERGY ASSOCIATION

A novel non-phosphorus cooling water treatment technology to address operational and environmental challenges

IDEA Campus Energy 2022
Thursday, February 17, 2022

Presented by:

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SUEZ - Water Technologies & Solutions

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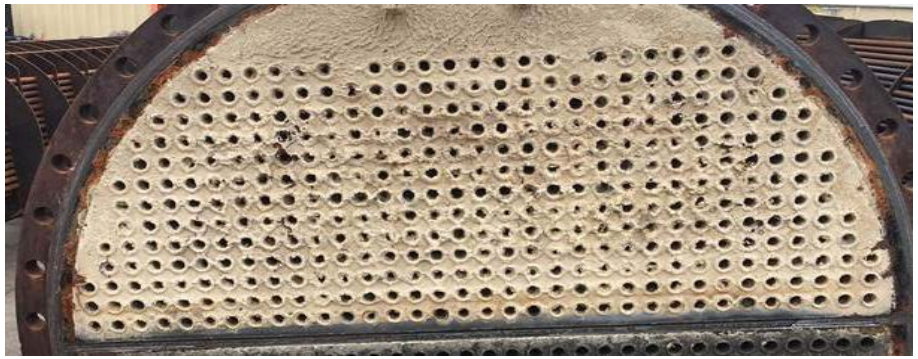
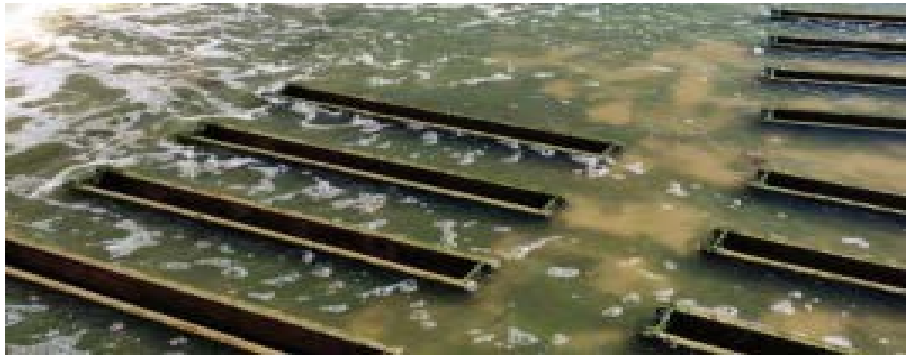
Q&A will not be answered live

Please submit questions in the Q&A box.
The presenters will respond to questions off-line.

Current challenges w/ phosphorus (P)

- Environmental pressure & changing regulations to limit “P” in effluent water
- Deposition risk in cooling systems
- Algae growth/blooms
- Global phosphorus shortage
- Brand/community image





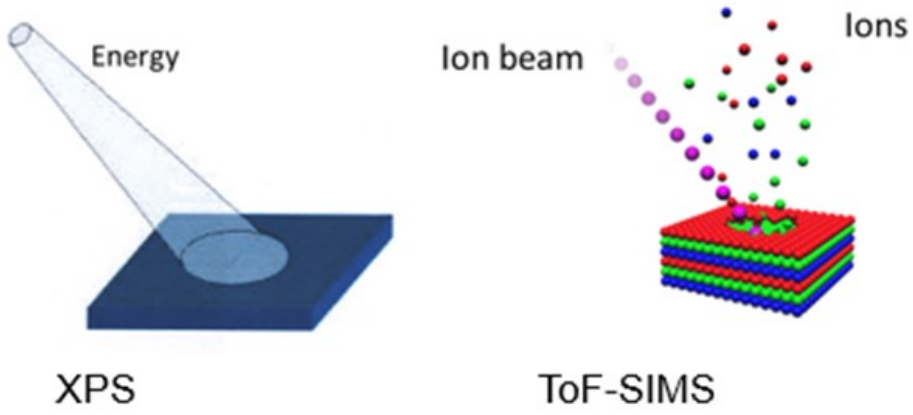
The right non-P technology solves (for example)

Environmental challenges	• NPDES regulated discharge requiring low or no phosphorus contribution • NPDES regulated TSS discharge, with problematic algae
Operational challenges	• Calcium phosphate deposition risk in heat exchangers and condensers • Microbiological, algae bloom, and algae growth issues • Desire to reduce/eliminate acid use and/or decrease water use
Supply chain challenges	• Precludes the need for phosphate or phosphonates for corrosion and scaling inhibition
Social challenges	• Desire to demonstrate social and environmental responsibility • Contribute to corporate sustainability goals

Engineering non-P protective films

SatEQ* – saturation modeling … multi-component equilibria

Surface analysis –



Thermodynamics/kinetics, structure-activity/dose-response, metal oxide/mineral salt/treatment chemistry formation, …

→ new non-P chemistries/guidelines/programs – **E.C.O.Film* Engineered Films**

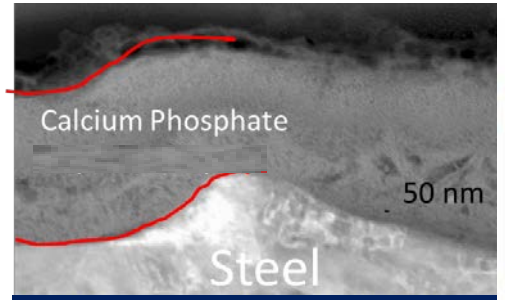
* Trademark of SUEZ; may be registered in one or more countries

E.C.O.Film* in action

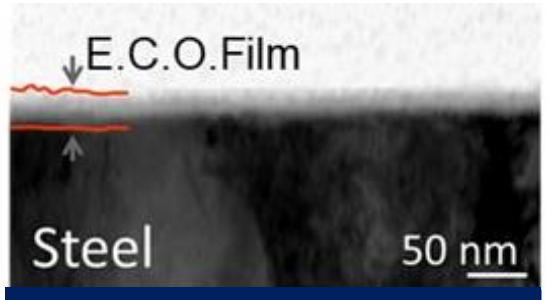
E.C.O.Film was engineered to:

- Function as a direct corrosion inhibitor and a surface film formation facilitator
- Work with the naturally cycled conditions in the system to enhance natural corrosion control
- Impede and reduce electron flow directly at the metal-electrolyte interface by facilitating matrix-CHO-SFFC film formation*

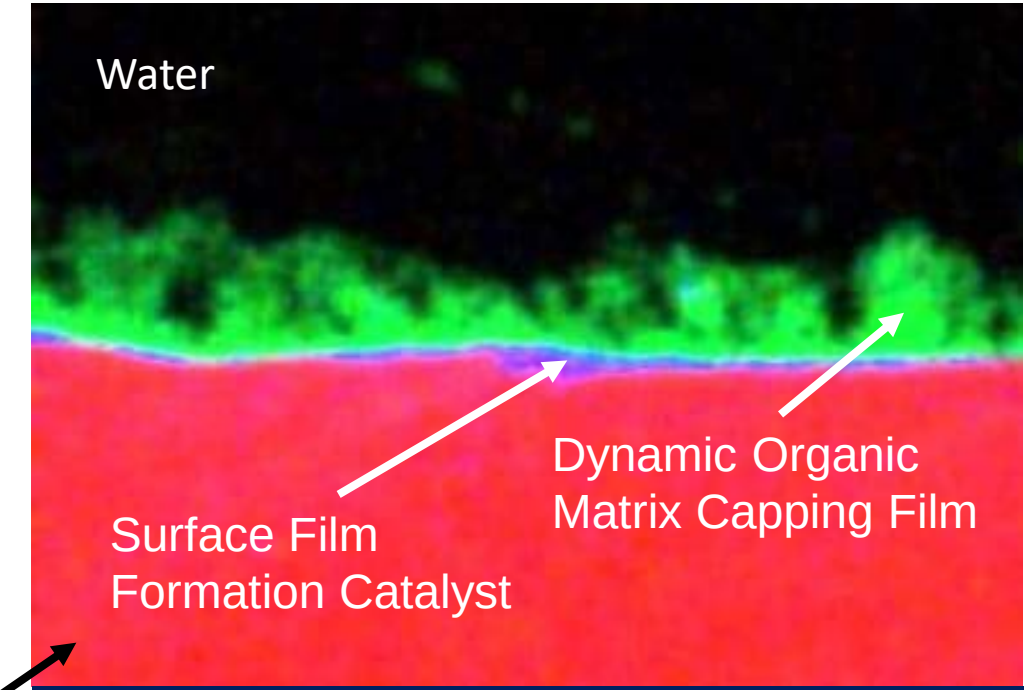
CHO = Carbon-Hydrogen-Oxygen-based inhibitor
SFFC = Surface Film Formation Catalyst.



Voluminous phosphate film
~150 nm multi-layer



~20 nm E.C.O.Film layer



E.C.O.Film w/ Surface Film Formation Catalyst (SFFC)

* Trademark of SUEZ; may be registered in one or more countries; E.C.O.Film = Engineered Carboxylate Oxide Film; May contain trace amounts.

What is E.C.O.Film?

- New cooling water technology using advanced in-situ surface film engineering for corrosion control
- Provides scale/deposit control & corrosion control w/o the use of phosphorus-based molecules
- Easy to monitor, feed & control
- Allows for elevate
- reduced … water
- Reduce
- No zinc
- No tin
- Patented technol

eliminate PO_4-based deposition potential … enhanced heat transfer, improved process throughput

emical usage → reduced $s

feed the

de usage

Average 7 day coupon mpy = 7.9

Average 7 day coupon mpy = 1.9

Key Conditions:

- 1 ppm Free Chlorine
- 600 ppm Ca as $CaCO_3$
- 8.0 pH

E.C.O.Film case studies

Case 1 – **Midwestern power plant** – **environmental** focus
E.C.O.Film to meet stricter phosphorus discharge regulations

Case 2 – **Midwestern power plant** – **environmental** focus
E.C.O.Film to address algae growth and meet TSS limits

Case 3 – **Southeastern chemical plant** – **operational** focus
E.C.O.Film to improve calcium deposition and mild steel corrosion protection

Case 4 – **Midwestern dry corn ethanol plant** – **environmental** & **operational** focus
E.C.O.Film to achieve stricter phosphorus discharge limits and improve mild steel corrosion protection

E.C.O.Film case study value

Case 1 – **Midwestern power plant** – **environmental** challenge resolved –
Capital cost avoidance of **$2 million USD**

Case 2 – **Midwestern power plant** – **environmental** challenge resolved –
Saved **>$2 million USD** annually in specialty chemical costs

Case 3 – **Southeastern chemical plant** – **operational** challenge resolved –
Reduced water usage, reduced sulfuric acid usage, and specialty chemical costs savings of **$100,000/year USD**

Case 4 – **Midwestern dry corn ethanol plant** – **environmental** & **operational**
$140,000/year USD savings – compliance and pipe replacement

Midwestern dry corn ethanol plant – E.C.O.Film case study 4

	Case 4 - Midwestern Dry Corn Ethanol Plant
Plant Details	Dry corn mill ethanol plant
Makeup Water	Well water, RO water
Blowdown Water	Discharge to river
Cooling Tower	Counterflow tower with high efficiency fill
System Volume	3,407 m^3 (900,000 gallons)
Recirculation Rate	227 m^3/min (60,000 GPM)
ΔT	8.3 – 11.1 C (15 – 20 F)
T_{skin}, max; T_{bulk}, max	71.1 C (160 F) T_{skin}; 60 C (140 F) T_{bulk}
Metallurgy	Mild Steel, Stainless Steels, ADM Brass
Why non-P?	Stricter (lower) phosphorus regulations

- Traditional alkaline pH/phosphate program to low phosphorus program due to lower phosphorus discharge limit (2018)
- Mild steel corrosion results were satisfactory at 3 mpy
- A move to E.C.O.Film to ensure discharge requirement met and to improve performance

Midwestern dry corn ethanol plant – E.C.O.Film case study 4

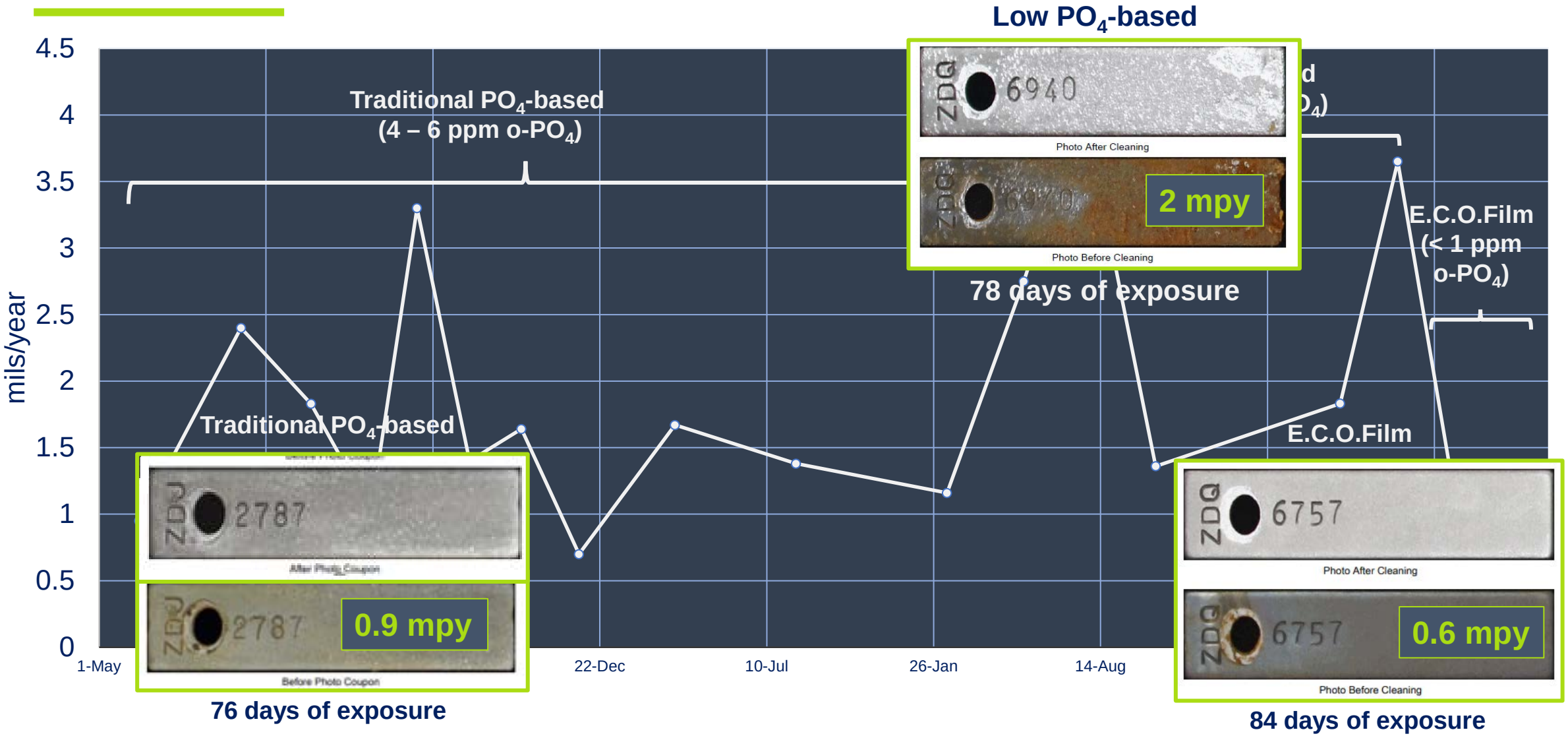
Program tower operation:

- MU water blend … well water and RO permeate
- 5 – 6 cycles (TDS-limited)
- pH 8.2 (raised from pH 8.0); w/ sulfuric acid
- E.C.O.Film; o-PO_4 discontinued; triazole
- Oxidizing biocide (unchanged)

Goals

- **maintain <0.68 ppm phosphorus, as P**
- **improve on Mild Steel corrosion rate (<3 mpy)**

Midwestern dry corn ethanol plant – E.C.O.Film case study 4



Midwestern dry corn ethanol plant – E.C.O.Film case study 4

Results summary:

Challenges:

- Reduced P limit of 0.68 ppm (as P)
- Maintain < 3 mpy (mild steel)

Conditions:

- Ca: 900 – 1,100 ppm (as $CaCO_3$)
- pH: 8.1 – 8.3
- o-PO_4: < 1 ppm (as PO_4)

Solution:

- E.C.O.Film; o-PO_4 discontinued; triazole

Results:

Achieved

- Mild steel corrosion rates achieved
- Phosphorus within discharge limits

Value

- Avoided need for capital for PO_4 removal
- Avoidance of environmental discharge fees
- Reduced P loading to the river by 60% ... algae reduction potential of 380,000 lbs/year
- Mild steel corrosion rates reduced 70%
- $140K/year savings - fees for non-compliance and pipe replacement cost avoidance

What E.C.O.Film can do for your facility

- Assist in ensuring changing environmental discharge requirements are met
- Reduce the risk of deposition and reduce the risk of surprises in operations
- Reduce biological growth challenges (non-P)
- Reduce exposure to phosphorous supply challenges
- Support & reinforce brand image and community goals

Address environmental & operational challenges *and* impact the bottom line $s, plus!

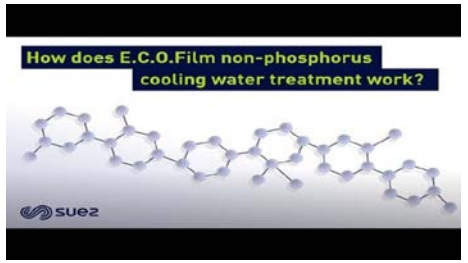
NO PHOSPHATE.

NO DEPOSITION.

NO SURPRISES.

E.C.O.Film

How Does E.C.O.Film Work?
https://www.youtube.com/watch?v=McGITeJw9tQ&feature=youtu.be



LSP Whitewater Power Plant Customer Testimonial
https://www.youtube.com/watch?v=v4r6egvsL-k&feature=youtu.be

Plus other print resources are available.

Surface film engineering with non-P technology
Further resources

Recent papers at CTI:

- “Metal and Organic Solutions for Reduced Phosphorus Applications”, P.R. Frail, C.C. Pierce, CTI TP19-10, 2019

- “Constructing non-P Passivation Films for Cooling Applications: Surface Science Perspective”, P.R. Frail, CTI TP20-24, 2020

Thank You!

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