What can C2 Technology do for Delayed Cokers?

- Extend Run Lengths
- Stabilize Coke Formation
- Eliminate Metal Sulfidation
- Reduce Metal Carburization
- Lower Heater Duty
- Reduce Greenhouse Gases
- Extend Equipment Life
Questions Addressed Here

☐ What is it?
☐ Does it stay bonded to the surface?
☐ Is it stable at high temperature?
☐ Why does it work?
☐ How is it applied?
☐ How long will it last?
☐ How can it be applied at your facility?
M.I.S.T.

- Ultra-Thin Film
- Diffusion Layer
- Substrate Material
TEM Image by Dr. Jane Howe, Oak Ridge National Laboratory
SAM of C2

Sputter rate~20nm/min

Zr
O
C

Fe

~30 nm

Diffusion Layer

Time (sec)

0 100 200 300 400 500 600 700 800

0 10 20 30 40 50 60 70 80 90 100

C
O
Zr
Fe

SAM Profile by Dr. Harry Meyer,
Oak Ridge National Laboratory
Strong Surface Bonding Example

Shot Sleeve
(Cold Chamber)
Erosion and Wear Resistance Example

Untreated Roll, 1 Week
Erosion and Wear Resistance Example

C2 Treated Roll, 10 Weeks
DR. GHAZ DICKAKIAN

References Include

EXxonMobil RETIRED
Thermogravimetric Analysis (TGA)
Graph of data from fouling results

![Graph showing fouling results](image)

- C/S 1018
- Coated 1
- Coated 2
- Coated 3
Untreated

"C2" Treated

Coke Stabilization Achieved

Half-Way Through Testing

F.A.C.T.

Fouling And Coking Technology, Inc.
Virtually Eliminated Sulfidation

Typical of 9Cr Furnace Coke Deposit

Coke Deposit
Iron Sulfide Layer
Tube Metal

Eliminated by C2
Conclusions

- Calculated Effectiveness of the coating in mitigating fouling effectiveness 60%
- C2 Stabilizes Temperature Increase
- C2 Retards Coke Formation
- C2 Prevents Metal Sulfidation
- C2 is Stable at Delayed Coker Furnace Operating Temperatures
- C2 does not Spall off and Contaminate the Product
Ethylene Cracker Testing at DOE’s Oak Ridge Nat’l Lab
75% Less Coke Deposition

1,000 Hours at 900°C
Other Petrochemical Applications:

• Hydrocrackers
• Hydrotreaters
• Reformers
• Venturi Scrubbers
• Caustic Attack
• $\text{H}_2\text{S}$ Attack
• ... and many others
Polish  Apply  Heat  Cool  Repeat
Polish
Apply
Cool
Repeat

4-6 Times

- Application cycle 8-12 hours

- Total onsite time 96 hours (max)
  - Includes rig in/out time & polishing
  - Incremental to typical pigging time
Risks
Field Application
How can you verify this technology at your site?

- Tube Segment
- Single Cell Treatment
- Whole Heater Treatment
Tube Segment

20’ Tube Segment

~4’ ~4’ ~12’
Single Cell
Or
Whole Heater
In situ
Low Risk/High Reward Proposition, providing:

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- **Reduce Metal Carburization**
- **Lower Heater Duty**
- **Reduce Greenhouse Gases**
- **Extend Equipment Life**
C2, LLC
1370 Union Hill Industrial Court E
Alpharetta, Georgia  30004
678-710-0760
www.c2nano.com
evan.hyde@c2nano.com