

INTEGRITY MANAGEMENT

SCALE CONTROL

SEPARATIONS

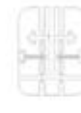
FLOW ASSURANCE

PRODUCTION ENHANCEMENT

# Metals Removal in Delayed Coker Operations

March, 9 2007  
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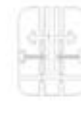




# Discussion Topics

- Metals Removal from Crude Oil
  - Desalter Operation
  - Providing Charge to Delayed Coker
- Plant Test Results
- Possible Mechanisms for Metals Removal
- Questions for Future Work





# Relevance

- Lowering the Metals Content in Coke Affects the Environment
- Metals in Fuel Grade Coke Become atmospheric pollutants
- Instead Metals Could be Separated and Placed Into Ground Formations
- Where They Originated From in the 1<sup>st</sup> Place
- The Best Possible Environmental Solution





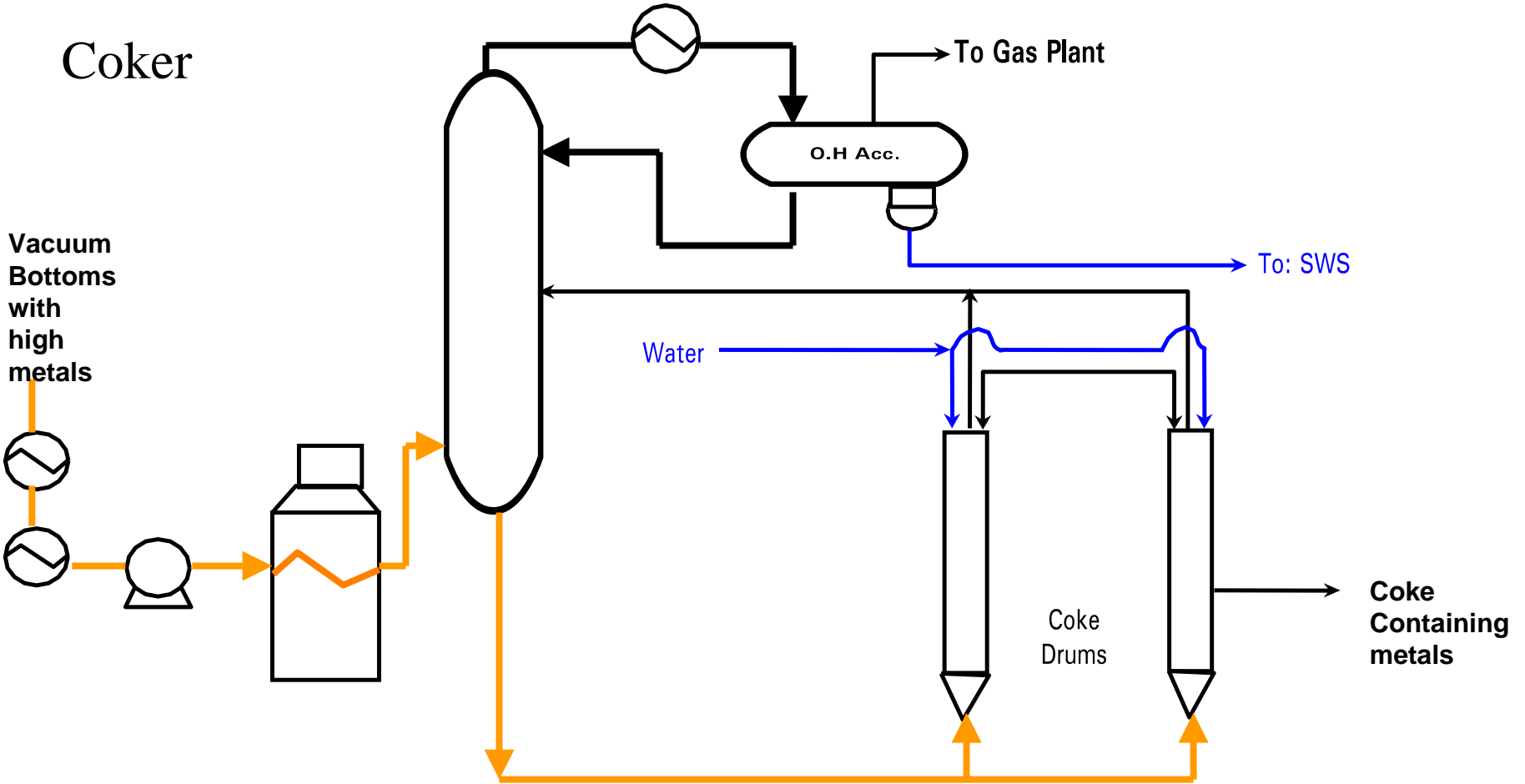
# Delayed Coker

- Vacuum Bottoms Charge
- Produced Anode Grade Coke
  - low metals
  - \$50.00 per ton
- Fuel Grade Coke
  - High metals content
  - \$5.00 per ton





# Coker





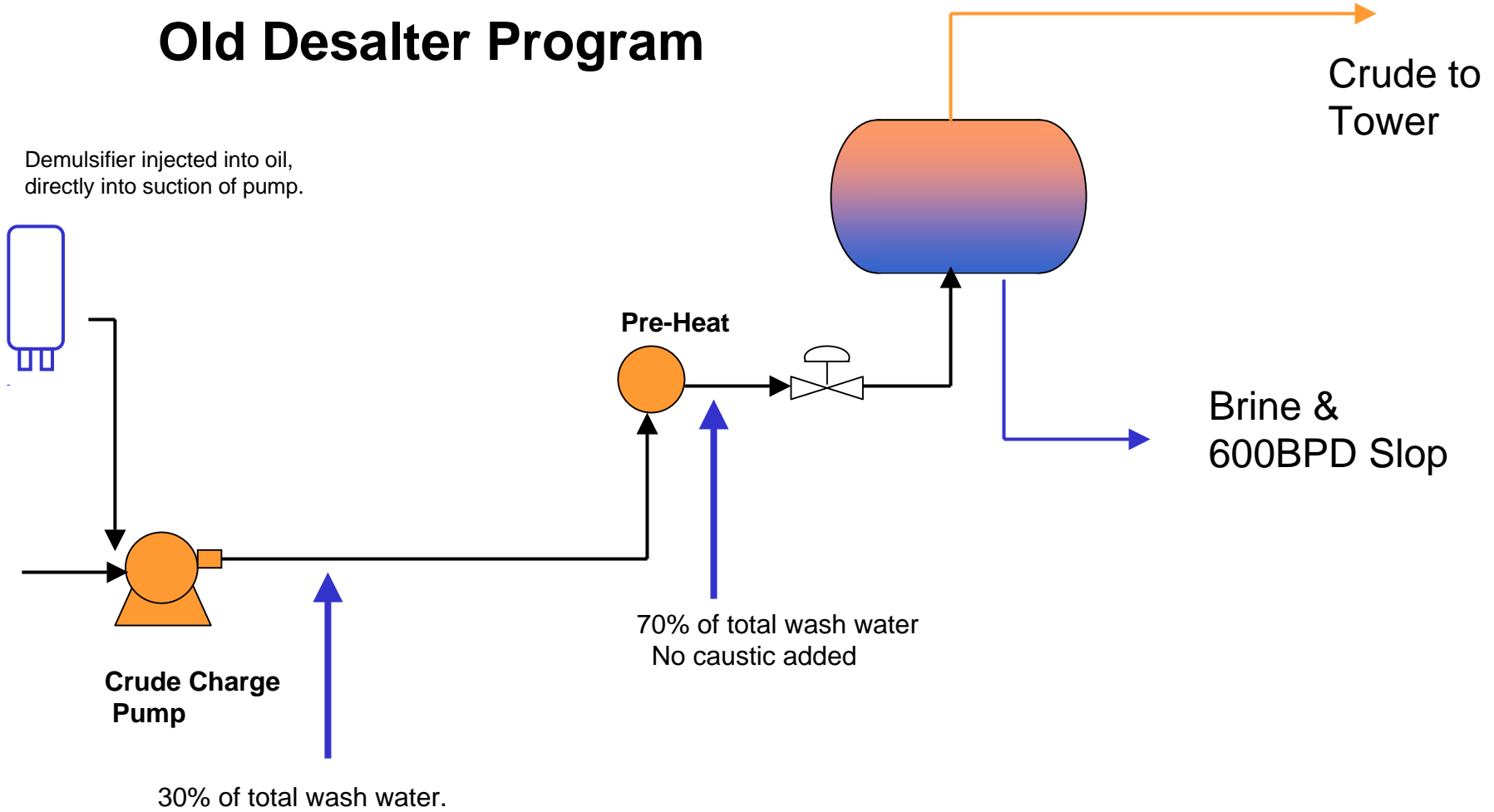
# Old Desalter Operation

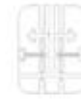
- Produced Interface on Purpose
- Collect metals
- Send slop to API Separator
- More than 400 barrels per day produced
- Desalter Operated at Upset
- Difficult to Control Interface
- High Metal Content in Coke





# Old Desalter Program





# Champions' Desalter Operation

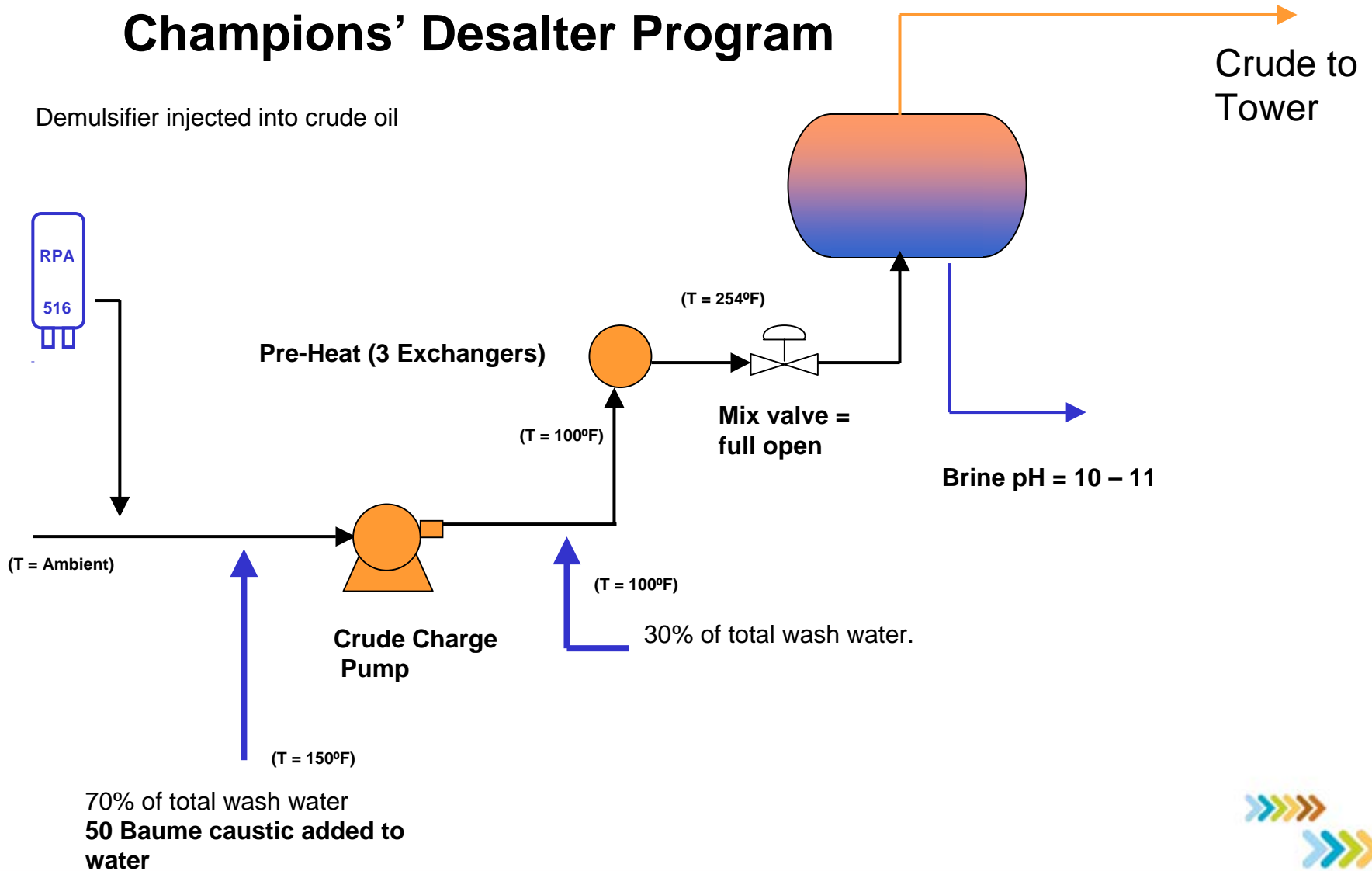
- Target Zero Interface
- High pH Operation
  - Water wet the Solids
- Drop Metals Into Desalter Brine
  - Suspended Solids
  - To API Separator





# Champions' Desalter Program

Demulsifier injected into crude oil

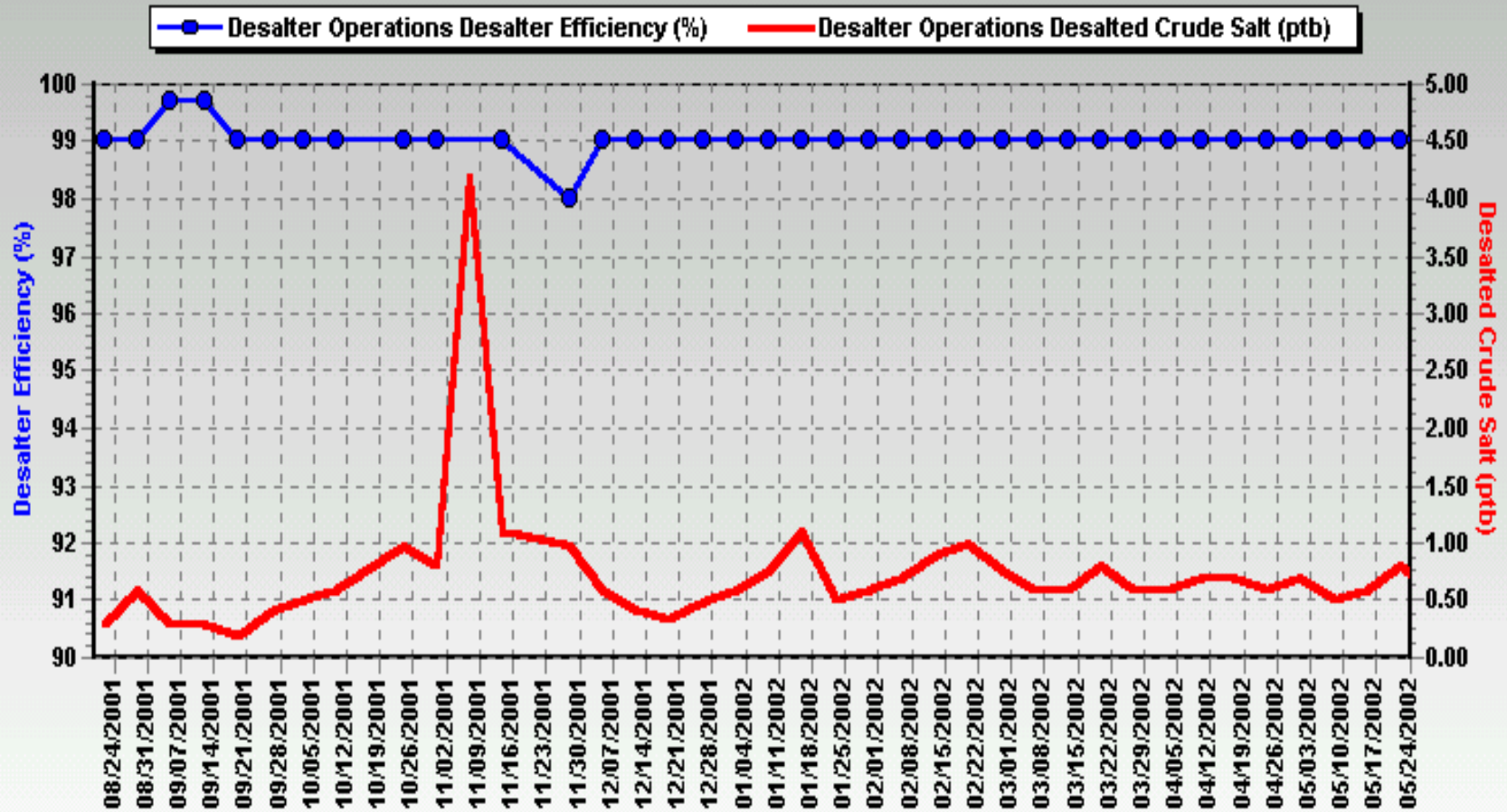




## Desalter Performance

### Desalter Efficiency & Salt Content of Desalted Crude

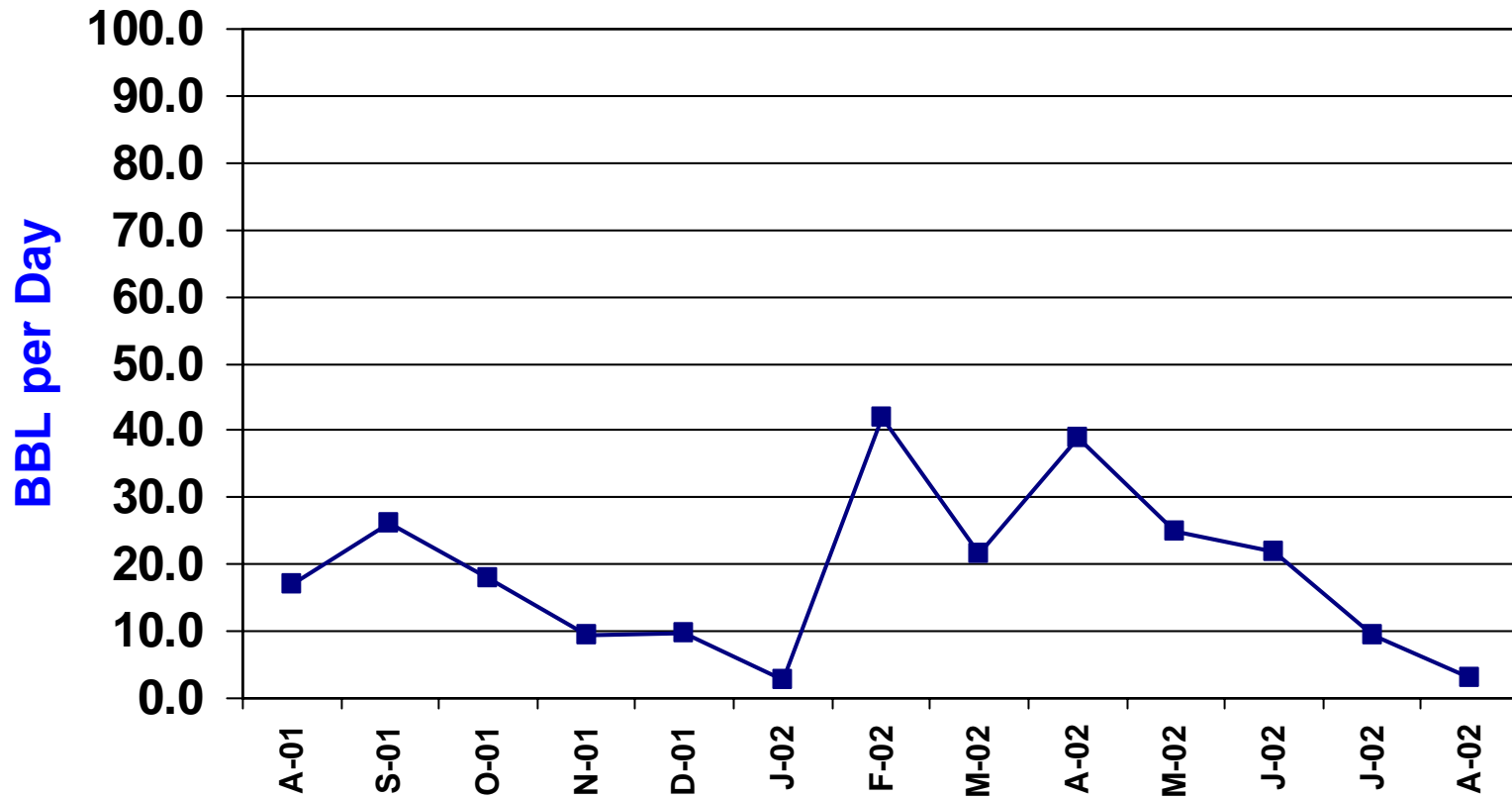
#### Crude Unit Desalter Performance





## Desalter Performance

Avg. Slop Oil Production

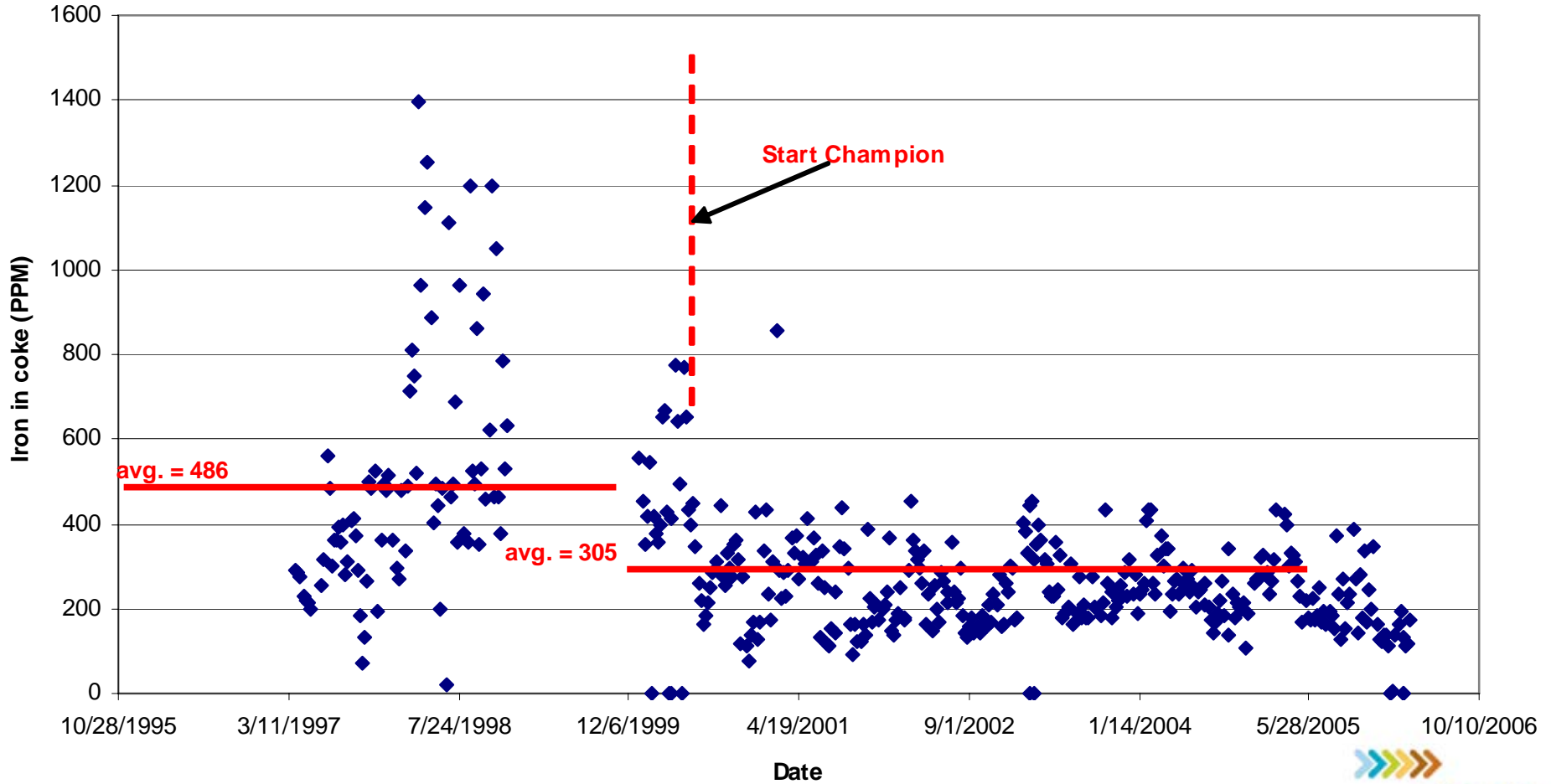


Average for 2002 < 20 bbls/day



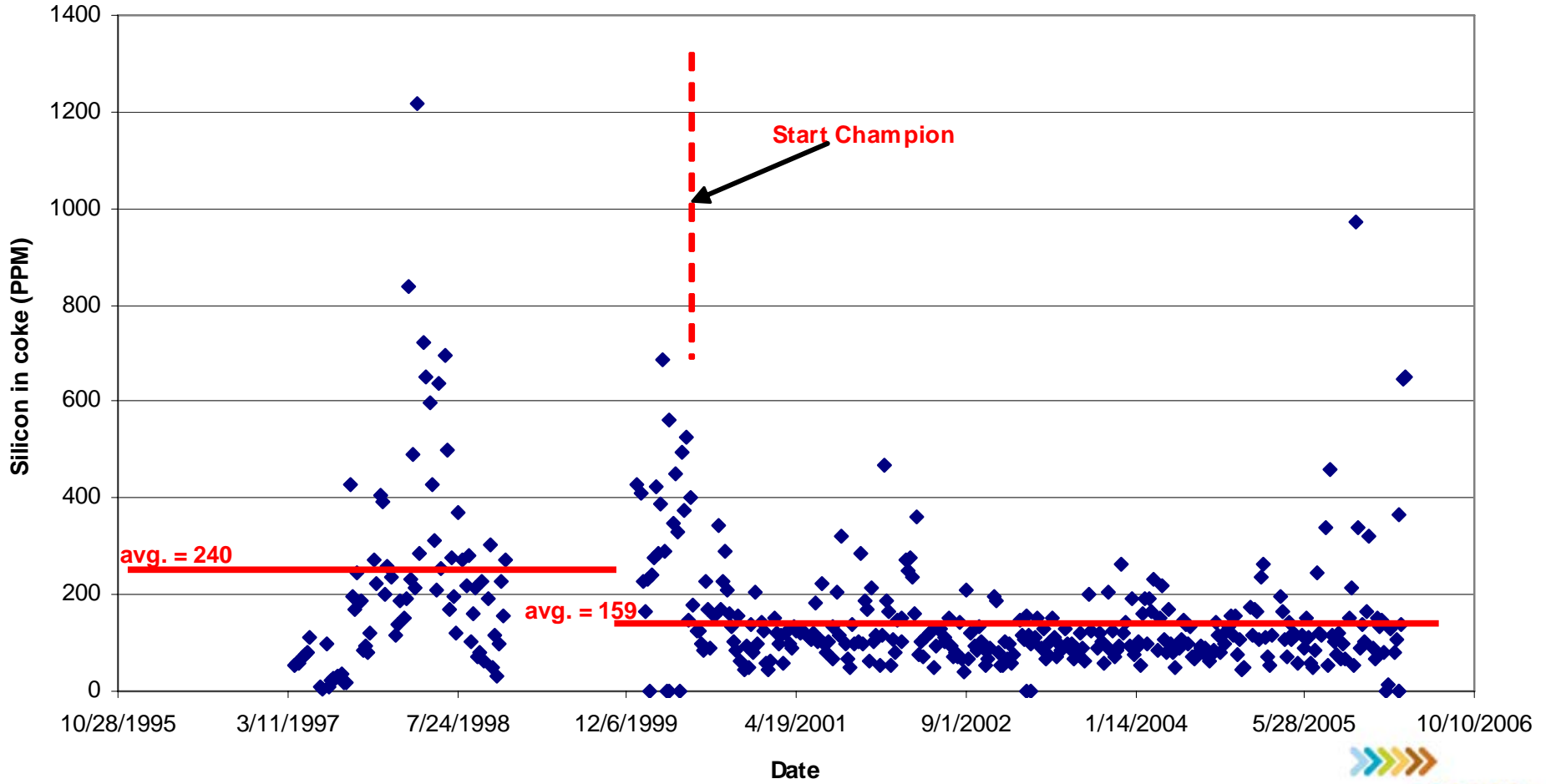


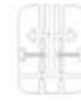
### Iron



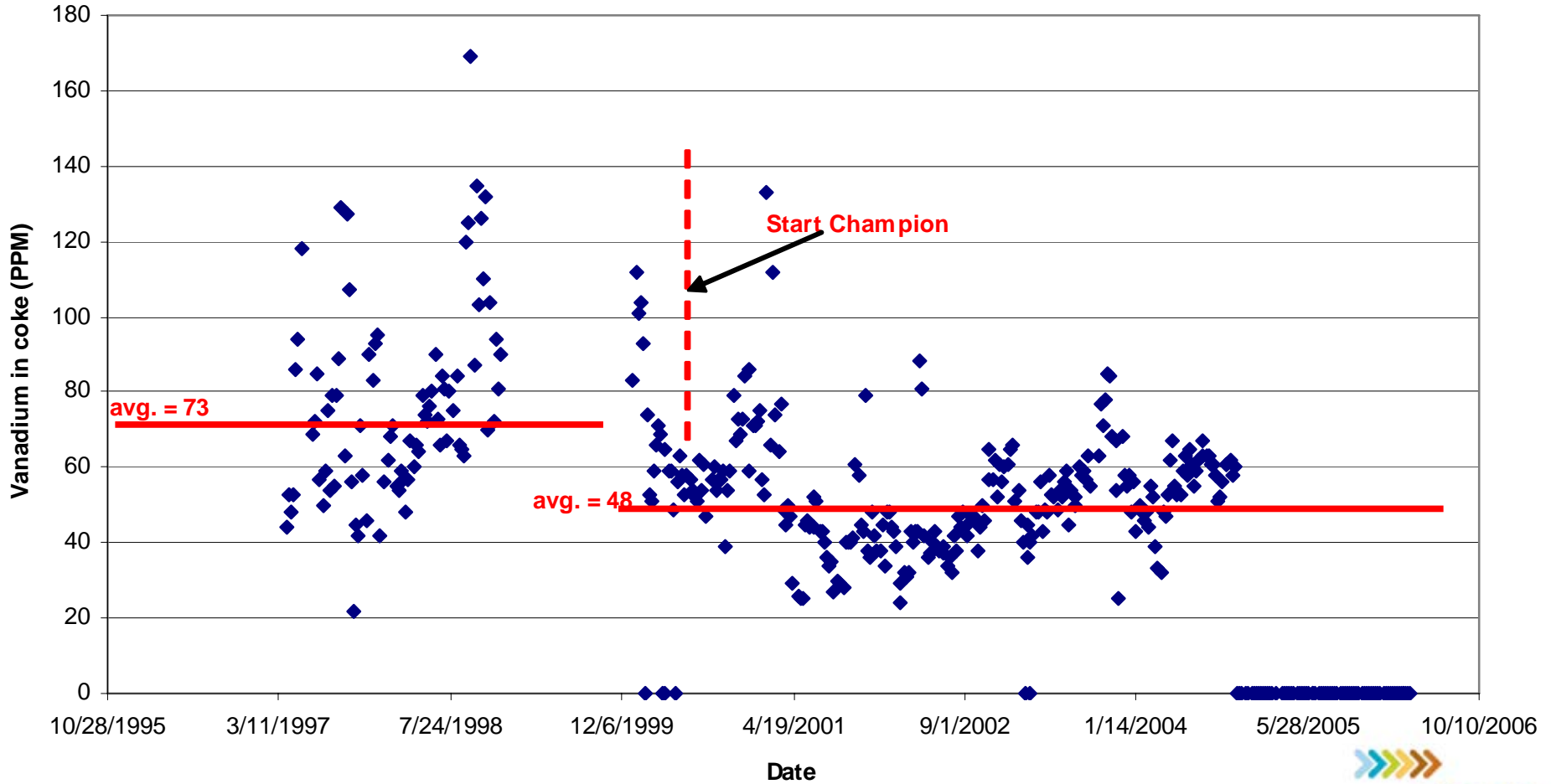


### Silicon



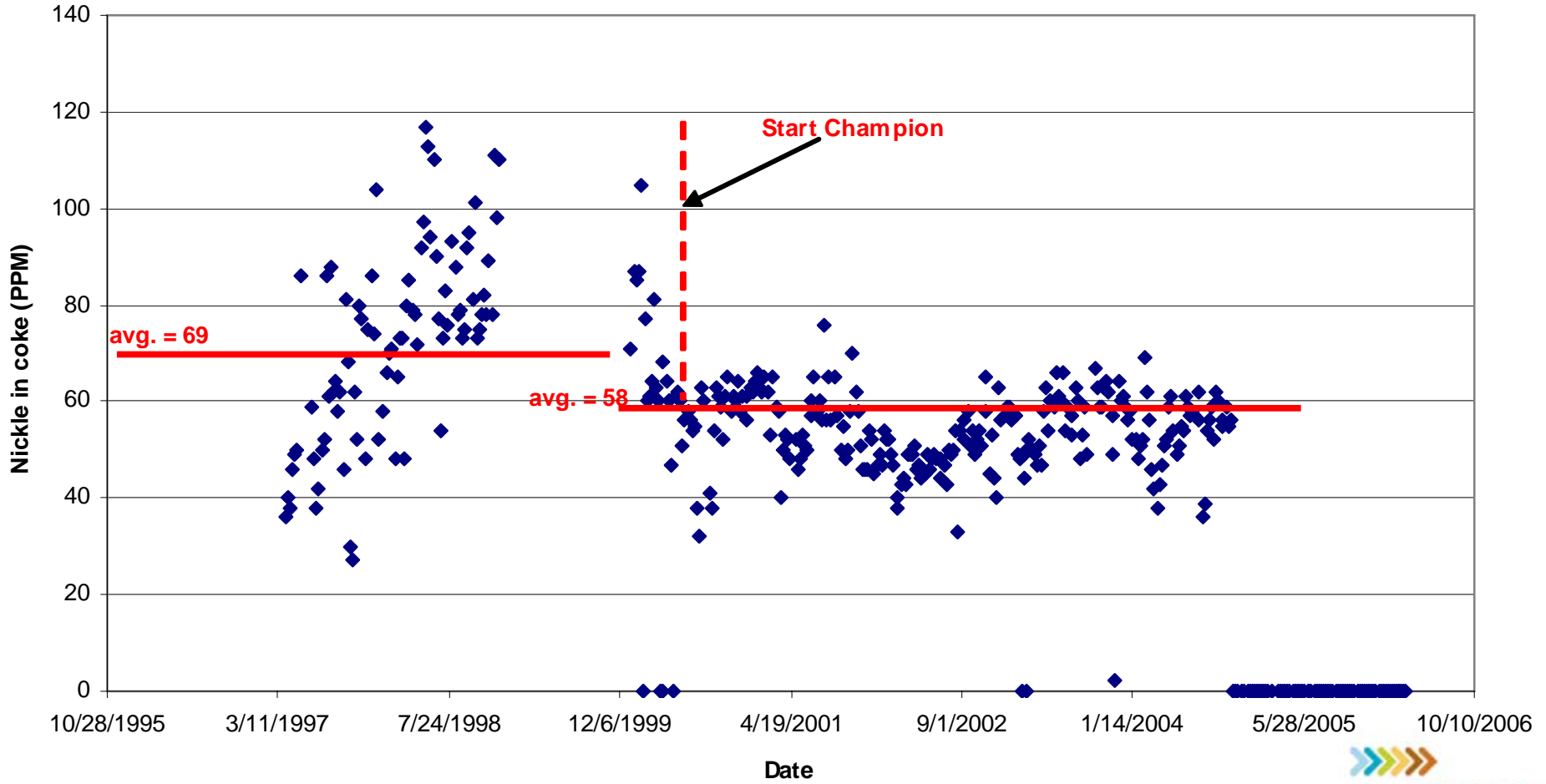


### Vanadium



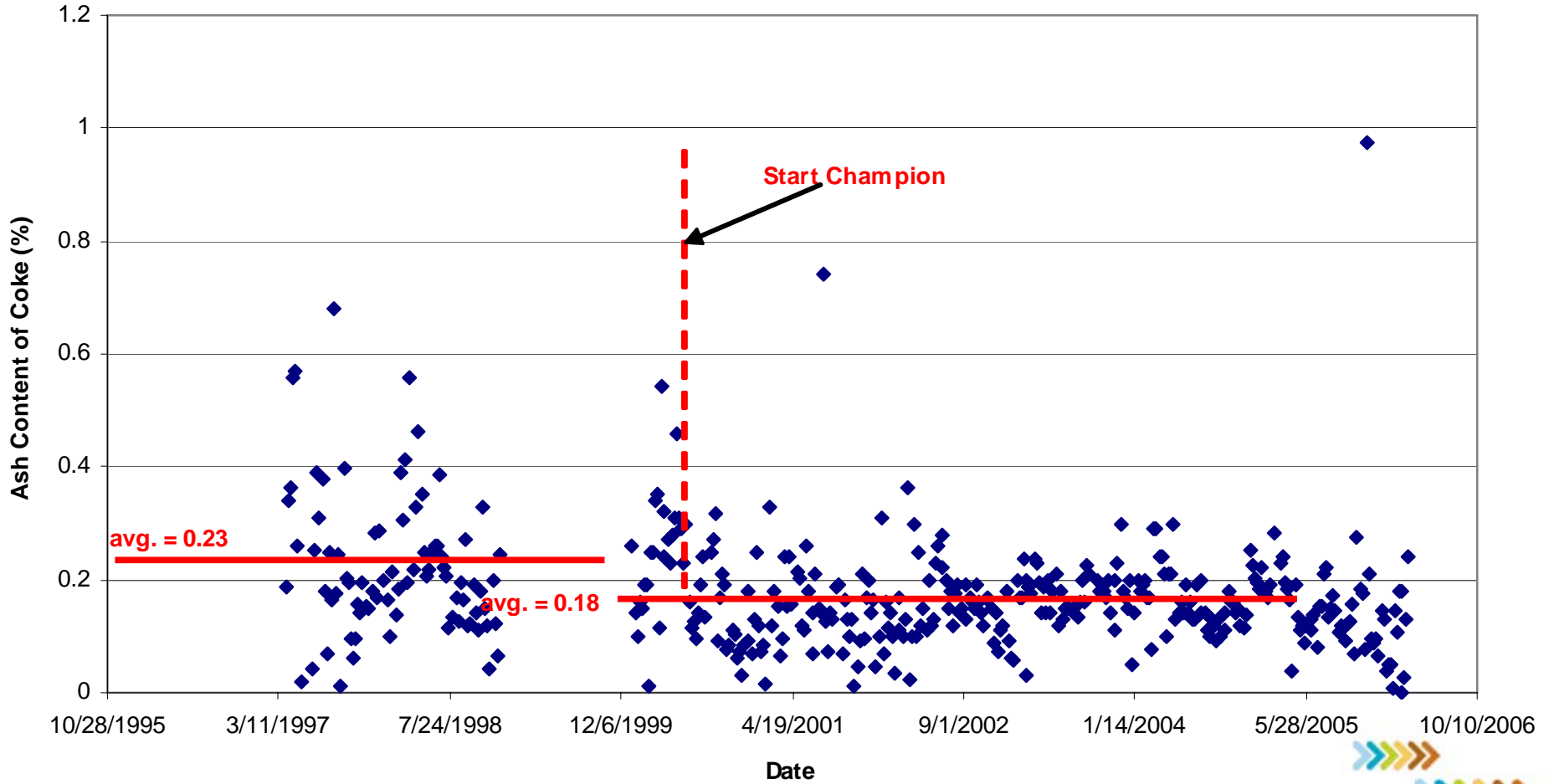


### Nickel





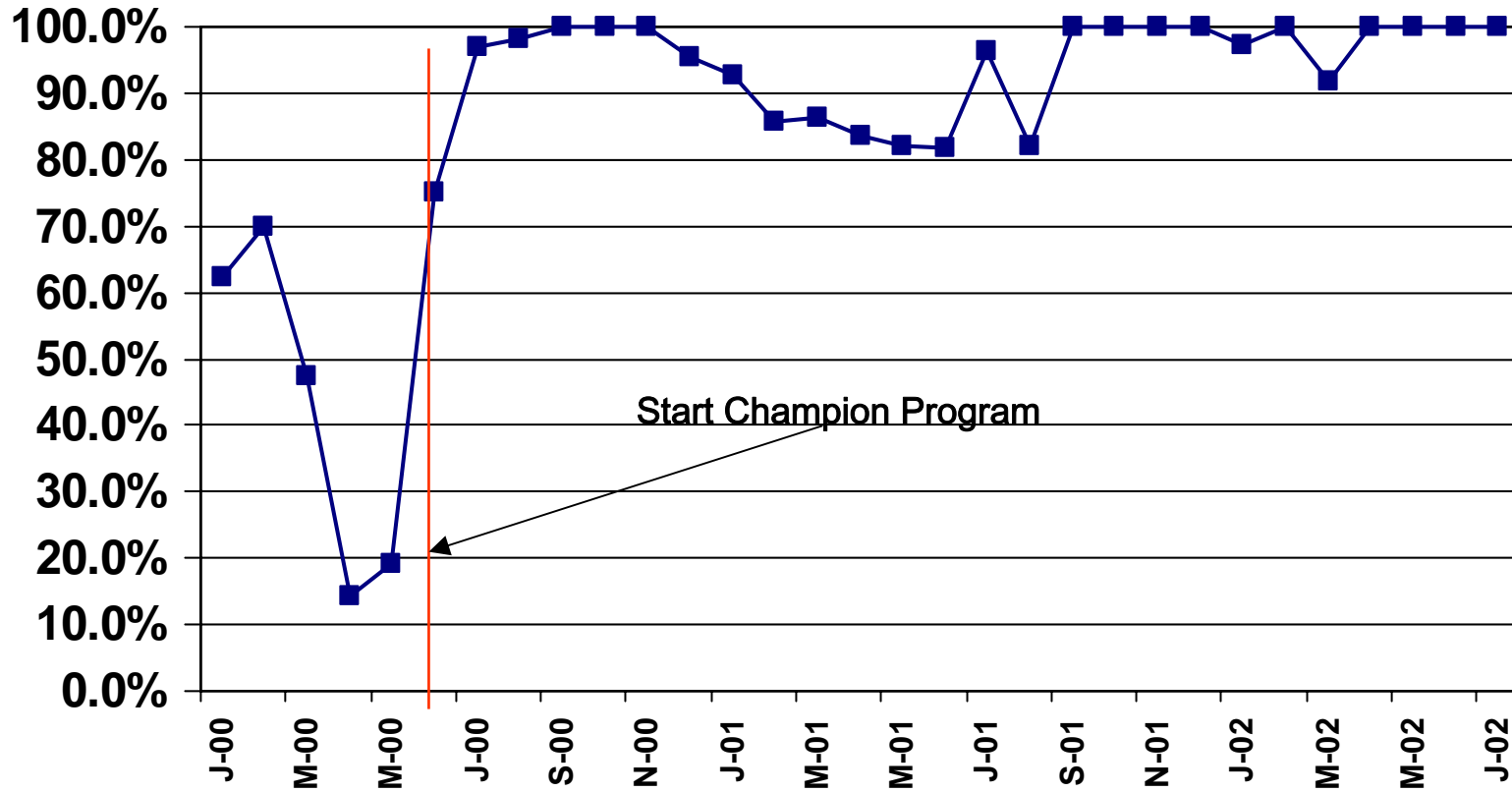
### Ash





# Anode Coke Production

% Passed Iron Specification





# Plant Test Achievements

- Consistently Operated Desalter at 99% Efficiency
- Lowered Slop Production to < 20 BPD
- Lowered Overhead Corrosion Rate
- Lowered Metal Content in Coke
- Made Anode Grade Coke 90% of the Time
  
- How & Why?
  - Better Desalting
  - Reduced Corrosion
  - More Metals Removal?

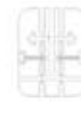




# How Metals Occur in Crude

- Oil Soluble
  - Organometallics
  - Asphaltenes
- Oil Encapsulation
  - Paraffins
  - Asphaltene Micells
- Suspension of Metals
  - Oxides
  - Hydrates
  - Emulsion Stabilized
- Water Soluble
  - Metal Hydroxides
  - Metal Salts





# Possible Removal Mechanisms

- Water Wetting Solids
  - Caustic has long been known to do this
  - Solids appeared in desalter brine
- Water Solubility of Metals
  - Increase or decrease
  - Metal Hydroxide Solubility vs. pH
  - Metal Salts
- Interface Effect
  - less seems better
  - Hydrate formation
  - de-Stabilize emulsion interface





# Research Questions

- How are Metals Distributed in Crude Oil
  - Suspensions
  - Oxides, Clays, Hydroxides, Hydrates, Salts
  - Oil or Water Soluble Species
  - Organic or Inorganic Species
- What is the best way to Separate For Identification?
- What Analytical Methods Should We Use?
- Sampling Procedures?
- Once we have answers to these questions, we can develop the appropriate Chemical/Mechanical removal process





# Thank You

Any Questions?

