

Overcoming Chloride fouling problems in FCC Fractionators

May 2nd, 2012
Galveston, TX

Introduction to Corrosion

- ▶ Active steel (anode): due to inclusions, galvanic cell generation, low pH
- ▶ H⁺ receives electrons from anode (steel), releasing Fe⁺² to an electrolyte
 - Electrolytes (Cl⁻, O⁻, S⁻², SO₃⁻², CN⁻)
 - Creates corrosion products (Fe-Cl₂, Fe₂-O₃, Fe-S, Fe-SO₃, Fe(CN)₆⁻⁴)
- ▶ Auto-passivation: Fe-S also protects anode from releasing Fe⁺²
- ▶ Protection: killed CS (less inclusions), higher pH(>8), dilution of electrolyte, filmer

FCC Chloride Concerns

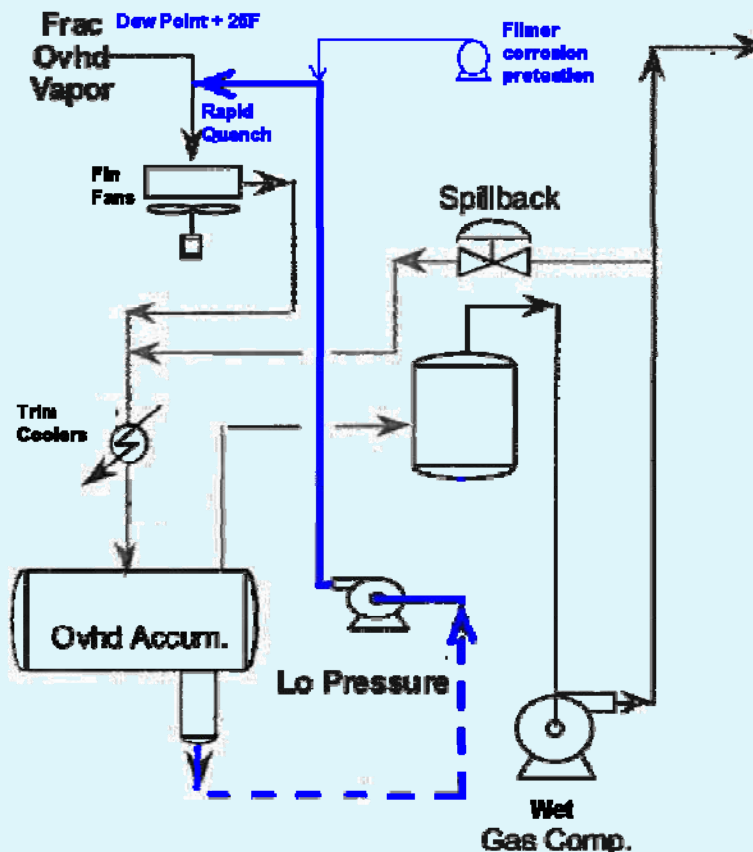
- ▶ **Crude Desalter**
 - Monitor sodium of HVGO or VTB
- ▶ **Main Frac trays**
 - Monitor flooding, tower scan
 - Dispersant or Tower water washing if needed (monitor Cl in LCO)
- ▶ **Main Frac overhead**
 - Minimum 10% free water at point of injection
 - Dilute HCl acid formation by rapid quench, Wash salts as soon as they precipitate
 - Filming amine to break anode/cathode corr. Mechanism
- ▶ **Wet gas compressor**
 - Naphtha rotor wash stop gap measure
- ▶ **HP condensers and fin fans**
- ▶ **Sponge absorber**
- ▶ **Debutanizer overhead**

FCC Corrosion Locations

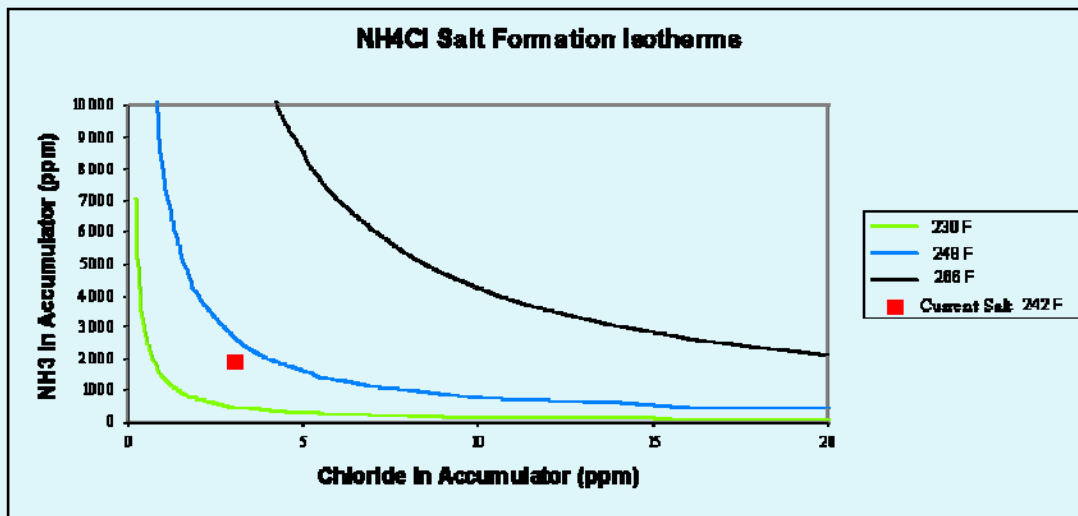
- ▶ Top trays of Main frac (chloride salts)
- ▶ Main frac overhead (HCl, chloride salts)
- ▶ WGC rotor blades (chloride salts)
- ▶ Primary Absorber (ammonium salts, ammonium bisulfide, cyanide)
- ▶ Sponge Absorber (hydrogen charging corrosion)
- ▶ Debutanizer overhead (hydrogen charging)

Main Frac Overhead Protection

- ▶ Maintain overhead temperature at least 25F above theoretical salt dew point
- ▶ Wash water source from overhead accumulator water boot – condensed atomizing, stripping and lift steams
- ▶ Chemical addition to wash water – filmer to protect against hydrogen blistering and corrosion
- ▶ Wash water header is branched to each fin fan inlet



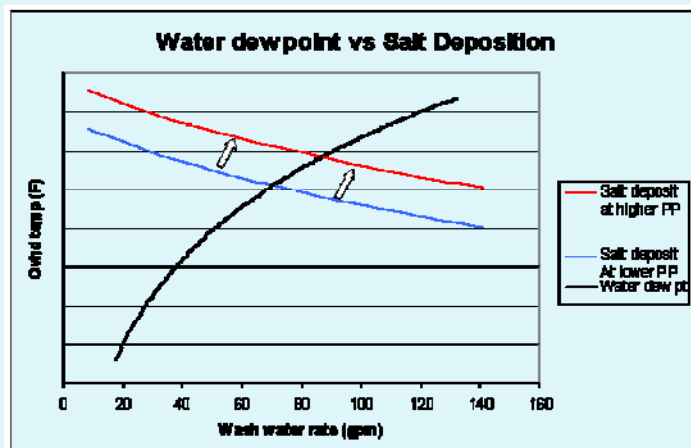
Hi Main Frac temp



"FCC Corrosion Concerns", Frank Denison
Nalco

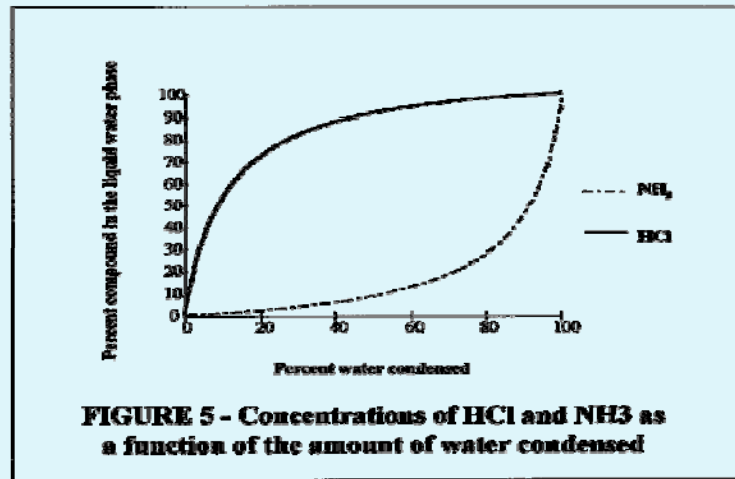
Wash water

- ▶ If sodium increases in HVGO, assume chlorides will increase in overhead of main frac.
 - Effect → Increases the temperature of salt deposition
 - Action → Increase wash water



Wash water

- ▶ Minimum of 10% free water: Quench and dilute



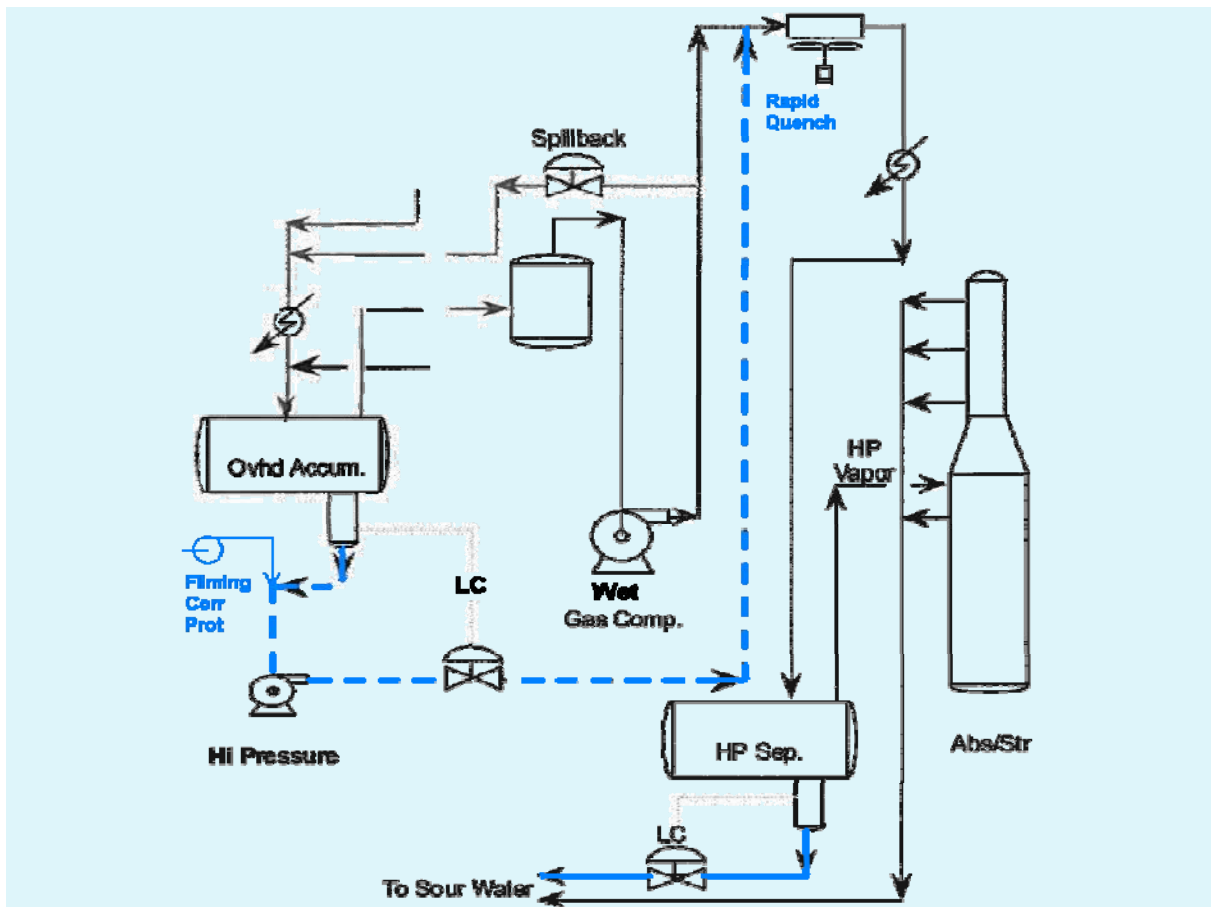
"Corrosion in Crude Distillation Unit Overhead Operations: A Comprehensive Review", NACE 2011

Wet Gas Compressor Protection

- ▶ Rotor wash may be used as a stop-gap measure
- ▶ Injection rates vary – gradually increase up to effective dosage
- ▶ Injection quills to get good dispersion and cross-sectional contact
- ▶ Aromatic naphtha with a salt dispersant

Hi Press Condensers and Fin Fan Protection

- ▶ Wash water source from overhead accumulator water boot – condensed atomizing, stripping and lift steams
- ▶ Filmer added to wash water to inhibit:
 - Ammonium bisulfide corrosion
 - Cyanide attack
 - Hydrogen blistering
- ▶ Wash water header is branched to each fin fan inlet



Sponge Absorber Protection

- ▶ Injected into lean oil
- ▶ Completely hydrocarbon soluble
- ▶ Corrosion inhibitor to protect against
 - Hydrogen blistering
 - Metal loss
 - Fouling caused by corrosion products
- ▶ Dosage rates vary
 - 4 - 8ppm

Debutanizer Overhead Protection

- ▶ Filming additive to protect against corrosion with good dispersant character
- ▶ Injected into overhead reflux
- ▶ Dosage rates of 4 to 8 ppm
- ▶ Protects debutanizer top trays and condenser
- ▶ Overdosing can cause water carry-over with LPG product

Monitoring

- ▶ HVGO sodium
- ▶ Main frac
 - Column Delta P's
 - pump around exchanger duties
- ▶ Main frac overhead
 - Maintain hi overhead temp
 - >25 F over salt deposition temp
 - Ensures no water condensation upstream of inj
 - Wash water (min 10% free water at inj pt)
 - pH>8 (<9), Fe<0.3ppm, Cl, NH3
- ▶ WGC
 - Vibration typically compressor side inbound

Corrective actions

Problem	Action
↑ sodium in HVGO	Increase cat adds, wash water and/or filmer
column flooding due to tray fouling	Add dispersant in PA's or water wash procedure (monitor naphtha/LCO salts) or sublimation procedure. Tower scan
Low main frac ovhd Temp	Avoid cat circ with feed out for long periods of time
WGC vibration	Naphtha rotor wash

Design considerations

- ▶ Wash water pumps, water boot, level cv and hydraulics should be designed for a min 10% free water at injection point. More is better.
- ▶ Wash water injection point in turbulent flow path
 - Determine need for injection quill for larger pipes
- ▶ Backup wash water pumps
- ▶ Dual rotor wash injection nozzles at WGC inlet

Contact Info

- ▶ Matt Meyers
- ▶ Process engineer
- ▶ matthew.meyers@wnr.com
- ▶ 915-775-3399