Concrete Repair Strategies For Coking Units

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Key Take Aways

- Safety needs to be a core value
- Repairing a Coker Unit is a process
- Understanding deterioration & damage mechanisms is important
- Performing a condition survey is a critical part of the process
- Engineering is also important
- Selecting an experienced contractor is critical to executing a successful project
Safety As A Core Value

◆ Safety First and Always
  - Continuous employee training on everyday safe work practices and specific client safety requirements.
  - Corporate safety culture includes formalized training emphasizing proper safety behavior; a safe, drug-free, and productive work environment. Safety execution plans generated for every project.
  - Employees attend routine safety meetings and training sessions.
  - Contractors should provide training in hazard recognition and safe work practices.
Repairing A Coker Unit Is A Process

- Cause & Effect
  - Defect, Damage or Deterioration
    - Leakage
    - Settlement
    - Deflection
    - Wear
    - Spall
    - Disintegration
    - Crack

- Repair Required?
  - Safety
  - Structural Catastrophe
  - Use Dysfunction
  - Leakage
  - Effects on Environment
  - Aesthetics
  - Preventive Maintenance

- Condition Survey
  - Evaluate
  - Quantify
    - Document
    - Prioritize

- Repair Analysis
  - Owner Criteria
    - Urgency
    - Cost
    - Expectations
    - Useful life
    - Aesthetics
  - Engineering & Contractor Issues
    - Structural Req.
    - Effect
    - Constructability
    - Environment
    - Safety

- Repair Strategy
  - Contractor Methods
    - Surface Repair
    - Stabilization
    - Strengthening
    - Waterproofing
    - Protection
  - Techniques
  - Materials

Repair
Structure Elements Of Interest Within Coking Units

- Anchorages
- Octagonal Penetrations
- Columns / Beams
- Switch Deck
- Head Deck
- Coke Pit, Coke Pad, Sluiceway
Deterioration & Damage Mechanisms In Coker Units

- Elevated temperatures
- Mass concrete shrinkage
- Dynamic loading
- Impact damage
- Fire damage
- Corrosion-induced deterioration
- Failed patch repairs
- Bucket 5mpact
- Dynamic, soil & hydrostatic loads

Octagon Wall
Temperature Readings

Temperature Readings

Higher Temperatures

Lower Temperatures

Heat

308°F

273°F

160°F

Thermocouple Thermometer Readings

Measured Temperatures On Octagon Faces
Microcracking of Cover Concrete

- Desiccated Cover Concrete
- Moisture Stable Concrete
Fire Damage

- Aggregate swells
- H₂O to steam
- Chemical alteration to concrete matrix
Factors Leading To Corrosion Within A Coker Unit

- Cast-in-chlorides
- Air-borne chlorides
- High temperature
- Moist/wet conditions inherent to process
- Shortcut access of elements through cracks
- High concentration of CO$_2$
Critical Unit Event Scenarios

- Dynamic & vibration
- Process loading
- Explosion/fire
- Hurricane/tornado
- High winds
- Earthquake
Condition Survey

- Field Investigation
  - Visual Inspection - Site Survey
  - Acoustic Impact Testing
  - Rebound Hammer Testing
  - Ferroscan Pachometer Survey
  - Ultrasonic Testing
  - Impact-Echo Testing
  - Ground Penetrating Radar
  - Sample Extraction

- Laboratory Tests
  - pH Testing and Carbonation Depth Determination
  - Chloride Ion Content
  - Compressive Strength Testing
  - ASR Testing via Uraynal Acetate Reagent
Condition Survey

Evaluate, Quantify, Document, Prioritize
Chloride-Induced Corrosion

- Oxygen, chlorides, moisture

Crack
Carbonation-Induced Corrosion

Carbon dioxide + moisture → pH decreases

pH 13 → pH 10 → pH 10

Corrosion occurs
Fast-Track & Turn-Key Opportunity

- Condition evaluation, site presentation & order of magnitude repair costs
- Engineering
- Repair & rehabilitation
- On line and/or turnaround repairs
- Quality assurance & quality control
Special Considerations For Coker Unit Repairs

- Determine need for shoring
- Corrosion protection: use of sacrificial discreet anodes
- Mechanical anchorage of substrate and repair material
Engineered Coke Support
Structure Shoring Plan
Finite Element Analysis
Coke Pit Panel Lining And Wall Extension Concept

Section A A
REPAIR STRATEGIES:

Repair-In-Kind
Engineered Repairs

Before

During

After
Octagon Wall Repair

Before

During

After
Sluiceway Repair

Before

During

After
Fireproofing

Before

During

After
Coke Pit Wall

Before

After
COKER REPAIR SPECIALISTS: Build Synergistic Team

- Refinery Operations
- Contractor Operations
- Turnaround Planning
- Engineering Design
- Project Management
COKER REPAIR SPECIALISTS:
Dedicated Crews
COKER REPAIR SPECIALISTS:

Vast Experience

Chevron
ExxonMobil
ConocoPhillips
Suncor Energy
Motiva Enterprises LLC
BP
CITGO
Coffeyville Resources
Valero Energy Corporation
Questions ?