A Total Engineered Approach to Coke Drum Skirt and Foundation Repairs

By

Becht Engineering Co., Inc
CTLGroup
Land Source

A team of specialty engineers and surveyors.
Why Use This Approach

1. Allows Owner Company to work with a single source for technical issues
2. Typically results in shorter turnaround time which can save significant maintenance and operating costs
3. End result is highly durable repair with extended service life
4. Physical repairs completed by mechanical/civil contractors
No Single Company has all the Answers

1. Utilize integrated technical team approach for best mix of experts in their respective fields
2. This team has worked together for past 15 years
3. Have been involved in numerous repairs to delayed coker drums and their associated foundations
Becht Engineering Utilizes Mechanical Experts in Coke Drum Repairs

1. Dr. Charles Becht, Mechanical Expert and President of Becht Engineering
2. Dr. Delroy Forbes, Civil/Structural expert with over 30 years experience with ExxonMobil
3. J.E. Sims, Welding Expert with over 30 years experience with CB&I
4. G.G. Karcher, Mechanical Expert with over 30 years experience with ExxonMobil

   Note: Sims and Karcher were co-authors of the “Coke Drum Evaluation Manual” Published by The Materials Property Council
Typical Repairs Encountered

1. Shim plates corroded and ejected
2. Vessel tilted and/or rotated
3. Cracks in steel skirt
4. Cracks in skirt to vessel weld
5. Skirt deformation and buckling
6. Broken, bent and corroded anchor bolts
7. Damaged concrete octagonal foundation
8. Deterioration of coke pit
Overview of CTLGroup

- Evolved from the R&D of Portland Cement Association
- Independent Engineering/Consulting/Laboratory Company since 1987
- Staff of 130 professionals and specialized technicians
- 85% of Professional Staff with Masters/PhDs and leaders on Technical Committee
- Range of High Profile Projects: Lincoln and Jefferson Memorial, Pyramids of Egypt, NASA - Goldstone Antenna, Launch Control Center, Shuttle Program, Lunar Concrete
Approach To Coker Evaluation

- Condition Surveys – Visual Examination
- Repair Design and Material Selection – Environmental Concerns, Chemical Attack
- Sensors – Structural Health Monitoring Systems
- Laboratory Testing – Petrographic Examination, Chloride Testing, Compressive Strength, Sulfate Contamination
Impulse Radar

Concrete Cover Over Reinforcing Steel

Minimum Concrete Cover (in.)

DRUM #1

DRUM #2
Impulse Response

- **F**: Hammer with internal load cell
- **V**: Geophone
- **S1** to **S9**: Signal analyser

**Key Plan**

- **Mobility Plot (M/Sec×10³)**
  - **Drum #1 - South Beam**
  - **Drum #2 - North Beam**

** mobility**: 20, 40, 60, 80, 100
Impact Echo

Flaw

Displacement

Time

Contact time

Force

Time

Impact Echo Testing
Service Life Prediction

Casting joint

70 mm

measurement point

service passage
Selection of Appropriate Repair Material

Coker Environment Issues:
- Chemical Attack
- Durability Concerns
- High Temperature and Shock Loading
- Repair Constructability Issues
Sensors

Structural Health Monitoring Systems
Sensors
Structural Health Monitoring Systems

- Develop Instrumentation Specifications
- System Design
- System Installation
- System Maintenance
- Data Management
- Data Analyses
- Training and Operation
Why Use Specialty Survey Organization?

LandSource has extensive experience working in petrochemical environment, coke drums in particular.
Comprehensive Survey Capabilities

LandSource has wide array of tools to address all measurement needs

- Conventional Survey Methods
- Robotic Reflectorless Total Stations
- 3D Laser Scanning Capability
Damaged Concrete and Rebar on Octagonal Foundation
Damaged Concrete in Octagonal Foundation
Old Shims Under Baseplate
Severely Corroded Shims
Vessels Prepared for Lift
Jack Pumps Prior to Lift
Plumb Bob Support at Top Flange of Coke Drum
Plumb Bob Over Target at Bottom of Flange of Coke Drum
150 Ton Jack in Raised Position
Lift Frame (36 in. WF)
New Shims with Rulon Slide Plates

4 tabs shown were detached after installation.
New Shims Installed
Concrete Test Cylinders
Forms, Rebar and Shims
Before Concrete Placement