

The Profiler

A NEWSLETTER OF INFORMATION FOR COKE DRUM OPERATORS

Coke Drum Bulge Stress Evaluation

CIA Inspection is introducing a stress analysis capability to our coke drum scanning service. Along with SRT - Structural Reliability Technology in Boulder, Colorado, sophisticated software tools have been developed to generate finite element analyses directly from our coke drum laser scan data.

Using the actual profile information captured by the laser, these models perform finite element analyses of the stresses in bulge areas of coke drums. A full "brick element" FEM completely analyzes the effect of the differing drum wall thickness of each weld course.

The load model characterizes a typical "worst case" combination of coke drum loads, namely:

- 40 psi cover gas pressure;
- the static head of a coke fill;
- a uniform thermal shock wave moving up the drum as it is quenched.

The inside profile of the drum is extracted directly from CIA's dense 1" X 1" laser range scan data. Meaningful analysis can be derived from accurate and dense profile information, as the stress concentrations around deformations tend to be very localized and could easily be missed.

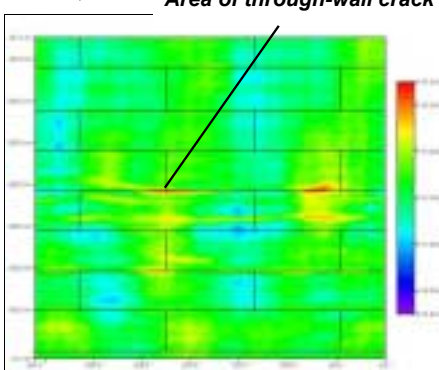
The FEM software used generates all 6 primary components of stress and strain. The components of interest in coke drums are the axial stress and strain as they lead to crack initiation and growth in circumferential welds. In addition, when a thermal "wave" load is applied, the difference between

minimum and maximum axial stress at a point on the drum is directly related to the fatigue stress applied. It is generally agreed that fatigue stresses are the life-limiting factor for coke drums.

Case Study

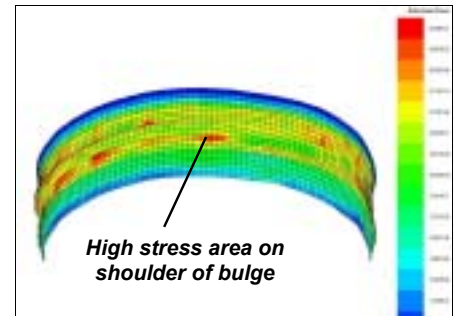
CIAI has recently applied our new stress modeling capability as a case study to a drum where a through-wall crack had occurred in a circumferential weld. CIAI's laser scan had identified a number of deformities in the drum, as shown.

When this drum was analyzed in our F E M model, sev-

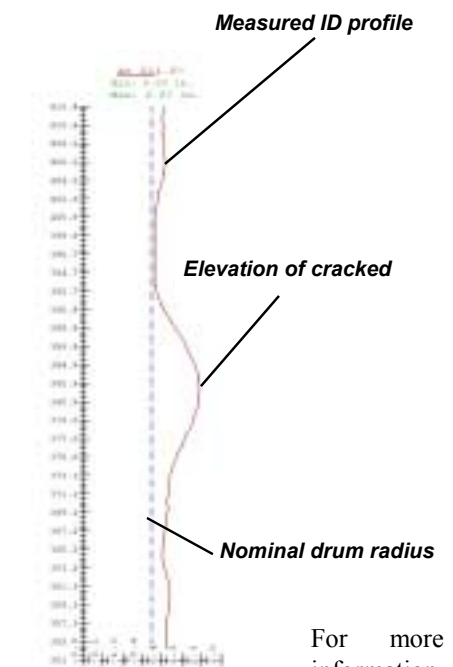


eral areas of the drum showed very high local concentrations of delta axial stress, up to 200% of the stress in non-deformed areas of the drum. The next figure shows a typical output of CIAI's stress analysis software showing high (red) axial stress areas.

One of these high stress areas overlapped a circumferential weld and it was in that particular weld location that the through-wall crack had occurred. The following vertical section through



the culprit bulge shows clearly that the upper "shoulder" of the bulge intersects the 385" elevation of the cracked circumferential weld.



For more information, please contact Rick Clark at 905-692-3678 or Daryl Rutt at 705-741-6336.

Coking Corner

As our first recurring article on the world of coke and delayed cokers, we will touch on the different kinds of coke. The information is courtesy of Chris Paul - Great Lakes Carbon Corporation and their paper entitled "Tutorial: Delayed Coking Fundamentals" which can be found on our web site at www.cia-inspection.com.

Shot coke looks like "tiny tar balls" or B-B's about two to five millimeters in size that can cluster into larger balls. It requires high concentrations of asphaltenes in the feedstock and velocity or turbulence in the coke drum. The operating conditions that favor higher coker liquid yields such as high coke drum temperatures, low coke drum pressures, and low recycle, also favor shot coke production. Shot coke is generally high in metals and sulfur which limit the use to fuel burned in circulated fluid bed boilers, other power generation facilities or cement kilns.

Sponge coke is named for its sponge-like appearance. There are two types of sponge coke - anode grade or fuel grade. Anode grade sponge coke is used in the making of carbon anodes for the aluminum industry. Good anode grade sponge coke requires strict control of the drum temperature along with cycle time and drum pressure to produce coke that is lower in volatile matter than typical fuel grade coke. Anode grade coke must meet sulfur and metals specifications required by the aluminum industry. Coke that fails to meet anode grade specifications is considered fuel grade and is used as described above for shot coke.

Needle coke is named for its needle-like structure. It requires special feedstocks very low in sulfur and metals without asphaltenes present, special coking procedures, and special calcination. As the premier coke used in graphite electrode manufacturing, it commands a high price. However, very stringent coke quality specifications must be met to enter the electrode grade needle coke market.

International Success



Our coke drum inspection service has been very busy in the Middle East and Europe over the last few months. Pictured above are Gahzi Eidi (Cartel Co.), Daryl Rutt, Rick Clark and Mark Anderson of CIA Inspection wearing the traditional Kuwaiti dress known as the "dish dasha", Hussein Ishmal (Mina Abdulla Refinery Manager - seated) and a representative from the Radisson SAS Hotel in Kuwait.

Coke Drum Questionnaire

CIA Inspection is always looking to enhance the value of the coke drum inspection service to our customers. With approximately 200 drum inspections performed to date, we have scanned enough drums to compare their performance relative to drums with similar metallurgy and design.

In the next few weeks, a representative from CIA will be contacting each of our customers to obtain the remaining information needed from each site to set up a comprehensive comparison database. The information obtained at each site will be held in strict confidence and used only to produce generic industry wide comparisons of coke drums.

We will be using industry experts to analyze our database to extract trend information and empirical comparison. The intent is to provide customers additional information with each inspection, based on the comparison of their drum profiles with industry trends, to localize problem areas in their drums for further inspection and maintenance activity.

HAPPY HOLIDAYS



We would like to wish all our customers and their families a very safe and happy holiday season!

See you in the next millennium!!!

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