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Service Life Determination for Damaged Delayed Coker Drum

By John Aumuller

Delayed cokers are an essential unit in oil sands plants and refineries since introduction of this technology to industry in the early 1930's. The delayed coker drum operates under severe service conditions of not only high temperature to 900°F (482°C) but also quenching to near ambient temperatures. The drums are also operated in a batch manner of approximately 24 hours which contribute to the severe, thermo-mechanical cyclic loading. Notable problems identified in a number of industry surveys undertaken by the API since the 1950's include:

- shell bulging and cracking
- skirt cracking
- vessel bending (banana effect)
- anchor bolt pull out

Other problems have been incrementally resolved through recognition of the thermo-mechanical damage mechanism and implementing fatigue compatible design and construction.

With society demanding reduction and minimization of carbon based energy production to halt and even reverse climate warming, industry operators need to anticipate possible stranding of facility assets. With coke drums being one of the most costly investments in their facilities, owners of existing units will want to operate existing equipment to the true limit of useable service life; owners contemplating new investment will want to design, construct, and operate this equipment in an optimal manner to maximize investment return.

The various methodologies, both direct and indirect, to evaluate thermo-mechanical damage to a coke drum have been unsatisfactory, yielding uncertain input to repair and replacement decisions. Bulging damage has complicated this evaluation.

Upcoming Training Courses

- **API 510 Pressure Vessel Inspection**
September 6-8, 2016
Pasadena, TX
- **API 570 Piping Inspection & Code**
October 10-11, 2016
Las Vegas, NV
- **API 650 Storage Tank Design & Maintenance**
October 13-14, 2016
Las Vegas, NV
- **API 936 Refractory Inspection**
January 31-February 2, 2017
Galveston, TX

For more information, see our website at www.carmagen.com.

Work Highlights

Legal

- *Provided ongoing litigation support to an overseas client and two legal firms defending his technology against apparent infringement.*

Machinery

- *Provided machinery engineering review of compressor design, installation, operation and maintenance plans, for equipment installed at a new chemical plant. Numerous areas for potential improvement were identified, but due to late receipt of information from the contractor and equipment supplier, little could be done before plant startup. This was a classic example of not having adequate and timely review of contractor and supplier performance while there is still time to rectify any deficiencies that are found.*

Carmagen has worked over the past 10 years with leading researchers and manufacturers to reconcile the available industry methodologies, such as the ASME VIII Division 2, ASME III Codes and ASME / API fitness-for-service standards to develop a robust and effective solution technique to accurately assess coke drums and provide accurate service life determination, especially for damaged coke drums. While these documents form the basis of a solution methodology, they do not address the notion of service life and the fit-for-purpose techniques required to effectively determine the true useable life of this equipment as it deteriorates in service.

During the upcoming ASME PVP2016 Pressure Vessels & Piping Conference in Vancouver, British Columbia, Carmagen will present a paper outlining this methodology and invite attendees to share their experiences and current equipment problems.

About the Author

John Aumuller graduated in Mechanical Engineering from the University of Waterloo, Ontario and the University of Alberta, in Canada. He specializes in the integrity assessment of pressure containing equipment.

John spent his early career with Imperial Oil and Exxon Company USA and has more than 30 years' experience in the design, maintenance, repair and fitness-for-service evaluation of pressure equipment such as boilers, pressure vessels, storage tanks, pumps, compressor and pressure piping in refining, oil sands, petrochemical, and power plant facilities.

He has also taught courses in finite element analysis, refractory, pressure piping and pressure vessel Code design, inspection, and maintenance and is currently completing post graduate research work in pressure equipment integrity and reliability specializing in coker drum thermo-mechanical damage assessment.

Please contact Vince Carucci (vcarucci@carmagen.com) if you'd like more information on Carmagen's expertise in this area.

