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COG Line Failure
Dated: 1976

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Date: November 5, 1976

Copies to:
N. H. Keyser
R. Langhoff
C. Lin
R. P. Winters
J. Zbos

To: Mr. J. T. Seaman

From: V. Beaucaire

Subject: Investigation of Coke Oven Gas Line Failure at Chicago "A" Furnace

Reference: D3-002-001

Attached is Mr. Lin's report on the failure of the coke oven gas circle pipe on "A" Furnace. The pipe failed due to corrosion caused by the coke oven gas. General corrosion was the chief mode of attach and resulted in the loss of up to 50 percent of the pipe's wall thickness at the point of rupture. Pitting corrosion was also observed at the point of failure, and this was a contributing factor. This failure occurred on September 7 between Nos. 12 and 13 tuyeres.

The major corrosives in coke oven gas are hydrogen sulfide, hydrogen cyanide, ammonia, water and oxygen. Probable mechanisms of attack on the pipe were presented in a recent paper by staff members at Carnegie-Mellon University (copy attached). Higher levels of any of these materials would accelerate the rate of corrosion. Also, compared to the gas main upstream of the compressor, corrosion rates would be, higher within the circle pipe due to the higher gas temperature (200°-300°F vs c 90°F) and higher gas pressure (c 46 psi vs 9 psi or less).

Assuming clean-up of the gas is not practical, Mr. Lin recommends A335 Grade P21 Cr-Mo alloy steel as a possible replacement for the 1022 steel now used to extend service life. In the interim, some relief might be obtained by injecting an effective anti-foulant/corrosion inhibitor compound into the gas stream. The Betz 711 product tried last spring was judged as an anti-foulant only and it was not successful. During the upcoming trial of Nalco's 5WB 470 product, we will consider its corosion inhibiting properties as well as its anti-foulant characteristics.

V. Beaucaire

V. Beaucaire

VB/mw

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INTEROFFICE
CORRESPONDENCE

Copies to:

Date: October 6, 1976

To: Mr. N. H. Keyser

From: C. Lin

Subject: Investigation of COG Line Failure in Chicago "A" Furnace

V. Beaucaire
R. Langhoff
J. Seaman
R. Winters
J. Zbos

Reference: D3-002-001

Characteristics of Failure:

1. Pipe line was made of carbon steel 0.22% carbon, $R_B \cong 80$.

2. Corrosion usually was uniform corrosion. Some locations ended up only half its original thickness left. (Figure 1)

Figure 1. Uniform Corrosion on COG Line (x200)

3. Only few corrosion pits were found. This was the major reason of failure. However, mild steel are not too sensitive to pit. Maybe these two reasons are why that pipe could last for 12 years. (Figure 2 and 3).

Figure 2. Pit Corrosion on COG Line, 200X

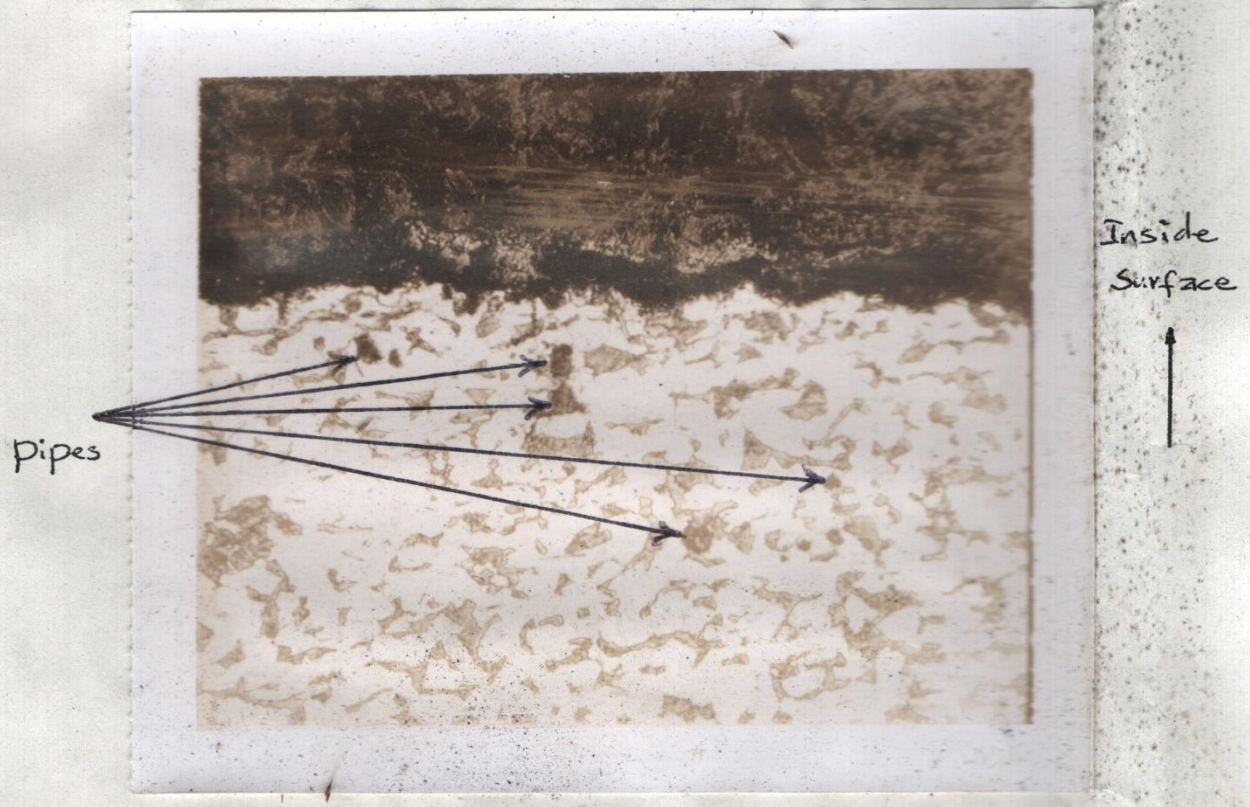

Figure 3. Another Example of Pit Corrosion on COG Line, 200 X. There are also some corrosion pipes away from surface.

4. The cleavage is 45° to its radial direction, since 45° to the tension direction has the highest shear stress (Figure 4). In addition, the longitudinal direction of cleavage was coincident with the grain structure of seamless pipe. (Figure 5).

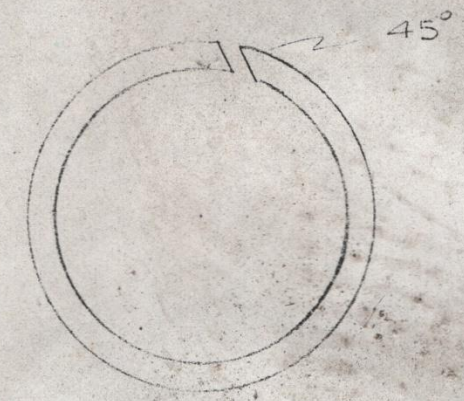

Figure 4. Cross Section of COG Line

5. The origin of failure was almost in the center of burst.

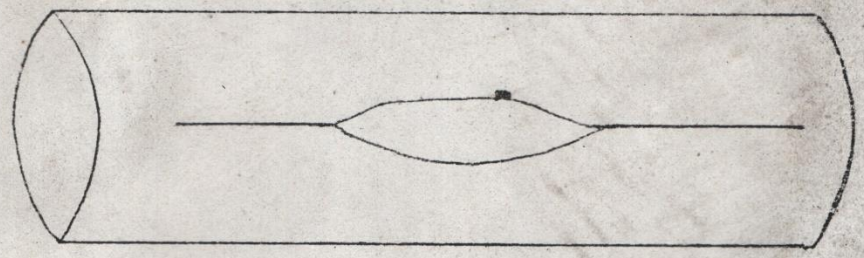

Figure 5. Burst of COG Line

Reason for Failure: Corrosion.

Pit corrosion caused stress concentration and thus resulted failure.