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SM-32-MC (REV 4-79)

PLAINTIFF'S EXHIBIT

SH-2680

Shell Oil Company • Shell Chemical Company
Interoffice Memorandum

FEBRUARY 23, 1987

FROM: INVESTIGATION TEAM

TO: J. D. JOHNSON, SUPERINTENDENT, CHEMICAL OPERATIONS

SUBJECT: NEAR MISS - CHLORINE FLANGE CORROSION

Summary

During the October 1986 VCM shutdown, while changing out a bad valve on the bottom of the south chlorine storage vessel, a badly corroded flange was discovered. Most of the flange faces were corroded away and the gasket had deteriorated. As a result, all flanges in the chlorine system were inspected and repaired as necessary.

No other flange was found with damage as extensive as the one initially discovered, but about 30% of the inspected flanges required repairs to correct some corrosion damage. During inspection and repair, the system was kept under a positive nitrogen pressure to avoid moisture intrusion. After repairs, the system was tested, dried, and returned to service.

Investigation

The first flange had extensive damage to the flange faces and the gasket was deteriorated. Most of the other damaged flanges had a narrow band of corrosion around the inner perimeter of the raised face and isolated pitting throughout the face area. Many of these flanges had used gaskets that did not cover the face area all the way to the inner perimeter, and this uncovered area appeared to be subject to corrosion. Many flanges also had significant external corrosion in the bolt circle area, and these flanges were repaired, cleaned, and coal tar coated. It appeared that vertical piping runs (horizontal flanges) had a higher incidence of corrosion, both internal and external.

The first flange showed evidence of "Never Sieze", a thread lubricant, on the gasket and faces. About 15% of the flanges showed evidence of lubricant, and about 40% of these were corroded. Of the remaining flanges with no evidence of lubricant, about 25% were corroded. These differences may not be statistically significant.

Four theories to explain the flange face damage have been advanced:

1. Use of thread lubricant on the gaskets/faces either generated high local temperatures or produced HCl on reaction with chlorine. Either could result in accelerated corrosion.

2. Use of improperly sized gaskets that did not completely cover the face area somehow led to corrosion in that area.

3. Permeation of the gaskets by chlorine migrating out and by moisture migrating in led to corrosion by wet chlorine.

4. The flanges were made up wet or with adsorbed moisture in the gaskets and faces.

Use of a lubricant could lead to high local temperatures. Microscopic examination showed no evidence of overheating above 1300°F and was unable to determine the cause of the corrosion. Analyses of gasket remnants by X-Ray Diffraction and X-Ray Fluorescence showed only traces of nickel (Never Sieze is a suspension of finely divided nickel in polybutylene grease).

However, if organic lubricants are used in the presence of chlorine, HCl would be produced which would lower the solubility for traces of water normally present. In addition, HCl reacts with traces of chlorine oxides to produce additional water. If a water phase is produced, the corrosion would be aggressive in the local area. Although use of a lubricant is unwise and could lead to serious corrosion, this does not appear to be a complete explanation for the current problems in view of the inspection statistics. The Chlorine Institute recommends against the use of lubricants for chlorine joints.

There is no current explanation for special attack on the face area not covered by the gasket. Gaskets that cover the entire face should be used.

Referring to the gasket deterioration, garlock asbestos gaskets tend to deteriorate with age, becoming dry and brittle, and this may have been aggravated by making up flanges too tight in some cases.

Some permeation of chlorine toward the atmosphere along or through the gasket probably occurs. Migration of water inward through a very fine pore structure is possible against large absolute pressure differences. Therefore, it is plausible to create a corrosion zone where the concentrations of both water and chlorine are high enough. The water is not consumed, but the chlorine is, so corrosion around the inner perimeter might be the expected result. The permeability theory was heard both from Diamond (Occidental) and NMC, and both are considering new gasket materials.

Some of the damaged flanges might have been made up wet the last time they were disturbed. In any case, the flange faces and gaskets were exposed to normal atmospheric humidity before being made up. This moisture could facilitate corrosion at the inner perimeter and lead to a slow migration of the corrosion front outward.

Conclusions

1. The need to avoid the use of lubricants in chlorine service and to take special precautions to exclude moisture will be re-emphasized in Operations and Maintenance. Action: N. T. Truitt, G Operations; R. W. Taylor, V Operations; D. B. Williams, Maintenance.

2. Assure that the proper size gaskets are stocked and used for the chlorine areas. Action: D. B. Williams.

3. Review inspection needs regarding flanges. Action: B. O. Bishop.

4. Investigate the merits of different gasket materials. Action: J. M. Gilbert, S. M. Walker.

5. Investigate the merits of special dry box storage for chlorine gaskets or other means to exclude moisture during make-up. Action: J. M. Gilbert, B. T. Weatherly.

6. Investigate means to seal moisture out of flanges in service. Action: B. O. Bishop.

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cc - Near Miss Distribution

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BCAK8705407

DPMC-07446