

THE COLORIMETRIC MEASUREMENT OF PHOSGENE  
IN THE PRESENCE OF HYDROGEN CHLORIDE

Task force "C", of Manufacturing Chemists Association, has an assignment relating to the safety of vinyl chloride transportation. More specifically, the task force is examining the situation of ruptured and burning tank cars with a view to estimating the presence of toxic gases such as hydrogen chloride, carbon monoxide and phosgene. Due to its particularly insidious nature, and the lack of pertinent information, phosgene has received the major attention. The portion of the investigation assumed by UNIROYAL CHEMICAL was the testing of commercially available testing kits to ascertain their suitability for on-site detection of traces of phosgene in the presence of low concentrations of hydrogen chloride gas. If the hydrogen chloride was found to interfere, the feasibility of a scrubber tube filled with zinc granules to eliminate the interference, was to be part of the investigation as well.

Summary

Tests were made with three detection systems:

- 1) M.S.A. Universal Tester, Model 1 with 89890  
Detector tubes<sup>(1)</sup>
- 2) Unico 400 Precision Gas Detector with No. 146  
tubes<sup>(2)</sup>
- 3) Scott-Drager Gas Detector Model 19/31, with  
025/b Phosgene detector tubes<sup>(3)</sup>

The detectors were used on air to which phosgene and hydrogen chloride were added in the following concentrations:

- |    |                                        |
|----|----------------------------------------|
| 1) | 0.5 ppm phosgene, no hydrogen chloride |
| 2) | 0.5 ppm " , 50 ppm " "                 |
| 3) | 2.5 ppm " , no " "                     |
| 4) | 2.5 ppm " , 250 ppm " "                |
| 5) | 50 ppm " , no " "                      |
| 6) | 50 ppm " , 500 ppm " "                 |

*Include in Group Report.*

The tube containing zinc was a medicine dropper tube, 7 mm OD, and 75 mm long. It held a column 40 mm long of Bakers "granular 40 mesh", Reagent Grade zinc. The weight of the zinc was 4.0 grams. Glass wool plugs held the zinc in place. The tube was connected to the detector tubes with very short rubber tubing sections so that there was a glass to glass butt.

#### Observations

We were unable to confirm MSA's claim that there was no interference from HCl below its allowable limits. At 50 ppm HCl, the MSA tubes gave negligible response to 0.5 ppm phosgene. A zinc pre-tube did not help. When the HCl was 250 ppm and the phosgene is 2.5 ppm, the color formed was faint with or without a zinc pre-tube. However, when the HCl is 500 ppm and the phosgene 50 ppm, good colors were formed with and without the zinc pre-tube.

The Unico-Kitagawa tubes were even more sensitive to hydrogen chloride. At all three levels of phosgene and hydrogen chloride, there was no color when hydrogen chloride was present, and colors with much reduced intensity with the granular zinc pre-tube.

The Drager tubes were sensitive to 250 ppm HCl when the phosgene was 2.5 ppm, and gave no color. However, the zinc pre-tube restored the sensitivity of the system. At 500 ppm HCl and 50 ppm phosgene, the coloration was good for tubes with and without a zinc pre-tube.

#### Conclusions

When the ratio of hydrogen chloride to phosgene is high (100:1), all the detection systems suffer interference.

When the ratio of hydrogen chloride to phosgene is reduced (10:1), only the Unico-Kitagawa system fails to perform adequately.

Probably the most satisfactory system is the Scott-Drager equipment with the detector tubes protected with a zinc pre-tube.

References

- (1) Expiration dates of two boxes, Oct. '70, May '71. Literature provided with detector tubes states that "other common gases in the range of their allowable limits do not interfere with accurate measurements".
- (2) Expiration date Mat. '70. Literature provided by Kitagawa with the tubes states that hydrogen chloride interferes by producing a similarly colored stain at concentrations over 50 ppm HCl. The Kitagawa detection system is also available from Matheson Co., Inc.
- (3) Expiration date Dec. 1971. A Drager bulletin (No. 38, May 1960) indicates tolerance of their system to high concentrations of hydrogen chloride. "Where the concentration of phosgene was 2.5 ppm, and that of hydrochloric acid 350 ppm, the phosgene reading was 3 ppm."

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1/12/70

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UJRL 17951