

The Copper Strip Corrosion Test: Background, Pitfalls and Improvements

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Carbonyl sulfide (COS), which occurs as an impurity in commercial sources of propane, can hydrolyze in the presence of water to form hydrogen sulfide (H₂S) and carbon dioxide (CO₂). All commercial and HD-5 grade propane is required to pass the ASTM copper strip corrosion test. While it is known that hydrogen sulfide will cause the failure of the copper strip test, it is widely believed that the hydrolysis of carbonyl sulfide can also cause the failure of the corrosion test. We have tested gravimetrically prepared mixtures of COS and H₂S in pure and commercial grade propane with a variant of the ASTM copper strip corrosion test. Minor changes to the published ASTM corrosion test were implemented for diagnostic purposes in making the measurements. Surprisingly, mixtures containing as much as 1000 ppm (mass/mass) COS did not cause a failure of the test, even when the copper strip was in contact with the COS mixture for two hours (twice the normal contact time). Mixtures containing H₂S caused the failure of the test; however, concentrations as high as 3.5 ppm (mass/mass) H₂S passed the test. Moreover, we were not able to reproduce the colors and patterns shown on the ASTM copper strip corrosion standards lithograph. Our work leads us to question the current concept and practice of the copper strip corrosion test. We are taking steps to improve the test, and these will be described briefly in the conclusion of this talk.