VERIFICATION OF QUANTITATIVE OPTICAL GAS IMAGING SYSTEM

Best Practices Recommendations

The Saskatchewan Research Council (SRC), in collaboration with CMC Research Institutes, developed and executed a technology verification testing plan to verify the performance of the QL320 quantitative optical gas imaging system developed by Providence Photonics. This technology is designed to work with FLIR GF300/GF320 handheld gas detection cameras and provides a remote quantitative measurement of mass leak rates or volumetric leak rates for most hydrocarbons.

Based on the testing completed, some observations and recommendations for the implementation of quantitative optical gas imaging systems are summarized below.

1. Take Environmental Factors into Consideration in the Test Planning

The QL320 was first tested in a controlled environment before being tested at a field site in collaboration with an industry partner. During the initial controlled tests, it was observed that windspeed had a large impact on plume dynamics, which were seen to affect the results. With low wind speeds, the plume would accumulate and swirl back and forth around the QL320's measurement ring, seen on the screen during testing, and biased the results high. In a high wind speed scenario, it was observed that the plume dispersed too quickly for the QL320 to measure, which biased the results low. Temperature differential (ΔT), or the difference between ambient and background temperature, also an important factor to take into consideration. ΔT is required to be at least 5C as stated by FLIR to view the gas. This is especially important with low flow rates.

Using Analysis of Variance (ANOVA) design of experiments, SRC was able to evaluate the significance of several environmental factors on the accuracy of the technology. The results showed that all the main factors should be considered when developing future test plans – wind speed, ambient temperature, temperature differential (ΔT) and distance between the leak and the FLIR camera.

2. Be Aware of Physical Infrastructure

During testing it was shown that insulation on the pipes caused disturbance in the measurements due to the reflectivity of the material. Even after removing the insulation, reflectivity was observed on the metal pipes and tank, regardless of being in a shady location on a cloudy day. Depending on the intensity of the leak, the reflectivity may not interfere with the readings, but it is something to be noted as this will be seen at all facilities when using this technology. Further testing is required using the exclusion box added to Version 2.0.0.0 of the QL320, which was developed to help resolve this issue.

Depending on the location of the leak, it may be difficult to set up the tripod required for the FLIR camera while ensuring a sufficient background/ΔT. In order to adequately use the QL320, the FLIR camera needs to be used with a tripod to ensure that it remains steady. Any movement in the camera can alter the readings of the QL320. There may be leak locations at a site where it isn't possible to set up a tripod along with an adequate background that has a sufficient ΔT.

3. Operator Training & Experience is Important

While the operation of the QL320 is user-friendly, it is important that the operator is well trained, understands how different wind speeds affects the plume dynamics, and is experienced in adjusting all settings available. A trained operator will be able to watch the plume on the QL320 and may be able to make an educated guess as to whether the reading will be high or low.

4. Be Aware of Challenges at Low Leak Rates

The readings at 1 lpm during this testing were statistically different from the actual release rate. Low ΔT and reflectivity in the pipes played a factor in the results. In QL320 Version 2.0.0.0 the exclusion box and threshold setting adjustments may be able to get more accurate results at low flow rates. Further testing is required.

5. Sample Averaging is Important

Analysis of testing showed that flowrates between 5 and 10 lpm of methane or the Gas C mixture tested on non-insulated pipes was accurate and verifiable. This means that if an operator were to take a large number of readings in the field of a system meeting those criteria, they could be 95% confident that the average of those readings would be the same as the actual flowrate. However, because of the large standard deviation of these readings, if an operator was to take a single reading of a leak/vent, the actual flowrate could be anywhere from zero to double that reading.

Conclusion

Data showed that gas type does have an effect on the results at flowrates between 5 and 10 lpm. Further analysis showed that if the ambient conditions are such that ΔT>10C, there is no reflective insulation, and the unknown release has a flowrate between 5 and 10 lpm of a gas similar in composition to gases tested, the measurement is expected to be +/- 30% of the actual flowrate.