

Development of a Novel Optical Remote Sensing Monitor for Fenceline Monitoring and Enhancement of Existing Leak Detection and Repair Programs

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Background

Manual leak detection and repair (LDAR) programs are currently implemented on a regular basis at refineries to limit fugitive emissions of VOC. However, LDAR surveys can be time –consuming and not cost-effective. Fenceline monitoring of refinery sites using optical remote sensing (ORS) instrumentation can be used to augment existing LDAR programs. The data collected with the ORS instrumentation can be coupled with meteorological data to help pinpoint the location of leaks, greatly reducing the cost of LDAR monitoring.

ARCADIS, working under contract to the US EPA, and US EPA Office of Research and Development are developing a prototype ORS instrument for long-term fenceline monitoring at industrial sites. The instrument is non-speciating, sensitive, simple, and much more cost –effective than traditional ORS instrumentation.

Study Objectives

- Develop a non-speciating prototype deep Ultraviolet Optical Sensor (DUVOS) that is much lower in cost and much simpler than traditional ORS approaches
- Build a prototype instrument from commercially available components
- Complete performance testing of the instrument
- Deploy the instrument as part of a long-term monitoring campaign

Example Fenceline Monitoring Configuration Using Two DUVOS Systems

The diagram illustrates a fenceline monitoring setup. A facility is shown with a plume of emissions. Two DUVOS systems are positioned on either side of the facility. The ORD System is on the left, and the ORS System is on the right. Wind direction is indicated by an arrow pointing right. A legend shows a square for Wind Measurement and a circle for Wind Direction.

DUVOS Instrument Linearity Test

Instrument response to increasing concentrations of calibration gas. Results shown are from two data sets.

Initial Performance Testing of DUVOS

Initial testing of the DUVOS system has been completed with encouraging results. The tests, which were completed at the U.S. EPA Office of Research and Development facility in Research Triangle Park, NC, included testing of the data acquisition and analysis software, instrument function, and instrument response. Instrument response was assessed during a laboratory test in which a 108 ppm gas mix of approximately equal amounts of benzene, ethyl benzene, o-xylene, and toluene with a balance of nitrogen was introduced to a 0.2606 meter calibration cell.

DUVOS Generation II Prototype

The diagram shows the internal components of the DUVOS Generation II Prototype. The components are labeled: SEaled UV WINDOW, PRIMARY MIRROR, SECONDARY MIRROR, FOCUSING LENS, BEAM SPLITTER, and DETECTORS.

Laboratory Test of DUVOS Instrument Response to a Hydrocarbon Mix

Absorbance peaks shown are in units of parts per million meter (ppmm). The results of the test show that detection limits below 1.0 ppmm are possible with the instrument with additional noise filtering and signal averaging.

Summary/Next Steps

- This presentation details efforts to develop a simple, low-cost, non-speciating optical remote sensing instrument .
- Initial testing of the prototype DUVOS instrument has shown that the instrument has sufficient range capability and measurement sensitivity to be useful for facility-wide fenceline monitoring.
- A second generation prototype DUVOS instrument is currently being constructed and will be undergoing a long-term deployment test at the U.S. EPA Office of Research and Development facility to assess instrument stability and robustness
- Upon successful completion of the testing, the second generation prototype instrument will be deployed as part of a six-month fenceline monitoring study at a collaborating refinery site.
- The future goal is to make the instrument available as a potential measurement tool for industry users.