Interferences from hydrocarbon vapors in mercury monitoring

Summary

We tested Picoyune's MA-1 in parallel with the incumbent mercury monitors with samples containing common volatile organic compounds (VOC). Picoyune's MA-1 showed no false positives or bias due to the presence of VOC. The competitive systems showed false positives and negative bias.

Experimental

The tests used Picoyune's MA-1 with a plasmonic mercury sensor, Nippon Instruments Corporation EMP-3 with an atomic absorption spectrometer (AAS), and Jerome J505 with an atomic fluorescence spectrometer (AFS). All parallel testing was completed by connecting the monitors to a shared sample line. Room air was filtered for particulate, mercury, and humidity and fed through a PSA Analytical Calibration Gas Generator. The manifold downstream of the calibration unit used PTFE tubing and fittings. Liquid hydrocarbons (gasoline, condensate, BTEX, or acetone) was added to a PTFE evaporator upstream of the monitors.

Results

Parallel testing showed **no measurable interference on Picoyune's MA-1** plasmonic mercury monitor for any of the VOC tested (BTEX, gasoline, condensate, and acetone). The tests confirmed previous findings for the incumbent instruments AAS and AFS. AAS showed false positive signals greater than 100 µg/m^3 for samples with VOCs (BTEX, gasoline, condensate, and acetone). AFS showed a negative bias of around 30% for a sample of 50 µg/m^3 of mercury from interfering condensate vapors.

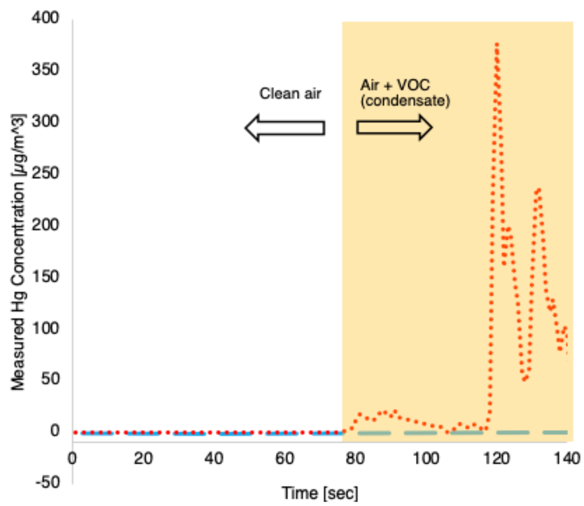

Figure. Hg readings from Picoyune MA-1 plasmonic sensor (blue dashed) and AAS (red-dotted) for mercury-free air with added VOC (condensate vapor) at 80 seconds.

Discussion

Prior to these tests we expected the plasmonic sensor in the MA-1 to perform well. Earlier work had found no interferences from water vapor, methane, natural gas, CO_2, SO2, NO_x, and H_2S. The sensor operated equivalently in air, nitrogen, methane, and natural gas mixtures (that include components of the VOCs tested here). This is supported by the physical model of the sensor. The sensor uses gold nanoparticles to collect and respond optically to the mercury vapor. Gold surfaces are mostly inert yet adsorb mercury vapor well. The plasmonic signal from mercury amalgamation is strong and there is no significant interference from VOC in the band of visible light used in the plasmonic sensor.

The atomic spectroscopies use mercury lamps and ultra-violet (UV) light. VOC are known to absorb these wavelengths, causing the positive interference seen in the AAS. To compensate for this issue the EMP-3 does a periodic correction by filtering out the mercury component of the sample and updating the signal offset. We found this to work in conditions of very stable VOC concentrations. Any changes in VOC lead to positive and negative readings. The AFS did not show a significant false positive for VOC but did demonstrate the expected quenching of the mercury signal when VOC was present.