

Laboratory Validation of AT527 Hydrogen Peroxide Sampler

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AT527 Hydrogen Peroxide Sampler

Assay Technology's 527 hydrogen peroxide (H_2O_2) sampler consists of a titanium oxysulfate (TiOSO_4) coated quartz fiber filter (QFF) within a 562-port polypropylene sampling grid.

The coated QFF collects vaporized H_2O_2 which is extracted with a dilute sulfuric acid (H_2SO_4) solution and analyzed by a UV-VIS spectrophotometer at 410 nm. The use of a titanium oxysulfate coated QFF for H_2O_2 collection has been previously reported in the OSHA method 1019.¹

1. Test Apparatus & Method

Vapor exposures of H_2O_2 were created by dynamic dilution from a liquid phase containing a 30% H_2O_2 solution. The liquid analyte was injected into a heated round bottom containing a flowing stream of air at a fixed rate via a syringe pump (Harvard), then dynamically mixed with flow-controlled input air provided by the Miller-Nelson 501 atmosphere conditioner. The conditioned air was provided at 50%RH and 25 °C. The controlled mixture was passed through an inert acrylic chamber containing diffusive samplers under test. Flows were verified by calibration, and exposure concentrations verified by commercially available cassettes from SKC, Inc. All samples were desorbed using a 1M H_2SO_4 solution and analyzed by a UV-Vis Spectrometer at 410 nm, as described in OSHA method 1019.

Each chamber run contained six diffusive air monitors in the mid chamber exposed to the H_2O_2 vapor with four cassettes sampling the chamber to serve as the reference for exposure concentrations.

2. Desorption Efficiency (DE)

Desorption efficiency (analyte recovery) was determined by spiking quadruplicate media samples at three different levels and analyzed via UV-Vis at 410 nm. The DE for AT527 was found to be 94.2%. Data from the DE analysis can be found in Table 1.

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Table 1. Desorption efficiency data for AT527 monitors

Spike Level 1	Amt Recovered (ug)	DE
Liquid Spike (no media)	27.2	
Spike 1	25.6	94.1%
Spike 2	24.1	88.6%
Spike 3	24.7	90.9%
Spike 4	25.6	94.0%
Spike Level Average DE:		91.9%

Spike Level 2	Amt Recovered (ug)	DE
Liquid Spike (no media)	52.8	
Spike 1	49.6	94.0%
Spike 2	49.4	93.7%
Spike 3	49.4	93.7%
Spike 4	49.4	93.7%
Spike Level Average DE:		93.8%

Spike Level 3	Amt Recovered (ug/mL)	DE
Liquid Spike (no media)	99.5	
Spike 1	96.4	95.8%
Spike 2	95.3	95.8%
Spike 3	97.0	97.5%
Spike 4	96.8	97.3%
Spike Level Average DE:		96.8%

AT527 DE	94.2%
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3. Verification of Diffusive Sampling Rate

Hydrogen peroxide exposures were performed as described in Section 1. Sampling rates were determined from evaluation of AT527 samplers compared to reference samples of commercially available cassettes. Exposures were applied to samplers in the vicinity 2.0x of the OSHA permissible exposure limit (PEL) for two hours. Results are reported in Table 2. The sampling rate for H₂O₂ was found to be 173.3 mLPM.

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Table 2. Data for H₂O₂ Sampling Rate Verification

Sample ID	Sample Description (ppm)	Sampling Time (min)	Reference Concentration (sampling tubes) (ppm)	H ₂ O ₂ Found on Sampler (µg)	Concentration Found by Badge (ppm)	Comparison to Ref Value (% Recovery)
041819_1B	AT527	120	4.2	121.5	4.2	99%
041819_2B	AT527	120	4.2	120.6	4.2	98%
041819_3B	AT527	120	4.2	122.4	4.2	100%
041819_4B	AT527	120	4.2	125.2	4.3	102%
041819_5B	AT527	120	4.2	120.6	4.2	98%
041819_6B	AT527	120	4.2	124.7	4.3	102%
				Avg:	4.2	100%
				CV:	1.7%	0.4%

4. Background (Blank) Determination

Unexposed samplers were analyzed to determine background analyte levels (if any) on the sampler prior to sampling. No significant background was detected.

5. Atmospheric Effects

Air Velocity & Orientation – Previous studies demonstrated that there is no significant effect of air velocity and orientation on sampling rate for this specific monitor design.

Temperature and Humidity – Previous studies demonstrated the absence of an effect of temperature and humidity on sampling rate in the range 0 – 50°C and 10 – 80% RH for this specific monitor design. OSHA method 1019 states no effect on H₂O₂ sampling at both low and high RH environments.¹

6. Bias Due to Reverse Diffusion

In OSHA method 1019, no adverse effects were seen in their reverse diffusion study. The complex formed between titanium oxysulfate and H₂O₂ is bright yellow in color and not expected to be volatile.

7. Capacity

The titanium treated quartz fiber filters were analyzed for total titanium and an average was calculated. Converting titanium to equivalent H₂O₂, a capacity of 3305 µg H₂O₂ was determined. Over an eight hour sampling period, this is equivalent to 28 ppm exposure; well above the PEL of 1 ppm.

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8. Storage Studies

Storage studies were undertaken to evaluate the best conditions for storing exposed samplers to ensure no analyte was lost during storage and prior to analysis. The OSHA 1019 method noted a decrease in storage recovery when exposed media were stored in the presence of light. With this note, samplers were stored in their sealed cover and in a dark place like a closed refrigerator or inside a desk drawer.

Sets of samplers were exposed to H₂O₂ vapor and stored at both 4 °C and room temperature for up to 1 month. One set of samplers were analyzed immediately after the chamber exposure to serve as the reference value to compare the stored samplers against. The amount of H₂O₂ found on the stored samplers were compared to the ones analyzed immediately to determine if any H₂O₂ was lost upon storage.

Samplers at both 4 °C and room temperature did not show any loss of analyte recovered over the 4 weeks indicating no H₂O₂ was lost during storage. Results are shown in table 3 and are an average of 4 samplers per condition. Recommended holding time is four weeks.

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Table 3. Assessment of H₂O₂ Storage Data over 4 weeks at Room Temperature and 4 °C: Average quantity recovered and % of initial collection.

H₂O₂ - 4 °C Storage		
Holding Time	Avg Qty (µg)	% Recovery
Initial	287.5	
1 week	285.4	99%
2 weeks	303.9	106%
4 weeks	283.0	98%

H₂O₂ - RT Storage		
Holding Time	Avg Qty (µg)	% Recovery
Initial	317.0	
1 week	343.5	108%
2 weeks	338.2	107%
4 weeks	317.0	100%

9. Summary Comments

Sampler AT527 has been evaluated for sampling vaporized H₂O₂. The overall system accuracy expressed as Maximum Total Error (95% confidence) is estimated at ≤25% at the PEL.

Capacity	
Sampling Time	15 minutes – 8 hours
Air Velocity	15 – 150 cm/sec
Temperature	0 – 50°C
Humidity	10 – 80% RH

The recommended maximum holding time after sampling is four weeks at room temperature and samplers should be stored inside the cover and placed inside the foil pouch, away from any light.

It is recommended that AT527 samplers be used within the envelope of conditions specified above, but, in general, minor excursions outside these limits would be expected to have only minor effects. Longer or shorter sampling times are possible but have not been evaluated.

References

1. OSHA Method 1019. Hydrogen Peroxide. OSHA, January 2016, Version 1.0.