OHIO LUMEX

WORLDWIDE LEADER
Environmental & Process Monitoring

Sorbent Tubes for the Measurement of Metals in Gaseous Fuels

Quick Notes

You should be able to hear me talking now. If you can't, use the questions module to describe your issue.

Two Audio Options: Phone or Computer
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Ask questions using the Questions Panel on the right side of your screen at any time.

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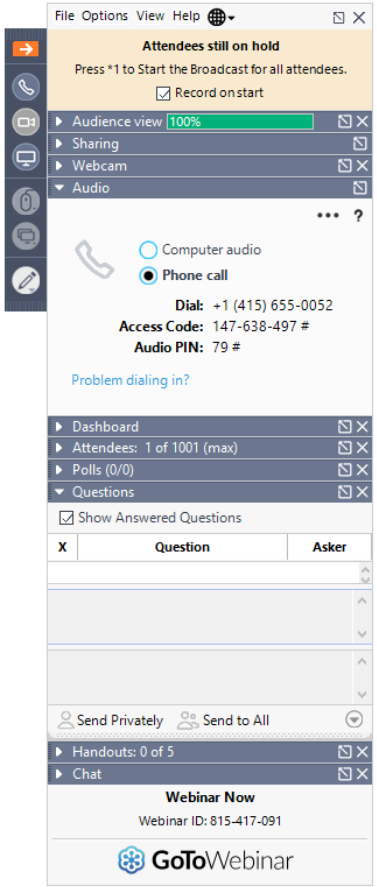


Audio

Questions

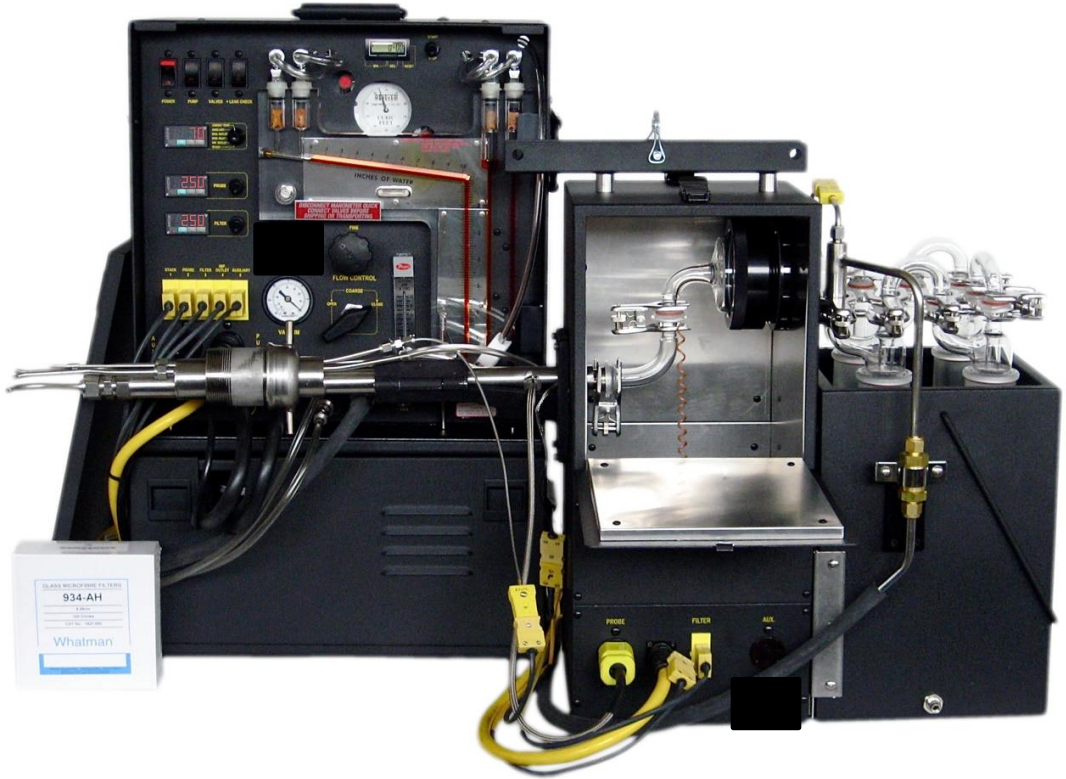
American Biogas Council
www.americanbiogascouncil.org

Context

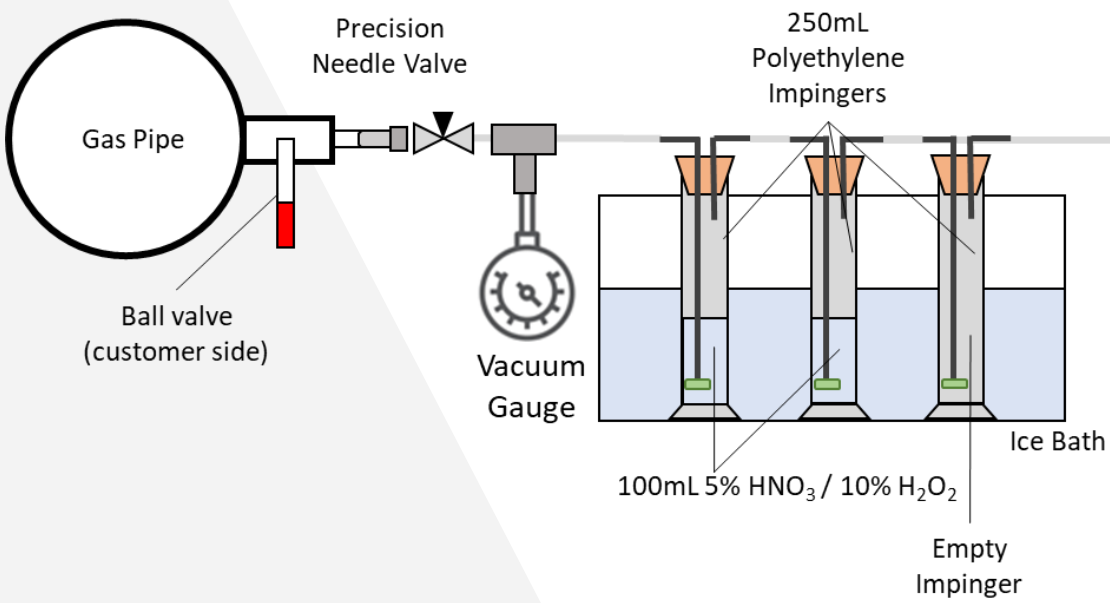
- **Why are we measuring metals in the first place?**
  - Utility tariffs and gas quality specifications
  - Carcinogenic and non-carcinogenic Health Protective Constituents (these metals are toxic)
  - Renewable Natural Gas (RNG) producers must demonstrate compliance
    - Currently includes Copper (Cu), Arsenic (As), Antimony (Sb), and Lead (Pb)

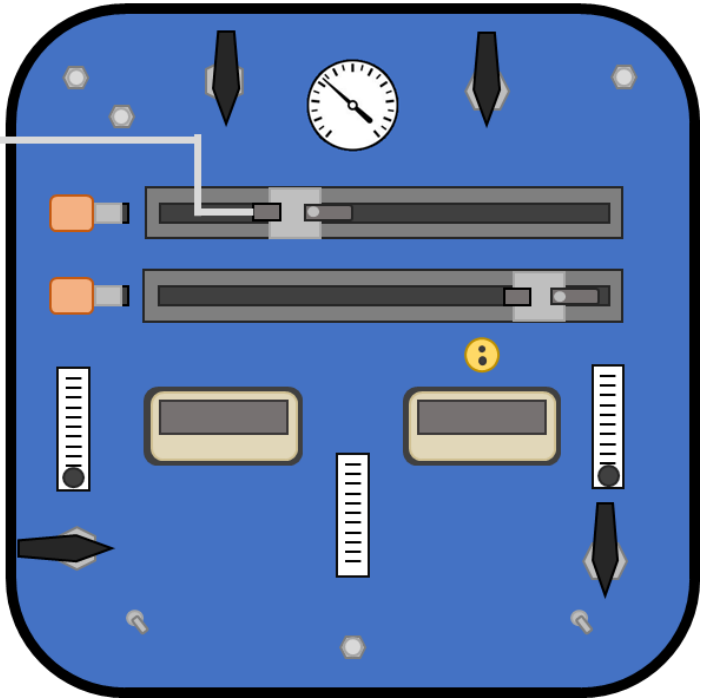
- **What is the purpose of this method development?**
  - Replace EPA Method 29 with sorbent tubes

EPA Method 29

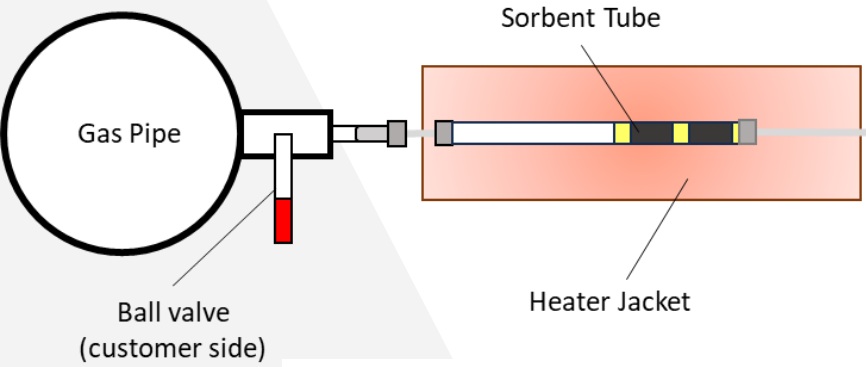


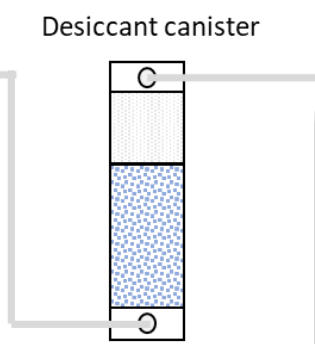
Modified Method 29





Sorbent Tubes



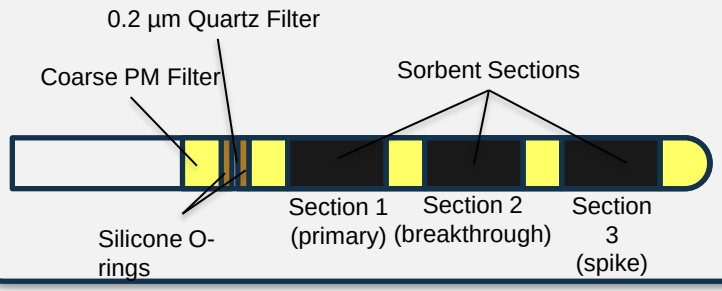


Background

EPA SBIR Research Project

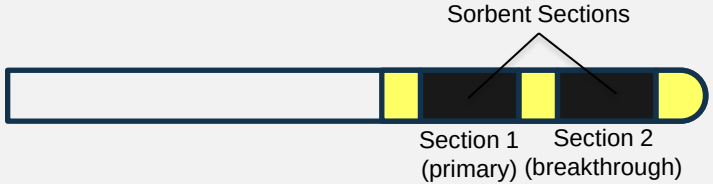
Sorbent Material Development

Emissions Sorbent Tube



- Coal-fired power plants, waste incinerators, cement, etc.
- Be, Cr, Mn, Co, Ni, Zn, As, Se, Cd, Cu, Sb, Pb, others
- Continuous compliance (7-day runs) and alternative to Method 29
- Modeled after EPA PS 12B

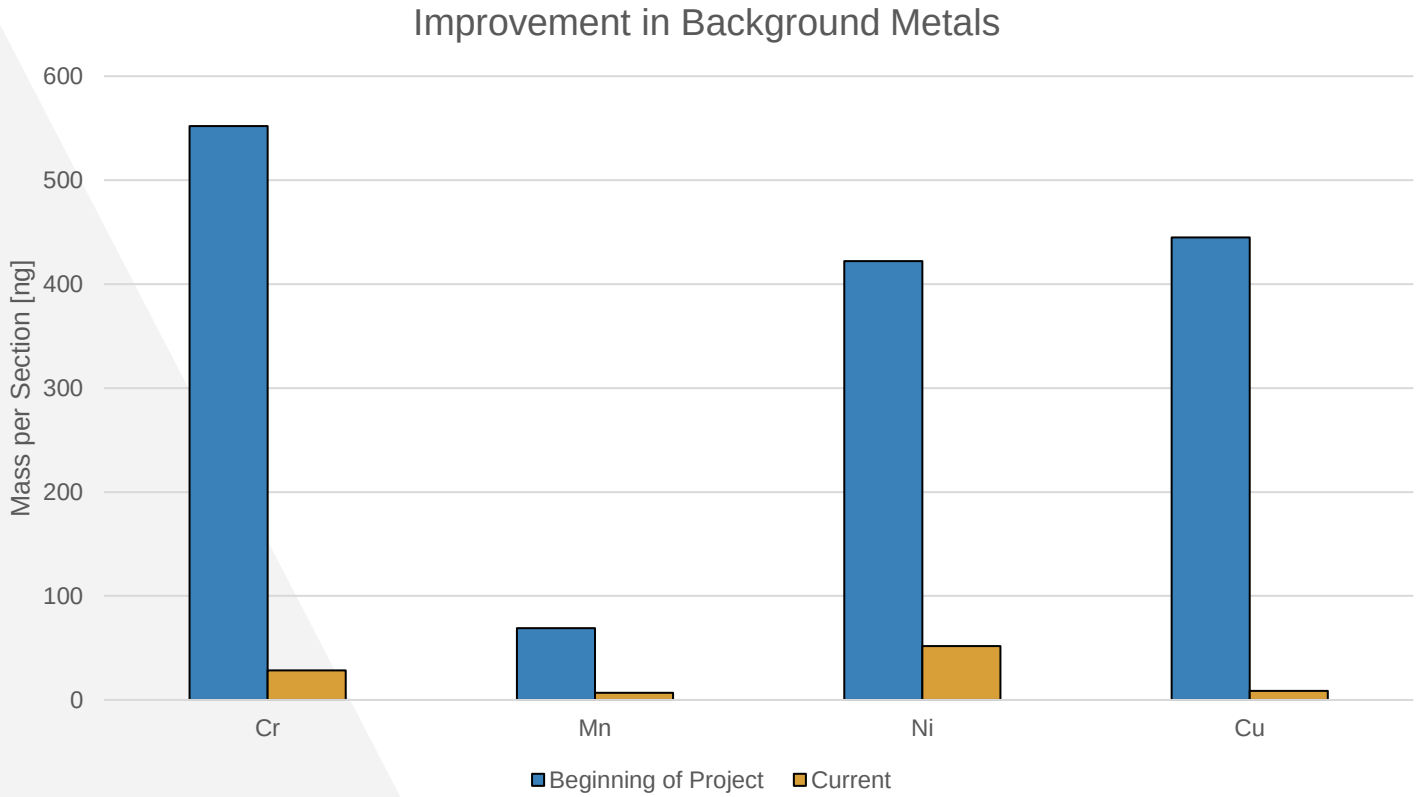
Gaseous Fuels Sorbent Tube



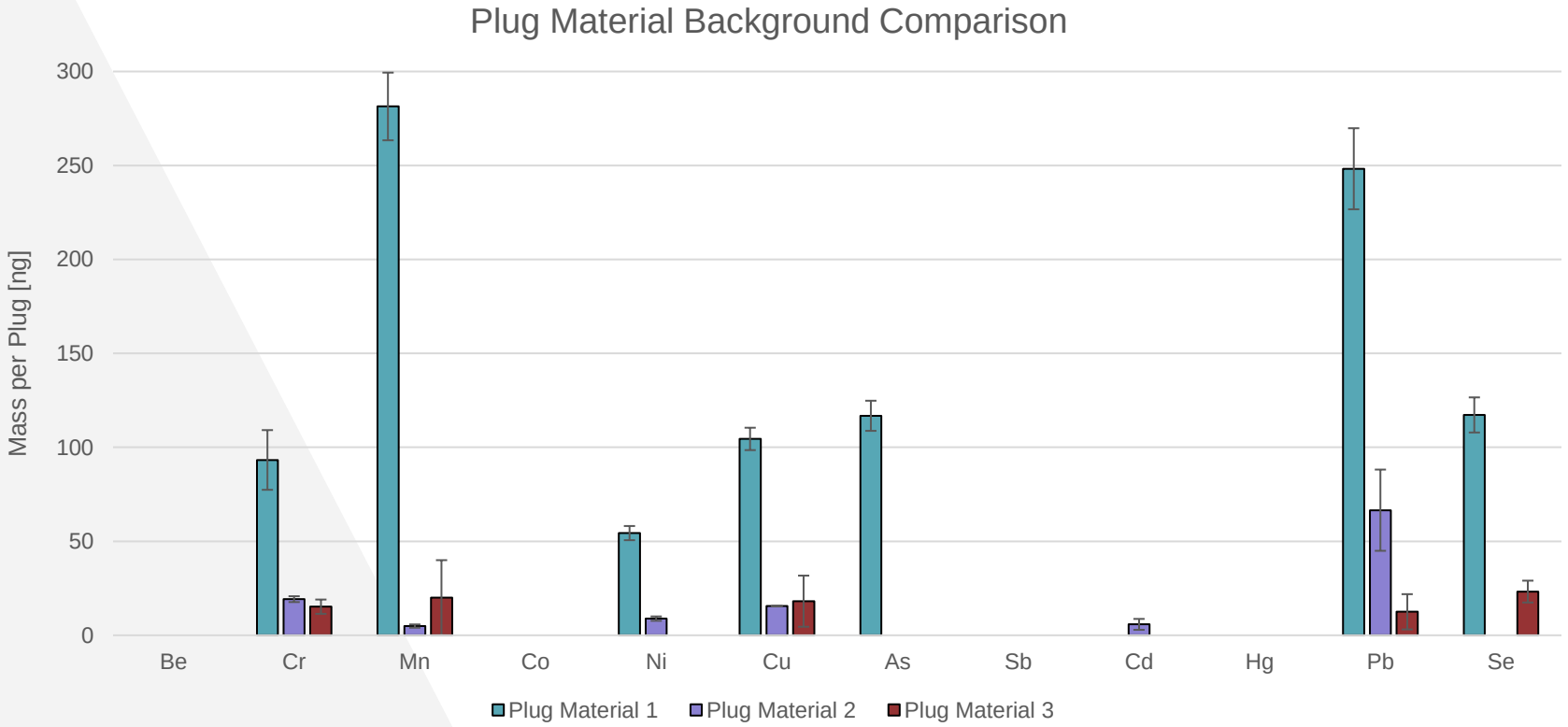
- Biogas and Renewable Natural Gas
- Primary focused on As, Sb, Cu, and Pb
- 1 hour runs

Objective #1 – Reduce Background Metals

Background – Sorbent Material

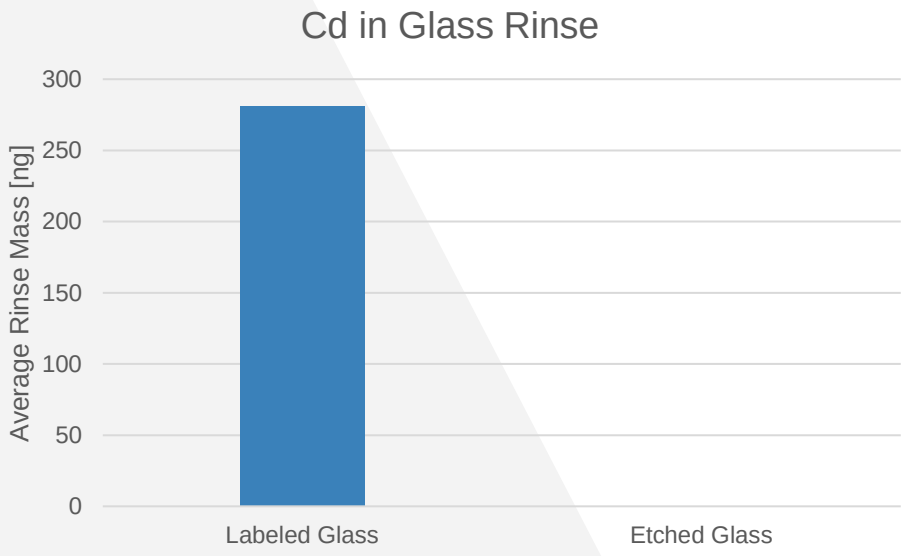


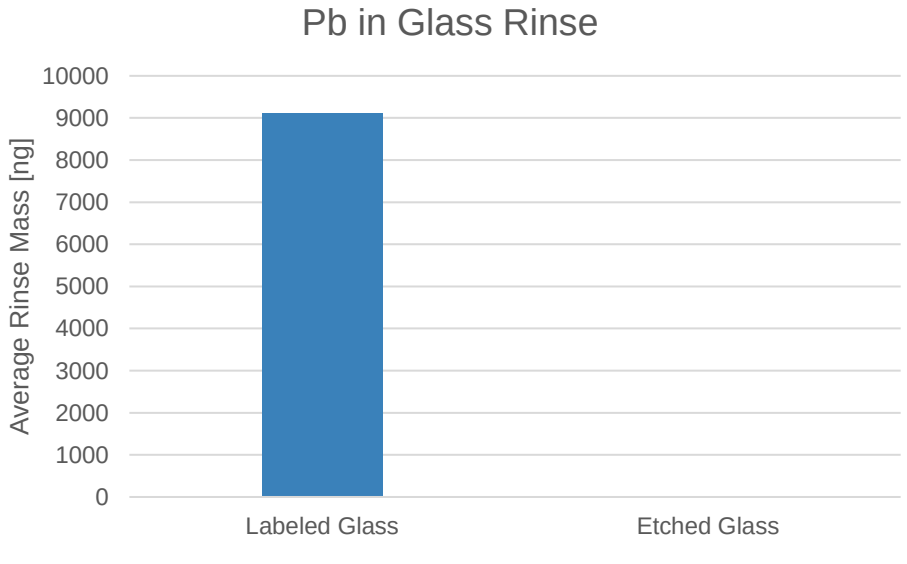
Background – Plug Material



Background – Glass Tubes

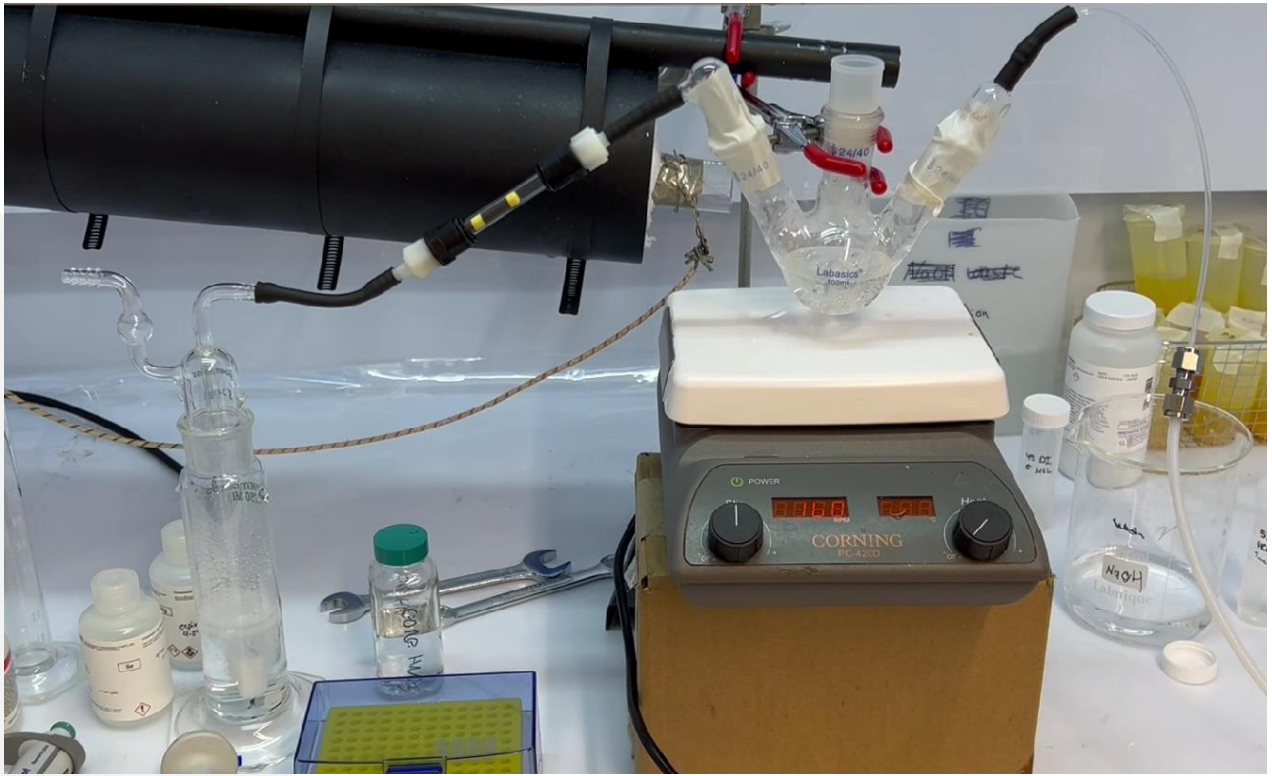
	Average Rinse Mass [ng]	
	Cd	Pb
Labeled Glass	280.8	9115.0
Etched Glass	0	0





Objective #2 – Optimize Capture Efficiency

Hydride Generation Experiment



Hydride Generation Experiment

Sample ID		Measured Mass (ng) Metal Hydride			
		As	Sb	Hg	Se
TYPICAL BACKGROUND					
Blank	OLM0005 - S1	1.6	2.4	0.0	2.6
	OLM0005 - S2	2.5	3.2	0.0	0.8
Run 1	OLM0004 - S1	10968.9	17778.7	1755.2	5042.5
	OLM0004 - S2	1874.8	124.7	268.6	0.0
	Breakthrough	17.1%	0.7%	15.3%	0.0%
Run 2	OLM0002 - S1	10165.8	15436.3	2388.5	4189.7
	OLM0002 - S2	1802.0	64.4	272.3	0.1
	Breakthrough	17.7%	0.4%	11.4%	0.0%
Run 3	OLM0003 - S1	8063.2	16396.8	2566.4	3511.4
	OLM0003 - S2	1745.2	113.4	155.0	0.0
	Breakthrough	21.6%	0.7%	6.0%	0.0%
Run 4	OLM0001 - S1 (Arsenic only)	13445.7			
	OLM0001 - S2 (Arsenic only)	2446.4			
	Breakthrough	18.2%			
	AVERAGE BREAKTHROUGH:	**18.7%**	**0.6%**	**10.9%**	**0.0%**

Field Validation Test 1 – No treatment

Sample ID	Gas Volume [L]	Concentration [ng/L]				Total [ng/L]				Breakthrough [%]			
		Cu	As	Sb	Pb	Cu	As	Sb	Pb	Cu	As	Sb	Pb
OLM0018-S1	18.83	4.6	161.8	147.3	1.0	7.3	274.3	176.2	2.8	58.6%	69.5%	19.6%	187.4%
OLM0018-S2		2.7	112.5	28.9	1.8								
OL720094-S1	49.00	1.9	50.1	75.0	69.1	8.0	138.1	167.3	78.3	312.7%	175.5%	123.2%	13.3%
OL720094-S2		6.0	88.0	92.4	9.2								
OL720089-S1	22.60	2.0	108.2	138.0	34.9	7.1	289.7	277.3	184.5	260.9%	167.8%	100.9%	429.5%
OL720089-S2		5.1	181.5	139.2	149.7								

Field Validation Test 2 – Treatment Method 1

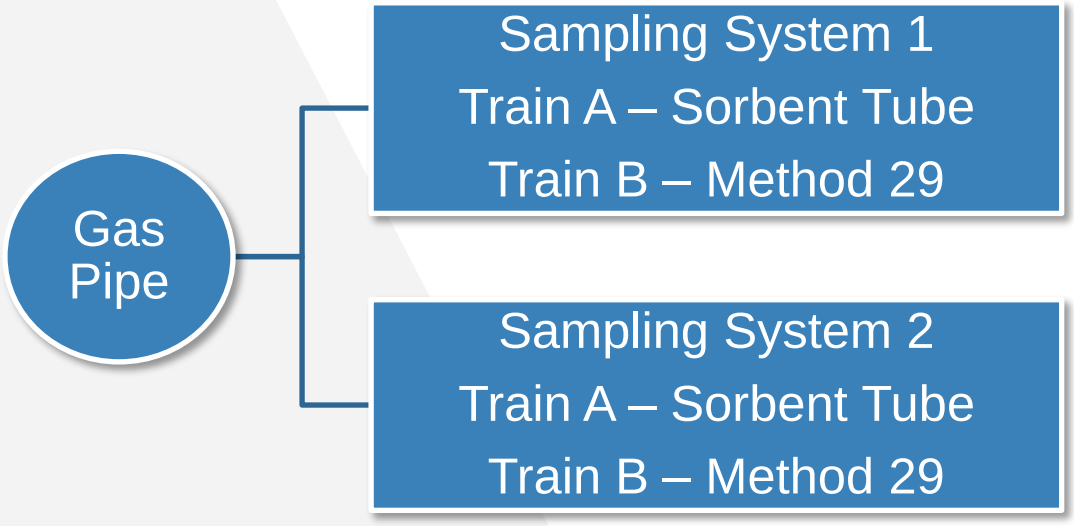
Sample ID	Gas Volume [L]	Concentration [ng/L]				Total [ng/L]				Breakthrough [%]			
		Cu	As	Sb	Pb	Cu	As	Sb	Pb	Cu	As	Sb	Pb
OLM00174-S1	33.73	1.3	630.1	511.8	ND	2.6	630.9	512.3	ND	102.8%	0.1%	0.1%	ND
OLM00174-S2		1.3	0.8	0.5	ND								
OLM00179-S1	37.88	1.1	575.2	486.9	1.1	2.9	576.7	487.3	1.1	171.2%	0.2%	0.1%	0.0%
OLM00179-S2		1.9	1.4	0.5	ND								
OLM00181-S1	40.08	1.2	246.5	199.3	ND	2.5	560.0	480.1	ND	113.4%	127.2%	140.9%	ND
OLM00181-S2		1.3	313.5	280.8	ND								
OLM00172-S1	38.59	1.3	513.7	463.1	0.3	2.4	515.6	463.6	0.3	84.7%	0.4%	0.1%	0.0%
OLM00172-S2		1.1	1.8	0.5	ND								
Blank		1.5	ND	ND	ND								

Field Validation Test 3

Sample ID	Gas Volume [L]	Concentration [ng/L]		Total [ng/L]		Breakthrough [%]		Notes
		As	Sb	As	Sb	As	Sb	
OLM00133-F	12.08	1.8	3.8	474.6	424.3	0.3%	0.1%	Flow rate = 0.2lpm
OLM00133-S1		471.4	420.0					
OLM00133-S2		1.3	0.4					
OLM00107-F	11.56	2.1	5.1	488.7	425.0	0.3%	0%	Flow rate = 0.2lpm
OLM00107-S1		485.2	419.9					
OLM00107-S2		1.3	ND					
OLM00106-F	35.78	0.8	2.7	470.1	413.3	0.3%	0.1%	Flow rate = 0.5lpm
OLM00106-S1		467.7	410.3					
OLM00106-S2		1.5	0.3					
OLM00108-F	34.56	0.6	1.9	448.3	392.2	0.4%	0.5%	Flow rate = 0.5lpm
OLM00108-S1		445.7	388.3					
OLM00108-S2		2.0	2.1					
OLM00130-F	58.31	0.2	2.2	450.5	421.6	6.9%	0.1%	Flow rate = 1.0lpm
OLM00130-S1		421.3	419.2					
OLM00130-S2		29.0	0.2					
OLM00134-F	58.65	0.3	1.9	431.9	408.0	6.6%	0%	Flow rate = 1.0lpm
OLM00134-S1		404.8	406.1					
OLM00134-S2		26.8	ND					
OLM00102-S1	28.63	400.9	398.2	402.4	398.2	0.4%	0%	No Filter. Flow rate = 0.5lpm
OLM00102-S2		1.5	ND					
OLM00103-S1	30.54	413.0	408.4	414.8	409.9	0.5%	0.4%	No Filter. Flow rate = 0.5lpm
OLM00103-S2		1.9	1.4					
				Avg. Relative Deviation		Avg. Breakthrough		
				1.9%	1.4%	2.0%	0.2%	

Objective #3 – Compare with Method 29

Method 29 Comparison - Design



- Analyze all M29 breakthrough impingers
- Minimize M29 dilution
- Sample each quad for same duration
- Pair sorbent traps directly against M29 on each console (eliminate possibility of systematic bias between consoles)

Method 29 Comparison - Data

Sampling Interval	Trap Total [ng/L]		Trap BT [%]		Trap RD [%]		M29 Total [ng/L]		M29 BT [%]		M29 RD [%]		RPD%	
	As	Sb	As	Sb	As	Sb	As	Sb	As	Sb	As	Sb	As	Sb
09/10/2024 11:39-12:39	385.0	359.6	1.5%	3.8%	6.1%	3.6%	316.5	335.8	70.8%	59.7%	4.1%	3.0%	19.5%	6.9%
09/10/2024 11:39-12:39	434.8	386.8	1.1%	1.5%			291.8	316.4	60.3%	47.4%			39.4%	20.0%
09/10/2024 13:40-14:40	369.0	349.9	1.8%	1.6%	11.4%	10.4%	314.5	320.3	60.7%	47.1%	1.3%	1.5%	15.9%	8.8%
09/10/2024 13:40-14:40	463.7	431.3	1.7%	2.4%			306.4	330.2	55.9%	49.1%			40.9%	26.5%
09/10/2024 15:37-16:37	398.0	361.7	2.5%	1.7%	2.9%	3.7%	337.7	331.0	72.2%	61.4%	4.1%	2.5%	16.4%	8.8%
09/10/2024 15:37-16:37	421.5	389.1	1.6%	2.1%			311.4	315.0	59.3%	40.3%			30.1%	21.1%
09/10/2024 17:31-18:31	394.8	372.2	1.4%	4.8%	1.0%	1.7%	319.5	326.5	51.6%	42.4%	5.1%	3.4%	21.1%	13.1%
09/10/2024 17:31-18:31	402.4	384.8	3.3%	2.9%			354.1	349.7	63.7%	61.3%			12.8%	9.6%
09/10/2024 19:26-20:26	413.3	372.8	2.9%	4.0%	2.7%	2.6%	313.2	309.5	73.2%	61.3%	3.0%	1.7%	27.6%	18.6%
09/10/2024 19:26-20:26	436.4	392.4	3.0%	1.3%			332.5	320.4	46.1%	57.0%			27.0%	20.2%
09/10/2024 21:18-22:18	427.5	387.5	5.2%	0.7%	0.9%	2.9%	304.3	298.8	67.5%	52.5%	5.6%	3.4%	33.7%	25.8%
09/10/2024 21:18-22:18	420.1	365.8	4.4%	3.2%			340.4	320.1	66.6%	63.3%			21.0%	13.3%
AVERAGE	413.9	379.5	2.5%	2.5%	4.1%	4.1%	320.2	322.8	62.3%	53.6%	3.9%	2.6%	**25.4%**	**16.1%**

Extrapolation Assuming Breakthrough through Impinger 2		
Impinger 1 Avg:	197.3	210.2
Impinger 2 Avg:	122.9	130.9
Lost to Atmosphere:	76.6	81.6
Total Conc:	396.8	422.7
RPD%	**2.1%**	**5.4%**

Method Status

- **Available for Use Now**
- **ASTM Standard**
  - WK91049 has been drafted and is currently going through balloting/revision process
  - Includes sampling and analysis criteria
    - Analysis is done by ICP-MS following microwave assisted digestion
  - Includes criteria for developing an alternative to Ohio Lumex sorbent material
  - Expect publication some time in 2025

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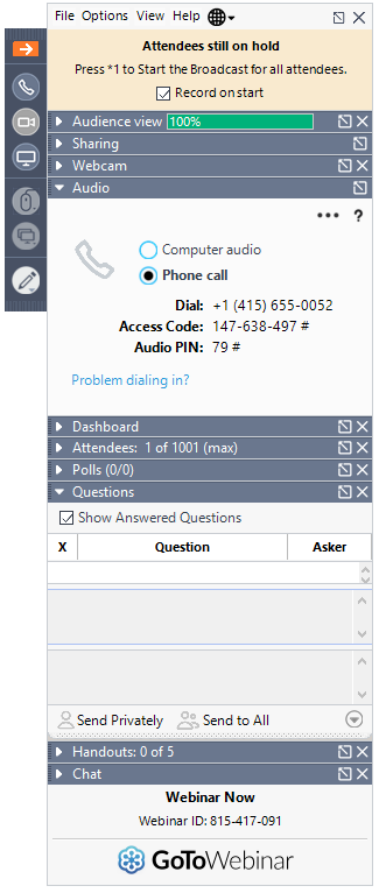
Q&A

Type in your questions under “Questions” in the toolbar.

Make sure to answer the survey at the close of this webinar.

Thank you!



Audio

Questions