

IMPROVED DIFFUSIVE SAMPLER for MERCURY VAPOR

by

**C.R. Manning
and J. Snyder**

Sampling for *MERCURY*

Problem 1 ...

- **Active Sampling**
 - **Costly & Inconvenient**

Problem 2 ...

- **Existing Diffusive Samplers**
 - **Not Sensitive Enough**

High Background Leads to Sensitivity Problem

typical **Sampling Rate** for a Hg Diffusive Sampler is ~ **1.2 Liter (air) / Hr**
typical **Hg Blank on Hopcalite** (or similar material) ~ **0.1 µg of Hg**

assuming the Detection Limit is roughly equal to typical Blank Values...

the **Typical Detection Limit (mass)** would be ~ **0.1 µg of Hg**
at 1.2 L/hr, **Volume for a 4-hr Sample** would be ~ **4.8 L**
SO ... Detection Limit (concentration) would be ~ **0.02 mg/M3**

Problem 2 ... Detection Limit too close to PEL

Mercury Background Blanks

(ug of Mercury / sampler)

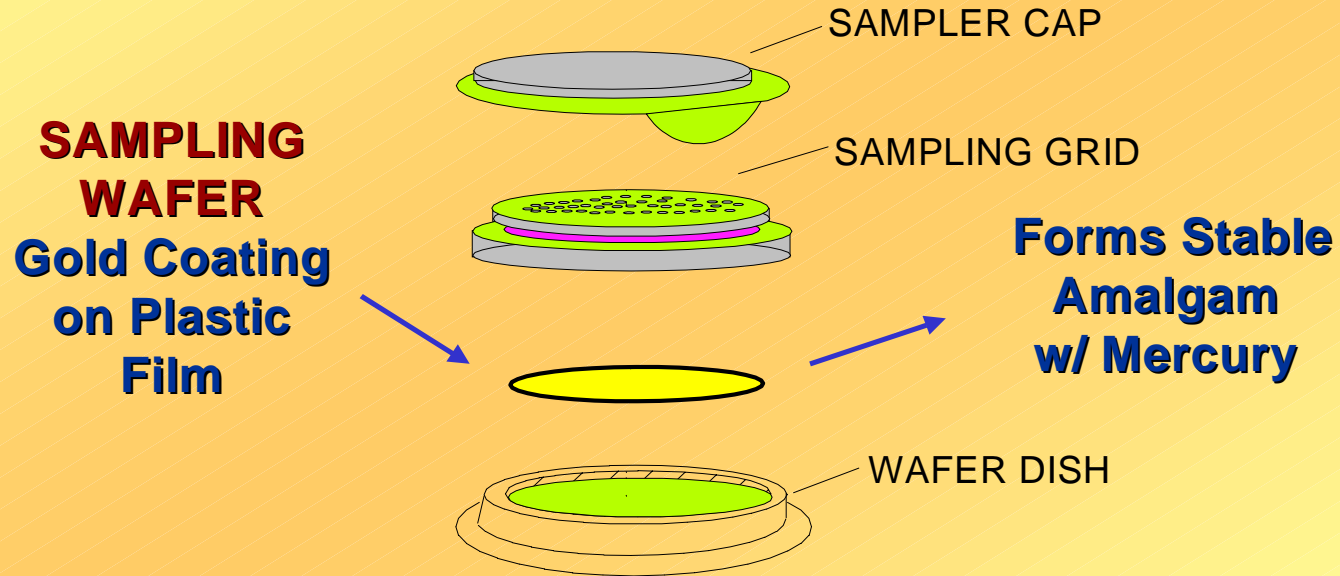
Hopcalite Sampler

	Set 1	Set 2	Set 3	Set 4
	0.13	0.17	0.11	0.11
	0.11	0.10	0.14	0.13
	0.15	0.11	0.08	0.11
Ave	0.13	0.13	0.11	0.12
S.D.	0.02	0.04	0.03	0.01

Gold Film Sampler

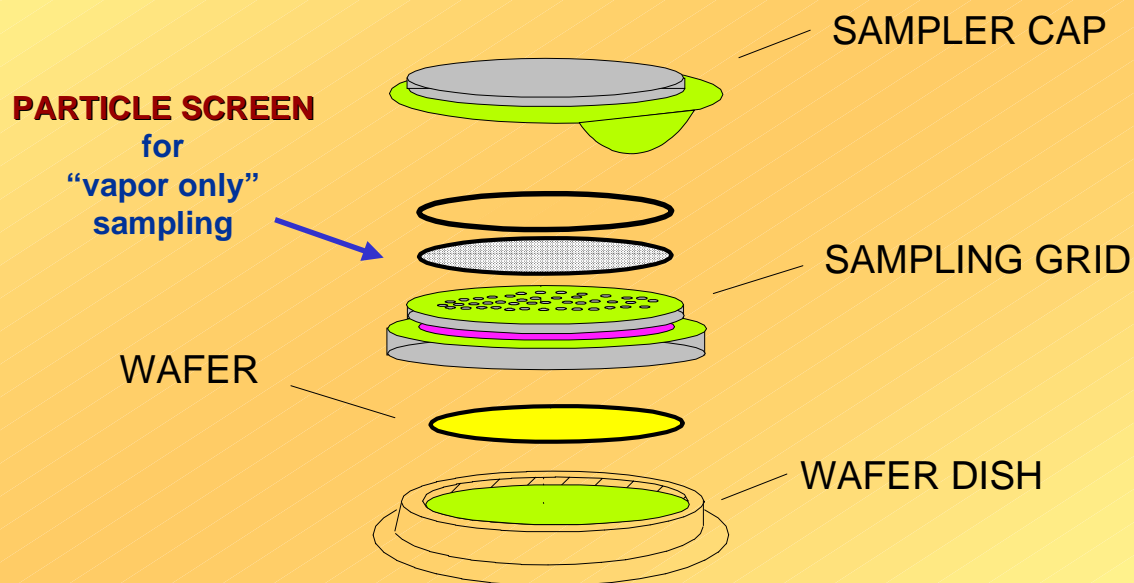
	Set 1	Set 2	Set 3	Set 4
	<0.02	<0.02	<0.02	<0.02
	<0.02	<0.02	<0.02	<0.02
	<0.02	<0.02	<0.02	<0.02
Ave.	<0.02	<0.02	<0.02	<0.02

Mercury Sampler AT593 ("gold film" sampler)



Mercury Sampler AT593

(optional particle screen feature)



Analysis of Mercury Sampler

- **OSHA 140**
 - Digest Sample HNO_3 & HCl
 - Add Reducing Agent (SnCl_2)
 - Bubble to Vaporize Mercury
 - Analyze Hg Vapor in Flow Cell
 - spectrophometer at 254 nm

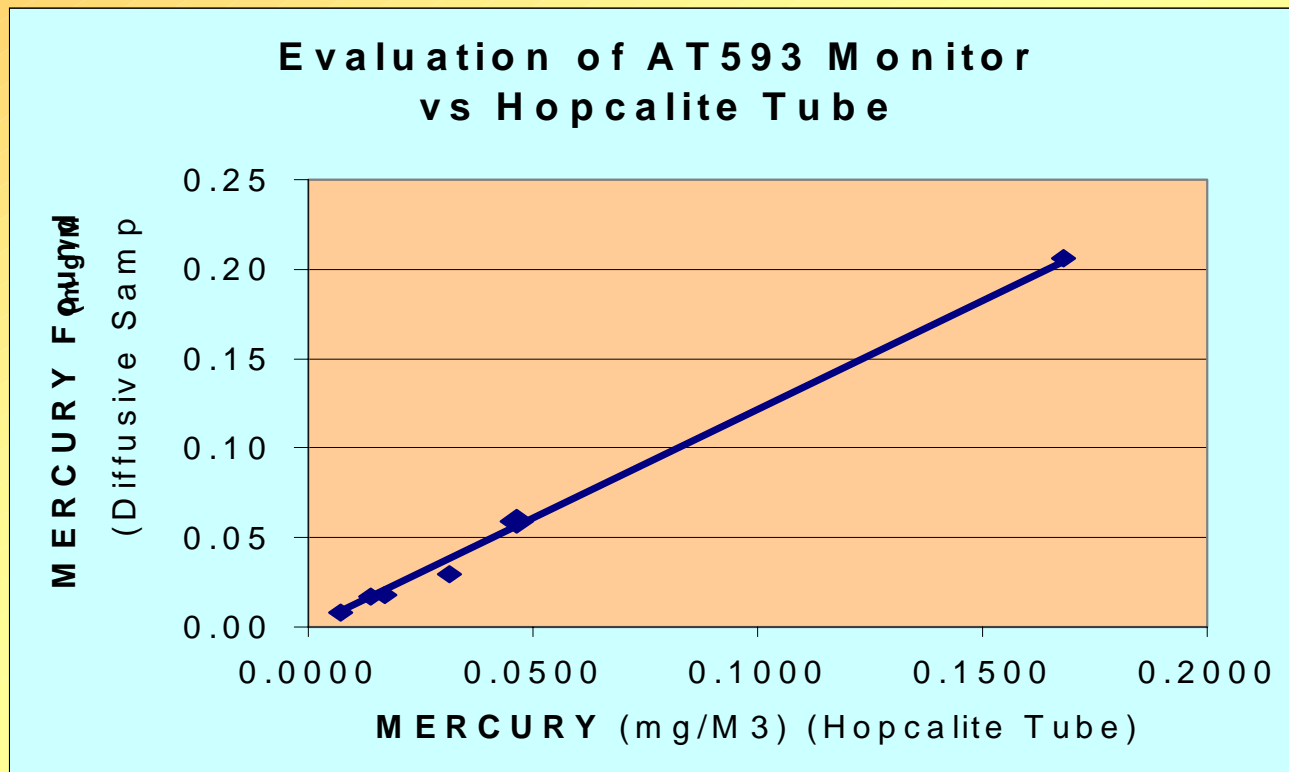
Comment:

Mercury from the gold amalgam film digests more slowly than Hopcalite.

Lab Evaluation of Mercury Sampler (Protocol)

- Mercury Vapor generated from large diffusion capillary source
- Mercury Diffuser Heated at 40°C
- Mercury passes into Polypropylene Chamber
 - at 100 ft / min (50 cm/sec)
- 4 Test Samplers in each Chamber Run
 - Diffusive Sampler (AT593)
- 4 Reference Samplers in each Chamber Run
 - “Hopcalite” Tube (active)
- Exposures ... 0.07 - 0.17 mg/M³Hg for 0.5 - 4 hours

Lab Evaluation of Mercury Sampler



Field Evaluation of Mercury Sampler (Protocol)

- Mercury Vapor generated “naturally” at mine site
- Test Atmosphere passes into “Isocratic” Sampler
 - Isocratic Sampler presents similar environment to all Samplers
- at least 4 Test Samplers in each of 4 Chamber Runs
 - Diffusive Sampler (AT593)
- at least 4 Reference Samplers in each of 4 Chamber Runs
 - “Hopcalite” Tube (active)
- Exposures in vicinity of 0.05 mg/M³ Hg for 7-8 hours

Field Evaluation of Mercury Sampler

A "natural" emission at a mine site presented to Test and Reference Samplers continuously co-located in an "Isocratic Sampler" designed to ensure that a uniform concentration will be presented to all samplers.

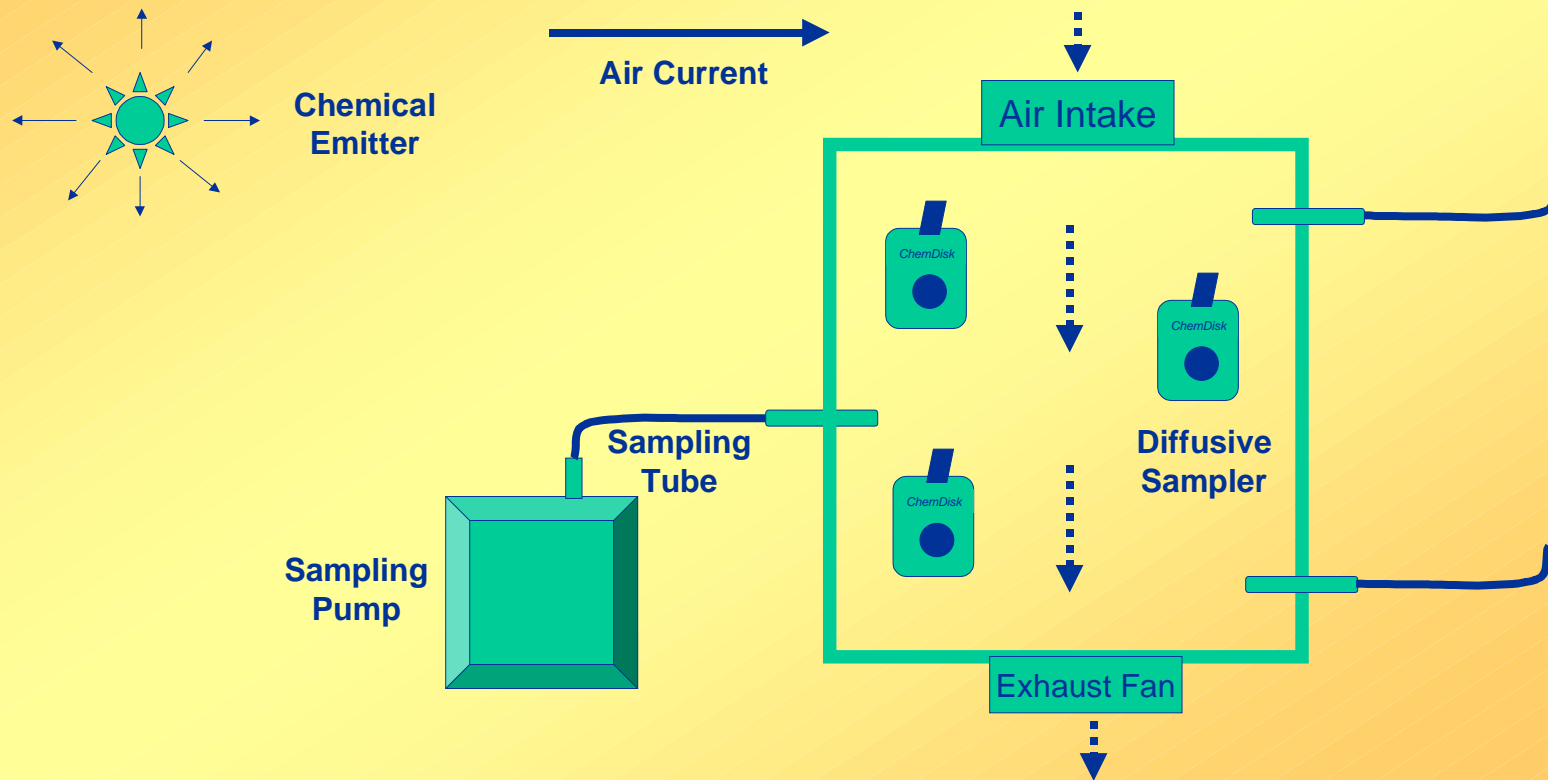
Reference Sampler (active) Hopcalite Sampling Tube

LAB #	Client #	Result ug/smpl	Exposure mg/m3
2001-024501	AT-101	3.40	0.059
2001-024502	AT-102	1.24	0.030
2001-024504	AT-103	4.39	0.084
2001-024520	BT-113	4.25	0.067
2001-024521	BT-114	2.80	0.052
2001-024522	BT-115	3.28	0.052
2001-024532	AT-125	4.28	0.060
2001-024533	AT-126	4.99	0.070
2001-024534	AT-127	4.17	0.058
2001-024546	BT-137	3.43	0.048
2001-024547	BT-138	3.76	0.053
2001-024548	BT-139	4.16	0.058
Lab blank		0.092*	
Ave. of all Samples =			0.058

Test (Diffusive) Sampler (AT Gold Film Sampler 593)

Lab #	Client #	Result ug/smpl	Exposure mg/m3
2001-024513	APG-108	0.171	0.055
2001-024515	APG-109	0.146	0.047
2001-024516	APG-110	0.141	0.046
2001-024518	APG-111	0.174	0.056
2001-024519	APG-112	0.158	0.051
2001-024527	BPG-120	0.137	0.044
2001-024528	BPG-121	0.132	0.043
2001-024529	BPG-122	0.176	0.057
2001-024530	BPG-123	0.188	0.061
2001-024531	BPG-124	0.140	0.045
2001-024540	APG-132	0.202	0.057
2001-024541	APG-133	0.248	0.070
2001-024542	APG-134	0.212	0.060
2001-024544	APG-135	0.225	0.064
2001-024545	APG-136	0.207	0.059
2001-024553	BPG-144	0.188	0.053
2001-024554	BPG-145	0.178	0.050
2001-024555	BPG-146	0.144	0.041
2001-024556	BPG-147	0.152	0.043
Lab blank		0.017*	
Average of all Samples =			0.053

Isocratic Sampler



Conclusions:

- **Compact Diffusive Sampler provides convenient method for monitoring employees**
- **Gold Film provides low background blank enhancing sensitive CVAA measurements**
- **Particle Screen affords protection against sampler contamination by mercury dusts**