A Comparison of the Air-O-Cell Slit Impaction and Bi-Air Filter Cassettes

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Sampling Parameters

- AOC Slit Impactor
- Sample times typically 2 minutes to 10 minutes at 15 lpm

- BA Filter Cassette
- Sample times typically 10 minutes to 8 hours at 1- 3 lpm

Longer sampling time [TWA] = smaller variance

Bi-Air Filter Cassette

Bi-Air Used to Collect Over 2,000 Personal & Area Remediation Samples

Bi-Air: Duplicate Samples

- **First Trace:**
  - Microscopy
- **Second Trace:**
  - Cultured on multiple media
  - Analyzed by QPCR*
  - Archived for legal

*Quantitative Polymerase Chain Reaction

QPCR Analysis On MCE Filter Media

QPCR on MCE Filter Media

"Can't be done"

Filters are "sterile",
And free of spores by microscopy,
But not free of "spore equivalents"
as measured by QPCR

Abstract 272: Park & Shogren

Six MCE Filter Blanks Submitted for Analysis by QPCR

FILTER
0
0
3
27
37
156

25 mm MCE filters

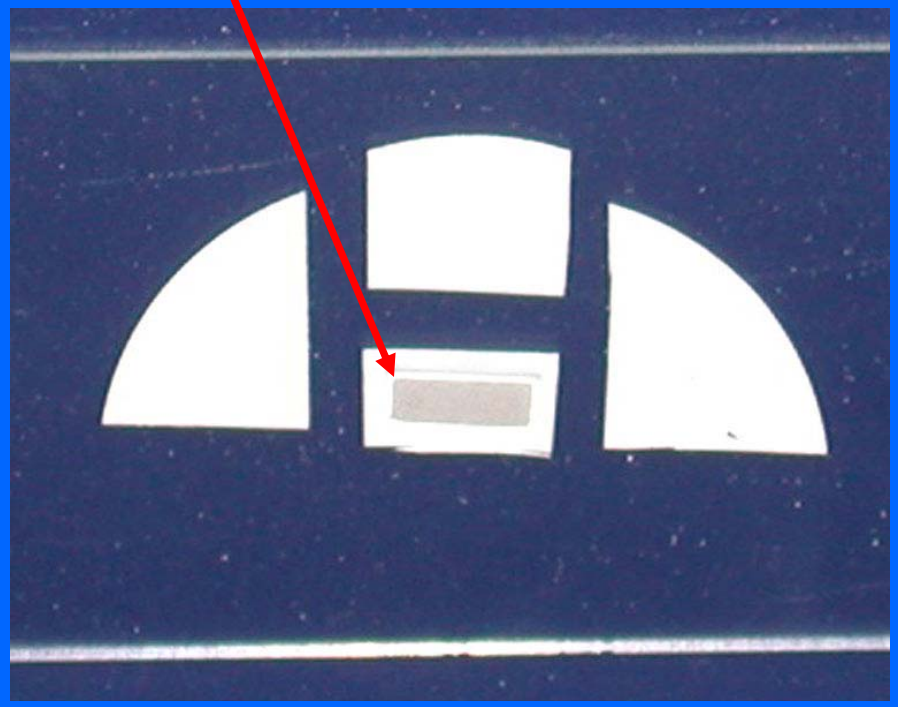
Total Sp-Eq are listed

Avg = 37 Sp-Eq / Filter

Why QPCR Analysis Worked

6 Blank MCE Filters: Sp-Eq/Trace

BA Sample < 4% of Filter



TRACE
0
0
0.1
1.1
1.5
6.2

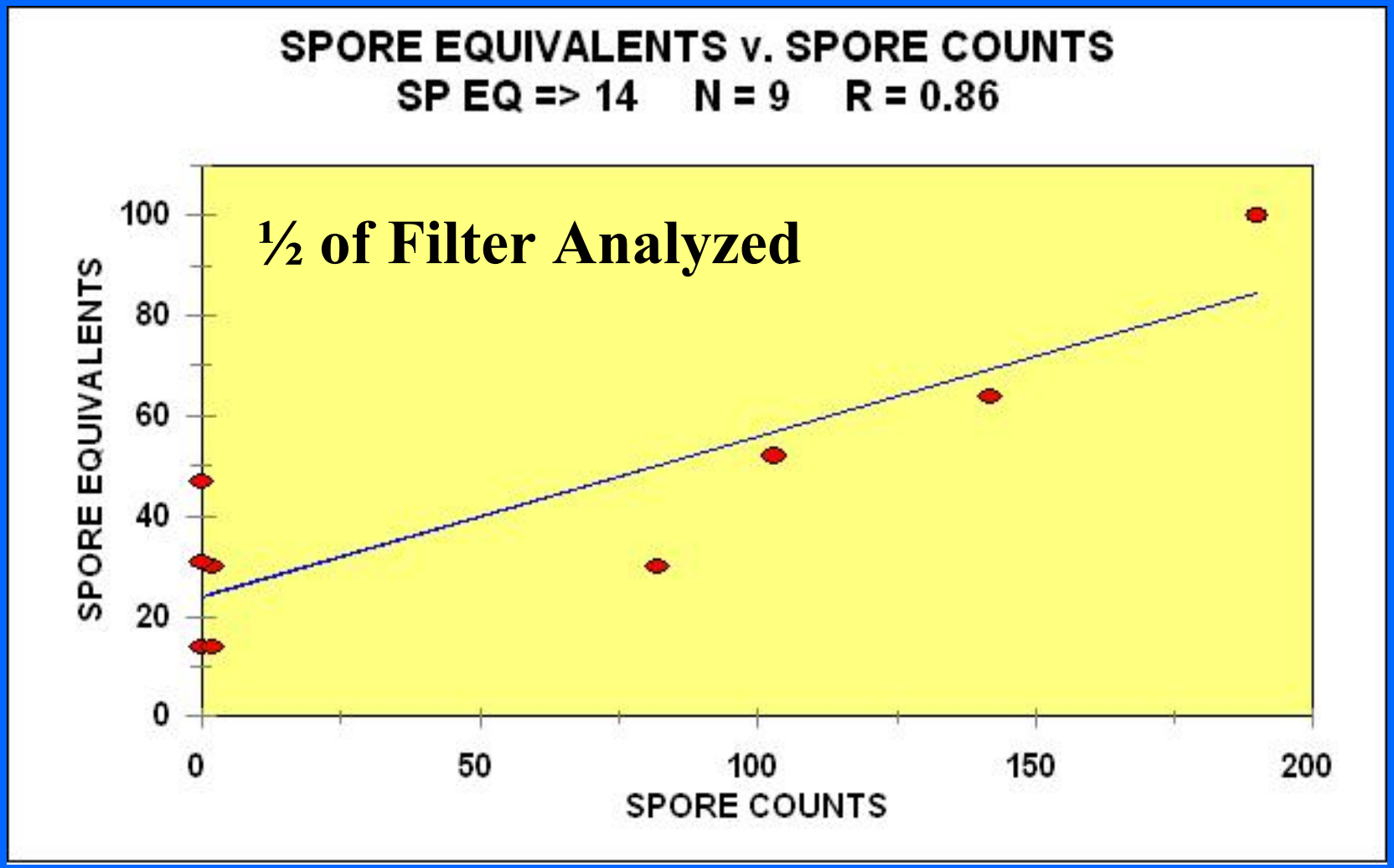
Avg = 1.4

Sp-eq/Trace

MCE Filters and QPCR

- **MCE filters are routinely analyzed by Dr. Lin using QPCR**
  - **Submitting blanks may be misleading**
    - Variable background
  - **BA uses < 4 % of the total filter area**
    - Lower background [1-2 sp-eq / trace]
    - Improved ease of handling [no folding]
    - Greater sensitivity [smaller wash volume]

QPCR: *Asp* & *Pen* on MCE Filters



Chamber Tests Comparing the Air-O-Cell and Bi-Air Cassettes

Large-Chamber Tests

150-200 samples in two days

Asp/Pen

Cladosporium

Stachybotrys

Ulocladium

15 AOC and 15 BA per Series

Data could not be interpreted:
Large chamber volume + short sample times = high variability

Settling Chamber Comparison of AOC and BA Cassettes

Smaller chamber volume
Longer sample times
Ideal ≈ 10,000 sp/m^3

Settling Chamber

***P. chrysogenum* = 3 um**

3 um close to AOC "cut size"

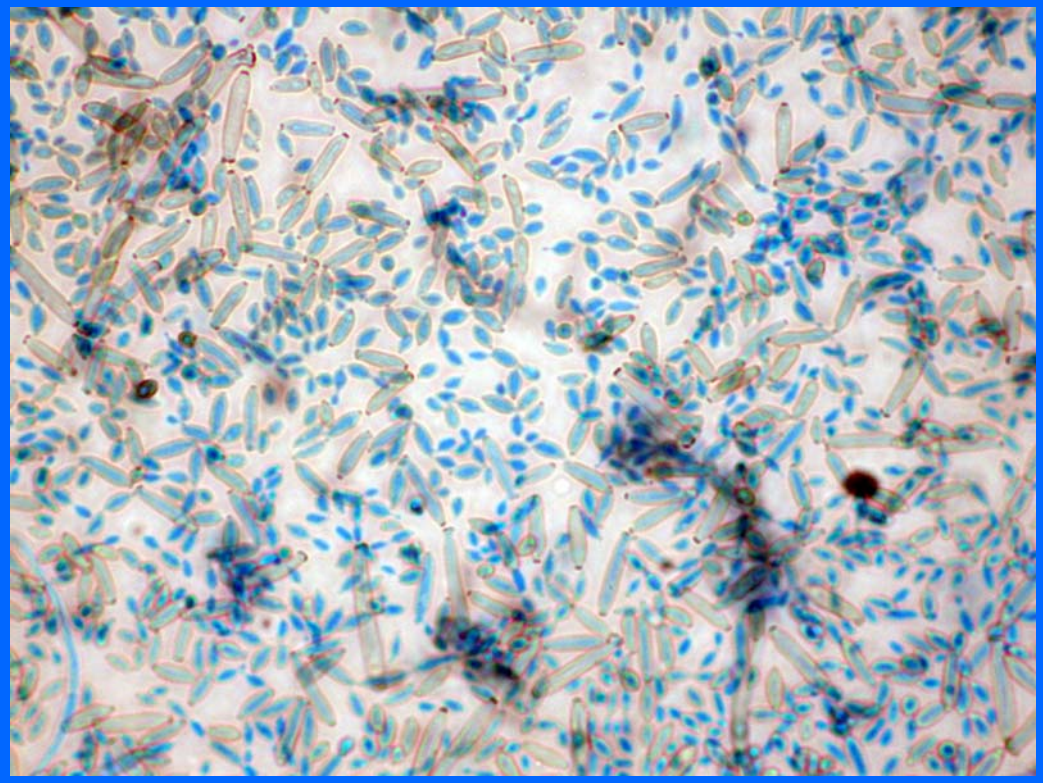
Expect BA to AOC ratio ≈ 2

AOC: Expect 1,000 s/m^3 to be reported for every 2,000 s/m^3 present

Utility of slit impaction samplers depends on this ratio, or systematic error, remaining constant

Is This Systematic Error Constant?

Field Comparison 1



Example photo only

Very small *Asp/Pen* like spores ≈ 2 um

Present in BA samples, but not in AOC samples

Field Comparison 1

Asp/Pen Like Spores

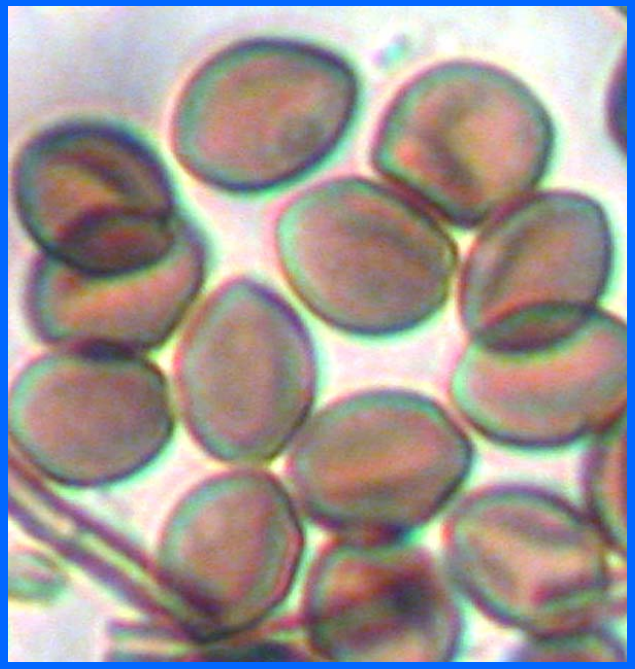
BA (60 min)	AOC (5 min)	Ratio
365,000	24,500	15
585,000	14,800	40
700,000	4,800	146
1,400,000	103,200	14

Ratios: neither ≈ 2, nor constant

Field Comparison 1

Spore Morphology: *Chaetomium*

Smooth spore with small contact area = "Bounce"



Spores/m^3

BA	AOC
1,800	60
1,150	0
300	0
2,700	0

Avg = 1,500 v 15

Expected Ratios: *Asp/Pen* Spores

SAMPLER	AOC (5 MIN)	BA (60 MIN)	RATIO
Samples	143	75	NA
GM	590	2,700	4.6
Average	5,000	24,000	4.8
95th %-tile	12,000	76,000	6.3

Comparison of concentration distributions

The Effect of Sampling Time on Data Interpretation

Sample Time ≡ Accuracy

Sample Volume ≡ Precision

My Point: It's not air samples that cannot be interpreted, it's short-term air samples that cannot be interpreted

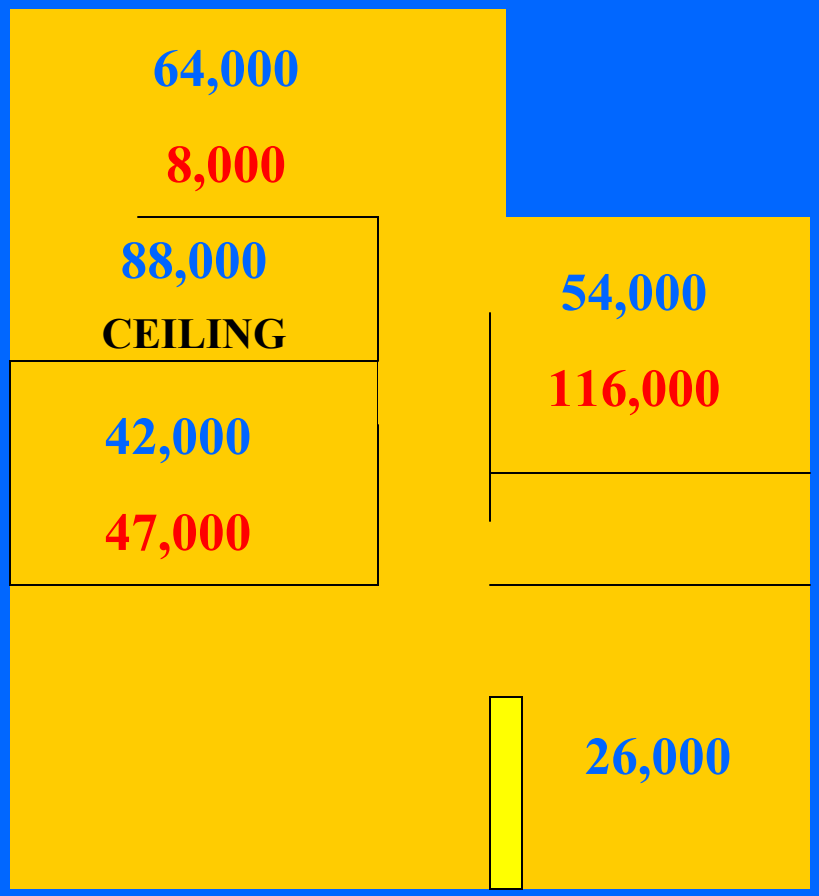
Field Comparison 2: *Asp/Pen* Spores Outside Contained Bathroom

	DAY 1		DAY 2	
LOCATION	AOC	BA	AOC	BA
Baseline, Kit	2,340	338	NA	NA
Kitchen, Demo	1,232	564	3,695	264
Bdrm, Demo	1,602	500	1,726	250

AOC: 5-minutes BA: 120 minutes

Data consistent with logic?

Field Comparison 3:
Collapsed Master Bathroom Ceiling



Asp/Pen, sp/m^3

Blue = 60 min BA

Red = 5 min AOC

Data consistent with incident history ?

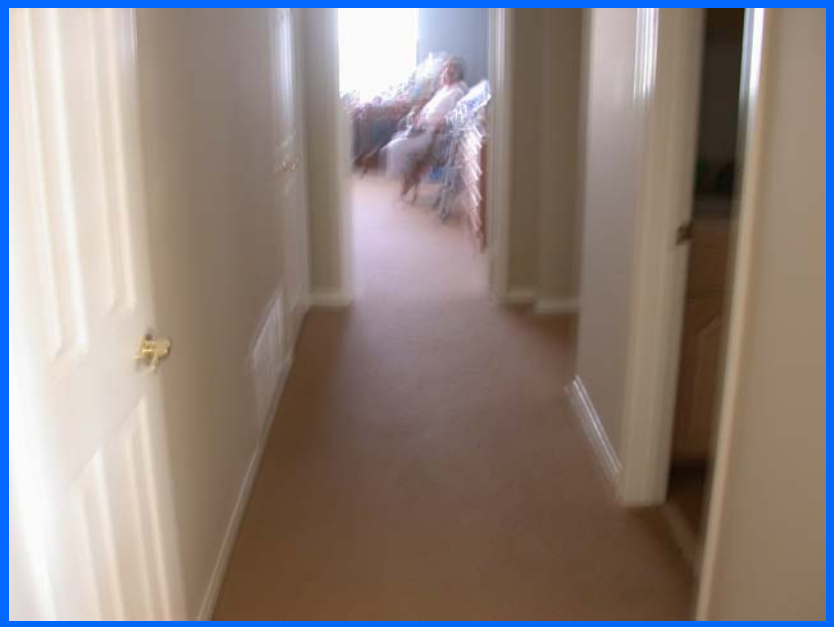
Field Comparison 3:
Variability of the three bedroom samples

	5 Min AOC	AUTO-CORRELATION 60 Min BA
AVERAGE	57,050	53,221
STD DEV	54,867	11,018
RSD	96 %	21 %

BA to AOC ratio ≈ 2? [0.9]

Implications for Risk Assessments?

Elderly woman bedridden with pneumonia in Bdrm



BA at photo location

Asp/Pen	Sp/m^3	%
Rough	1,072	22
Smooth	1,408	29
Very Small	2,358	49

AOC v. AL-D?

Conclusions

- The BA to AOC ratio for *Asp/Pen* was not constant
  - Varied substantially between projects
  - Expected ratio of about 4.6 – 4.8
- Spore morphology
  - significant effect on spore retention
- Longer sampling times of filter samplers
  - Less variability
  - Improved data interpretation
- Assessing occupant risk
  - Slit impaction samplers may have serious limitations

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