Improved Bio-Agent Recovery From Simulated Environmental Surfaces with Liquid Rinse Vacuum Collection System

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Detection Technologies 2008

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Why are We Talking About Sampling at a Detection Conference?

- All detection starts with sampling
- If you can't COLLECT it, you can't DETECT it
- If the capabilities of modern detection equipment are to be realized then we need to start with a quality sample

Calculating Efficiency: Sampling to Detection

- Sampling Efficiency (η_{Sam})

  $\eta_{Sam} = \eta_{Loc} \times \eta_{Rec}$

- Detection Efficiency (η_{Det})
  - Not all detection devices are equal
  - Assume η_{Det} is 1.0 for this presentation
- Overall Process Efficiency (η_{Tot})

  $\eta_{Tot} = \eta_{Sam} \times \eta_{Det}$

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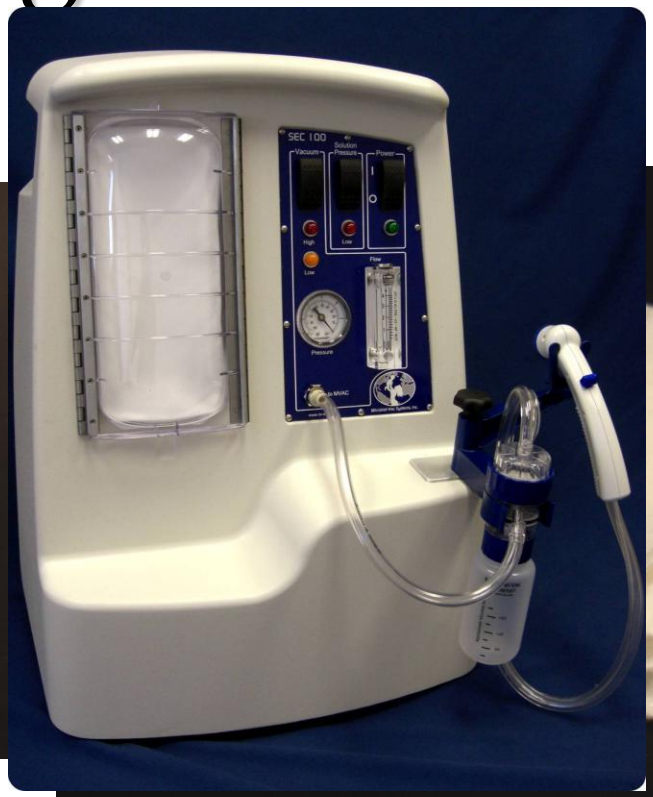
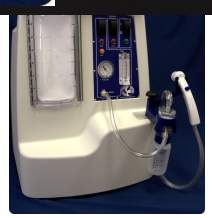
  This presentation deals with improving this

Sampling Devices Compared

- Swab
  - Cotton tipped
  - Pre-moisten
- Sponge
  - Cellulose ba
  - Pre-moisten
- Cotton Gau
  - 2″ x 2″ 8 ply
  - Pre-moistened
- Microbial-Vac System (M-Vac)
  - Surface rinse
  - Vacuum collection



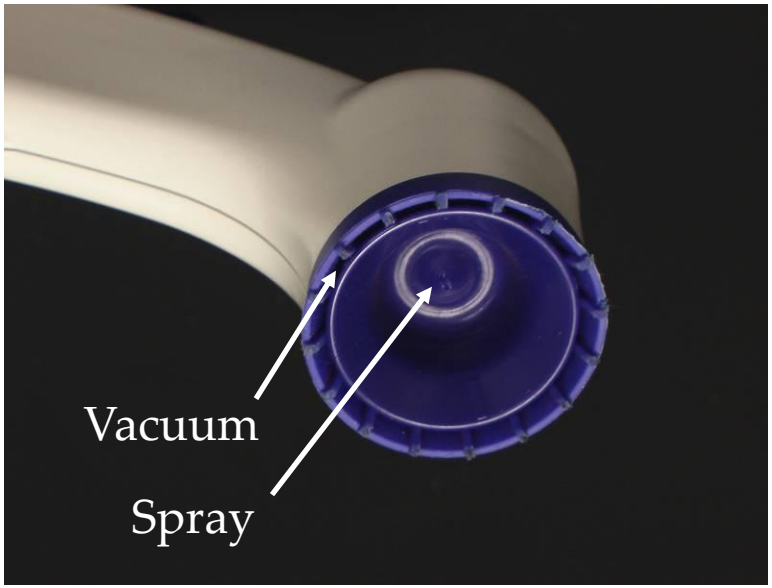


Overview of the M-Vac

SEC

SRS

M-Vac & Sampling Head
(MS Kit)



Sampling Efficiency Equation

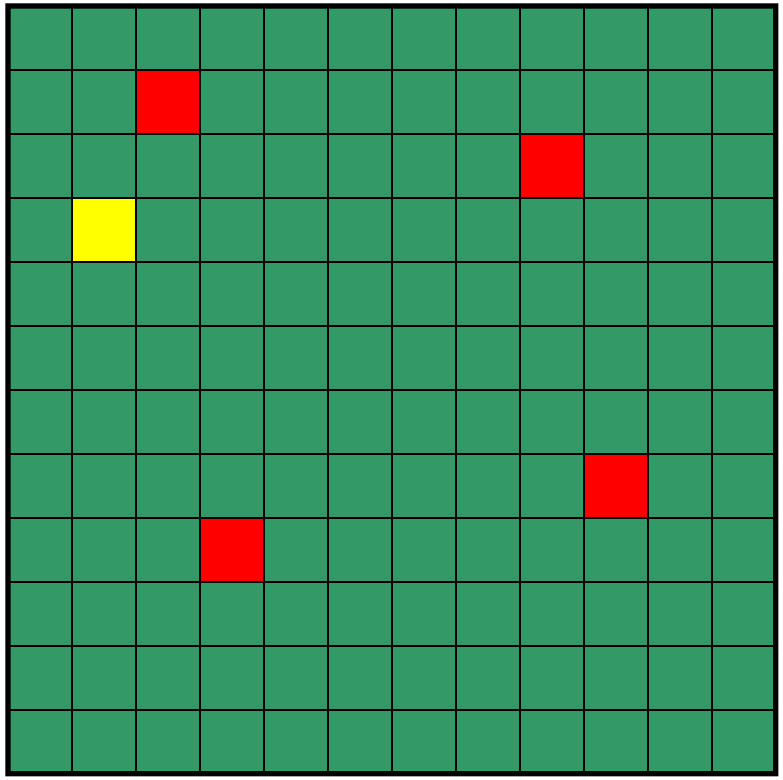
$$\eta_{Sam} = \eta_{Loc} \times \eta_{Rec}$$

Location Efficiency (η_{Loc}) cont.

= Contamination

= Swab sample sites*

*Swab sample sites are 2″ x 2″



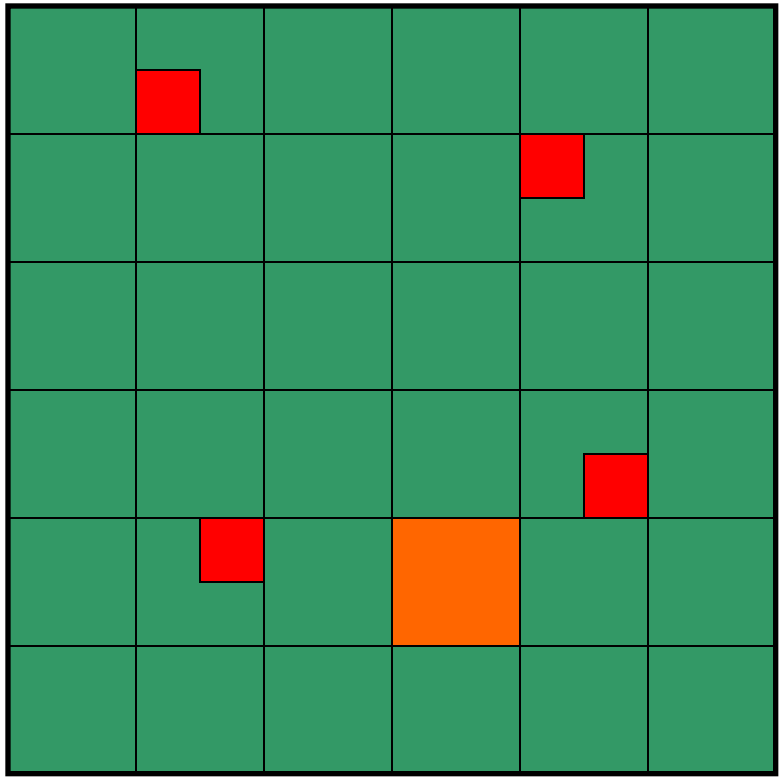
4 sq ft Surface with 2″ x 2″ grid and 4 isolated sites of contamination

Location Efficiency (η_{Loc}) cont.

= Contamination

= Sponge sample sites*

*Sponge sample sites are
4″ x 4″ or ~ 100 sq cm



4 sq ft Surface with 4″ x 4″ grid and 4 isolated sites of contamination

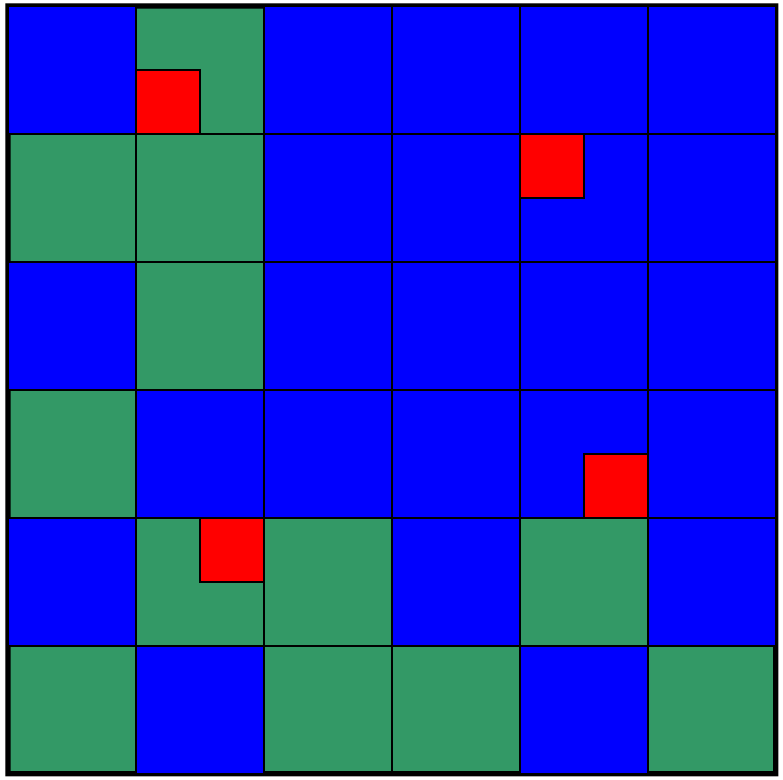
Location Efficiency (η_{Loc}) cont.

= Contamination

= M-Vac sample sites
(1 M-Vac sample ≈ 256 sq in ≈ surface area of 16 sponges)

Method	# of samples	Total surface area covered (sq in)	η_{Loc}*
Swab	65	260	21%
Sponge	16	256	92%
M-Vac	1	256	91%

*Assumes sampling a contaminated site would result in a positive detection result.



4 sq ft Surface with 2″ x 2″ grid and 4 isolated sites of contamination

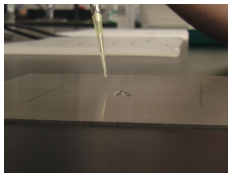
Sampling Efficiency Equation

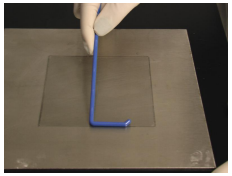
$$\eta_{Sam} = \eta_{Loc} \times \eta_{Rec}$$

Recovery Efficiency (η_{Rec})

Procedures for determining ηRec

1) Spot Inoculate
   - B. sub spores
   - 150/surface





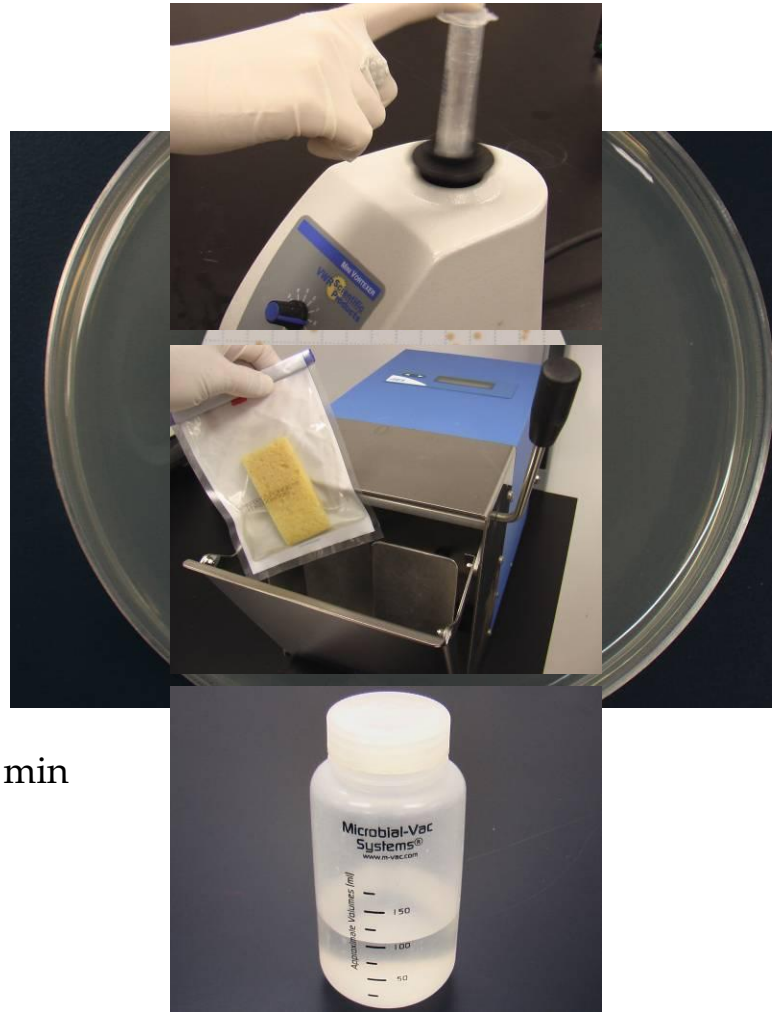
2) Spread inoculum over entire area

3) Allow inoculum to dry/adhere

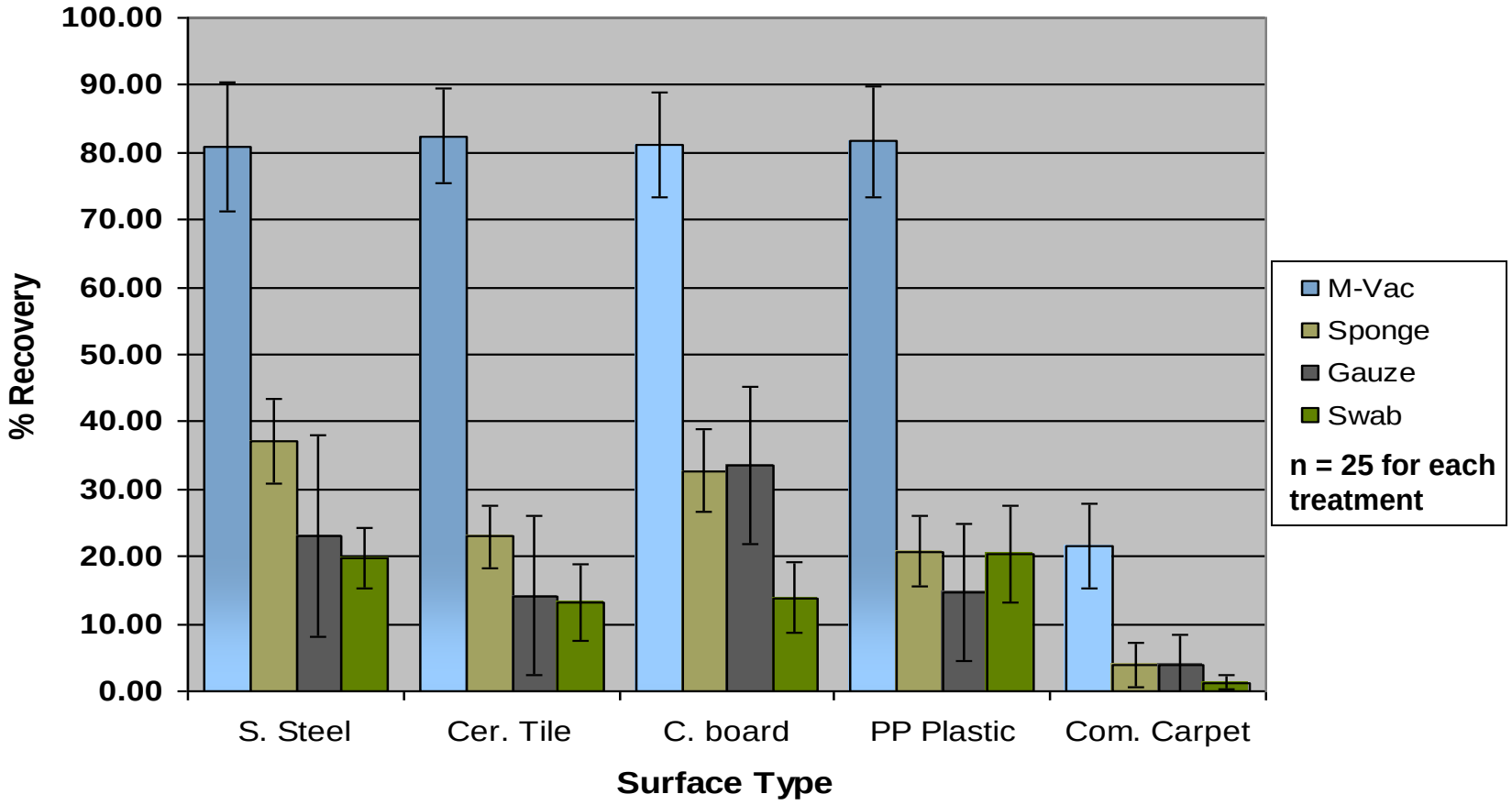
4) Sample following standard procedures or manufactures suggestions for use

5) Elute bacteria from sampling device
   - Swab: Place in 10mL, Vortex 12 times for 10 sec.
   - Sponge/ Gauze: Stomach sponge and 15 mL for 2 min at 240 RPM
   - M-Vac: Wrist shake 5 – 10 sec.

6) Plate on TSA plates, incubate 18 – 24 hrs, enumerate by direct plate count



Recovery of *B. subtilis* Spores from Simulated Environmental Surfaces



Reasons for Increase of η_{Rec}

Two areas of improvement using the M-Vac

- Extraction efficiency (η_{Ex})
  - Ability to remove microbes from cracks, fissures, and other surface irregularities using surface rinse solution
  - Transition from ***passive*** sampling to ***aggressive*** sampling
- Elution efficiency (η_{El})
  - M-Vac collects the bacteria in solution eliminating the need for elution
  - Overcome the sampling paradox between extraction and elution

Results of the Equation

Method	η_{Loc}	x	η^{*}_{Rec}	=	η_{Sam}
Swab	.02	x	.20	=	**.003**
Gauze	.12**	x	.23	=	**.03**
Sponge	.12	x	.37	=	**.04**
M-Vac	.91	x	.81	=	**.74**

*Values for ηRec pertain to recovery results from stainless steel.
**Sponge value used

Conclusion

- M-Vac provides numerous advantages over historic sampling methods
  - Greater location efficiency with fewer samples to the lab (Fewer detections performed in lab)
  - Greater recovery efficiency (Improved characterization of surface contamination)
  - Increased repeatability between users
  - Increased efficiency of sample prep in the lab
  - Less exposure of lab personnel to pathogens
- Increased η_{sam} leads to increased efficiency overall ($\eta_{Tot} = \eta_{Sam} \times \eta_{Det}$)

Contributors:

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