BSC MythBusters: Does Heat Really Affect Protection?

Kara Held, Ph.D.
Science Director

BSC Mythbusters

• There are a lot of rules and “guidelines” for using a BSC.
• Which are true?
• Which are not?
• WHY?
Heat sources in a BSC

- Potential Myth:
  - Do not use a Bunsen burner in a BSC.

- Theoretical reasoning:
  - The gas needed to light the flame would be dangerous flowing around the hot BSC motor.
  - Heat changes airflow dynamics

Volatile Gas release

Using our previous research (see Volatile Chem Use in a BSC on BakerCo.com), we can calculate how much propane can be released into a BSC safely without explosion given there is no spark or excessive heat:

\[
ER = \frac{Q_l \times MW \times LEL \times 473}{403 \times SG \times S_F \times 100} = \frac{267 \text{cfm} \times 44.1 \text{g/mol} \times 2.1\% \times 473}{403 \times 1.52 \text{g/mL} \times 10 \times 100} = 19 \text{mL/min}
\]

- Release rate of propane from a tank to a Bunsen burner
  = 0.12 mL/min
Volatile Gas release

- Auto Ignition temperature of propane = 504°C
- Maximum motor/blower allowable temperature = 150°C

Airflow disruption

- Visually
- Smoke
- BSC performance/Containment
  - Particle Counting
  - NSF Standard 49 Biological Testing Criteria

Personnel Protection Test  Product Protection Test  Cross Contamination Test
Sources of Heat

- Four Commonly used Heat Sources:
  - Standard Bunsen Burner
  - High Heat Bunsen Burner
  - Bacti-Cinerator
  - Spirit Lamp

Biosafety Cabinets (BSCs)

- A ventilated enclosure for work with biohazard agents assigned to biosafety levels 1 through 4, as per the BMBL.
- Provides 3 types of CONTAINMENT:
  - Personnel protection
  - Product protection
  - Environmental protection
- All BSCs contain: 1+ HEPA filters & motor/blower
Biosafety Cabinet Classification

Class I
- Personnel and Environmental Protection

Class II
- Personnel, Product, and Environmental Protection

Class III
- For highly infectious agents
- Gas-tight, physical barrier

Type A1
- Recirculated
- Minimum 75 fpm intake velocity

Type A2
- Recirculated
- Minimum 100 fpm intake

Type B1
- Partial recirculation

Type B2
- 100% Exhaust

Type C1
- Partial recirculation

Class II Type A2 BSCs
- Personnel, Product and, Environmental Protection
- Minimum 100 fpm intake air
- Partial recirculation
Normal BSC Operation

Heat Sources in a BSC

- Problems:
  - Lighting a flame in a windy environment
  - Keeping it lit for the duration of the experiment
Airflow Disruptions

- Upward flow of air

High Heat Bunsen Burner

Normal Operation
Contamination Experimentation

- Tested on a 6 ft and 4 ft Class II Type A2 BSC (SterilGARD e3)
- Split work surface into zones

Particle Counting

- Maintain ISO Class 5?

  - Spirit Lamp ✅
  - Bacti-Cinerator ✅
  - Bunsen Burner ❌
  - High Heat BB ❌

- Taller flames affected the Momentum Air Curtain and intake air
Biological Testing

• Microbiological aerosol testing in accordance with NSF International Standard 49 testing
• Locations A, B, C, D

Biological Testing

• Bunsen Burner
  • 6ft:
    • Personnel = PASS
    • Product = 3/5 FAIL
    • Cross = FAIL
  • 4ft:
    • Personnel = FAIL
    • Product = FAIL
    • Cross = FAIL
Biological Testing

• High Heat Bunsen Burner
  • 6ft:
    • Personnel = 1/4 FAIL
    • Product = 3/4 FAIL
    • Cross = FAIL
  • 4ft:
    • Personnel = 1/2 FAIL
    • Product = FAIL
    • Cross = FAIL

• Bacti-Cinerator
  • 6ft:
    • Personnel = 3/4 FAIL
    • Product = 1/4 FAIL
    • Cross = 1/2 FAIL
  • 4ft:
    • Personnel = 1/2 FAIL
    • Product = FAIL
    • Cross = FAIL
Biological Testing

• Spirit Lamp
  • 6ft:
    • Personnel = PASS
    • Product = 1/4 FAIL
    • Cross = 1/2 FAIL
  • 4ft:
    • Personnel = 1/2 FAIL
    • Product = FAIL
    • Cross = FAIL

Biological Testing

• Cross Contamination Microbiological Testing

plates = 14”
burners = 6”

23”
Observations of Note

• Heat built up quickly within the BSC
  • The worst results were seen after the burners had been on for a while.

• Results were worse in the 4ft BSC vs. 6ft BSC
  • Smaller work area = greater airflow disruptions

• Aerosol generation was affected by burners
  • Flow out of the nebulizer could be seen fluctuating

• All experiments assumed an 8” sash opening

Conclusions

• Heat sources in a BSC cause problems
• Gas in a BSC only an issue if a spark
• Loss of Personnel, Product and Cross Contamination Protection to varying degrees
• Whole cabinet is affected

• Burner alone
• BSC alone
• Together
Upcoming BSC MythBusters

• 2+ people in a 6’ hood?
• How much is “overloaded”?

If you have BSC myths you want tested, send them to me! We’ll get you your answers.
kheld@bakerco.com