Air Barrier Containment

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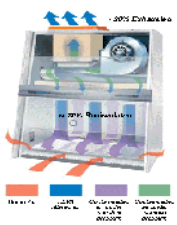
Abstract

The aim of this project is to investigate the various methods used indetermination air barrier containment of Biological Safety cabinets and validate their effectiveness. The Project's research showed that the aerosol test used in determination of the air barrier containment should be endorsed in the Australian standard as a valid method of testing.

Introduction

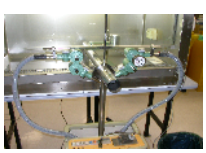
Biological safety cabinets have proven to be an essential item of equipments inside any research and or diagnostics laboratories. Our dependency on them has improved drastically. Cabinets are essential component in handling biological hazardous materials. It is the only mean of safety from getting infected with dangerous substance that contribute to a high death rate that can be prevented simply by just using proper biological safety cabinets. This research focused on the air flow inside the cabinet and how it could affect the air barrier at the sash of the cabinet. In addition to establishing a methodology of validating the Aerosol test.



Methods

Test 1

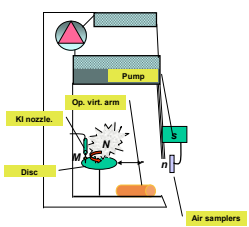
- Setting up the cabinet according to the British standard.
- Test the cabinet using potassium Iodide Discus method. Examine the environmental factors that may affect the cabinet.



- Examine and observe the droplets affect of the KI.Examine and observe the droplets affect of the KI. scrutinize the effects of varying the velocity of the main fan motor and the exhaust fan motor on the performance of the air barrier and on the performance of the potassium iodide discus results. Investigate the operator protection factor.
- On the original setting of the cabinet in accordance to the British standard test the cabinet using the smoke generator test (the aerosol test). Examine the outcomes and correlate the results.
- Determine the differences and the similarities and determine if the test pass or fail. Enhance the photometer with the use of particle counter in order to achieve a quantitative results.
- Repeat the test with setting up a cabinet in accordance to the Australian standard then start to test it using the potassium iodide discus. Produce a graph of comparison of the suitable air velocity that could be used where both tests fails/ passes.
- Outline the findings in terms of performance and air velocities.

Test 2:

- Scattering effect around the cabinet.
- Use a die to observe the scattered potassium iodide around the cabinet.
- Is it sufficient to test the centre only?
- Move the sampler of the KI discus towards the side of the cabinet and carry out a test. Work out the operator protection factor at the new positions of the samplers.
- Correlate the results obtained versus the results obtained from testing at the centre only. Investigate the areas where the barrier is vulnerable.



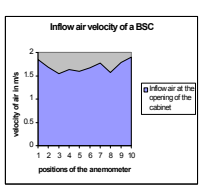
Test 3:

- Work out the centripetal force that the particles hitting the barrier with for both the KI discus method and the aerosol liquid method.
- For the KI discus method
- 38mm spinning disc (28,000 r/min) + nozzle delivering ***M***=20ml of 15g/l solution of KI, generating ***N*** particles
- Air samplers ***s***=100dm^3/min with 25mm filter membranes
- Count the spots on developed membranes: ***n***.
- Calculate A_{pf}:
  - with $N = 3.1 \times 10^7 \times M$
  - $A_{pf} = Ns/10^4 n$
- If $n = 62$, $A_{pf} = 1 \times 10^5$
- If $n = 1$, $A_{pf} = 6.2 \times 10^6$
- Correlate with the force of generating aerosol.

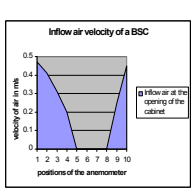
Results

Now at these optimum conditions

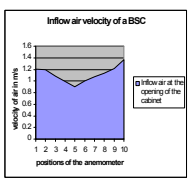
- Testing the inflow of the air across the opening of the cabinet using anemometer at 10 labelled spots, hence 50 mm from each sides of the cabinets then with in a spacing of 100 mm after the sides.
- Average air velocity of 1.7m/s



- By lowering the speed of the exhaust fan
- Average air velocity of 0.21 m/s

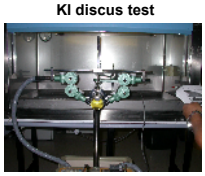


- By lowering the speed of the main fan
- Average air velocity of 1.12 m/s



Validation and Comparison Results

KI discus test



Aerosol liquid test

• The cost of the equipment	• Cheaper equipment multi-purpose
• The time taken to set up, and the general down time to the cabinet	• Short down time to the cabinet
• The use of low air velocity 0.3 m/sec	• Using adequate air velocity 0.4m/sec to 0.45m/sec
• The metal cylinder is fixed which doesn't represent the actual action of the operator	• Simulating operators movements
• The localised position of the samplers at the centre.	• Testing along the whole sash
• The droplet effects of un-evaporated KI	• Penetrations of smoke particles
• Particle size range from 4 to 10 µm	• Particle size consistent less than 0.3 µm
• No substance reference to OPF of 10^5	• Real time scanning

Conclusion

The Key factor or controller of the air barrier is the exhaust fan motor. The barrier is maintained proportionally to the adjustment of the exhaust fan as shown from the results. lowering the air velocity of the main fan interrupt the barrier, and raise the main issue of cross contamination inside the cabinet. From the comparison performed, Aerosol liquid test provide better qualitative method of testing the air barrier since it cover lots of aspects of practical informative method of test. KI discus test can not be carried out at any laboratory since it could contaminate the work in the actual laboratory. In contrast to aerosol test which doesn't interfere with the nature of work carried out in the laboratory.

Acknowledgement

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References

- Australian standard 2252.2.
- Australian standard 1807.26-2004
- Australian standard 1807.22
- IMVS, CTL , procedure manuals for mechanical testing.
- ESCO Global Co-operation, Singapore.
- Published article reviews on KI discus