ISO 14698 & MICROBIOLOGICAL AIR SAMPLERS

Jason Kelly Kenelec Scientific

This Article has been previously published in Cleanroom Technology Journal U.K (Jul 2005) and Controlled Environments magazine USA (Nov 2005).

Introduction :

Microbiological Air Sampling of Cleanrooms is carried out to ensure that levels of airborne micro-organisms are within recognised international standards. There are two categories of air sampling ; Passive air sampling devices such as Settle Plates and Active air sampling devices such as Impact, Impingement and Filtration. Air sampling methods include ; Inertial Impact, Centrifugal, Filtration and Sedimentation. Inertial Impact has become very popular over the last couple of years mainly due to the ease of use and the fact that the Petri dishes are easily placed and removed from the air sampler and put straight into incubation with minimum post sample contamination probability.

Fig 1 is an example of an active air sampling device using the impaction method. This Air Sampler is well designed with 316 L stainless steel sampling head (real thermal sterilisation) and wipe down friendly body. There are many different models on the market but the choice of model is critical for Grade A/B cleanrooms.

Fig.1 Ascotec Active Air Sampler

Theory :

According to **ISO 14698-1 2003 Annex A.3.2** there are many factors to consider when choosing an Air Sampler. *"the sampling rate duration of sample and type of sampling device can strongly influence the viability of the micro-organisms that are collected. Because of the number and variety of microbial air sampling systems commercially available, the selection for a particular application should consider, as a minimum the following factors;*

(a) Type and size of viable particles to be sampled.

(b) Sensitivity of the viable particles to the sampling procedure.

(c) Expected concentration of viable particles.

(d) Ability to detect high or low levels of bio contamination.

(e) Appropriate culture media.

(f) Time and duration of sampling.

(g) Ambient conditions in the environment being sampled.

(h) Disturbance of unidirectional airflow by sampling apparatus.

(i) Sampler Properties such as;

1) Appropriate suction flow rate for low levels of viable airborne particles.

2) Appropriate impact/airflow velocity.

3) Collection accuracy and efficiency.

4) Ease of handling and operation.

5) Ease of cleaning and disinfection or sterilisation.

6) Possible intrinsic addition of viable particles to the bio contamination to be measured.

The exhaust air from the sampling apparatus should not contaminate the environment being sampled or be reaspirated by the sampling device

Annex A 3.4.2 Outlines the characteristics for the correct air sampling device to be selected. *"a) impact velocity of the air hitting the culture medium that is a compromise between*

1) being high enough to allow the entrapment of viable particles down to approximately 1 µm and,

2) being low enough to ensure viability of viable particles by avoiding mechanical damage or the break up

Kenelec Scientific

"What does Physical Efficiency mean ?"

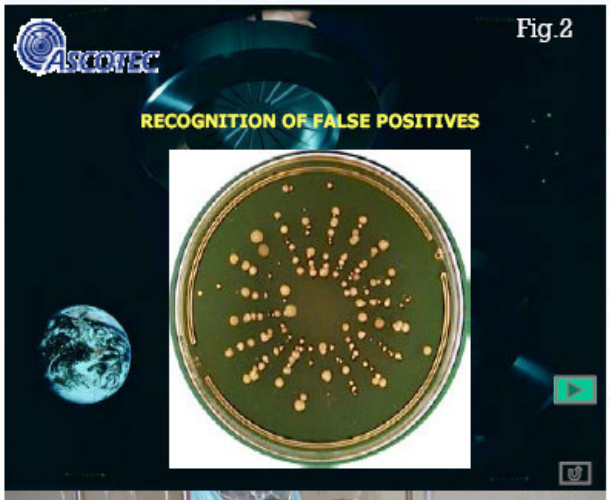

Fig.2


Minicapt PS1

Biological sampling in Isolation technology

Fig.3


Class B installation (EU-GMP/FDA Guideline)

Fig.4

Of clumps of bacteria or micromycetes.

b) Sampling volume that is a compromise between being large enough to detect very low levels of bio contamination and being small enough to avoid physical or chemical degradation of the collection medium.

In areas of high biocontamination,the impaction method and sampling volume should be selected in such a way appropriate to achieving separate colonies, to allow the results to be interpreted . The device should meet the following requirements;

1) *sufficient flow rate to collect 1m³ in a reasonable time, without significant drying of the sample medium.*

2) *Appropriate air impact speed to the culture medium."*

As we see from the above excerpts from ISO 14698-1 the choice of Air Sampler is very important. I would see physical efficiency and biological efficiency as very important factors.

What does physical and biological efficiency mean ?

Physical Efficiency is the ability of the Air Sampler to collect various sizes of particles. This efficiency is the same whether the particle is a micro-organism, carries a micro-organism or is an inanimate particle.

Biological Efficiency is the efficiency in collecting microbe-carrying particles. That will be lower than physical efficiency for a number of reasons, such as the survival of the micro-organisms during collection and the ability of the collection medium to support their growth.

Fig.2 Shows a sample which illustrates good physical and biological efficiency. We see that the colonies can be clearly defined and counted and by experienced design of the sample head the recognition of false positives can be easily determined.

As we see the collected micro-organisms are clearly impacted onto the culture medium as a mirror image of the sample head (see fig 5. where sample head is shown located beside a filling head in a class A environment)

With this design any micro-organisms outside this area are clearly not from the air sample taken and so the false negative can be eliminated. This would be critical in a Grade A Cleanroom where 1 CFU is the limit. Fig.3 and Fig.4 Show installation in Class A and Class B environments respectively.

"What is the Micro/Quality Manager's Goal ?'

Conclusion :

As we have seen the selection of an Air Sampler for microbiological monitoring is extremely important and a number of factors and considerations must be taken into account. To surmise from ISO 14698-1 2003 the;

Air Sampler must be *easy to disinfect or sterilise*. From experience we know that stainless steel is very clean-room friendly and stainless steel 316L can be thermally sterilised effectively.

The *ease of use* is also important and the user interface where critical information is also required such as flow rate, sampled volume and warning alarms (if there is a flow restriction or similar).

External Filtered exhaust is also a requirement as the sample could recontaminate if not externally filtered.

Physical and Biological efficiency is critical as we have shown that the ability to detect a range of different viable particle sizes and the ability not to render them non-viable by the impaction method is paramount.

Detection of *false negatives* is also important especially working in class A environments where the detection of 1 cfu per m^3 is of huge consequence its important that you can confidentially identify that it is a false negative.

Overall the microbiologist must look into the selection very carefully and ask himself or herself what is the purpose ? which should be ***"to protect the products from microbic contamination by means of routine control of cleanroom"*** and to promptly intervene in case of values outside of alarm conditions.

Therefore the goal is "***the evaluation of bacterial contamination associated with airborne particles."***

References:

ISO 14698-1/2/2003.

Ascotec : "How to ensure correct Microbial sampling in cleanroom" 2003, Enrico Bompadre.

Biological Report CAMR(Biosafety Investigation Unit) Allan Bennet/Peter Hammond 2000.

EU GMP Annex 1.

Fig.5

Remote Biocapt head installed close to the filling point (Pharma)

To achieve this goal we have put together the the ten fundamental characteristics to consider when selecting an active air sampler. Also the supplier must also be part of the equation with respect to after sales service/calibration and experience as they are your first point of contact if ever you need help or guidance.

TEN FUNDAMENTAL CHARACTERISTIC FOR A MICROBIOLOGICAL AIR SAMPLER

RELIABILITY OF DATA

REPRODUCIBILITY

HIGH EFFICIENCY PARTICLE COLLECTION

VALADATION OF DATA

ABSENCE OF INTRINSIC IMPURITIES

STERILIZABILITY

EASE OF OPERATION

LOW MANPOWER FOR SAMPLING

COMPLIANCE WITH INTERNATIONAL REGULATION

NO STRESS ON COLLECTED MICROBES

For further information on ISO 14698 contact jason@kenelec.com.au Training on Cleanroom Standards, Cleanroom Technology is available on-site and can be arranged at any time.

About the author; Jason Kelly a former Managing Director of Optical Sciences Ireland has been working in the Cleanroom Industry for the past 12 years. He has worked in the semiconductor Cleanroom industry with Intel before moving over to the Pharmaceutical Industry working as Service Manager with Sartorius before joining Optical Sciences several years ago. He has many years experience installing Facility Monitoring Systems and validation of FMS to the regulatory requirements of IMB, FDA, EC GMP & ISO. If you have any requirements for Environmental Monitoring or Consultancy on Cleanroom Technology or Standards he can be contacted at the above email address.