New Technologies Improve Detection of Airborne Biological Particles

The health effects of airborne particles have become the subject of increased scrutiny in recent years. However, initiatives to improve air quality are dependent on accurate and reliable monitoring methods for physical, chemical and biological particles. In this article, Romain Verollet, from Bertin Technologies in France, examines the traditional methods for bioaerosol monitoring and explains the advantages that are now available with a new 'wet walled cyclone' technology.

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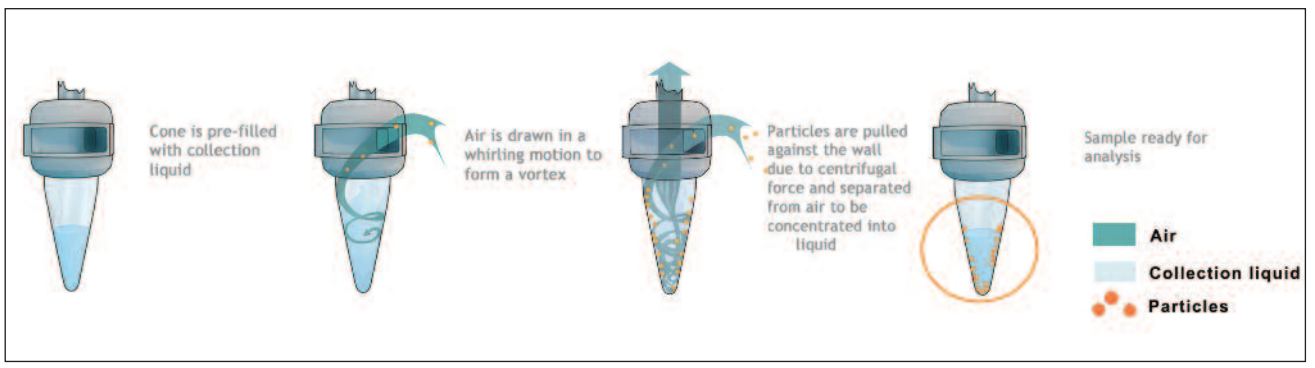
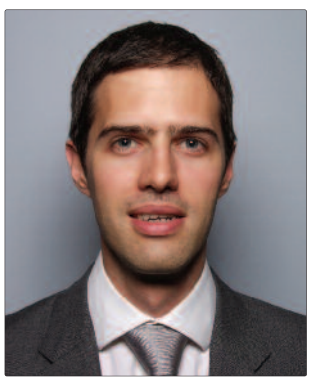


The Coriolis µ rapidly collects biological particles in liquid at a high flow rate with validated efficiency



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This improved method for sampling bioaerosols such as bacteria, pollen, endotoxins, viruses and fungal spores, has coincided with advances in microbiological analysis. In combination, these developments have reduced testing times and significantly lowered detection limits, which greatly expands the opportunities for understanding the biological quality of air in applications such as occupational exposure, hospital acquired infection, infectious diseases in animals and ambient pollution

New sampling technology

Traditional techniques rely on the impaction of particles on a solid agar medium, and are limited by low flow rates and unreliable impaction. They are also restricted to particles that can be cultivated. In contrast, the wet walled cyclonic instrument (Coriolis µ) rapidly collects biological particles in liquid at a high flow rate (300lpm) with validated efficiency and the liquid containing the particles is compatible with a number of rapid microbiological analysis methods. This includes PCR, which enables the quantification and qualification of most targets.

The Coriolis µ was developed for applications in which the performance of traditional techniques is insufficient. For example, air with a high bioaerosol burden would quickly saturate traditional solid media, whereas the Coriolis µ offers the possibility to divide the liquid into multiple agar plates. This technology also has advantages in air with a low burden, because the Coriolis µ can collect for an extended period (up to hours), which would not be possible with traditional methods due to desiccation of the agar plate.

Air quality instrumentation specialist Air Monitors Ltd, (www.airmonitors.co.uk, T. +44 (0) 1684 857530) is launching the Coriolis µ in the UK market. Their Managing Director Jim Mills says "This is an exciting development and I hope that it will become a standard method very quickly. In the meantime, I can see a wide variety of research and air quality investigation applications that would greatly benefit from this technology. For example, the UK suffers from regular outbreaks of Legionnaires' disease and I believe that the ability to sample Legionella bacteria in the air; when they are able to cause infection, would significantly improve detection and prevention work."

Outdoor environment

Coriolis µ sampling outdoors

Composting sites, wastewater treatment works and air-cooling towers all represent a significant potential hazard from airborne bioaerosols. However, the microbial diversity of bioaerosols released during the operation of these facilities is poorly understood.

Composting is growing in popularity as governments look to recycle waste materials, so the number of new composting sites looks set to continue. This has generated a greater requirement for bioaerosol monitoring to ensure that local inhabitants are not affected by new developments. In many countries, it is common practice to routinely monitor bioaerosols at composting sites, and work has been undertaken to identify potential microbial indicators [1].

Legionnaires' disease has been most commonly associated with hot and cold water systems in large buildings, such as hospitals and hotels, and infections are usually sporadic as opposed to outbreaks with large numbers of people affected. Historically outbreaks have been associated with wet evaporative condensers (cooling towers), but increased controls have reduced incidences. Nevertheless, traditional monitoring techniques have focused on water samples whereas Legionella bacteria are dispersed in aerosols and very little work has been undertaken to assess the levels of airborne infection.

Since Legionella are difficult to cultivate on classical agar dishes, they are not detectable with the traditional method of impaction. However, Legionella can be detected in air and quantified with chemiluminescence antibody microarrays within a short response time [2].

Medical applications

The Coriolis µ has also been employed in hospitals by hygienists with responsibility for bio-safety assessment in locations such as surgeries, recovery rooms and patient wards. If air purifiers are not available or during building rehabilitation work, Coriolis µ has been used to collect the global air burden in a short period of time and since hospital laboratories are equipped with the latest qPCR equipment and corresponding primers, rapid evaluation has enabled fast remedial action [3].

When the concentration of target particles is low, or when events occur unexpectedly, the Coriolis µ has an option to collect over a longer period - 1 hour or more. This solution is currently being evaluated in the bio-surveillance of virus Influenza A&B in hospital corridors and emergency rooms (qPCR Identification and Titration).

Veterinary applications

It is also necessary to determine the exact nature of the bioaerosols in animal housing. This will improve the understanding of worker exposure and related diseases, and the understanding of the transfer of diseases between animals. Research in the dairy sector has demonstrated the vast complexity of bioaerosol components which could play a role in occupational respiratory diseases [4] and further work is underway to assess the effects of biological air quality on animal breeding in a confined environment.

Conclusion

The complexity of airborne biological particles has been hidden by traditional microbiological techniques; however researchers, environmentalists and public health authorities are now looking to better understand biological contamination and these new developments in sampling and microbiological analysis are providing an insight that has not been viable in the past. As scientific knowledge in this area grows and early adopters demonstrate the advantages of the new technology, cyclonic collection in combination with the latest rapid microbiological analysis methods will soon become standard methodology.

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Coriolis µ sampling indoors

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