NBC Resilience Article:

The principles of biological detection using particle size and shape.

By Steve Evans, Key Account Manager, Biral UK.

Largely driven by renewed concerns over the use of biological weapons, work began in the late 1980s to look at how micro-organisms might be detected and analysed without the need to remove them from the atmosphere and thereby provide real time results.

The major challenge with real time biodetection is to distinguish harmful target particles against an enormous concentration of background particles. To make matters worse, a significant portion of the background, such as pollen, fungal spores and naturally occurring benign bacteria will have similar biological nature to the agent itself and is therefore difficult to discriminate.

The most common technique developed for characterising airborne particles is to count and size individual particles using light scattered by these particles when they pass through the focus of a light beam. The size of a particle may be inferred from the intensity of the light it scatters. This scattered light varies in intensity with the angle from which it is viewed, the size and shape of the particle as well as its optical properties. A spherical particle scatters light in all directions symmetrically, whereas a fibre particle scatters light in a perpendicular plane. This distinctive information on size and shape provides an important indicator of the type of particle present.

The fundamental principle of biodetectors employing size and shape techniques is to physically characterise the ambient aerosol in real time. The background “signature” is analysed in terms of particle concentration as a function of size and shape. Special algorithms identify systematic changes in this signature and thereby activate alarms or trigger signals. The power of the technique rests in the sensor’s ability to spot small but significant changes in a complex background. Furthermore many benign aerosols and interferents such as pollens, fuel oils and smoke have clearly different size and shape distributions from the threat and so can be discriminated and discounted.

A limitation of the technique is that it is non-specific, in other words it will not indicate if the aerosol is biological. Shape and size detectors cannot differentiate the arrival of a cloud of particle containing biological agent from a new source of innocuous material with a similar parameter set. Detection capability of this kind, i.e. the ability to discriminate bioaerosols from non-bio aerosols is termed “generic”.

The most common method of achieving generic detection is to measure the intrinsic fluorescence of the aerosolised particles. Detectors such as Biral’s VeroTect sensor, which combines fluorescence with the benefits provided by shape and size have a very powerful generic biodetection capability and represent the state of the art in real-time biodetection.

S.P. Evans
November 2005