

Biological particles in the atmosphere

18

A terrorist attack with biological agents or the spread of an animal disease like Q-fever – such threats can spread invisibly and inodorously through the air. Often they only become apparent when people become ill or die. Biosensors are able to detect these threats very early but in order to do so they have to quickly and reliably analyse small quantities of the respective micro-organisms. A special experiment is required to establish how well such biosensors perform. TNO in Rijswijk has one of the very few bioaerosol test chambers in Europe able to do this. Industry, government and end users can have their biosensors tested in this chamber for a variety of biological agents, including bacteria, spores and viruses.

How does the bioaerosol test chamber work?

A bioaerosol is generated in the test chamber under controlled and reproducible conditions. Outside air is blown into the test chamber through a HEPA (High Efficiency Particulate Air) filter to prevent other particles from entering. An atomiser then sprays a solution containing the biological test agent in fine particles and by using a variety of atomisers, it is possible to produce bioaerosols with a particle distribution of 1-10 µm. In the test chamber itself the air is mixed well with the atomised droplets to ensure that the bioaerosol is spread as evenly as possible. The biosensor to be tested is connected to the underside of the bioaerosol test chamber, where several biosensors can be tested at the same time.

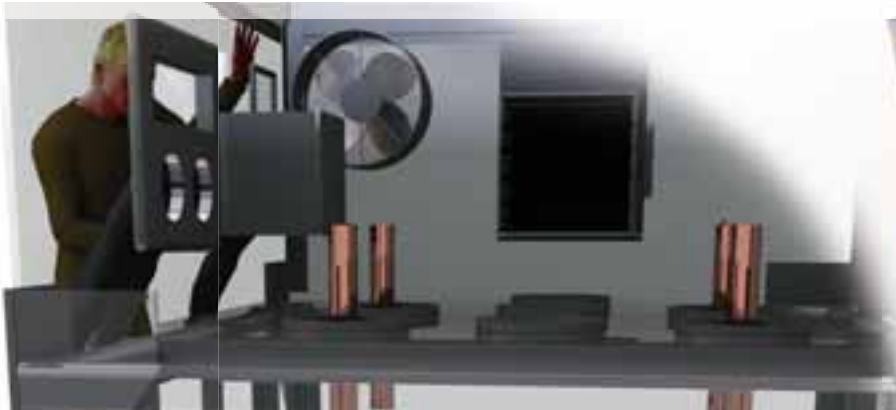
What is tested?

The primary application of the bioaerosol test chamber is to test biosensors; during the development as well as in the acquisition phase of defence and public safety applications. A special defence application is to substantiate the perception of a threat of biological attack by performing measurements on the stability of bioaerosols and the effectiveness of commercial atomisers. The test chamber can also be used to test sampling equipment or filters as well as test the effectiveness of air decontamination by ozone, UV or plasma for example.

The air enters the bioaerosol test chamber via an air-conditioning system and a HEPA filter.

Access door with window and feed-through gloves.

The biological agent to be measured is placed in the bioaerosol test chamber via the air lock.




Military biosensor

TNO has tested the performance of the BiosparQ biosensor in the bioaerosol test chamber for the Netherlands Ministry of Defence. The BiosparQ is a new biosensor developed by TNO that can quickly and sensitively reveal a broad spectrum of bioaerosols in the air using mass spectroscopy. The test showed that the BiosparQ is able to successfully detect low concentrations of diverse biological agents and thus contribute to the safety of military personnel. In addition to bioaerosols, diesel exhaust gases and particulate matter were used in the test chamber to get as close as possible to the real-life situation.

Cold plasma technology

For the Groot Salland Water Board TNO has tested the performance of an air treatment installation that uses cold plasma technology. This system is part of an experiment for a sewage water purification installation for a hospital whereby medicinal residues must be removed from the waste water. Given the location of this experiment, public health demands for extra requirements on the decontamination of the air emissions. The test results provided insight into the extent to which the installation was able to adequately decontaminate the air emissions.





Ventilators ensure an even distribution of the bioaerosol in the chamber. The air flow in the chamber can be varied from 0 to 11,750 litres per minute.

The outgoing air exits through a HEPA-filter to prevent bioaerosols getting into the outside air. In the chamber there is an underpressure of ca. 50 Pa, comparable with the requirements for a 'biocontainment' laboratory. The chamber itself can be decontaminated using UV lamps.

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Bioaerosols

Aerosols are tiny solid or liquid particles in a gas. Clouds and mist are examples of aerosols comprised of very tiny water droplets. Smoke is an example of an aerosol comprising solid particles. A bioaerosol is a solid or liquid particle containing biological material like bacteria, mould, viruses or a protein. Only so-called biosimulants are used in the bioaerosol test chamber. These micro-organisms are harmless to humans, animals and the environment and their characteristics are representative for the real biological threats. Frequently used biosimulants are spores of the *Bacillus globigii* (simulant for anthrax) and other bacteria like *Erwinia herbicola* or *Escherichia coli* (simulant for pestilence), viruses like MS2 or Baculovirus (simulant for smallpox) and proteins like ovalbumin. As a benefit no special licence or safety measures are required for the usage of these biosimulants.

How do we measure the quantity of bioaerosols?

The required concentration of bioaerosols is constantly measured by special measuring equipment. This ensures regulated and verified test conditions. The bioaerosol concentration is expressed in Agent Containing Particles per Litre of Air (ACPLA): the quantity of living particles that a litre of air contains. It differs from to the normal microbiological units because one aerosol particle may contain several micro-organisms.

Measuring equipment for bioaerosol concentration.