Mathematical model for the prediction of airborne microbial contamination in closed environments

Ref-Nr:

Technology abstract

The BIOSMHARS (BIOcontamination Specific Modelling in HAbitats Related to Space) project was a joint collaboration between Europe and Russia and was co-financed by the European Commission. MEDES, the French Institute of Space Medicine and Physiology was in charge of the coordination of the project. The model developed could be used on Earth, for instance in hospitals for the prevention of nosocomial infections, and to prevent biocontamination in public buildings and transportations.

- Private group -

- Nicolas Louée -

Technology Description

During the period 2011-2013, BIOSMHARS aimed at developing, calibrating and validating a mathematical model to predict the transportation of bio-aerosols in a closed environment and the concurrent spread of biocontamination. The objective was to predict airborne microbial contaminant dispersion and concentration distribution in a spacecraft. The resulting 3D CFD model provides reliable prediction for dispersion of airborne biocontamination.

Besides its use in spacecrafts, this model could have applications in hospitals for the prevention of nosocomial infections. It could also prevent biocontamination in public buildings and public transportations. Applications in the pharmaceutical and food industries are also possible. Finally, it can also help devising strategies against biocontamination related to biological terrorist attacks.

Innovations & Advantages

The development of a reliable mathematical model to predict bio-aerosol particle dispersion and deposition in closed space habitats significantly improves the microbial biocontamination management.

Such a model can be used to pinpoint critical locations in a certain habitat design or operation and develop adequate prevention and monitoring procedures.

In the BIOSMHARS project a CFD model was developed to describe and predict the airborne microbial contamination in confined space habitats, taking in to account the

specific characteristics of ventilation in such habitats.

Further Information

This video presents some of the results obtained with the developed model:
https://www.youtube.com/watch?v=jhI47lBVlec

Current and Potential Domains of Application

The current domain of application is the prediction of biocontamination in spacecrafts.
Terrestrial applications include:

- prevention of nosocomial infections hospitals
- prevention of biocontamination in public buildings and transportations
- contribution to strategies against biocontamination related to biological terrorist attacks
- prevention of contamination in the pharmaceutical industry
- prevention of contamination in the food industry

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Microbial risks in manned spaceflight

SPACE MICROBIOME

Health → Technical

Health:
- Dysbiosis
- Autoinfection
- Cross-infection
- Hypersensitivity
- Deterioration water and food quality

Technical:
- Biodegradation
- Biocorrossion

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U Magnitude
1.83
1.6
1.2
0.8
0.4
0