Respiratory viruses' behaviours on filters of air handling units

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One of the most important topics that occupy public health problems of our century is air quality (Fenger, 1999). Air is a vector transporting microorganisms from outdoors to indoors. In the indoor air, we can distinguish among the existing aerosols, the bioaerosol such as bacteria, viruses and fungi (Gonzalez, 2014). Respiratory viral infections are a major public health issue because they are usually highly infective. Most of them are easily transmitted by direct contact, droplet or by aerosolization (Morawska, 2006). As we spend about 90% of our time in closed environments, indoor air contamination by chemicals and bioaerosols is one of the main public health problems of our century. Ventilation systems and air handling units allow the spread and transport of viral particles inside buildings (Fabian et al., 2008).

The aim of this work is to understand the behavior and the persistence of respiratory viruses on filters used in air handling units (AHU). Moreover to recover energy in many offices building, up to 20 % of the indoor air flow could be recycled.

As a model of RNA respiratory virus, Mengovirus is aerosolized in a vertical column with outputs equipped with a fiberglass filter F7 (EN 779-2002). Viral particles passing through the filter are collected by Biosampler (SKB). The detection of virus particles and the study of viability on the filters are made by qPCR and $TCID_{50}$ respectively. (Figure1)

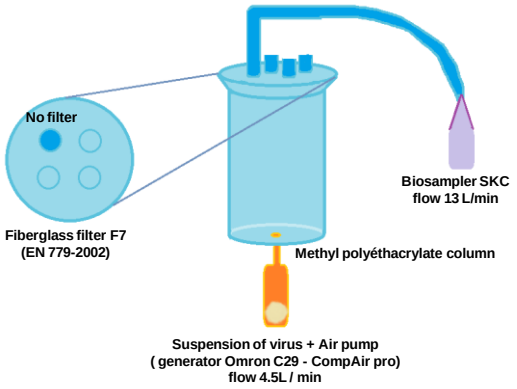

Figure 1. Experimental pilot to study viral aerosol loss

The experimental set up and protocols was validated by the Fluorescein (CAS number: 518-47-8, Merck KGaA). In the system, up to 0.7896 mg of fluorescein was collected from an initial input of 0.7966 mg leading to a set-up efficiency of 98.72%.

Preliminary results on mengovirus aerosolization experiments showed that most of the virus is present in the set-up. To an initial input of 5.45E+07 mengovirus PFU, 4.78E+07 mengovirus PFU were recovered in the system leading to a set-up efficiency of 87.7%. (Table 1)

	Mengovirus (PFU)
No recovered Mengo Total Mengo recovered (Filter+Biosampler)	4.78E+07 3.68E+04
Total Mengo in the system Mengo initially aerosolized	4.78E+07 5.45E+07
Set-Up efficiency	87.7 %

Table 1. Average of the Mengovirus Plaque forming unit (PFU) recovered in 2 experiments

Preliminary results on infectious mengovirus show that 2.18E+04 infectious mengovirus PFU pass through the filter and 2.52E+03 infectious mengovirus PFU are recovered on filter.

This information has to be taking account as some AHU recycles air. In epidemic period of respiratory virus this recycling has to be avoid to protect people health. Information validates the efficiency of the experimental set up and protocols by aerosolized Mengovirus.

The experimental set up and the investigation of the virus on F7 filter in the air handling units are in progress.

Fabian, P. and al. , 2008. Influenza Virus in Human Exhaled Breath: An Observational Study. Plos One 3, e2691. doi:10.1371/journal.pone.0002691

Fenger, J., 1999. Urban air quality. Atmos. Environ. 33, 4877–4900. doi:10.1016/S1352-2310(99)00290-3

Morawska, L., 2006. Droplet fate in indoor environments, or can we prevent the spread of infection? Indoor Air 16, 335–347. doi:10.1111/j.1600-0668.2006.00432.x

Swan, J.R.M., 2003. Occupational and environmental exposure to bioaerosols from composts and potential health effects A critical review of published data : final report [WWWDocument].

Tang, J.W. and al., 2006. Factors involved in the aerosol transmission of infection and control of ventilation in healthcare premises. J. Hosp. Infect. 64, 100–114. doi:10.1016/j.jhin.2006.05.022