Innovative air filtration strategies at the exhaust fans of a quarantine building

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Introduction

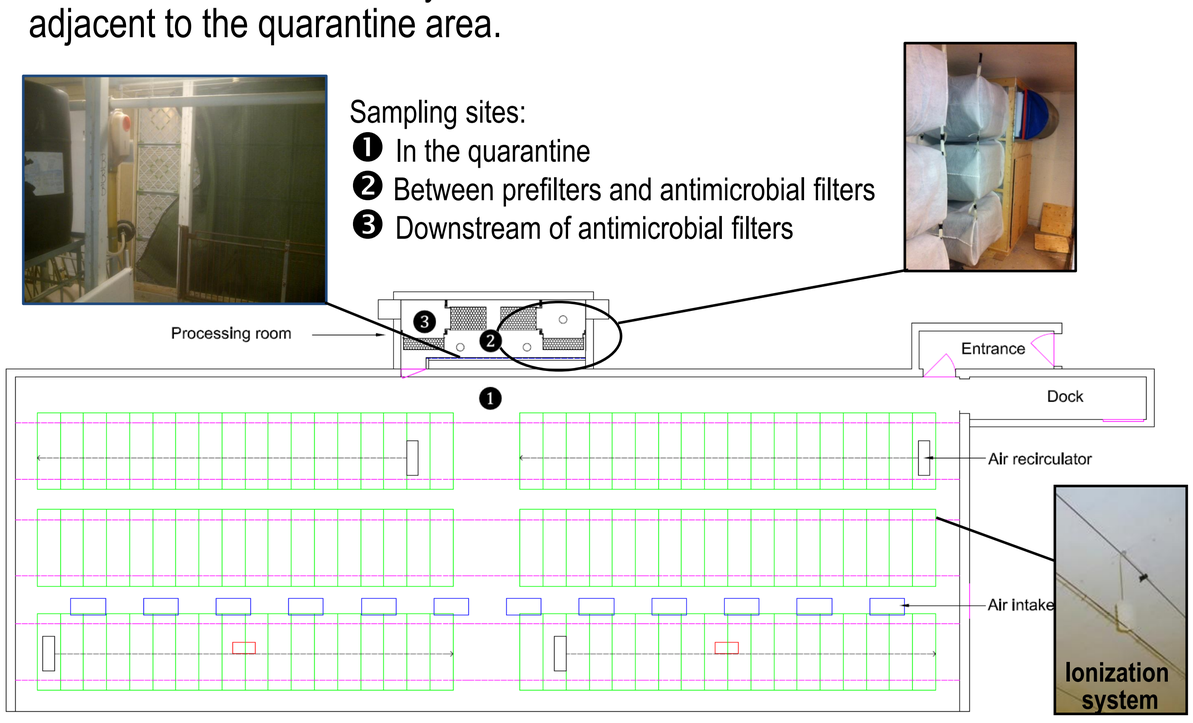
- Gilt quarantine is a biosecurity measure that reduces the risk of introducing pathogens (e.g. PRRSV) into production sites.
- It is a costly measure if built far away from production sites.
- However, located on production sites, gilt quarantines constitute a contamination hazard even if biosecurity measures are reinforced as airborne transmission is possible for PRRSV, Influenza, and other viruses.
- There is a solution:
  - Biocontainment of quarantine buildings by filtration strategies at the exhaust fans.

Objectives

- To evaluate an innovative biocontainment system adapted to a quarantine building to reduce the risk of airborne virus spread.
- To evaluate technologies for reducing the clogging rate of prefilters and antimicrobial filters installed at the exhaust fans: **combination of prefilters and filters** and an **ionization system.**

Material and methods

- A 108-gilt quarantine attached to the existing farrowing barn;
- Air inlets were equipped with antimicrobial filters made up of 15 layers of filtering membranes;
- Fans and the air filtration system at the exhaust vent were located in a room adjacent to the quarantine area.



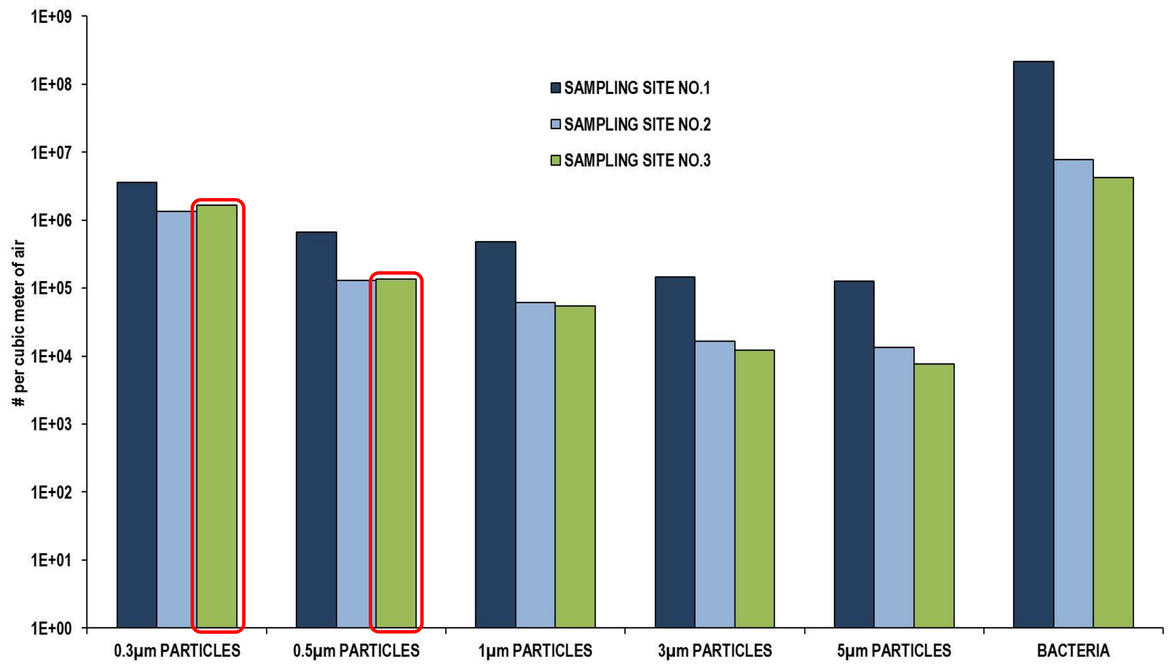
- The air filtration system included a **MERV13 prefilter combined with a polypropylene geotextile** and **antimicrobial filters made up of 10 layers of filtering membranes** with prefilters.
- An **ionization dust abatement system** (Electrostatic Particulate Ionization, Baumgartner Environics Inc.) was installed in the quarantine.
- **Two 25-day batches** in an all-in, all-out configuration:
  - A MERV13 prefilter **with an ionization system;**
  - A MERV13 prefilter **without an ionization system.**
- Static pressure was taken every 10 minutes via 8 pressure transducers (PXU, Veris Industries Inc.) to evaluate the **clogging rate of prefilters and antimicrobial filters** installed at the exhaust fans.
- Airborne particles, total dust and bacteria were sampled once a week on **3 sampling sites.**
- **On each sampling site:**

An 8-hour sampling at 2 L/min (GilAir-5 pumps, Gilian)
Total dust (SKC, 0.8 µm PVC filter) ⟶ gravimetric analysis
Total bacteria (SKC, 0.8 µm PC filter) ⟶ PCR quantification

A 5-minute reading at 28 L/min
0.3, 0.5, 1, 3, and 5 µm MMAD **particle counting**
(particle counter model 3315, Met One)

Results and discussion

- Experiments took place during the **autumn.**
- The presence of the **ionization system** allowed for an average reduction of 43 to 60% in the concentration of particles of different sizes, 83% in bacteria, and 64% in total dust mass concentrations.
- The **combination of the MERV13 prefilter and the antimicrobial filter** ensured the capture of 54 to 94% of dust particles depending on their sizes and 96 to 98% of bacteria.



- Such combination allowed reducing total dust mass concentration by 62 to 91%.
- There was, however, a **re-emission of 0.3 and 0.5 µm particles** from the antimicrobial filter on batches 1 and 2. A release of 1, 3, and 5 µm particles was also observed on batch 1 (data not shown).
- The differential pressure at the antimicrobial filters did not increase with time depending on a given airflow rate, which means that the MERV13 prefilters as well as antimicrobial filters did not clog during the two 25-days trials.

Conclusion

- Airborne dust, bacteria and particles were efficiently reduced by:
  - An ionisation system;
  - A combination of a MERV13 prefilter and antimicrobial filters at the exhaust fan of a quarantine.
- It is possible to filter the air at the exhaust fans of a building without causing major clogging problems in the air filtration system.
- The biocontainment system tested does not generate large savings as regards installation costs in comparison with a quarantine facility built very close to the farrowing barn (less than 500 m), except if the air coming out of quarantine facilities built in close proximity to the farrowing barns must also be filtered.
- Our filtration strategies need to be validated for:
  - The warm season;
  - For the capture efficiency of PRRSV.

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