Novel Biocontainment Concept for Quarantine Facilities

Canadian Swine Health Board / Conseil canadien de la santé porcine

Valérie Dufour, M. Sc.,
Project Manager, Centre de développement du porc du Québec inc. (CDPQ)
Christopher Robitaille, Jr. Eng.,
R. Robitaille et Fils

The quarantine facility plays an important role to preserve a good health status in a farrowing barn. However, this swine building is often located within 100 meters of the breeding facility. Scientific studies have shown that the PRRS virus (PRRSv) can be transmitted through the air over 9.2 km. Having the quarantine building in the vicinity of the farrowing barn thus represents a high contamination risk if the animals in it happen to be PRRS-positive. In such a case, it becomes important to contain the viruses inside the quarantine building in order to protect the neighboring sow herd. Since it has already been shown that filters located at the air inlet are efficient to prevent PRRSv spread, then why not use them at the exhaust fan? The main issue in this design idea is obviously the high dust concentration in the swine building that would cause the filters to clog up rapidly, thus making their maintenance complicated and costly. In an effort to solve this problem, CDPQ, R. Robitaille et Fils and the Institut universitaire de cardiologie et de pneumologie de Québec (IUCPQ) Research Centre tested a novel biocontainment concept in a quarantine facility attached to a farrowing barn.

This simple concept consists of filtering the air at both the air inlet and the exhaust fans to contain the contaminated air while using an ionization system in order to reduce the dust concentration inside the building and thus the clogging rate of the filters. More precisely, the biocontainment system contains:

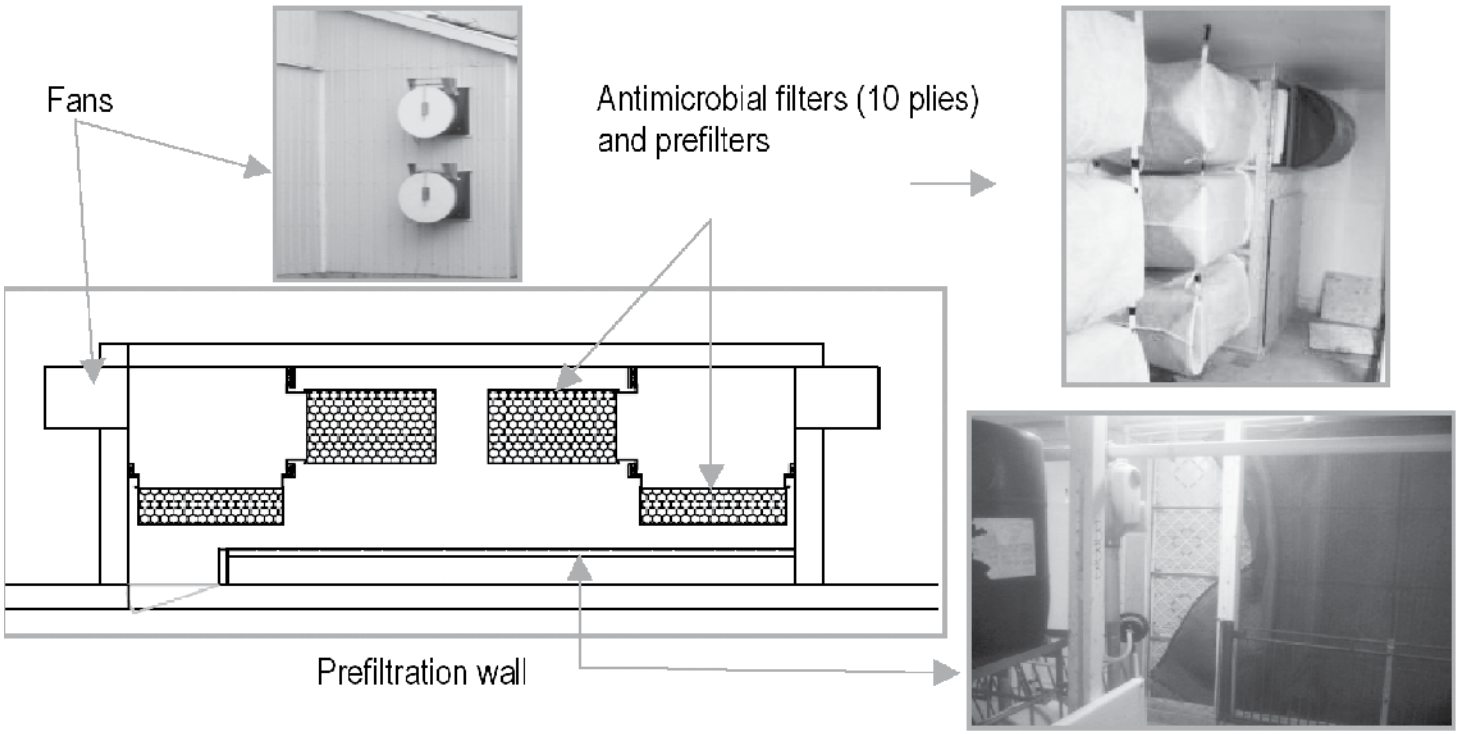
1. An ionization system consisting of:
   a) An electronic control generating a high voltage that ionizes the air through discharge lines and stainless steel spikes, thus producing negative ions (EPI Air®, Baumgartner Environics, MN, USA). The ionization process induces an electric charge on the dust particles and the grounded surroundings (walls, ceiling and equipment) behave as magnets that attract those particles. (See photo)

2. An air filtration system located in an air treatment room at the air exhaust consisting of:
   a) A prefiltration wall made with MERV 13 prefilters (Clarcor, IN, USA) at the air treatment room inlet that intercepts the majority of the particles remaining after the ionization process. This allows keeping the downstream antimicrobial filters clean for as long as possible, thus maximizing the efficiency of the antimicrobial agents within the filter fibres;
   b) Two filtration boxes provided with antimicrobial filters (Noveko, QC, Canada) made up of 10 plies of antimicrobial membrane along with their prefilter to mechanically block and chemically kill the viruses that may exit through the fans;

3. An air filtration system in the attic spaces consisting of:
   a) An antimicrobial filter made up of 15 plies of membrane and a prefilter (Noveko, QC, Canada) installed at each air inlet to avoid contaminated air backdraft to the environment that may contaminate the adjacent sow herd.

> "The potential economic impact of a PRRS outbreak to producers is estimated at $35-$140 per sow."

By itself, the ionization system was able to to significantly reduce the dust concentration (64%) and the total bacteria concentration (83%) in the building. The airborne particle reduction (sizes varying from 0.3 to 10 µm) due to the system is 60% on average and varies from 54 to 97% according to the size. The smallest reduction is for the 0.3 µm particles, those that are the most difficult to capture by filtration. It was found that these reductions remove the need for filter and prefilter maintenance and that the only necessary maintenance was in between the batches of gilts.



Installation and layout of antimicrobial and prefilters.

Therefore, the clogging rate of the filters with this concept is satisfactory. The necessary cleaning frequency during summer is currently not known but a tight monitoring of static pressures with a manometer will definitely be needed.

Globally, the implementation of this novel concept results in net savings of approximately $3,000 compared to a quarantine facility located 100 meters from the farrowing unit. Other savings could potentially be added to it (animal transportation, working time, etc.). However, whether the producer invests in this concept or not should primarily be driven by the PRRSv contamination risk that the gilts represent to the sow herd. The insertion of a health problem due to PRRS in a sow herd can lead to very important revenue losses ($35 to $140 per sow) (Klopfenstein et al., 2013). Moreover, the necessity to filter the air at the outlet of the quarantine facility, typically located within 100 meters of the farrowing barn, should be further analyzed with regards to PRRS airborne transmission. Such filtration necessity would economically support the need to build the quarantine facility and the farrowing barn in the same building.

This biocontainment concept met all expectations in terms of clogging rate during fall but further tests should be conducted during summer to assess whether or not the prefilters should be replaced during the quarantine cycle due to the higher airflow rates. It would also be interesting to test other prefilter alternatives in order to ensure we have the best possible combination in terms of efficiency and cost and to determine the necessary filtration level to avoid contamination of the adjacent sow herd. In this project, the MERV 13 prefilters were systematically changed at the end of each batch but it would be interesting to test them over more than one batch. Ways to divert the airflow away from the filtration system following the confirmation of the good health status should be developed to avoid the early clogging of the filters when they are not required.

Since this was a pilot project and that each individual situation may differ, it is important to consult both your veterinarian and your engineer specialized in ventilation and filtration before going forward with this type of building.

Acknowledgements

Partners who contributed to five different air filtration projects financially supported this project. The sector councils of Quebec, Ontario, Alberta, Manitoba and Saskatchewan, who administer the Canadian Agricultural Adaptation Program (CAAP) for Agriculture and Agri-Food Canada, provided a portion of project funding. This study was also funded by the Ministére de l'Agriculture, des Pêcheriés et de l'Alimentation du Québec (MAPAQ) under part 3 of the Programme d'appui financier pour un secteur agroalimentaire innovateur (Innovative Agri-Food Sector Support Program), Canadian Swine Health Board (CSHB), R. Robitaille et fils, Fédération des producteurs de porcs du Québec (FPPQ, Quebec Federation of Pork Producers), Ontario Pork, Manitoba Pork, Sask Pork, Alberta Pork, Institut universitaire de cardiologie et de pneumologie de Québec Research Centre affiliated to Université Laval, JSR Genetics, Prairie Swine Centre (PSCI) and Centre de développement du porc du Québec inc. (CDPQ, Quebec Centre for Pork Development).