Improving ventilation efficiency in dairy cattle buildings using computational fluid dynamic tools

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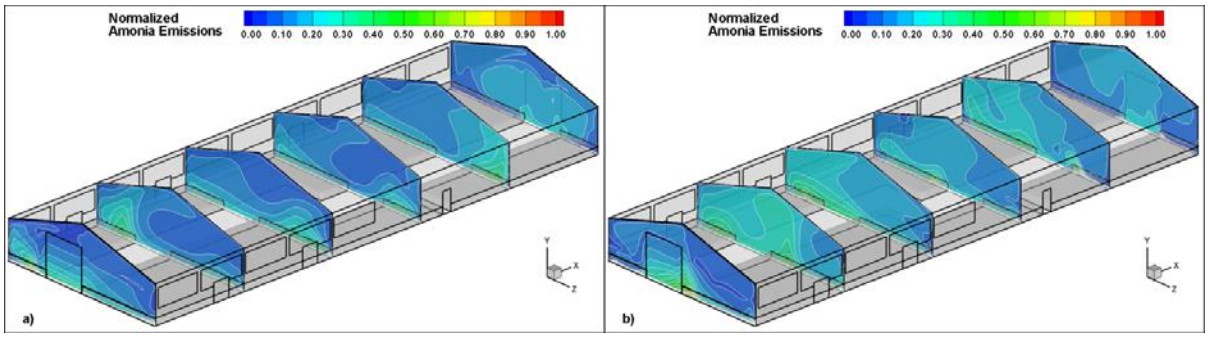
Livestock production is significantly influenced by animal health and comfort. The internal microclimate in livestock buildings can be controlled either passively by natural ventilation building systems wherein appropriate construction geometry and materials (i.e. insulation panels) are designed prior to construction or actively by the ventilation system and electromechanical equipment operation during building operation. Ventilation of animal housing to remove moisture and odors and replacing them with fresh air is necessary for livestock productivity. Ventilation also provides air movement that promotes cooling and improves air quality for confined animals. While good ventilation contributes to profitability, if not properly designed, the energy used by a cooling and ventilation system can significantly reduce those profits. Therefore an efficient ventilation system is crucial for an efficient livestock production. The majority of large dairy cattle livestock buildings using natural ventilation systems for air renewal. Experimentally it is very difficult to analyse airflow and associated microclimate patters and air pollution in large ventilated buildings but it can be assessed using modelling techniques such computational fluid dynamics (CFD). Numerical techniques, like Computational Fluid Dynamic (CFD) can render efficiently and accurately the quantification of the variables compound the microclimate inside livestock buildings. Additionally, parametric investigation can be conducted studying the impact of the external wind speed and direction on the distributions of air flow, temperature and ammonia in specific points inside the building. Furthermore, these techniques are widely used in residential buildings studies in order to relate the internal flow pattern with the effectiveness of ventilation system. In this paper the use of computational fluid dynamics tools for analysing the ventilation effectiveness of large dairy cattle livestock buildings was presented, analysed and discussed. Results include ventilation effectiveness, microclimate patterns and ammonia emissions of various designs of dairy care buildings, from author's ongoing research and selected literature work.



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