

COMPARISON BETWEEN STRUCTURED AND UNSTRUCTURED MESH GENERATION METHODS ON THE STUDY OF NEGATIVE PRESSURE VENTILATION SYSTEMS IN SWINE FACILITIES

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Abstract

The data for configuring the boundary conditions were collected at a commercial swine facility located in the municipality of Indaiatuba. Dry bulb temperature, air velocity and thermal image were used to determine the boundary conditions. Structured mesh presents values closer to the collected ones in comparison with the unstructured mesh. In case the user choose the unstructured generation method, it is necessary a detailed study, testing various mesh sizes and refinements

Key words: CFD, Mesh Study, Pigs

Introduction

Structured meshes discretize the domain in elements with implicit connectivity, this means that only with the node coordinates of the domains all the existing connectivity relations are obtained, speeding up the solution process (Batista, 2005; Maliska, 2004). On the other hand, internal nodes of the unstructured meshes have variable number of adjacent elements (Morais, 2004), not belonging to any construction law, where the control volumes are not aligned with a determinant coordinate system. The aim of this study was to verify by illustrations air velocity distribution in structured and unstructured meshes

Results and Discussion

The present study was carried out at the CFD laboratory of the Faculty of Chemistry Engineering of the State University of Campinas. The data for configuring the boundary conditions were collected at a commercial swine.

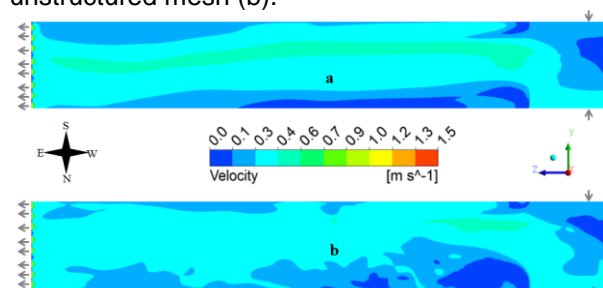
Temperature (DBT, °C) and air velocity (Var) data were collected. To measure the superficial temperatures of the walls, floor and ceiling a thermal camera was utilized. These data were used to determine the boundary conditions.

The software package ICEM ANSYS® 14.0 was used to create the meshes. After the development of meshes, the software ANSYS CFX® was used to simulate the model and visualize the pre-processed data. With the intentions of comparing the meshes, maps of air velocity (Figures 1) distribution were created.

Table 1. Mean values of temperature for evaluating the mesh structure type.

| Compared variables | Collected x Structured | Collected x Unstructured |
|--------------------|------------------------|--------------------------|
| Collected | 28,7215 a | 28,7215 a |
| Structured | 28,24 a | -- |
| Unstructured | -- | 27,8 a |
| Probability | 0,9289 | 0,1634 |
| VC (%) | 4,82 | 4,61 |
| P > 0,05 | | |

Figure 1. Difference of air velocity profile between the simulations with structured mesh (a) and unstructured mesh (b).



We verified that there was no difference ($P > 0,05$) between the mesh types in relation to data collected in the field, therefore both meshes can be used and the simulations are considered valid. However, the structured mesh ($P = 0,9289$) presents values closer to the collected ones in comparison with the unstructured mesh ($P = 0,1634$). Facing the data showed above, attesting that structured meshes have a better quality in relation to the unstructured mesh, it's possible to say that the airflow profile showed to be more uniform on the simulation with a structured mesh.

Conclusions

In case the user choose the unstructured generation method, it is necessary a detailed study, testing various mesh sizes and refinements.

Acknowledgement

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¹ Batista, V. H. (2005). Geração de Malhas Não-Estruturadas Tetraédricas Utilizando um Método de Avanço de Fronteira. *Master's Thesis*.

² Maliska, C. R. (2004). *Transferência de Calor e Mecânica dos Fluidos Computacional*. Rio de Janeiro, RJ: LTC Editora.

³ Morais, E. L. (2004). Verificação de Soluções Numéricas de escoamentos Laminares Obtidas com o Método dos Volumes Finitos e Malhas Não-Estruturadas. *Master's Thesis*. Curitiba, Paraná, Brasil. .