Evaluation of indoor thermal comfort in rooms with desiccant air conditioning system using OpenFOAM®

Kazuhisa YAMAMOTO *,‡1, Masashi IMANO1, Hidekazu TANAKA1
Akira KOMATSU2, Sumio SHIOCHI2, Yuzo SAKAMOTO1

1 The University of Tokyo
2 DAIKIN Industries, LTD.

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Control of humidity plays an important role in keeping comfortable indoor thermal environment. However, it is difficult for conventional packaged air conditioner to regulate the temperature and humidity separately. As the solution to such a problem, desiccant air conditioning system has lately attracted considerable attention. In this study, field measurement and CFD analysis of temperature and humidity in a test room with multi-split type and desiccant air conditioning system were conducted in summer. In addition, we developed utilities for OpenFOAM® which calculate PMV (Predicted Mean Vote) and SET* (Standard Effective Temperature) to evaluate thermal comfort quantitatively. These customized solver and utilities and example case files have been contributed to an wiki site for OpenFOAM® [1].

As a result of comparing measurement result and CFD result in a test room, we found that these generally match each other for both temperature and relative humidity. Using the customized utilities, we calculated distribution of PMV and SET* in the test room.

After the test room experiment, we conducted a survey of actual living space (a room for graduate students in The University of Tokyo) and compared the result with the simulation. In addition to that, predicted thermal comfort indexes such as PMV and SET* using OpenFOAM® were compared with those calculated from the result of the field measurement.

REFERENCES
[1] Unofficial OpenFOAM wiki  http://openfoamwiki.net/

‡ Corresponding Author: Kazuhisa Yamamoto (yamamoto@env.arch.t.u-tokyo.ac.jp)
Kazuhisa YAMAMOTO, Masashi IMANO, Hidekazu TANAKA, Akira KOMATSU, Sumio SHIOCHI, Yuzo SAKAMOTO

Figure 1: Test room plan

Figure 2: Comparison of measurement result and CFD result (left: temperature, right: relative humidity, FL+1.1m)

Figure 3: Result of PMV[-] simulation (section A-B of figure 1)

Figure 4: Result of SET[^°C] simulation (section A-B of figure 1)