World Academy of Science, Engineering and Technology
International Journal of Civil and Environmental Engineering
Vol:14, No:08, 2020

# Computational Fluid Dynamics Based Analysis of Heat Exchanging Performance of Rotary Thermal Wheels

**Authors :** H. M. D. Prabhashana Herath, M. D. Anuradha Wickramasinghe, A. M. C. Kalpani Polgolla, R. A. C. Prasad Ranasinghe, M. Anusha Wijewardane

**Abstract :** The demand for thermal comfort in buildings in hot and humid climates increases progressively. In general, buildings in hot and humid climates spend more than 60% of the total energy cost for the functionality of the air conditioning (AC) system. Hence, it is required to install energy efficient AC systems or integrate energy recovery systems for both new and/or existing AC systems whenever possible, to reduce the energy consumption by the AC system. Integrate a Rotary Thermal Wheel as the energy recovery device of an existing AC system has shown very promising with attractive payback periods of less than 5 years. A rotary thermal wheel can be located in the Air Handling Unit (AHU) of a central AC system to recover the energy available in the return air stream. During this study, a sensitivity analysis was performed using a CFD (Computational Fluid Dynamics) software to determine the optimum design parameters (i.e., rotary speed and parameters of the matrix profile) of a rotary thermal wheel for hot and humid climates. The simulations were performed for a sinusoidal matrix geometry. Variation of sinusoidal matrix parameters, i.e., span length and height, were also analyzed to understand the heat exchanging performance and the induced pressure drop due to the air flow. The results show that the heat exchanging performance increases when increasing the wheel rpm. However, the performance increment rate decreases when increasing the rpm. As a result, it is more advisable to operate the wheel at 10-20 rpm. For the geometry, it was found that the sinusoidal geometries with lesser spans and higher heights have higher heat exchanging capabilities. Considering the sinusoidal profiles analyzed during the study, the geometry with 4mm height and 3mm width shows better performance than the other combinations.

**Keywords :** air conditioning, computational fluid dynamics, CFD, energy recovery, heat exchangers
**Conference Title :** ICEEBP 2020 : International Conference on Energy Efficiency and Building Physics
**Conference Location :** London, United Kingdom
**Conference Dates :** August 20-21, 2020