Proceedings of the 9th World Congress on Mechanical, Chemical, and Material Engineering (MCM'23)
Brunel University, London, United Kingdom –August 06-08, 2023
Paper No. HTFF 176
DOI: 10.11159/htff23.176

Performance Investigation of Axial-flow Fan with Exhaust-side Eccentric Blockage Disk

Yuki Matsuo[1], Chihiro Sugiyama[1], Ibuki Matsumura[1], Koichi Nishibe[1], Kotaro Sato[2]
[1] Graduate School of Integrative Science and Engineering, Tokyo City University
1-28-1 Tamazutsumi Setagaya-ku, Tokyo 158-8557, Japan
g2281060@tcu.ac.jp; g2281035@tcu.ac.jp; g2281061@tcu.ac.jp; knishibe@tcu.ac.jp
[2] Department of Mechanical System Engineering, Kogakuin University
1-24-2 Nishi-Shinjuku, Shinjuku-ku, Tokyo 163-8677, Japan
at12164@ns.kogakuin.ac.jp

Extended Abstract

Axial-flow fans, which have a simple structure, are suitable for the cooling of heating elements, such as the electronic components inside personal computers (PCs), owing to their high flow rate and low differential pressure performance. However, under normal operating environments, the performance and efficiency of fans are degraded because their intake or exhaust side is surrounded by numerous components (obstacles) inside a PC. Several studies have been conducted to elucidate the influence of different obstacle geometries and their positions on fan performance to mitigate adverse effects. Kang et al. [1] reported that the performance and efficiency of a fan with a circular obstacle on the intake side decreased when the distance between the obstacle and the fan intake was less than a specific distance. In addition, experimental and Computational Fluid Dynamics (CFD) results revealed that when the distance was extremely narrow, a flow instability with a pair of high-pressure and low-pressure regions that propagate in the circumferential direction was generated in the distance. An experimental study of the relationship between the eccentricity of the installation position of the intake-side obstacle and the fan performance has also been conducted [2]. On the other hand, when obstacles are installed on the exhaust side, the fan performance at a specific distance between the obstacle and the fan is higher compared to the case without the obstacle [3]. However, the available results are limited and a more systematic investigation is needed to elucidate the mechanism of the improvement in fan performance.

This study investigates the influence of the position of a circular exhaust-side blockage disk on the fan performance when its rotation axis of the fan and the centre position of the obstacle are eccentric. Moreover, the relationship between the flow field and performance by comparing the results obtained from both experimental and CFD analysis, with reference to previous studies. It was confirmed that changes in the performance occur due to the eccentricity of the obstacle placed on the exhaust side to the axial-flow fan. Comparing the results obtained with and without eccentricity using CFD, differences in the flow and pressure fields were observed, which also led to differences in the results of the performance curve (P-Q curve). The optimal distance between the fan and the blockage disk depended on the eccentricity of the obstacle on the exhaust side.

References

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