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# Optimal Design of Middle and Low Pressure Axial Flow Fan based on Varying Cycle Flow Type

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In general, the gas flow at the impeller of the axial flow fan is the three–dimensional flow. The pressure and velocity which represent performance of the fan are different according to the height and direction of the blade, and the shapes of blades are determined according to the types of the gas flow.

Shape of the blade is one of the important parameters in the design of the axial flow fan impeller because it affects the characteristics and performance of the axial flow fan. So the gas flow which passes through the blade is related with shape of the blade closely.

In design of the axial blade based on the uniform cycle flow type, it is supposed that the total pressure and the hydraulic loss are equal according to the blade height and the performance of the blade is appreciated only with the loss of the average cross section. Nevertheless, in fact, the distribution of the total pressure according to the blade height is not constant when the gas flow passes through the aerofoil array. In other words, the hydraulic loss according to the blade height is not constant.

The design of the axial blade based on the uniform cycle flow type has the disadvantage that it doesn't reflect the real flow correctly and ensure the required performance. In this essay, in order to reflect the real aerodynamic changes of the gas flow in the axial flow fan correctly and raise the accuracy of the base design of the axial flow fan, the optimal design method of the middle and low pressure axial flow fan, which is based on the varying cycle flow type, was researched.

The optimal model with the highest hydraulic efficiency which satisfies the given design parameters of the middle and low pressure axial flow fan composed of the inlet guide vane, impeller and outlet guide vane has been suggested, and then reasonable varying cycle exponent and structural design parameters have been determined.

The optimization variables are adopted with the varying cycle exponent $a$, aerofoil array tightness $\tau$, the tightness of the inlet and outlet guide vanes $\tau_p$ and $\tau_s$, and the hub ratio $\bar{d}$ . And the availability of the optimal design method mentioned in the previous design and the essay was proved by the CFD numerical simulation.

As the results of optimization, the value of the varying cycle exponent was 0.95, and at the nominal flow rate the efficiency was 3.32% greater and the shaft power was 30W smaller while the aerodynamic noise was 2dB smaller than the original. This shows that the optimal design method based on the varying cycle flow type is effective for the middle and low pressure axial flow fan.