ABSTRACT

The fan as a tool to create airflow is considered to have good performance when the flow that produced is fast and stable. Through various applications (cooling fans, exhausts, and ventilators) it is known that the applications are carried out on different objects and work systems but have the same effect on the main product performance. On the other hand, it is known that fan performance is influenced by torque that generated from the motor and propeller design parameters, so the trend to improve fan performance is developed through engineering the design parameters to maximize the driving motor capacity. The engineering of the propeller design parameters can be done by changing the design of the blades, one of which is the use of airfoil geometry. The performance improvement is based on the ability of the airfoil to provide an advantageous flow separation through the difference in surface thickness from the leading edge to the trailing edge. The advantage of this flow separation is then represented through performance parameters in the form of lift and drag which are converted into lift-to-drag ratio values. Efforts to improve the basic performance of the airfoil can be achieved through the application of a design parameter in the form of a tubercle leading edge (TLE) structure that can provide support for the creation of airfoil benefits through the effect of increasing lift and decreasing drag. This design parameter was developed from the the humpback whale fins through a sine wave model where wavelength and amplitude are used as forming factors. In addition, the application of the structure is also easy to do because the determination of the factor value is usually taken from the length of the airfoil geometry (chord). This research was conducted to obtain an increase in fan performance (air flow) by optimizing the tubercle leading edge structure in the airfoil design. The national advisory committee for aeronautics (NACA) airfoil basis is used to facilitate the airfoil geometry design process which is then applied to the existing fan blades. The completion of the research was carried out using a design of experiment (DoE) on the Taguchi method with computational fluid dynamics (CFD) as a simulation model for the test system. In addition, a validation process was carried out on the selected design from the application of the TLE structure (C3) and the blade design with the initial airfoil (AA) regarding the results of increasing airflow. After comparing the results to existing products, an increase of 5.4% in AA and 8.5% in C3 design was obtained.

Keywords: Tubercle structure, airfoil geometry, lift-to-drag ratio, fan, Taguchi method, computational fluid dynamics.