INTISARI

Turbin Tesla merupakan jenis turbin tanpa bilah yang memanfaatkan viskositas dan adhesi fluida kerja untuk memutar rotor. Piringan-piringan datar yang tersusun berlapis pada satu poros berperan sebagai media transfer momentum dari fluida ke poros turbin. Performa turbin ini sangat bergantung pada geometri celah antar piringan, karena celah yang terlalu lebar membuat fluida tidak berinteraksi optimal dengan permukaan disk, sedangkan celah yang terlalu sempit meningkatkan rugi gesekan. Penelitian ini bertujuan merancang dan memanufaktur turbin Tesla skala kecil, serta menganalisis pengaruh variasi jarak celah antar disk dan laju aliran fluida masuk terhadap performa turbin.

Penelitian ini menggunakan metode eksperimental yang didukung studi literatur. Peneliti memvariasikan jarak antar disk pada 0,5 mm, 1 mm, 1,5 mm, dan 2 mm menggunakan enam disk berdiameter 150 mm dengan tebal 2 mm, serta memvariasikan laju aliran udara bertekanan pada 10 L/s, 12 L/s, 15 L/s, dan 18 L/s. Prototipe turbin dicetak menggunakan mesin printer tiga dimensi dan dirakit bersama sistem akuisisi data berbasis tiga unit Arduino yang membaca laju aliran, kecepatan putar poros, dan gaya pembebanan secara bersamaan melalui software LabVIEW. Torsi diukur menggunakan metode prony brake, sedangkan kecepatan putar poros diukur menggunakan sensor inframerah. Pengujian dilakukan di Fakultas Teknik Universitas Gadjah Mada dengan variabel terikat berupa kecepatan putar poros, torsi, dan daya.

Hasil pengujian menunjukkan bahwa torsi mencapai nilai puncak pada jarak antar disk 1 mm untuk laju aliran 12 L/s, 15 L/s, dan 18 L/s, dengan kenaikan berkisar 12% hingga 47% dibanding jarak 0,5 mm. Daya tertinggi pada laju 10 L/s, 15 L/s, dan 18 L/s justru diperoleh pada jarak antar disk 0,5 mm, sementara daya tertinggi pada laju 12 L/s berada pada jarak 1 mm. Penurunan daya paling tajam pada seluruh laju aliran terjadi pada rentang jarak 1 mm hingga 1,5 mm. Temuan ini menegaskan bahwa jarak antar disk optimum tidak seragam untuk setiap kondisi laju aliran, karena nilainya bergantung pada ketebalan lapisan batas fluida yang terbentuk pada masing-masing kecepatan aliran.

Kata kunci: *Turbin Tesla, Disk, Jarak, Laju Aliran, Torsi, Daya.*

ABSTRACT

A Tesla turbine is a type of bladeless turbine that utilizes the viscosity and adhesion of the working fluid to rotate the rotor. Flat discs arranged in layers on a single shaft serve as the medium for transferring momentum from the fluid to the turbine shaft. The turbine's performance is highly dependent on the geometry of the gaps between the disks, as gaps that are too wide prevent the fluid from interacting optimally with the disk surfaces, while gaps that are too narrow increase friction losses. This study aims to design and manufacture a small-scale Tesla turbine, as well as analyze the effects of variations in the gap width between disks and the inflow fluid velocity on the turbine's performance.

This study employed an experimental method supported by a literature review. The researcher varied the distance between disks at 0.5 mm, 1 mm, 1.5 mm, and 2 mm using six disks with a diameter of 150 mm and a thickness of 2 mm, and varied the compressed air flow rate at 10 L/s, 12 L/s, 15 L/s, and 18 L/s. The turbine prototype was 3D-printed and assembled with a data acquisition system based on three Arduino units that simultaneously read the flow rate, shaft rotational speed, and load force via LabVIEW software. Torque was measured using the Prony brake method, while shaft rotational speed was measured using an infrared sensor. Testing was conducted at the Faculty of Engineering, Gadjah Mada University, with the dependent variables being shaft rotational speed, torque, and power.

The test results show that torque reached its peak at a disk-to-disk distance of 1 mm for flow rates of 12 L/s, 15 L/s, and 18 L/s, with increases ranging from 12% to 47% compared to a distance of 0.5 mm. The highest power at flow rates of 10 L/s, 15 L/s, and 18 L/s was actually obtained at a disk spacing of 0.5 mm, while the highest power at a flow rate of 12 L/s was achieved at a spacing of 1 mm. The sharpest drop in power across all flow rates occurred in the range from 1 mm to 1.5 mm. These findings confirm that the optimal inter-disk distance is not uniform for all flow rate conditions, as its value depends on the thickness of the fluid boundary layer formed at each flow velocity.

Keywords: *Tesla turbine, disk, distance, flow rate, torque, power.*