ABSTRAK

Perkembangan teknologi manufaktur mendorong peningkatan efisiensi energi dan kualitas proses produksi, termasuk pada mesin *injection molding* yang banyak digunakan dalam industri plastik. Mesin *injection molding* berbasis hidrolik memiliki keterbatasan berupa konsumsi energi yang relatif tinggi, respons sistem yang kurang presisi, serta tekanan dan kecepatan injeksi yang belum optimal. Penggunaan servo motor sebagai sistem penggerak diharapkan mampu meningkatkan efisiensi energi dan ketepatan pengendalian proses injeksi. Penelitian ini bertujuan menganalisis pengaruh variasi parameter servo motor terhadap konsumsi energi listrik, waktu siklus, dan stabilitas tekanan injeksi serta menentukan parameter operasi yang optimal. Penelitian menggunakan metode eksperimen dengan pendekatan kuantitatif pada mesin *injection molding* yang telah dilengkapi sistem servo motor. Variabel bebas berupa variasi parameter pengoperasian servo motor, sedangkan variabel terikat meliputi konsumsi energi listrik, waktu siklus, dan stabilitas tekanan injeksi. Jenis material, suhu proses, massa material, dan kondisi cetakan dikendalikan agar tetap konstan. Pengumpulan data dilakukan melalui pengukuran daya listrik, tekanan injeksi, dan waktu siklus pada setiap variasi perlakuan. Data dianalisis menggunakan statistik deskriptif, uji prasyarat, analisis varians (ANOVA), dan regresi untuk mengetahui pengaruh parameter servo motor serta menentukan kondisi operasi yang paling optimal. Penelitian ini diharapkan menghasilkan rekomendasi pengaturan servo motor untuk meningkatkan efisiensi dan produktivitas proses *injection molding*.

Kata kunci: *injection molding, servo motor, energy efficiency, cycle time, injection pressure.*

ABSRACT

Advancements in manufacturing technology are driving improvements in energy efficiency and production process quality, particularly for the injection molding machines widely used in the plastics industry. Hydraulic-based injection molding machines suffer from limitations such as relatively high energy consumption, imprecise system response, and suboptimal injection pressure and speed. Utilizing a servo motor as the drive system is expected to enhance energy efficiency and the precision of injection process control. This study aims to analyze the impact of varying servo motor parameters on electrical energy consumption, cycle time, and injection pressure stability, as well as to determine optimal operating parameters. An experimental method with a quantitative approach was employed using an injection molding machine equipped with a servo motor system. The independent variables consisted of variations in servo motor operating parameters, while the dependent variables included electrical energy consumption, cycle time, and injection pressure stability. Material type, process temperature, material mass, and mold conditions were kept constant. Data collection involved measuring electrical power, injection pressure, and cycle time for each treatment variation. The data were analyzed using descriptive statistics, prerequisite testing, analysis of variance (ANOVA), and regression to assess the influence of servo motor parameters and identify the most optimal operating conditions. This research is expected to yield recommendations for servo motor settings that enhance the efficiency and productivity of the injection molding process.

Keywords: Injection molding, servo motor, energy efficiency, process optimization, quantitative research.