

ANALISIS PENGARUH VARIABEL PEMOTONGAN (*FEED RATE, SPINDLE SPEED, DEPTH OF CUT*) TERHADAP KEKASARAN PERMUKAAN DAN TEMPERATUR PEMOTONGAN PADA PROSES CNC (*COMPUTER NUMERICAL CONTROL*) MILLING BAHAN PADUAN ALUMINIUM 6061

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ABSTRAK

Proses *Computer Numerical Control (CNC) milling* merupakan salah satu proses pemesinan yang digunakan untuk menghasilkan komponen dengan ketelitian dimensi dan kualitas permukaan yang baik. Kualitas hasil pemesinan dipengaruhi oleh parameter pemotongan, yaitu *spindle speed*, *feed rate*, dan *depth of cut*. Penelitian ini bertujuan untuk menganalisis pengaruh variabel pemotongan terhadap kekasaran permukaan dan temperatur pemotongan pada proses *CNC milling* Aluminium 6061, serta menentukan kombinasi parameter pemotongan yang optimum menggunakan metode *Taguchi*. Penelitian ini menggunakan metode eksperimen dengan rancangan *Taguchi Orthogonal Array (OA) L9* yang terdiri atas tiga faktor dan tiga level. Variabel penelitian meliputi *spindle speed* (1500, 2000, dan 2500 rpm), *feed rate* (98, 132, dan 170 mm/menit), serta *depth of cut* (0,5; 1; dan 1,5 mm). Pengukuran kekasaran permukaan dilakukan menggunakan *Surface Roughness Tester*, sedangkan temperatur pemotongan diukur menggunakan *Infrared Thermometer*. Data dianalisis menggunakan *Signal-to-Noise (S/N) Ratio* dan *Analysis of Variance (ANOVA)*. Hasil penelitian menunjukkan bahwa *feed rate* merupakan faktor yang paling berpengaruh terhadap kekasaran permukaan dengan kontribusi sebesar 33,031%, diikuti *depth of cut* sebesar 27,505% dan *spindle speed* sebesar 22,384%. Kombinasi parameter optimum diperoleh pada *spindle speed* 2500 rpm, *feed rate* 132 mm/menit, dan *depth of cut* 1 mm. Temperatur pemotongan berada pada kisaran 39,4–40,7°C sehingga kondisi termal selama proses pemesinan relatif stabil. Dengan demikian, kualitas permukaan Aluminium 6061 lebih dipengaruhi oleh variasi parameter pemotongan, terutama *feed rate*, dibandingkan oleh temperatur pemotongan.

Kata kunci: *CNC milling*, Aluminium 6061, *feed rate*, *spindle speed*, *depth of cut*, kekasaran permukaan, temperatur pemotongan, metode *Taguchi*.

**ANALYSIS OF THE EFFECTS OF CUTTING PARAMETERS
(FEED RATE, SPINDLE SPEED, AND DEPTH OF CUT) ON
SURFACE ROUGHNESS AND CUTTING TEMPERATURE
DURING CNC (COMPUTER NUMERICAL CONTROL)
MILLING OF ALUMINIUM 6061 ALLOY**

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ABSTRACT

Computer Numerical Control (CNC) milling is one of the machining processes widely used to produce components with high dimensional accuracy and good surface quality. The machining quality is influenced by cutting parameters, namely spindle speed, feed rate, and depth of cut. This study aimed to analyze the effect of cutting parameters on the surface roughness and cutting temperature of Aluminium 6061 during the CNC milling process and to determine the optimum cutting parameter combination using the Taguchi method. This research employed an experimental method based on the Taguchi Orthogonal Array (OA) L9 design consisting of three factors and three levels. The cutting parameters included spindle speeds of 1500, 2000, and 2500 rpm, feed rates of 98, 132, and 170 mm/min, and depths of cut of 0.5, 1.0, and 1.5 mm. Surface roughness was measured using a Surface Roughness Tester, while the cutting temperature was measured using an Infrared Thermometer. The experimental data were analyzed using the Signal-to-Noise (S/N) Ratio and Analysis of Variance (ANOVA). The results showed that feed rate was the most influential factor affecting surface roughness, contributing 33.031%, followed by depth of cut (27.505%) and spindle speed (22.384%). The optimum cutting parameter combination was obtained at a spindle speed of 2500 rpm, a feed rate of 132 mm/min, and a depth of cut of 1 mm. The cutting temperature ranged from 39.4 to 40.7°C, indicating relatively stable thermal conditions during machining. Therefore, the surface quality of Aluminium 6061 was influenced more by the cutting parameters, particularly the feed rate, than by the cutting temperature.

Keywords: CNC milling, Aluminium 6061, feed rate, spindle speed, depth of cut, surface roughness, cutting temperature, Taguchi method.