عنوان مقاله:

Multi-objective optimization of turning of titanium alloy under minimum quantity lubrication

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خلاصه مقاله:

In the present study, the machining performance of titanium grade-۱ alloy is evaluated in terms of resultant cutting force, machined surface roughness, and material removal rate (MRR) through a multi-objective optimization approach. Turning experiments were performed with CVD-coated TiCN-Al۲O۳ carbide inserts using vegetable oil-based nanofluid under minimum quantity lubrication. The nanofluid was prepared using coconut oil as a base fluid mixed with boron nitride (hBN) nanoparticles. Experiments were performed by varying the cutting speed, feed, depth of cut, and nanoparticles concentration in a base fluid. The Desirability Function Approach (DFA), a Technique for Order of Preference by Similarity to Ideal Solution (TOPSIS), Grey Relational Analysis (GRA), and Non-dominated Sorting Genetic Algorithm (NSGA-II) are used to optimize the machining performance. The optimized solutions from different optimization techniques are observed in better agreement. The results show optimum performance at the higher cutting speed, higher depth of cut, lower feed, and lower concentration of nanoparticles. Lowest values for resultant force and surface roughness of ۳۸۷ N and ۰.۴۷ µm, respectively, and maximum MRR of ۹۳۷۵ mm۳/min could be obtained using the cutting speed, feed, depth of cut, and nanoparticles concentration of ۱۲۵ m/min, ۰.۱ mm/rev, ۰.۷۵ mm, and ۰.۳%, respectively. However, little compromising the surface roughness to a higher value of ۰.۸۳ µm with almost the same resultant force, the higher MRR of ۱۵۰۰۰ mm۳/min could be obtained using higher cutting parameters. It has been observed that the resultant force and surface roughness are significantly affected by the depth of cut and feed, respectively. However, the concentration of nanoparticles has been observed to have a lower prominent effect on .the surface roughness and resultant force

کلمات کلیدی:

Titanium alloy, Machining, Nanofluid MQL, Grey Relational Analysis, TOPSIS, NSGA-II