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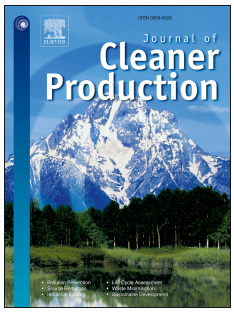

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Optimization of Machining Parameters Considering Minimum Cutting Fluid Consumption

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Abstract

Dry or near dry machining is often regarded as an effective strategy for reducing ecological impacts of the cutting processes. However, due to the application limitations of dry or near dry machining, reduction of cutting fluid supply through machining parameter optimization offers a cost effective alternative. To this end, an optimization model of machining parameters considering minimum cutting fluid consumption and cost is proposed. Process cost and cutting fluid consumption are treated as the two objectives in the optimization model, which are affected by four variables, namely cutting depth, feed rate, cutting speed, and cutting fluid flow. In the model, process cost includes production operation cost and cutting tool cost, whilst cutting fluid consumption by a machining process, which consists of reusable cutting fluid and non-reusable cutting fluid, ie., the remaining cutting fluid deposited on the workpiece and chips as well as that diffused into the environment. The multi-objective optimization problem is solved by a hybrid genetic algorithm programmed in Matlab7. An illustrative case study was implemented to verify the effectiveness of the multi-objective optimization model, and the simulation results showed 17% reduction of fluid consumption compared to that without optimization. This indicates that the proposed optimization is effective and has great potential to be adopted by industry.

Keywords: Machining parameters; Cutting fluids; Multi-objective optimization; Genetic algorithm (GA)

Nomenclature

a_p	Cutting depth (mm)
b	Width of the chip being cut (mm)
C_m	Machining cost rate (dollars/min)