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ENVIRONMENTAL BURDEN PREDICTION OF MANUFACTURING PROCESS IN VIRTUAL MANUFACTURING

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Abstract. *A method for evaluating the environmental burden due to manufacturing process is proposed using virtual manufacturing processes based on Life Cycle Assessment (LCA). The total environment burden is evaluated from the electric consumption of machine tool components, coolant quantity, lubricant oil quantity, cutting tool status, and metal chip quantity. The initial step of this study is focused on machine tool operations. Global Warming Potential (GWP) of 100 years impact is taken as a key factor and equivalent CO_2 emission is evaluated. The relation between cutting conditions and environmental burden of machine tool operations is analyzed in this study. The results reveal the appropriate cutting conditions and can be used to predict and reduce the amount of CO_2 generated from machine tool operations.*
Keywords: Environmental burden, LCA, Virtual manufacturing, Machine tool operations

1. **Introduction.** Emission generated from manufacturing process has become a crucial environmental concern. In addressing this issue, efforts need to be undertaken to mitigate the environmental burden, whose cost will be considered in the near future. This research proposed an evaluation concept of environmental burden in manufacturing processes based on the activity in virtual manufacturing utilizing environmental burden analyzer. The concept is initially focused on machine tool operations. The evaluation is used to simulate and predict the environmental burden of machine tool operations prior to commencement of operation.

Cutting conditions play an important role to improve productivity of machine tool operations. Until now, the relation between cutting conditions and the effect of environmental burden of machine tool operations has not been explored. The analysis of cutting conditions to achieve the possible minimum environmental burden and the effect of high speed machining are essential for future manufacturing.

In this research, we develop a method to optimize cutting conditions to achieve a significant reduction of environmental burden in machine tool operations associated with electric consumption of machine tool components, coolant quantity, lubricant oil quantity, cutting tool status, and metal chip quantity [1]. Two case studies are analyzed to demonstrate the feasibility of the proposed system. The effect of cutting conditions in Numerical Control (NC) program and coolant usage is analyzed in the first case study