MULTI OBJECTIVE OPTIMIZATION FOR SUSTAINABLE MANUFACTURING, APPLICATION IN TURNING

Hassine, H.* **; Barkallah, M.*; Bellacicco, A.**; Louati, J.*; Riviere, A.** & Haddar, M.*

* Laboratory of Mechanical Modeling and Manufacturing, National Engineering School of Sfax, University of Sfax, Tunisia
** Laboratory of engineering of the Mechanical Structures and Materials, Height Institute of Mechanic of Paris, Saint Ouen, France
E-Mail: hassinehichem@yahoo.fr

Abstract
As manufacturing converts raw materials into products, environmental wastes and emissions are simultaneously generated from the consumption of materials and energy during the manufacturing processes. Then, sustainable manufacturing is defined as the creation of manufactured products using processes that minimize negative environmental impacts, conserve energy and natural resources and that are safe on employees, communities and consumers. Such an approach requires a compromise between ecological and economic aspects to meet the pillars of sustainable development.

This paper presents the implementation of particle swarm tool in order to solve multi-objective optimization for sustainable manufacturing. Hence, this study might serve as part of a global approach to model sustainable manufacturing. The main objective of this approach is to develop operations that allow production with respect of ecological, economic and technological constraints. We developed a case study on the cutting conditions during turning at the end of our study.

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Key Words: Sustainable Manufacturing, Multi Objective Optimization, Particle Swarm Optimization, Turning

1. INTRODUCTION

In recent years, energy consumption and environmental impact of manufacturing processes have gained great concern in response to the global trends towards sustainable manufacturing. The reasons for this concern include regulation requirements, product stewardship, enhanced public image, potential to expand customer base and potential competitive advantages.

Intensive energy consumption in industry has drawn increasing attention due to its adverse environmental impact and the exhaustion of natural resources. According to the International Energy Agency, the energy consumed by manufacturing industries accounts for 30 % of the total world energy, and 36 % of the global CO₂ emission.

Reducing the energy impact can help companies accomplish green production. Some authors have developed a model of the sustainable manufacturing base energy. So far, energy has been indirectly considered in machining optimization through including power as a constraint in the optimization problem. Then, in 1981, De Fillippi et al. integrated energy as an objective in their study [1]. Later, in the mid-90s, Munoz and Sheng [2] proposed an environmentally-conscious multi-objective model which considered energy consumption as the most important component. It also presented a global approach to carry out an optimization procedure from an ecological perspective. Haapala et al. [3] studied a series of manufacturing processes like sand casting, bending, welding and laser cutting using steel in the production process. Their objective was to estimate materials, energy consumption and waste correlated using a spreadsheet.

Gutowski et al. [4] studied the energy requirements for various manufacturing processes. They concluded that the specific energy requirement varies with respect to unit processes, which is in opposition to the way the energy process is treated in most LCA studies.


