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Extension of performance indices for the improvement of environmentally efficient materials selection

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Keywords

Materials selection, Performance index, Life cycle approach, Environmental Impact, Design for environmental sustainability

Abstract

The need to strengthen the strategies for product life cycle optimization, which in principle are the most efficient for environmental protection in product design, requires interventions starting from the conception and design phases, in which a reasoned and efficient management of the choice of materials plays a decisive role, in the face of an increasingly broad spectrum of product requirements.

In this work, the possibility of extending the performance functions used for a materials selection approach based on efficient combinations of properties for the purposes of the specific application (performance indices), developed according to the Ashby method, is investigated, in order to include environmental aspects linked to the whole life cycle of the material, and to search for an optimal choice that integrates these aspects with the requirements aimed at guaranteeing the primary functionalities.

With this aim, an integrated approach to the optimal choice of materials is outlined, which allows the management of design parameters of different nature (material properties, significant geometric parameters), taking into account various types of requirements: functional, economic, environmental. Regarding this last aspect, through the introduction of specific formulations of the impact of the life cycle combined with the performance functions, material selection metrics are obtained which are able to take into account a wide range of implications on the environment. In the most general form the latter are attributable to all the processes constituting the main phases of the life cycle of the material, but they can also be modulated and parameterized with respect to the specificities of the product to which the choice of material applies.

The advantages of using metrics extended to the product life cycle, also in this specific field of design, parameterized according to some determining factors for the environmental impacts, generally confirm the need to implement in the development of metrics for environmentally sustainable design the holistic vision necessary to avoid design choices that limit themselves to shift the environmental criticalities between the life cycle phases, without pursuing an efficient balance so to outline an effectively sustainable solution.

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