

## Products in Early Development Phases: Ecological Classification and Evaluation Using an Interval Arithmetic Based Calculation Approach

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**Abstract :** As a pillar of sustainable development, ecology has become an important milestone in research community, especially due to global challenges like climate change. The ecological performance of products can be scientifically conducted with life cycle assessments. In the construction sector, significant amounts of CO<sub>2</sub> emissions are assigned to the energy used for building heating purposes. Therefore, sustainable construction materials for insulating purposes are substantial, whereby aerogels have been explored intensively in the last years due to their low thermal conductivity. Therefore, the WALL-ACE project aims to develop an aerogel-based thermal insulating plaster that would achieve minor thermal conductivities. But as in the early stage of development phases, a lot of information is still missing or not yet accessible, the ecological performance of innovative products bases increasingly on uncertain data that can lead to significant deviations in the results. To be able to predict realistically how meaningful the results are and how viable the developed products may be with regard to their corresponding respective market, these deviations however have to be considered. Therefore, a classification method is presented in this study, which may allow comparing the ecological performance of modern products with already established and competitive materials. In order to achieve this, an alternative calculation method was used that allows computing with lower and upper bounds to consider all possible values without precise data. The life cycle analysis of the considered products was conducted with an interval arithmetic based calculation method. The results lead to the conclusion that the interval solutions describing the possible environmental impacts are so wide that the result usability is limited. Nevertheless, a further optimization in reducing environmental impacts of aerogels seems to be needed to become more competitive in the future.

**Keywords :** aerogel-based, insulating material, early development phase, interval arithmetic

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