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Editorial

Sustainable Materials for the Thermal and Noise Insulation of Buildings: An Editorial

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Climate change and global warming issues are becoming more and more important nowadays: the atmospheric concentration of carbon dioxide has been significantly increasing since the twentieth century, mainly due to energy use and anthropogenic activities. In the period of global warming, the lack of non-renewable energy sources, and the greenhouse gas effect play an important role, and adequate knowledge of environmental issues is required. Buildings account for around 40% of energy consumption and 36% of CO_2 emissions in the EU. Thus, the energy performance of the building envelope could be a significant contribution in the mitigation of global warming and climate change, improving the interior comfort of the occupants and increasing the requests for energy saving. The thermal insulation properties of the components of both opaque and transparent envelopes are a crucial requirement in the building design in order to achieve the aim of nearly zero energy buildings (NZEBs) and to reduce heat losses and energy consumption for buildings' conditioning. In addition to the thermal aspect, sound insulation properties are a key issue in acoustic comfort, in line with the recent legislation regulating the passive acoustic requirements of buildings. In this context, it is crucial to consider eco-sustainable materials with low environmental impact, which allow good thermal and acoustic insulation of the building envelope.

In this context, the Special Issue for *Sustainability* was edited to collect the latest research on the thermal and acoustic characterization of innovative materials with low environmental impact and on their performance in buildings, also evaluated through dynamic simulations. Specifically, the Special Issue addresses the following topics: the improvement in the thermo-acoustic properties of the materials for energy savings and of buildings' energy performance; polices to promote the circular economy; and the low environmental impact by means of the use of sustainable and waste materials.

Considering these topics, the Special Issue received several submissions and published five papers. In particular, in the papers studied both conventional and innovative materials for building energy savings and the thermo-acoustic comfort of occupants. Sheikh Ahmad Zaki [1] and his colleagues conducted a study of a special type of bed linen in order to prevent an excessive use of air conditioners during sleeping hours and to improve the quality of the occupants' life. The use of the cool bed linen with the increase in air conditioner set-point temperature by 3 °C leads to a reduction in electricity consumption. Heating and cooling losses in residential buildings can also be limited through the use of innovative materials with high energy efficiency, such as monolithic aerogel. Mary K. Carroll [2] and her colleagues describe several approaches and techniques for the preparation of monolith panes in addition to the incorporation of artistic effects using dyes and laser etching in order to improve the aesthetics of aerogel-monolith-based glazing systems and visible light transmission, as well as ensuring excellent thermal and acoustic performance.

Another problem is represented by the thermal bridges, especially when creating ventilated façades. The paper [3], authored by Rastislav Ingeli, Jozef Gašparík, and Lucia Paulovičová, evaluates the influence of the thermal bridges on transmission heat losses through the external cladding by means of a finite element mesh analysis. Different types

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of external cladding composites are analyzed, and it is shown that the application of anchors and their number significantly affects the thermal properties of the envelope. Moreover, a patented proposal composed of the only plastic-coated anchoring element is studied, achieving a significant economic and technological effect due to the savings of the production of materials and of energy in buildings.

Papers [4,5] deal with the circular economy and sustainable development perspectives. In particular, Chiara Quintaliani [4] and her colleagues focus their attention on the thermal and acoustic performance of natural hydraulic lime mortars with vegetal fiber additives for structural applications. Different types and sizes of fibers were studied, and both good thermal and acoustic absorption performance were obtained, especially with ground materials. In Reference [5], the authors Giuseppe Ciaburro, Rosaria Parente, Gino Iannace, and Virginia Puyana-Romero performed an acoustic characterization of a new membrane metamaterial based on three layers of a reused PVC membrane with reused metal washers attached. This structure will be adopted for the construction of acoustic panels to be used for improving room acoustics. Different configurations are analyzed and used in order to train a model based on artificial neural networks for the prediction of the sound absorption coefficient. The possibility of regulating the shape of the unit cells allows one to modulate the type of sound absorption on specific frequency bands and to design acoustic panels according to the specific needs of the user.

In conclusion, this Special Issue provides new and relevant insights that can be considered by various stakeholders, including public institutions. More high-quality research is expected in the near future on energy efficiency in buildings and innovative materials with low environmental impact for building construction while also encouraging the recovery of wastes and stimulating awareness at the industrial level. These are primary decisive actions in a sustainability perspective allowing the reduction in the waste volume and in the extraction of new resources, thus reducing the environmental impact. For the great importance of these issues, other Special Issues could be organized periodically in order to provide updates on the state-of-the-art.

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