

## Opportunities of Using Nanocellulose in Construction Materials

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Numerous efforts have been made to mitigate the negative impacts of the production of construction materials on the environment. A reduction in the usage of virgin raw materials and the utilization of the waste materials or the biobased materials are examples of these efforts. However, a potential threat to the environment persists. Bacterial nanocellulose shows promise as a further way to produce environment-friendly construction materials.

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### Sustainability in Construction Materials?

Preservation of natural resources used in construction materials from depletion can be regarded as a key element in achieving sustainability in construction and in reducing the negative impact of construction on the environment. However, the (1) cost affordability and the availability of these natural (virgin) materials, and (2) the unending urbanization and deforestation in the world, appear to make increased exploitation of natural materials inevitable. Cementitious materials in general and concrete products in particular consist of virgin materials; water, fine aggregate (sand), coarse aggregate (gravel) are the common materials used in the production of the conventional construction materials, which are still to be consumed massively. Moreover, carbon oxide emission and the depletion of available fresh water in the world are considered as a rising threats to sustainability in construction, attributable to their worldwide usage in construction. Attempts have been made to utilize waste construction material. Such efforts reduce but do not eliminate the consumption of virgin materials. Therefore, there is a need to have an alternative material to be used in construction. Wood products in construction seem to be a promising alternative to other conventional construction materials, but with a precaution attributable to biodegradable behavior during the service life of these products and the conservation of the main source of the wood products, the forests. Wood construction materials (products), biobased additive manufacturing, biobased (obtained from plants) cementitious materials, and geopolymer concrete are considered as promising alternative types of materials that mitigate or eliminate the threat of the conventional concrete material on the sustainability in construction. However, these alternative materials consume wood resources, and this requires careful attention to protect the existing forests from extinction. Additionally, massive waste is generated from the usage of biobased construction products.

## Rethink Reuse Concept in Construction Materials

An essential challenge in typical construction practices is that the usage of materials is linear. Thus, once the construction material has been used to build a certain part, it is not reused after demolishing at the end of the service life of the building. This implies that there is a crucial need to shift the usage of virgin materials in construction from linear to circular, thereby reusing and reducing the consumption of the virgin materials. Efforts have been made to efficiently utilize the industrial waste such as fly ash or sludge as a replacement to the cement as a binder or additive or a water reducer in the production of construction materials to mitigate the consumption of the virgin materials and the negative impact on the environment. The World Green Build Council in its 2019 report stated a goal that by 2030, “all new buildings, infrastructure will have at least 40% less embodied carbon” and no embodied carbon in the infrastructure by 2050 (Ghosh *et al.* 2021).

## Nanocellulose in Construction Materials

In the construction industry, cellulose and nanocrystals (CNC), nanocellulose (NC), and nanofibrillated celluloses (NFCs) have been introduced as additives in the production of the cementitious materials (cement based), to enhance the mechanical properties and to mitigate the negative impact of cement products on the environment and to reduce the utilization of the conventional virgin materials of gravel, sand, clay in this industry (Ferreira *et al.* 2021; Santos *et al.* 2021; Szafraniec *et al.* 2022; Abdollahiparsa *et al.* 2023). Wood is one of the main sources of the plant biobased fibers, from which to obtain cellulose and lignocellulose. In our opinion, this still constitutes a threat to the forests. There must be an alternative to produce cellulose and nanocellulose without jeopardizing the forests through further increased usage of virgin materials. It is notable that, as an alternative to trees, cellulose and nanocellulose can be obtained from algae. Moreover, algae showed the ability to capture (CO<sub>2</sub>) (Iglina *et al.* 2022). This can contribute to a balance in the construction industry and a remedy drawback in current infrastructures.

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