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## Building the future: sustainability of construction materials

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Modern trends in frontier materials science are commonly related to finding and characterizing suitable materials for advanced and innovative technological applications. However, even in the field of materials that are commonly considered “low-tech” such as construction materials and binders, there are a number of open, timely, and rather challenging issues to be confronted. Possibly the most urgent and crucial problem is the sustainability character of materials used to build human infrastructures: bricks, structural ceramics, concrete, advanced binders, insulation materials. Cement and concrete at present are the most used materials after water, and it is clear that modern buildings and infrastructures are critically dependent on such materials. The volume of annual world production of concrete, in the order of 10 10 tons and growing, exceeds the volume of consumed fuels (oil and coal).

The fundamental concept of circular economy in the anthropocene era [ 1 ] demands that the use and misuse of natural and man-made mass-produced materials ought to be linked not only to the artificial loops dominated by finance-based economy, which is now the dominating parameter, but rather to the evaluation of the sustainability and the life cycle assessment of the resources [ 2 ]. Adoption of the R3 philosophy (reduce, reuse, recycle) is simply mandatory.

These concepts will be discussed in relationship to present trends in cement and concrete production. Promising cements and binders alternative to Portland clinker are based on (a) clay-based materials, (b) alkali activated materials, and (c) the so-called geopolymers. The advantages and disadvantages of these novel materials are discussed. The knowledge-based selection of materials and their optimization in large-scale productive processes is extremely important both for developed and developing economies [ 3 , 4 ].

**Primary author:** ARTIOLI, Gilberto (Università di Padova, Dipartimento di Geoscienze, Padova, Italy)

**Presenter:** ARTIOLI, Gilberto (Università di Padova, Dipartimento di Geoscienze, Padova, Italy)

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