A unique additive for the ideal concrete

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Kumar Abhishek develops new additives in the lab. Credit: EPFL

Whether it's for drying time, hardness, or uniformity, a new additive developed at EPFL can give concrete, mortar, and cement the desired consistency, all in one shot. Made from inorganic compounds, the additive can also extend buildings' lifetimes. A startup called Nanogence has just been created to develop and market the innovation.

Soon all it will take is a single step for manufacturers to set the

properties of construction materials during preparation and improve their properties once hardened. Nanogence, an EPFL spin-off, has developed a lone additive that stands to replace the plethora of additives currently used to obtain an ideal concrete, mortar or cement. It can even prevent reinforcing bars from deteriorating, thereby extending the lifetimes of buildings. A magic potion? Almost.

Simplifying concrete preparation

To the uninitiated, concrete seems to be both singular and immutable. So pedestrian that you'd think it's fairly straightforward with no hidden secrets. But in reality, making it requires juggling a slew of parameters that can differ not only from one company to the next, but also from one batch to the next. For instance, clinker, the basic ingredient in concrete, can vary depending on the natural surroundings of the rock it's produced from. The temperature to which clinker should be heated can also vary, as can the residence time inside a kiln, cooling conditions, and cement-mixture composition.

Manufacturers tailor the cement they make to the building it's intended for and the journey it will take to get there. "For example, if it'll be used for a building in the middle of a large city, it needs to harden slowly so that builders can still work with it despite the time it will take to get it to the construction site," said Kumar Abhishek, CEO of Nanogence. That means cement is typically enhanced with varying amounts of different additives until the ideal texture is found. The lone additive developed by the spin-off thus constitutes a mini-revolution for the industry. Manufacturers will just need to tweak the proportion to get the right consistency.

Because the additive is inorganic – that is, carbon-free – it also eliminates the porosity problem that leads to carbonatation and deterioration of the concrete. This problem stems from the carbon links

and the moisture that can seep into the tiny cracks between the metallic structures that reinforce the building and the debris in the cement. But Kumar's inorganic compound can get rid of that problem, thereby making buildings last longer.

The additive also boosts the hardness of construction materials. That means builders can make thinner walls, thus using less concrete. The ensuing savings are significant, given that concrete accounts for 5–10% of carbon emissions but is still one of the world's cheapest and most widely-used construction materials.

The secret: a thesis on concrete's nanoscopic structure

So how does this "miracle" additive work? The basic idea behind the new process came from the in-depth knowledge of concrete's nanoscopic structure that Kumar acquired during his thesis. He then used nanotechnologies to develop chemical substances that can improve concrete's properties. The recipes of those substances must, of course, remain secret.

This summer – two patents later – Kumar launched his startup. He's currently in talks with two major European concrete producers and has kicked off production of a compound specifically for white concrete. This niche market is particularly targeted to high-end interior decoration. But Kumar doesn't intend to rest on his laurels. He is also developing an additive that can improve concrete's thermal insulation. "The idea is to eventually develop prefabricated elements that combine longevity with good thermal insulation," said Kumar, who takes a big-picture view. "Over 40% of energy worldwide is used for construction. Rethinking construction materials will hopefully enable us to reduce this usage."

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