

Building an Ecosystem for the up-scaling of lightweight multi-functional concrete and ceramic materials and structures



The future of materials: towards a new idea of concrete



LIGHTCOCE

Contents

This is the seventh edition of the newsletter related to the LightCoce Project.

This issue is dedicated to an overview of the main innovation in the concrete industry, focusing on new materials. Moreover, the last news will be presented.

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What is LightCoce project?

LightCoce is a research project funded by the European Community under the H2020 program, with the aim of creating an ecosystem of business innovation capable of upscaling and testing new multifunctional lightweight materials for SMEs.

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How LightCoce helps you overcome complex standards and regulations?

Standardization and regulatory compliance are key issues for further exploitation and commercialization of innovations.

Testing will be in alignment with international standards (CEN, ISO, ASTM, etc.) and regulatory framework aiming to develop products towards EU standards.



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Which is the target market of LightCoce?

LightCoce can address different types of customers such as: Banks, Funds / Investors, Incubators / Accelerators Public Bodies and Owners of Infrastructures Research Institutes / Universities, Large Enterprises, SMEs, Startup / New Ventures Industrial Associations or GroupsRaw Materials Providers.



Do you need to innovate your business?

Innovation services are open access under specific fees to all parties, such as: development of business model, marketability assessment, suggesting technology to enable your value proposition or embodying it in a product / service in favour of the user, ensuring the proper protection of the IP developed and identifying the funding opportunitiesat local or EU scale.

SADE AND PRACTICES

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Can large-scale modeling help you evaluate new opportunities?

The Modeling Group focuses on process modeling and simulation through the development of holistic models of processes through multi-scale modeling of materials and unitary operations. Moreover, predictive modeling at different levels will be implemented to generate a chain of models that leadto full-scale simulation of real structures, to evaluate the overall performance of solutions at a global level.

Which professionals can benefit from LightCoce services?

The relevant reference markets are different, such as: Constructions Industry, Bricks and Tiles Industry, Aerospace Industry, Automotive Industry, Defense Industry.

Towards a new idea of concrete

While **concrete** has always been a primary material in the construction industry, its status poses a problem with regard to the goals of greener construction methods and more environmentally friendly building products.

In the last few years, studies have been conducted and research work has been carried out towards innovative, customized concrete that can be lightweight and flexible, and that also features high heat and electrical conductivity properties.

From more environmentally friendly mix methods to concrete that can literally heal itself, new concrete technology offers seemingly limitless possibilities for the **future** of construction. A number of concrete innovations across the globe are presented in this newsletter.

Self-healing concrete

Can concrete heal itself? Hendrik Jonkers, a microbiologist at Delft has a plan to increase the lifespan of the concrete. His innovation aims at reducing the amount of concrete produced while also reducing maintenance costs thanks to... bacteria.

The **self-regeneration** of concrete revolves around water. Water normally presents an issue to concrete health, specifically when water from the surrounding environment or rainwater starts penetrating the cracks of damaged concrete. These self-activating, limestone-producing bacteria (Bacillus



pseudofirmus or Sporosarcina pasteurii) are inserted and distributed evenly throughout the concrete and activate only when water penetrates the cracks of concrete, thus producing limestone that eventually **repairs** the cracks.



This invention comes in three forms:

 A spray that can be applied to existing construction for small cracks that need repairing;

• A repair mortar for structural repair of large damage;

• Self-healing concrete itself, which can be mixed in quantities as needed.

While the spray is already commercially available, the latter two are currently in field tests. According to Jonkers himself, highway infrastructure will be the main beneficiary of this new technology, as roads get continuously damaged by the use of de-icing salts, which is notoriously harmful to concrete-paved roads.

Martian concrete

A helping hand for the **future of concrete** could be coming from another planet: **Mars**. Materials scientist Lin Wan and her colleagues at Northwestern University's Center for Sustainable Engineering of Geological and Infrastructure Materials (SEGIM) in Evanston, Illinois, have developed a "recipe" for generating concrete using "ingredients" that are largely available on planet Mars, simultaneously eliminating the use of water - a resource that will be limited and precious on the planet Earth.



The key material for this type of "concrete" is **sulphur:** after heating it around 240°C so that it becomes liquid, sulphur is mixed with Martian soil, which acts as an aggregate, and then is left to cool. The sulphur solidifies, binding the aggregate and creating concrete. And voila! **Martian concrete.**

The testing process wasn't too difficult: after some trials that involved mixing the aggregate with different percentages of molten sulphur and allowing the samples to cool into blocks, the team proceeded to analyse the physical properties of the resulting materials, together with a chemical analysis of the mix, and a simulation of its performance. Researchers concluded that the best mix for producing Martian concrete is 50 percent sulphur and 50 percent Martian soil with a maximum aggregate size of 1 mm. This combination produced a material with a compressive strength of 50 MPa: to give a reference point, standard concrete used in buildings on Earth has a compressive strength of about 20 MPa!

'Green-mix' concrete

Producing concrete using **recycled waste materials** represents a large step towards sustainability as it allows for a reduction in the use of raw materials, hence reducing the utilization of landfills while also lowering costs.

In a recent project in Malayasia, researchers at Universiti Teknologi MARA introduced an innovative green concrete called **"green-mix concrete".** This newly designed concrete is composed starting from traditional materials, which get however partially replaced with suitable waste and recycled materials, thus accomplishing more economic and sustainability results without loss in performance.



Green concrete is made of **new raw materials**, namely, fly ash, recycled concrete aggregates and aluminum can fibres:

• Fly ash is a waste product produced by coal power plants and gets normally discarded in ponds and sent to landfills. Researchers found out that fly ash has the potential to replace cement, which notoriously bears a high environmental price tag due to the pollution expelled from the cement plants. • Recycled, crushed concrete can be used as aggregate for the production of new concrete, thus reducing consumption of raw materials and minimising waste generated from demolished concrete structures.

• Aluminium cans are used as reinforcement in concrete as they can be easily processed into chopped fibres.

Producing this new concrete, however, requires a certain level of technical expertise with regards, for example, to this new concrete mix design, new raw materials, and new knowledge of green concrete properties. Still, this newly developed green concrete is not only **environmentally friendly** but also **cost-effective,** thanks to optimized material proportions necessary for the new concrete mix design.

A permeable Concrete that absorbs 4 Liters of Water per Minute!

Topmix is a recently-developed, permeable concrete (recommended by the U.S. Environmental Protection Agency (EPA)), capable of **absorbing an impressive 4 liters of water per minute.** It is a great solution to traditional concrete to prevent the overflow of abundant rainwater, amongst other issues. Its porous microstructure allows water to permeate through it, thus contributing to the re-accumulation of groundwater while simultaneously preventing surface excess water which normally accumulates on hard surfaces (like roads).

Its incredible fast draining ability makes it possible for stormwater to be quickly redirected off streets, parking surfaces, driveways, and walkways. Its ability to do this provides fantastic cost savings for long-term maintenance. Its use allows also for the more efficient use of land by making retention ponds, swales, and other stormwater structures less necessary, or even obsolete. The main goal of

its development has been to combat **flooding during storms.** However, it can also greatly assist in the **prevention of car crashes on wet roads.**

Graphene-infused concrete

An **electricity-conducting concrete?** It might not be a utopia, thanks to the work of an Australian advanced materials technology company, Talga Resources. This is possible thanks to the use of an additive developed from the company's graphene-graphite R&D lab in the UK.

According to the Managing Director, Talga's **graphene-enhanced concrete** "achieves such high electrical conductivity that it can act like the heating element of an electric stove". Moreover, "Talga's successful tests follow work published by Exeter University showing 146% improvement in concrete strength using graphene". Thanks to this improved strength, it has been calculated that an estimated 50% reduction of cement used to achieve the same level of strength would entail a 446kg/tonne reduction in carbon emissions by the cement industry, which is currently the third-largest industrial energy consumer and second-largest industrial CO2 emitter in the world.

The breakthrough offers substantial potential in existing and emerging **industrial applications.** For example, it adds a potential 'heating element' function to the world's most used construction material. Some applications which are already being used include underfloor heating, anti-static flooring, EMI shielding, strain sensors, and grounding/lightning protection. Future potential uses, on the other hand, could comprise an environmentally friendly way of clearing ice and snow from key transport routes and airports (compared to the use of ploughs, corrosive salt, and deicing chemicals), or a dynamic and wireless charging of electric vehicles while driving.

Root Vegetables' Nanoplatelet-Reinforced Concrete

Can you believe that vegetables make concrete stronger than common, marketavailable additives? This is what engineers from Lancaster University have discovered in collaboration with industrial partners at Cellucomp Ltd UK. They set out to study the means to strengthen concrete mixtures and to make them more eco-friendly by the addition of "nano-platelets" derived from the fibres of root vegetables. The study, which received support from the European Union's Horizon 2020 funding, will exploit and develop the outcomes that previous tests have already accomplished, which have shown that concrete mixtures that include nano-platelets from carrot or sugar beet possess significantly **improved** mechanical properties.



Amazingly, it was also discovered that the vegetable-composite concretes outperformed all the cement additives available in the market (for example, carbon nanotubes and graphene) while coming at a substantially lower cost. The root vegetable nano-platelets have a twofold functionality: they increase the amount of calcium silicate hydrate (the main substance controlling concrete performance), while simultaneously preventing the formation of cracks in concrete. Thanks to these general improvements in performance, lesser amounts of concrete are required in construction, thus delivering various economic and environmental benefits as mentioned above.

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Breaking News

LightCoce Spin-off on the social media



LightCoce Spin-off on Follow the LightCoce Spin-off on:

in	LinkedIn
f	Facebook
	<u>YouTube</u>

LightCoce next plenary meeting in Genova

The next LightCoce plenary meeting will be hosted by STAM in Genova (Italy). The meeting will be held on Tuesday the 5th of July (full day) and Wednesday the 6th (until noon).

The first day will be related to the project's meeting while the second day will be deputed to our internal workshop organized by ISQ together with SIE.



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Building Decarbonisation 2022 Conference

BUILDING DECARBONIZATION 2022" is an International Conference that will take place for the first time in Athens on the 6th and 7th of October 2022. The conference will bring together Engineers, Architects, Academics, Professionals of different disciplines, and other stakeholders who contribute and advance the state of the art of the built environment.

The Conference is organized by the ASHRAE Task Force for Building Decarbonization (TFBD) in collaboration with the Hellenic Chapter. A special conference issue will be published in ASHRAE's research journal, "Science and Technology for the Built Environment".



You can find more detailed information on: https://tfbd2022.ashrae.gr/

CNANO to the National Chemical **Engineering Conference in Patra**

CNANO submitted a paper to the National Chemical Engineering Conference in Patra (Greece) that will take place on the 2-4 of June 2022.

The work presented will be related to the preparation of nanometakaoline dispersion as a concrete additive and it has been developed in collaboration with NTUA.



Welcome to LightCoce partners 4 / 26 - seventh group



Titan Cement Company

TITAN Cement S.A. is the largest cement University of Padova is a major research and building materials producer in Greece university and currently has 13 schools. and ranked among the top 30 producers It will be represented in the project by globally. Founded in 1902, TITAN Group the Department of Industrial Engineering. employs more than 5,450 people worldwide The department promotes and manages and is growing as a multi-regional, scientific and technological research vertically integrated cement producer. The projects in all fields of Industrial portfolio of TITAN covers the production Engineering, including Aerospace of cement, concrete, aggregates, Engineering, Chemical and Process mortars, and other building materials; the Engineering, Electrical Engineering, Energy transportation - distribution of products, Engineering, Materials and Mechanical and the processing and industrial utilization Engineering, as well as industrial of fly ash. TITAN Group's CSR and technology transfer initiatives. Sustainability commitment is demonstrated in its own policies and practices as well as through active participation in international initiatives.

Contact info: www.titan-cement.com





Università Degli Studi Di Padova

Contact info: www.unipd.it

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UniSMART Fondazione Università di Padova

UniSMART is the Foundation of the University of Padova, in charge of managing all the technology transfer and innovation consulting activities directed to companies, industrial associations, professionals, investors, banks, and other public and private bodies - both on a national and international scale. UniSMART focuses its activities in the provision of innovation and business support services to its Community of 50+ industrial companies and SMEs operating in several market sectors (e.g. Manufacturing, ICT, Transport, Construction, Environment, Energy, etc.). The service portfolio of UniSMART includes innovation radar activities, ICT competence assessment, technology rating, business modelling and planning, access to finance and investment support, market studies, as well as business development services, enabled by the knowledge of the University researchers across different disciplines and scientific areas.

Contact info: www.unismart.it

Inspiration



"Every idea becomes concrete; it materializes and becomes a reality."

Emile Coue

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Connect with us!

Are you eager to know more about the state of the art of lightweight concrete and ceramics?

Are you a professional or a company providing services that LightCoce might need?

Are you an expert in the field of lightweight materials?

Contact us to share your feedbacks and ideas on this page: info@ lightcoce-oitb.eu

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