POR Calabria 2014-2020
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UNIONE EUROPEA
FONDI STRUTTURALI E DI INVESTIMENTO EUROPEI

REPUBBLICA ITALIANA

REGIONE CALABRIA

3D BIOCOMED
Sviluppo in 3D di BIOCOMpositi per l'EDilizia

Funded by: POR CALABRIA FESR-FSE 2014-2020

ASSE I – Promozione della Ricerca Scientifica e dell'Innovazione

Obiettivo specifico 1.2 "Rafforzamento del sistema innovativo regionale e nazionale"

Azione 1.2.2 "Supporto alla realizzazione di progetti complessi di attività di ricerca e sviluppo su poche aree tematiche di rilievo e all'applicazione di soluzioni tecnologiche funzionali alla realizzazione delle strategie di S3"

AVVISO PUBBLICO per il finanziamento di progetti di ricerca e sviluppo

The project

The aim of the project "3D-BIOCOMED - Development in 3D of bio-composites for buiding industry" is the creation and experimentation of an industrial demonstrator for the 3D manufacture of innovative building components, starting from composites in natural fibres.

The Innovation Pole for materials managed by Calpark S.C.p.A., within its Research Agenda projects, has developed new materials particularly interesting for applications in green building.

These new materials are composites of natural fibres (plants and minerals) and polymerizable compounds from traditional chemistry. The advantage of new composites is that natural components are largely in the majority compared to traditional chemical components (epoxy and polyurethane resins). Natural components acquire a weight of more than 70% in the final composite materials, leaving the traditional ones below the 30%.

The study of the mechanical properties of the new composites highlighted their high mechanical strength and elasticity, and at the same time their greater lightness compared to traditional building materials (concrete conglomerates, etc.). Furthermore, the new materials, being composites, can house inside them absolutely healthy compounds that reduce their flammability and give them thermal and acoustic insulation properties.

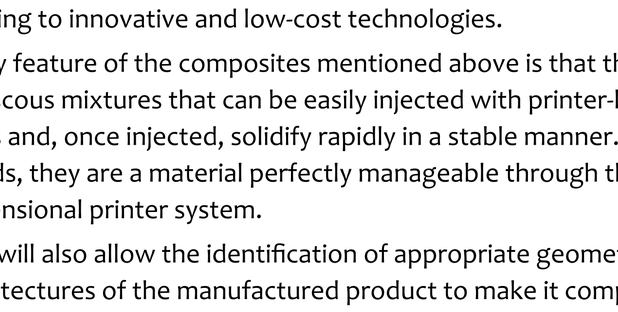
Scientific results have also been the subject of patents and scientific publications implemented by lead researchers at the Pole.

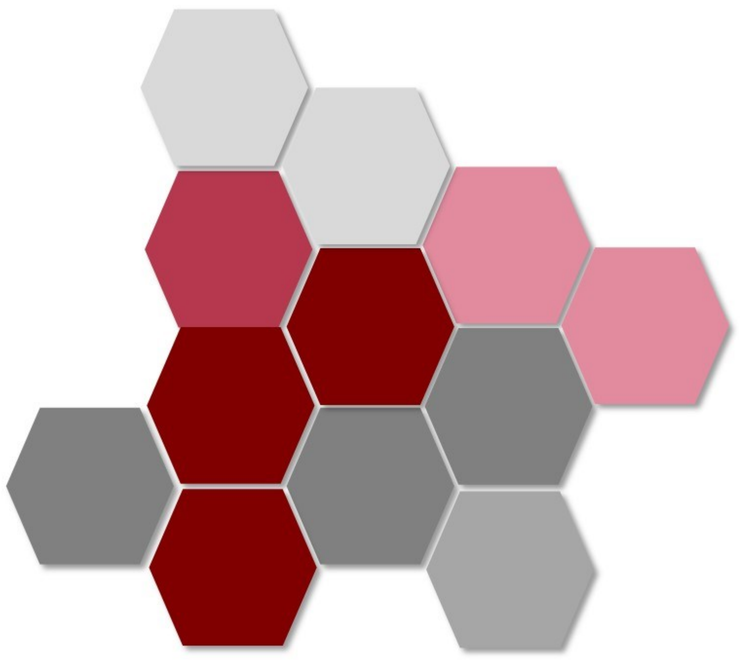
Since the developed materials lend themselves perfectly to the construction of components both in flat and three-dimensional form, which can be used in the building sector, the project aims to produce a prototype machine for the manufacture of these components, according to innovative and low-cost technologies.

A key feature of the composites mentioned above is that they are fluid viscous mixtures that can be easily injected with printer-like systems and, once injected, solidify rapidly in a stable manner. In other words, they are a material perfectly manageable through the three-dimensional printer system.

This will also allow the identification of appropriate geometries/ architectures of the manufactured product to make it compliant, in addition to the requirements on fire/fumes, toxicity, eco-compatibility, structural, also to thermal and acoustic requirements without resorting to further additions of insulation materials.

In practice the artefact, with a single monobloc of reduced dimensions, will meet all the requirements that can be reached today only using stratigraphies composed of various materials or large products. The product will also be bearing and not simply an infill material allowing to avoid the use of structures like pillars, today source of thermal bridges, difficult to eliminate and with additional costs.





Expected results

- Preparation of formulations of epoxy and polyurethane **composites, based on functionalised natural fibres** and other additives, which are able to confer important properties for applications in green building; they must also be printable through a 3D printing process.
- Realization of **an industrial demonstrator** for three-dimensional moulding process of natural fibre composites. The demonstrator shall include: 1) a screw-type mixer in which the various components, that can be simultaneously mixed and started to molding, are inserted; 2) extrusion heads that allow molding of predefined shapes. These heads must be interchangeable in order to guarantee continuous moulding process.
- **A moving head** for the 3D printer, powered by heated hoses, able to draw the designed geometries, so that the artefact satisfies all the requirements of an high efficiency building envelope.
- Some **artefacts** that meet the thermal, acoustic, structural, eco-compatibility and fire/smoke requirements and certified prototype tests that verify the compliance with the target requirements.

Project activities

The project consists of the below Work Packages.

WP1: Project management, dissemination and communication activities.

WP1 activities will concern: the coordination of project activities; the verification of their appropriate timing; the activation of effective external and internal communication; the verification of the consistency of the technical contributions produced according to objectives; the continuous monitoring of research progresses; the periodic preparation of technical reports and technical-administrative documentation to Calabria Region and / or the Management Body.

WP1 activities will also concern the exploitation and dissemination of results by using different sets of tools, such as articles and publications, presentations, seminars and workshops, realization of the project graphic identity and a bilingual website, targeted meetings with subjects potentially interested in the exploitation of project results.

WP2: Design of demonstrator and artefact

WP2 activities concern the design of the demonstrator, represented by an extruder and a "3D printing" machine, for the extrusion of prepared materials and the printing of a demonstration panel that meets all requirements.

It will therefore be necessary to jointly design a monobloc artefact which, with its particular architecture, meets all the requirements imposed by the objectives.

WP3: Development of material mixtures

Different types of materials will be selected for composites, available during the entire duration of the project, at low and competitive costs compared to the production of new composites for the green building materials.

The project will then continue with:

- the realization on a laboratory scale of polyurethane and epoxy composites, varying the composition of formulations and process conditions;
- the study of rheology under the consolidation phase;
- the study of chemical-physical properties (density, water uptake, aging by exposure to light, hot/cold cycles, vapors, etc.);
- the study of mechanical properties (elasticity, shear, tensile and compressive strength).

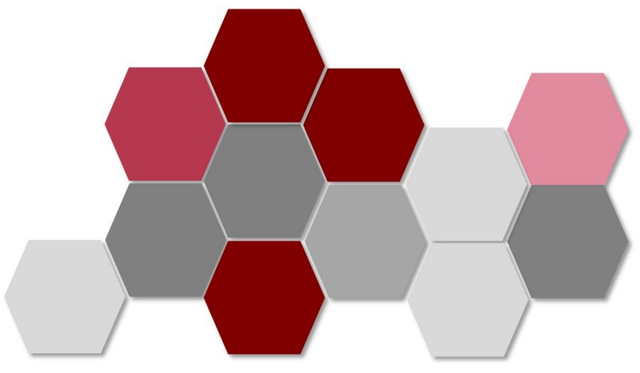
WP4: Realization of the demonstrator

In this phase the extruder and the Cartesian robot will be realized; they will take care of the nozzle movement and therefore of the artefact 3D printing.

WP5: Experimentation of the demonstrator and the artefact with the production of construction elements

The demonstrator and the artefact designed and realized through 3D printing will be experimented, by implementing the following main activities:

- Three-dimensional modeling of the constructive element to be produced;
- Model optimization for the printing using the demonstrator;
- Slicing configuration for printing with the product demonstrator;
- Slicing of the model and production of the G-code;
- Printing of the model; laboratory tests: with thermo-flow meter, acoustic insulation, reaction to fire, fire resistance, structural and eco-compatibility tests.



Project Partners

The project is carried out by a Temporary Association (ATS) which includes:

- **Z LAB S.r.l.** - Lead company - which operates in the industrial and civil sector and offers acoustics and RAMS analysis services
- **iMaS s.r.l. -** company operating in the sector of digital technologies (robotics, coding and 3D printing), applied to education
- **CALPARK S.C.p.A.** - Science and Technology Park of Calabria
- **University of Calabria -** Department of Chemistry and Chemical Technologies

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