Call for Exploratory Research Projects in all Scientific Domains 2024

FCT launches this call to fund exploratory research projects across all scientific domains.

19 december 2024 (17h)
Opening of applications

25 february 2025 (17h)
Closing of applications

February 26th 2025
Opening for acceptance of the application by the principal contractor

March 11th 2025
Closing for acceptance of application by the principal contractor

Overview and objectives

The consolidation and reinforcement of the National System of Science and Technology are key priorities of the national science and technology policy. These efforts aim to enhance national and international competitiveness in science and technology, foster innovation, and facilitate knowledge transfer. They also align with the global aspirations outlined in the United Nations' Agenda 2030 Sustainable Development Goals. In this context, promoting and strengthening scientific and technological institutions through the active participation of research teams in projects is particularly significant. To support these goals, FCT launches this call to fund exploratory research projects across all scientific domains, focusing on original projects for younger researchers, and on ideas or concepts with a high degree of novelty that demonstrate disruptive potential, compared to previous work, for more experienced researchers.

GENERAL DATA:

Title

Mycelium Composite Bio-Insulation Panels

Acronym

MyCoBIP

Keywords

Mycelium-based composite, insulation, *Pleurotus ostreatus*, energy efficiency

Project Typology

Exploratory Research Project

Scientific Domain

Engineering and Technology

Scientific Area

Industrial Biotechnology

Scientific Subarea

Bioproducts, Biomaterials, Bioplastics, Biofuels, Bio-derived Bulk and Fine Chemicals and Bio-derived Novel Materials

RESEARCH TEAM

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WORK PLAN

Abstract

Bio-composite insulation materials are emerging as cost-effective and environmentally friendly alternatives, minimizing environmental impact by reducing CO_2 emissions, lowering the carbon footprint associated with conventional building material manufacturing, and promoting circular economy principles through the repurposing of agro-industrial residues (**Zhang et al., 2022**). Mycelium-based composites (MBC) show strong potential as insulating materials due to their thermal and acoustic insulation properties compared to conventional products, along with advantages such as lightweight structure and even air-purifying capabilities (**Walter & Gürsoy, 2022; Al-Qahtani, Koç & Isaifan, 2023**).

Our project proposes the fabrication of an MBC using *Pleurotus ostreatus* cultivated on waste feedstock sourced from the Faculty of Sciences at the University of Lisbon (FCUL), with the goal of implementing these materials as insulation for classrooms and external walls of buildings that currently suffer complaints of lack of insulation or thermal comfort. The research team comprises three master's students in Applied Microbiology, with expertise in the cultivation of filamentous fungi through solid-state fermentation.

To achieve this, various combinations and ratios of feedstocks will be evaluated for their effectiveness as substrates, as the chemical and physical composition of each substrate significantly influences the final properties of MBCs. The feedstocks to be tested include different ratios of coffee grounds from the faculty's bars, compost from HortaFcul and cardboard or waste papers, all of which are abundant in the faculty's context. These materials will be sterilized, inoculated with a standardized mycelium ratio cultivated as one glass jar of spawn, for optimal and efficient fungal colonization and then placed into acrylic forms 500 mm (L) x 500 mm (W) x 50 mm (H) square shaped to grown into the insulation panel. Once fully colonized, the composites will be dried and coated with bee's wax, as proposed by Alaneme et al. **(2023)**, to ensure water resistance and durability. Finally, the panels will be mounted on the walls and covered with a fiberglass mesh before being painted.

The finished MBCs panels will undergo characterization tests, including assessment of growth morphology, density, thermal conductivity, and sound insulation performance (**Al-Qahtani, Koç & Isaifan, 2023**). These parameters will be benchmarked against commercial inorganic insulation materials to evaluate the thermo-acoustic performance of each formulation. The best-performing MBC formulation will be identified, and its feasibility as an effective solution for partially insulated classrooms will be assessed. If results are favorable, installation will proceed with the support of a professional construction team in the classrooms and outside of buildings with more complaints of thermal inadequacy.

State of Art and Objectives

According to the European Commission **(n.d.)**, 40% of the energy consumed by the European Union is used in buildings, of which 80% supports heating and cooling processes of homes. The Energy Performance of Buildings Directive **(EU/2024/1275)** provides a legislative framework and policies to help achieve the European Green Deal's objectives for greener buildings with high energy efficiency, as well as to decarbonised building stock by 2050.

Bio-composite insulation materials are emerging as cost-effective and innovative solutions to minimize environmental impact from the manufacture of construction materials and to reduce energy consumption related to construction and maintenance of comfortable thermal indoor environments

(Chen et al., 2024). Recently, an increasing number of authors **(Al-Qahtani, Koç & Isaifan, 2023; Bonga et al., 2024; Chen et al., 2024; Walter & Gürsoy, 2022)** have acknowledged mycelium-based composites (MBC) as an economical and environmentally beneficial novel insulation material due to their acoustic and thermal insulation as well as air purification and carbon sequestration properties. As such, MBC may present an innovative solution for greener energy performance for both new and old buildings, in line with EU guidelines and directives, while increasing thermal and acoustic comfort for indoor environments.

MBC materials are constituted by the growth of interweaving hyphae of selected fungal species on lignocellulosic substrates, ultimately forming a highly porous, cost-effective and fire-resistant material **(Fellah et al., 2024)**. As pointed out by Walter & Gürsoy **(2022)**, one problem for in the large-scale implementation of MBC production is the difficulty in establishing stable growth and fabrication protocols because porosity and microstructure of the material varies significantly according to the combination of fungal species, base substrate and growth conditions. *Pleurotus ostreatus* is a popular choice when it comes to selection of the mycelium fungal species, mainly due to its fast growth rate and adaptability to different conditions, low-resource and quickly grown on a diverse range of natural substrates, including lignocellulosic waste from the agricultural industry, contributing to a circular economy logic.

Bonga et al. **(2024)**, successfully developed an MBC based on a coffee industry byproduct and the mycelium from *P. ostreatus*. The final product presented thermal and acoustic isolation values that compete with other conventional insulation materials such as polyurethane foams or glass wool. As review by Al-Qahtani, Koç & Isaifan **(2023)**, MBC's ability to maintain thermal indoor comfort, capacity to absorb sound and atmospheric particulate matter thanks to its porous, fibrous and low-density structure. Another MBC of *P. ostreatus* mycelium grown on rye berries produced by Zhang et al. **(2022)**, demonstrated high thermal inertia, stabilizing indoor temperature fluctuations while at the same time reducing energy consumption, from annual heating and cooling, and CO_2 emissions, by an average of 10% when compared to the use of lightweight clay aggregate and expanded vermiculite, of two conventional natural insulating materials.

The Faculty of Sciences of the University of Lisbon (FCUL) is devoted to promoting sustainable energetic and hydric resources consumption and management. As denoted by the Ciências Sustainability Report 2019-2021 **(Sustainability Commission of The Sustainability Living Lab, 2023)**, FCUL strongly defends the United Nations Sustainable Developmental Goals (SDG) in education, research and investigation, employing performance indicators for its facilities. FCUL also promotes initiatives from the community that aim to solve social problems and provide visibility on alternative sustainable development solutions.

In line with the SDG and the Energy Performance of Buildings Directive defended both by FCUL and the European Green Deal's strategy, we propose the development of an MBC created by growing *Pleurotus ostreatus* mycelium on residues found at FCUL campus, including coffee grounds from FCUL bars, compost produced at the HortaFCUL and waste cardboard that comes with new lab equipments. We aim for an "in-house" composite that is feasible to produce on FCUL grounds and can be utilized on external and internal walls of FCUL buildings and classrooms in order to improve thermal insulation and reduce heating and cooling expenses. According to remarks made by teachers and students, and as denoted by the Ciências Sustainability Report 2019-2021 **(Sustainability Commission of The Sustainability Living Lab, 2023)**, classrooms in the C1 and C2 buildings, as well as C3 amphitheatres, are at many moments throughout the year too cold, demanding higher energy inputs for the heating systems, only active on C3 amphitheatres, or too hot and lacking ventilation, especially on the upper floors on C2 building. The proposed MCB, when placed inside classroom, would also function to promote air quality in these closed environments due to its atmospheric adsorption properties. Finally, the MBC would provide pleasant class ambience, reduce noises from the corridors and other floors as a result it's the sound absorption properties.

We chose *Pleurotus ostreatus* because this species has a decent amount of investigation backing up its valuable properties as a mycelium network suitable for this kind of composite **(Al-Qahtani, Koç & Isaifan, 2023; Chen et al., 2024; Pires, 2017; Walter & Gürsoy, 2022)**, the easiness to grow on various substrates with minimal contamination and most important because it's a familiar species to FCUL present in its culture collection for investigation and classes (Teresa Granja, personal communication, 13/05/2025). Inspirated by the Dilena Fungi Project (**https://ciencias.ulisboa.pt/pt/dilena-fungi**), we propose to once again instal the circular economy framework at FCUL, and base our substrate for the mycelium growth on coffee grounds, organic compost and waste cardboard produced in the campus by numerous activities. With this innovative material we not only plan to promote ecological friendly and energy efficient buildings, but also to improve well-being for this learning place and synergies between all Ciências' community.

Research Plan and Methods

The main aim of this project is to develop a versatile MBC to be employed in both acoustic and thermal insulation of FCUL buildings, enhancing the energy efficiency and comfort of employees and students.

Compost matter from HortaFCUL, coffee grounds from (Fcul bars) will be used as feedstock, as well as waste cardboard and paper scraps will be used as substrate for MBC production inoculated with the faculty's *P. Ostreatus* strain.

Task1 constitutes the preparation of substrate materials and sterilization of mixtures. Waste cardboard and paper (WC) will have to be shredded prior to partitioning and sterilization. Compost matter from HortaFCUL (HC) is as a result of the composting process sufficiently decontaminated to be sterilized in autoclave and coffee grounds (CG) from the faculty's bars are finely ground and need no pre-treatment beyond sterilization. Partitioning of these substrates will yield 4 different mixtures: A (1/3 WC 1/3HC 1/3CG); X (2/3WC;1/3HC+CG); Y (2/3HC; 1/3 CG+WC) and Z (2/3CG;1/3 WC+HC).

Task 2 will consist in the cultivation of P. Ostreatus spawn. To ensure the availability of a sufficient inoculum to produce the MBC, *P. ostreatus* will be grown from pure culture, present in FCUL's culture bank, on autoclaved wheat grains in glass jars and incubated at 25 ºC in the dark for two weeks**.**

Task 3 encompasses the construction of perforated acrylic forms and the distribution and inoculation of the substrate mixtures. Square acrylic forms 500 mm (L) x 500 mm (W) x 50 mm (H) will be disinfected with 70% ethanol in which a substrate mixture will be distributed, previously homogenised and inoculated with *P. ostreatus* spawn cultivated in task 2. The 12 acrylic forms will be built to test the 4 different ratios of substrate composition, A, X, Y and Z, with 3 replicates each.

Task 4 includes the incubation of the MBC forms and neutralization of the mycelium. Growth will proceed in an incubation chamber at 25 ºC and 75% relative humidity for 3 to 4 weeks. The forms will be flipped every week to ensure homogenous mycelial growth after which the panels will be removed and the mycelium neutralized by dehydration at 60ºC for 5 hours with an expected decrease in volume of the obtained MBC.

Task 5 requires characterization and testing of mechanical, acoustic and thermal insulation properties of the obtained MBCs. Following the neutralization of the mycelium, morphological, mechanical and thermal characterisation of the MBC panels will be done allowing the identification of the best production substrate and selection of the best panel for each desired function.

Acoustic insulation will be assessed via the use of a simple sound level meters in an impedance tube. The different MBCs will be tested with 3 replicate samples each against sound frequencies of 100Hz to 2000Hz by intervals of 100Hz **(Bonga et al., 2024).** Bees wax can be used as a protective layer applied if needed to prevent degradation of the MBC for an acoustic insulation application **(Alaneme et al., 2023)**.

Thermal insulation potential is determined by thermal conductivity measurements with use of the TPS (transient plane source) method requiring preparation of samples in which the chosen TPS sensor (Hot Disk TPS 2500 S) will be placed. Two samples (50mm(H)x 150mm(L) x150mm(W)) will be cut from the various MBCs with three replicates each. Each pair will be stacked in between which the sensor is placed before proceeding with the measurements **(Pires, (2017).**

Mechanical and morphological characteristics will be assessed by photographs to characterise the growth of the Mycelium and its structural integrity since this material structure depends largely on the characteristics of the substrates and on the growth of the mycelium.

Task 6 will look for application solutions to both main objectives of this project. Best performance acoustic insulation panels can be regrown and applied to classrooms after a protective coating of beeswax. Pannels can be nailed or glued to the walls with no further treatment necessary. Thermal insulation MBC panels can be applied in the exterior of buildings with screws, following the addition of reinforcing render mesh made from woven fibre glass and then painted.

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TASKS

1

Substrate Preparation

The ingredients of the established substrate formulation will be collected and weighed out to the necessary weight. For the waste cardboard and paper (WC), collected from laboratories and waste card recycle bins and compost, the material will be grinded to more appropriate particle size. Organic compost will be requested to HortaFCUL, and coffee grounds from the multiple bars and vending machines dispersed in FCUL's campus.

After collection of a satisfactory quantity of substrate ingredients, 4 different mixtures will be formulated: A (1/3 WC 1/3HC 1/3CG); X (2/3WC;1/3HC+CG); Y (2/3HC; 1/3 CG+WC) and Z (2/3CG;1/3 WC+HC).

Finished substrates will be stored in separated polypropylene bags. According to the measured innate humidity of each formulation, water will be added to adjust the humidity to 65%. The bags will then be sterilized at 121ºC for 2.5 hrs.

Duration: 4 weeks
Costs: Polypropylene bags

2

Spawn Production

First, *Pleurotus ostreatus* cultures from the FCUL culture bank will be reactivated on PDA medium petri dishes. After 10-12 days, when the mycelium has fully colonized the petri dishes, in the sterile environment of a biosafety cabinet, a 1x1cm wedge of mycelium on agar will be transferred to 3 new PDA petri dishes.

To prepare the spawn substrate, wheat grains will be hydrated for 12 hours until full hydration, demonstrated by the swelling of the grain with few grains having burst. The water will be drained. The grain will be mixed with chalk and calcium carbonate at the right proportions (2% and 0.5% respectively) and 1% water will be added to balance the moisture. The mixture will then be homogenized thoroughly. Jars with appropriate air exchange filters will be filled with 0.5 kg of the mixture. The jars will be sterilized in the autoclave.

Once the 3 petri dishes have been fully grown out with mycelium, in the biosafety cabinet, 2X2 cm wedges of the agar will be added to each of the spawn substrate bags. These jars will be let to colonize for 12-14 days at 25ºC.

Duration: 4 weeks
Costs: Petri dishes, wheat, supplements, jars, PDA medium

3

Acrylic Forms Inoculation

The 12 acrylic forms will be made to custom built with the established dimensions, 500 mm (L) x 500 mm (W) x 50 mm (H) and disposed in the final positions inside the incubation chamber. These forms also have perforations to enable gas exchanges.

Each glass jar of grown spawn will be combined with the different substrates A, X, Y and Z prepared at task 1 and thoroughly homogenized to distribute the grains throughout the substrate equally. The 12 acrylic forms will test the 4 different ratios of substrate composition with 3 replicates each.

Duration: 2 weeks
Costs: Acrylic sheets

MBC Incubation and Monitoring

Combinations of substrate and mycelial spawn will be incubated in adjusted conditions for optimal growth at 25ºC and 75% humidity in the dark for an estimated period of 3-4 weeks.

Monitoring will include weekly manual flipping of the forms to ensure full colonization and homogeneous growth of the mycelium. After of adequate mycelium growth in the substrate, the forms will be neutralized by dehydration at 60ºC for about 5h. Height of the forms was already designed, in task 3, as 50 mm keeping in mind the decrease in volume concurred with the dehydration process.

Obtained MBVs will be morphologically described right after adequate dehydration through measurement of the final panels, size standardization and photos will be taken to better analyse colour and compared the products.

4

Duration: 6 weeks
Costs: Dryer service and incubation chamber

MBC Testing

Acoustic dampening characteristics will be tested for each MBC produced. For each MBC group, a round 100 mm and a 29 mm diameter samples will be cut from each replicate with a bandsaw, sanded to a flat surface and mounted on a Brüel and Kjær's Impedance Tube Kit (50 Hz–6.4 kHz) Type 4206 with an ASTM E1050-12 standard.

Acoustic impedance will be performed for a frequency range of 100Hz to 2000 Hz in intervals of 100 Hz. The 100 mm diameter sample will be tested against lower frequencies (100-1600 Hz) and the smaller 29 mm diameter against higher frequencies (600-2000Hz). This will be repeated for each MBC replicate and a subsequent statistical analysis will be performed to obtained absorption coefficients allowing the identification of the best MBC for this role.

Thermal insulation capacity will be assessed by measuring the thermal conductivity of each MBC group. Samples will consist in 150mm by150mm and 2,50 mm thick square portions of the MBC panel which will then be stacked with the Hot Disk TPS 2500 S sensor in between. Thermal conductivity results of the different replicates of each MBC group will then be statistically analysed to establish the most adequate MBC for thermal insulation.

5

Duration: 4 months
Costs: Impedance tube kit, Bandsaw, TPS sensor

Construction Setup

This task includes public perception, appreciation and the dissemination of the project's idea and communication with FCUL's administration services and staff. The main goal is the

6

application of the produced MBC's panel at the most needed FCUL's places which we intend to localize trough public needs and contacts.

At the beginning of the project our team will start contacts with HortaFCUL and FCUL administration to discuss the best course of action for the implementation of the project. Ciências' Community will be challenged with questionaries and formularies to understand the most urgent needs and final objective of our proposed MBC.

During the project's time span we intend to divulge it with small publications and updates inside FCUL grounds, major outcomes will also be published at national level and tests results from task 5 will be collected for a final publication at a scientific journal.

After production and testing of the MBC's panels the main step is implementation and collect data about public perception and appreciation of the applied panels. Implementation includes a previous treatment of the panels with a protective coating of beeswax followed by simple nailing or gluing to the assigned walls. Additionally, MBC panels for overall buildings' thermal insulation can be applied on exterior walls with screws, following the addition of reinforced render mesh made from woven fibre glass and paint.

Duration: all project
Costs: Construction service, Fiber glass, Paint

MILESTONES LIST

∗ M1: Communication with FCUL community

Month 1: Requires inquiry of FCUL community to assess the necessity and optimal locations for the installation of the MBCs.

∗ M2: Substrates Inoculated

Month 3: Milestone 2 includes the conclusion of inoculation that is required for the progression of further tasks as it is the beginning of the growth process of the MBCs. At this point we will perform our first progress report describing the methods used and conclusions about public perspectives.

∗ M3: Ready for Testing

Month 4: Milestone 3 is associated with the end of task 4. After the dehydration and morphological characterization of the MBCs, testing of the different panels produced can begin to assess their performance.

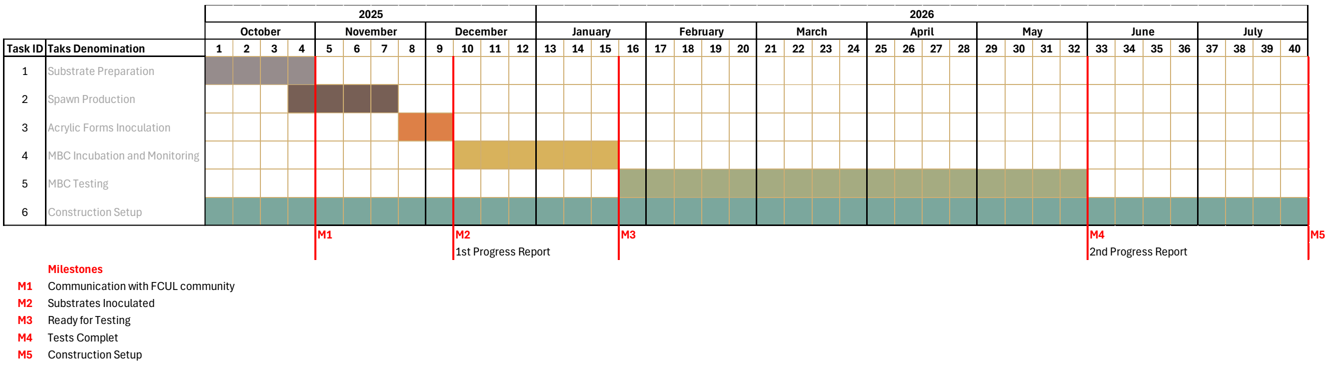
* M4: Tests complete

Month 8: Milestone 4 is concluded simultaneously with task 5. With the Performance of the MBCs evaluated, the application of the Final panels can proceed to a small-scale building plan. A progress report will be written at this stage about the main conclusions of the MBCs testing.

* M5: Construction setup

Month 10: The final milestone is comprised of the installation of the best MBC panels chosen for the specific roles in mind, acoustic and thermal insulation. At the end, a final scientific publication containing methods, results and difficulties throughout the project's duration will be released.

Timeline



Ethical Issues

None applied

2030 Agenda

This project is of relevance to the UN Sustainable Development Goals: **7 (Affordable and Clean Energy)**, **9 (Industry, Innovation and Infrastructure), 11 (Sustainable Cities and Communities)** and **12 (Responsible consumption and production),** considering that it proposes the fabrication of a biodegradable insulation material based on residues with the objective of improving buildings' comfort and liveability while reducing energetic dependency for temperature and air control.

Indicators

Expected output indicators and Dissemination

To prove the suitability of the proposed fabrication and application of a mycelium-based composite (MBC) in the Faculty of Science of the University of Lisbon (FCUL) buildings and classrooms we first aim to collect information through a survey to the FCUL community about users' perception regarding their thermal comfort and energy consumption patterns. Our main target will be the students, professors and staff that work in C1 and C2 buildings, which do not present heating or cooling systems. It has been reported and is a frequent topic of discussion that these buildings easily become overheated in summer or cold in winter.

With this survey we aim also to present our project and see the general perception of the FCUL community towards the implementation of an MBC. With the results from the survey, we plan to elaborate a report to divulge Ciências' community needs and our project, to the FCUL directive boards for further validation and dissemination of the project.

The team also plans on participating in seminars, training sessions and talks with experts in mycelium growth and biomaterials manufacturing. We will first start by making small prototypes to help promote and present the project in FCUL and external sustainable innovation events. As each milestone is completed, we intend to produce publications about the aspects and novelties we fund through the project development. Some accomplishments will be suitable for publication in national publishers for citizen science outreach like Casa das Ciências and Rede Nacional da Ciência Cidadã.

When our MBC presents the intended characteristics, we will test it in some classrooms and the results will be published as a more traditional article in a scientific journal. With our results we expect to provide a sustainable source and manufacturable material that besides its insolation and acoustic properties promotes comfort and good environment at a learning and research development centre as it is the Faculty of Sciences of the University of Lisbon.

Budget

<table>
<tr><th>Nº</th><th>Task ID</th><th colspan="6">Type of expenditure and Justification</th></tr>
<tr><td rowspan="3">1</td><td rowspan="3">**Substrate Preparation**</td><td>Human Resources (HR)</td><td>Materials (M)</td><td>Knowledge Dissemination (KD)</td><td>Equipment/ Services (ES)</td><td>Extras (10%)</td><td>Total</td></tr>
<tr><td>2 500 €</td><td>40 €</td><td></td><td>2 500 €</td><td>504 €</td><td>5 544 €</td></tr>
<tr><td colspan="6">HR includes 2 participants that will collect and process the chosen substrates. M includes polypropylene bags required in this task. ES corresponds to shredder used to homogenize the substrates and use of the autoclave to sterilize them.</td></tr>
<tr><td rowspan="3">2</td><td rowspan="3">**Spawn Production**</td><td>Human Resources (HR)</td><td>Materials (M)</td><td>Knowledge Dissemination (KD)</td><td>Equipment/ Services (ES)</td><td>Extras (10%)</td><td>Total</td></tr>
<tr><td>2 500 €</td><td>350 €</td><td></td><td>100 €</td><td>295 €</td><td>3 245 €</td></tr>
<tr><td colspan="6">HR includes 2 participants that will prepare the wheat grains to reactivate the fungal growth. M includes PDA medium, wheat grains, glass jars, supplements necessary for propagation of spawn and Petri dishes needed for this step. ES is associated to use of autoclave.</td></tr>
<tr><td rowspan="3">3</td><td rowspan="3">**Acrylic Forms Inoculation**</td><td>Human Resources (HR)</td><td>Materials (M)</td><td>Knowledge Dissemination (KD)</td><td>Equipment/ Services (ES)</td><td>Extras (10%)</td><td>Total</td></tr>
<tr><td>3 000 €</td><td>165 €</td><td></td><td>250 €</td><td>341.5 €</td><td>3 756.5 €</td></tr>
<tr><td colspan="6">HR includes 3 participants that will be required to construct the perforated acrylic forms and inoculate them. M is required to obtain the acrylic panels mentioned In Task 3. ES refers to a band saw that will be needed to construct the acrylic panel forms.</td></tr>
<tr><td rowspan="3">4</td><td rowspan="3">**MBC Incubation and Monitoring**</td><td>Human Resources (HR)</td><td>Materials (M)</td><td>Knowledge Dissemination (KD)</td><td>Equipment/ Services (ES)</td><td>Extras (10%)</td><td>Total</td></tr>
<tr><td>2 500 €</td><td></td><td></td><td>3 500 €</td><td>600 €</td><td>6 600 €</td></tr>
<tr><td colspan="6">The budget for HR includes 2 participants that will closely monitor the growing mycelium on the acrylic forms as stated in task 4. ES budget includes the drying oven buy or service rent for mycelium dehydration and incubation chamber occupation fees.</td></tr>
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<table>
<tr><td rowspan="3">5</td><td rowspan="3">MBC Testing</td><td>Human Resources (HR)</td><td>Materials (M)</td><td>Knowledge Dissemination (KD)</td><td>Equipment/ Services (ES)</td><td>Extras (10%)</td><td>Total</td></tr>
<tr><td>2500 €</td><td>500 €</td><td></td><td>12000 €</td><td>1500 €</td><td>16 500 €</td></tr>
<tr><td colspan="6">HR includes 3 participants that will sample the MBC panels and perform the acoustic impedance and thermal conductivity tests. M includes computers and software for statistical analysis. ES budget corresponds to the Impedance tube kit and Transient Plane Source thermal conductivity sensor and associated software.</td></tr>
<tr><td rowspan="3">6</td><td rowspan="3">Construction Setup</td><td>Human Resources (HR)</td><td>Materials (M)</td><td>Knowledge Dissemination (KD)</td><td>Equipment/ Services (ES)</td><td>Extras (10%)</td><td>Total</td></tr>
<tr><td>300 €</td><td>1 000 €</td><td>7 000 €</td><td>10 000 €</td><td>1 830 €</td><td>20 130 €</td></tr>
<tr><td colspan="6">HR budget includes the team personnel who are responsible by the project management and dissemination.
KD budget includes the expenses associated with publications, conference and public communication.
M budget for this task includes the protective coatings like beeswax, glass fibre and paint to be applied at the final MBCs panels when application through FCUL’s buildings takes place.
The budget for ES is the estimated price needed to pay for the application of the panels by a professional construction service, contracted externally.</td></tr>
<tr><td colspan="2">TOTAL Budget</td><td colspan="6">55 775.5 €</td></tr>
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