Eco-friendly material production with agricultural waste in sustainable construction materials

Fadhel ALOULOU

Professor at ESSTHS, University of Sousse, Tunisia

Director of Materials and Energy laboratory : LabEM (LR11-ES34)

Sousse, Tunisia

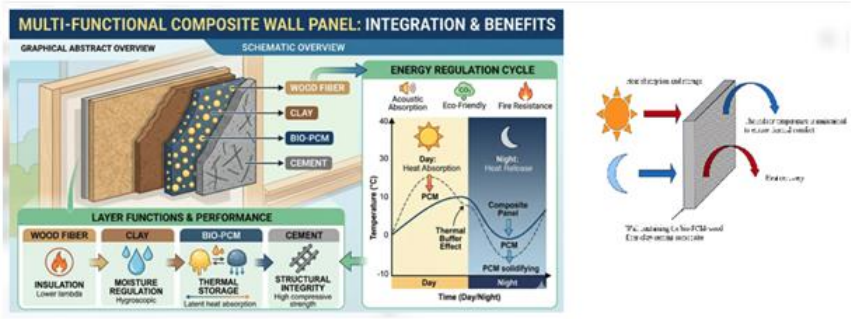
Project Idea: Cluster 5: Climate, Energy and Mobility

Destination 4: Using energy in buildings and industry in an efficient, affordable and sustainable way

HORIZON-CL5-2026-09-D4-08: Full-scale demonstration of heat upgrade solutions in industrial processes

- **Objectives:** The goal of this initiative is to create a circular economy standard for the entire region by integrating recycled construction waste into new road infrastructure. This startup reduces agricultural waste by transforming it into sustainable synthetic wood for the manufacture of sustainable building materials. This project, focused on social housing and ecological integration, trains young researchers to build high-energy-performance houses from compacted earth blocks mixed with natural agricultural waste. This project promotes the use of bio-based interior finishes that enable natural energy management within eco-friendly homes.
- **Expected Results**: The following trends are expected regarding energy consumption in the building sector:
- • To reduce energy consumption in the construction sector, it is essential to:
- • Compile a list of the energy consumption of building materials, address the root causes, and penalize energy-intensive products. Eco-friendly material production with agricultural waste in sustainable construction materials.
- • Use advanced methods and materials to reduce energy consumption throughout the building's life cycle.

- Solving the problem of agricultural and environmental wast.



About

With two imperatives addressing the climate disaster and lowering the rising energy demand brought on by the current global population explosion the construction and building industry poses a significant worldwide challenge. Furthermore, the energy demand for buildings is rising significantly due to population expansion and fast rising purchasing power in developing nations; this demand could expand by 50% in the years to come. Furthermore, as the construction industry accounts for 40% of all energy consumption, it offers the greatest opportunity for energy savings and significant potential for lowering carbon emissions. In an effort to design sustainable, low-carbon structures, the use of plant-based and bio-based building materials has been explored for a number of years. There are currently many different kinds of bio-based building materials accessible, with an emphasis on a variety of uses for the eco-design of new structures and the repair of existing ones.
In fact, because of their remarkable hygrothermal qualities, bio-based materials can greatly enhance the indoor thermal comfort of buildings (controlling temperature and relative humidity). Because eco-construction using biomaterials lowers carbon emissions by more than 50% for every new square metre built, public bodies have expressed a strong interest in this approach. Future generations' quality of life may be negatively impacted by the pollution levels seen in recent decades. They have prompted extreme measures to lessen the ecological imprint in all areas. This is definitely the reason for the recent rise in environmental consciousness and sustainability awareness. Using sustainable construction materials is one of the many methods that can be used to create an environmentally friendly structure. These are parts that have had as little of an ecological impact as possible during their design,

installation, and upkeep. At the moment, a significant quantity of non-renewable energy is used by the building industry. Researchers are working to create a new generation of environmentally friendly bio-renewable structures in response to the reduction of high carbon emissions and global warming.

The substantial use of air conditioning systems, which is indicative of the low energy performance of these building envelopes, can account for such building energy use. Thus, it is evident that the traditional building materials brick, mortar, and cement concrete are inappropriate for the climate of the area. These materials also have detrimental effects on society and the environment. Research has been done to provide environmentally friendly building materials with better thermal performance based on these findings more eco-materials, such as clay-rice straw composites, compacted concrete including laterite and glass waste, and burnt clay blocks containing wood ash expanded polystyrene and glass particles, have been developed and characterised as a result of numerous more investigations.

None of the created eco-materials have undergone thorough characterization that is, the simultaneous assessment of all its mechanical, durability, thermal, hygroscopic, and physical properties among all the investigations mentioned. All of this explains why the nation's eco-materials for creating sustainable structures have not been widely adopted.

Additionally, the abuse of air conditioning equipment, especially in buildings, is caused by the lack of national or regional thermal comfort regulations. For residents of hot, humid areas like southern Tunisia, such a temperature is regarded as comparatively low. Therefore, even with a bio-based envelope, aiming for a temperature of 26°C in a building will probably result in energy waste, which is why a comfort study is necessary.

The following patterns can be seen in the building sector's energy consumption:
• In order to lower construction sector energy usage, it's critical to:
• Compile a list of construction materials' energy usage, deal with the root reasons, and penalise energy-intensive goods.
• Use cutting edge methods and materials to lower energy usage over the course of the building's life cycle.
The use of innovative composite materials is advantageous not only in terms of cost and energy but also in terms of lowering the frequency of natural fibre production and resource usage. Natural fibres provide superior mechanical and thermal qualities and are renewable. Additionally, these fibres can take the role of carbon and glass fibres in a variety of applications.

In fact, within the industry, these natural fibers represent a significant economic sector due to the advantages they offer to many industries.

Topic

- Decarbonisationof energy intensive industries (IA)(Processes4Planet and Clean Steel partnerships)
- Clean Technologies for Climate Action
- Efficient energy input from renewable sources and energy management in the process industries (Processes4Planet and Innovative Advanced Materials for the EU partnerships)
- Advanced manufacturing for key products (Made in Europe partnership)
- Innovative advanced materials and new production processes – reducing dependencies on Critical and Strategic Raw Materials (Innovative Advanced Materials for the EU and Processes4Planet partnerships)
- Circular innovative advanced materials: facilitating the transition from design to markets (RIA) (Innovative Advanced Materials for the EU and Made in Europe partnerships)
- Technologies for innovative processing of raw materials
- Boosting biorefinery competitiveness through biotech
- SSbD bio-based alternatives for fertilising and/or crop protection products
- SSbD bio-based solutions for home and/or personal care
- Biotech routes for valorisation of residual biomass
- SSbD bio-based polymers from alternative sources