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كلية العلوم الدقيقة



PEOPLE'S DEMOCRATIC REPUBLIC OF ALGERIA
MINISTRY OF HIGHER EDUCATION AND SCIENTIFIC RESEARCH
Constantine 1 University – Frères Mentouri
Faculty of Exact Sciences

ANNONCE DE SOUTENANCE



Conformément à la décision n° 53/D3C/2026 du 04 Mai 2026 autorisant la soutenance d'une thèse de doctorat, le Vice-doyennat chargé de la post-graduation, de la recherche scientifique et des relations extérieures, a n o n c e la soutenance publique d'une thèse de DOCTORAT :

Le Samedi 16 Mai 2026 à 16 HOO

Lieu : Salle de conférences sise au Campus Chaab Errsas.

Filière : PHYSIQUE

Spécialité : Energies Renouvelables

Doctorante : **BELHADAD Halima**

Sur le thème: « Study on heat and moisture transfer in a multilayer building envelope made of bio-based materials ».

Devant le jury d'examen :

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A b s t r a c t

The construction sector faces increasing pressure to reduce its environmental footprint while ensuring adequate thermal, hygric, and mechanical performance of building envelopes. Although bio-based construction materials have been widely investigated, olive husk remains generally under-documented in the scientific literature, and its hygric behaviour, particularly in terms of moisture transfer and buffering, has not been systematically studied. In addition, intrinsic limitations of olive husk, notably its residual oil content, are frequently identified as barriers to its effective incorporation into mineral matrices, highlighting the need for a rigorous experimental assessment.

This thesis addresses these gaps by evaluating olive husk as a multifunctional bio-based resource for construction materials, with a specific focus on heat and moisture transfer behaviour. An experimental multi-scale approach was adopted, encompassing raw material characterisation and composite material development. Raw and treated olive husk, as well as isolated olive bones, were fully characterised based on RILEM TC BBM recommendations. Olive husk was subsequently incorporated into three material families: lightweight bio-concretes, mortars (cement-based and earth-based), and fully bio-based insulation panels. The resulting composites were experimentally characterised with respect to thermal properties governing heat transfer (thermal conductivity, specific heat capacity, thermal diffusivity, and effusivity), hygric properties governing mass transfer (water absorption and moisture buffering capacity), and mechanical performance.

The results demonstrate that olive husk treatments significantly reduce residual oil content and improve binder compatibility. In lightweight concretes, partial replacement of mineral aggregates by olive husk led to substantial reductions in density and thermal conductivity, together with enhanced thermal inertia. Earth-based mortars incorporating raw olive husk, particularly when stabilised with gum Arabic, exhibited effective moisture regulation, limited shrinkage, and adequate mechanical strength for non-load-bearing applications. Fully bio-based olive husk–gum Arabic insulation panels showed low thermal conductivity, very low thermal diffusivity, high specific heat capacity, and exceptional recyclability.

Overall, this work demonstrates that olive husk–based composites can be combined to form bio-based wall systems with enhanced thermal and hygric performance, enabling efficient regulation of heat and moisture transfers and supporting their use in sustainable building envelopes adapted to Mediterranean climates.