Politecnico di Torino

# Honors Thesis

Master of Science in Sustainable Architecture

## Abstract

**Valorization of agricultural by-products of the Sicilian territory.
Thermal, hygroscopic and acoustic performance of materials and components for sustainable buildings derived from olive trees pruning**


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September 2022

The research activity here carried out, originates in the Sicilian territory, in particular in the province of Trapani. Sicily, among the first in Italy for cultivation of olive groves and oil production, generates from the agricultural activities of pruning olive trees a large amount of residues, which in most cases, by custom or unawareness, are burned within the fields producing CO2 emissions into the atmosphere.

The objective of this work was, specifically, to investigate the potential of materials and components derived from olive tree pruning chips for application in the building sector, through the evaluation of thermal, hygroscopic, acoustic, and aesthetic performance.


**Figure 1.** The production process of the by-product from olive tree prunings

The research consisted of several stages: finding the agricultural by-product obtained from pruning wood chips; making samples of insulation panels using a natural binder composed of water and flour; conducting experimental investigation. Given the positive results related to the stability of the panel, made at this stage of the research with a simple natural binder for practical feasibility reasons, the next step was executing numerous tests for thermal, hygroscopic, and acoustic characterization of some mixture variants. A total of eight specimens was realized and classified through the general TX_O% P% criterion, thus depending on the percentage content of olive tree pruning wood chips (O), shredded wood chips (OB), and a second purely associative by-product for experimental issues regarding the ratio in grams between wood and glue (w/g), namely pine shavings (P). The first realized sample was T1_P100, consisting of 100% pine chips with w/g equal to 40/70, and then the ratio of pine shavings, olive wood chips and glue has been swept until the realization of sample T10_O100, with 100% olive wood chips and w/g equal to 40/50. The intermediate produced samples are: T2_O25P75, T3_O50P50, T5_O75P25, T6_O90P10, T7_OB90P10, T9_OB100. The hygroscopic characterization involved all the above-mentioned samples, as well as the acoustic characterization, which was also conducted on the pine and olive loose samples. In contrast to the above, thermal characterization involved only samples T3_O50P50, T10_O100, and loose olive tree pruning chips.


**Figure 2**. Samples produced with increasing percentage composition of olive wood chips

Tests of thermal conductivity, specific heat, Moisture Buffer Value practical and sound absorption coefficient of both bonded and loose samples were conducted in the laboratories of the Energy Department of the Polytechnic University of Turin. The results obtained, which were particularly encouraging, showed how the valorization of these agricultural by-products is a way forward. In this direction, possible applications in the construction field were then hypothesized, although remaining in an exploratory phase prior to technological application. In particular, two insulated drywalls, one with loose pruning wood chips and the other with bonded panel, were subjected to performance evaluation and comparison with conventional solutions, and some configurations of sound-absorbing and moisture-regulating structures were designed to be placed on the interior surfaces of the rooms, with photorealistic rendering through modeling and rendering of the internal environments.

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