

POLITECNICO DI TORINO
SECOND SCHOOL OF ARCHITECTURE
Master of Science in Architecture for the Built Environment
Honors theses

Plaster as active element to manage indoor environment thermal conditions in winter and summer

Research and development for plaster formulation with vegetables, PCM and Aerogel
by Cinzia Ferrua

Tutor: Valentina Serra

Co-tutors: Marco Dutto, Marco Massolino

This thesis is based on the activities carried out during the training period spent in Vimark, a Piedmontese enterprise that has been manufacturing materials, systems and providing services for specialized customers in the building industry for the past 30 years.

Through the study of Italian and European legislation concerning energy efficiency in buildings (in particular of D.Lgs 19/08/05 n. 192, D.Lgs 29/12/06 n. 311 and of the European Directive 2002/91/CE), introducing very restrictive limits for what concern thermal transmittances of building envelopes, it has been possible to underline the evolutionary process regarding the plaster in the latest years.

This building component has been transformed from protection and finishing element to a functional layer characterized by its own internal structure presenting thermophysical properties able to contain and reduce the heat losses through the building envelope.

In particular the search for systems able to improve the energy performance of buildings has led manufacturers to introduce natural or synthetic insulating aggregates within plasters, allowing to develop a new generation of plasters with improved insulation and inertia properties.

The in-depth analysis on insulating plasters has been strongly stimulated by the involvement of Vimark, during the thesis work, in two research projects, SI² and HIPIN, whose goals were:

- for what concern SI² (Sistemi Isolanti Innovativi – Advanced Insulation Systems), included in the programme “POR-FESR Asse I progetto di ricerca e/o sviluppo sperimentale” of the Piedmont region, the development of innovative, eco-friendly and high-tech insulation systems to be used in new buildings construction and in retrofit interventions;
- for what concern HIPIN (High Performance Insulation based on Nanostructure encapsulation of air), which is a project supported by the European Union under the “Seventh Framework Programme”, the development of three nanostructured systems (paint, plaster and panel) to improve thermal efficiency in existing buildings and new constructions.

During the SI² project in Vimark were developed two insulating plasters containing natural materials:

- VGT: formulation based on Natural Hydraulic Lime (Chaux de Wasselonne), vegetable granules with different particle size distribution resulting from the treatment of the cob of corn and macroporous expanded aggregates (perlite and vermiculite);
- CORK: formulation based on Natural Hydraulic Lime (Chaux de Wasselonne) and recycled cork, vegetable granules, mineral and natural expanded aggregates;
and a new low thickness mineral finishing for the thermal control of indoor environments, exploiting an increased inertia due to the adoption of Phase Change Materials (PCM) in the plaster mix.



VGT: application test

The thermal conductivity reached by VGT in this intermediate stage of SI² (approximately around 0,10 W/mK), is considered a very satisfactory result, since its value makes this new plaster competitive with most of other products on the market.

Regarding the finishing based on PCM it was not possible to report the results of the thermophysical analysis because the measurements are still in progress at the Department of Energy at the Polytechnic of Turin, but first data are enough encouraging.



Finishing based on PCM: mixing tests in laboratory

During the HIPIN Research Project a thermal insulating plaster for internal applications containing granular Aerogel was developed. This new plaster, thanks to a very low thermal conductivity, can be very impacting in the building sector from the energy point of view, allowing high efficient retrofit also in buildings where it is very difficult to insulate the envelope with conventional materials.



Plaster based on granular Aerogel: samples preparation in laboratory

For further information, e-mail:

Cinzia Ferrua: cy.ferrua@gmail.com