ICQIS 2020 INTERNATIONAL CONFERENCE ON QUALITY INNOVATION AND SUSTAINABILITY

POLITÉCNICO DE LEIRIA

# ECO INNOVATION FOR SUSTAINABLE MORTARS


## ABSTRAT

In the context of sustainability and the promotion of a greener economy, the construction sector, like many others, lacks innovative developments that will help to reduce the carbon expenditure (around 40% of energy expenditure in Europe), is recognized as essential. It is in this context that a technical coating mortar for rehabilitation, ensuring the energy efficiency of the building using raw materials (some classified as waste) that contribute to environmental sustainability is under development. Thus, it is intended to develop an eco-innovative mortar with good thermal insulation capacity (λ≤0.05 W. (m / K)), with a low rate of sound reduction (≤44dB) and in terms of reaction to fire that is considered a non-combustible product (class A1), ensuring the good general performance of all other mortar characteristics. There are being several formulations developed considering a component of binder, another of aggregates and another one of additives. According to the binders are being mainly used natural hydraulic lime and hydrated lime and a residual part of cement. Related to the aggregates it was used sawdust, however this proved to be unfeasible, having been replaced by the aggregates of expanded perlite (a light and non-combustible inert) and expanded cork (a residue with good sound absorption). In terms of additives there are being used cellulose ether and hydrophobic agent. Until now we achieved a very promising mortar, which uses 65% of binder, 34.5% of aggregates (cork + perlite) and 0.5% of additives. Its essential characteristics in terms of mechanical characteristics, water vapor permeability and water absorption were achieved. The samples of these formulations are being prepared for the tests of thermal conductivity, sound insulation and reaction to fire.


## METHODOLOGY

Several formulations have been developed considering different raw materials (as shown below).

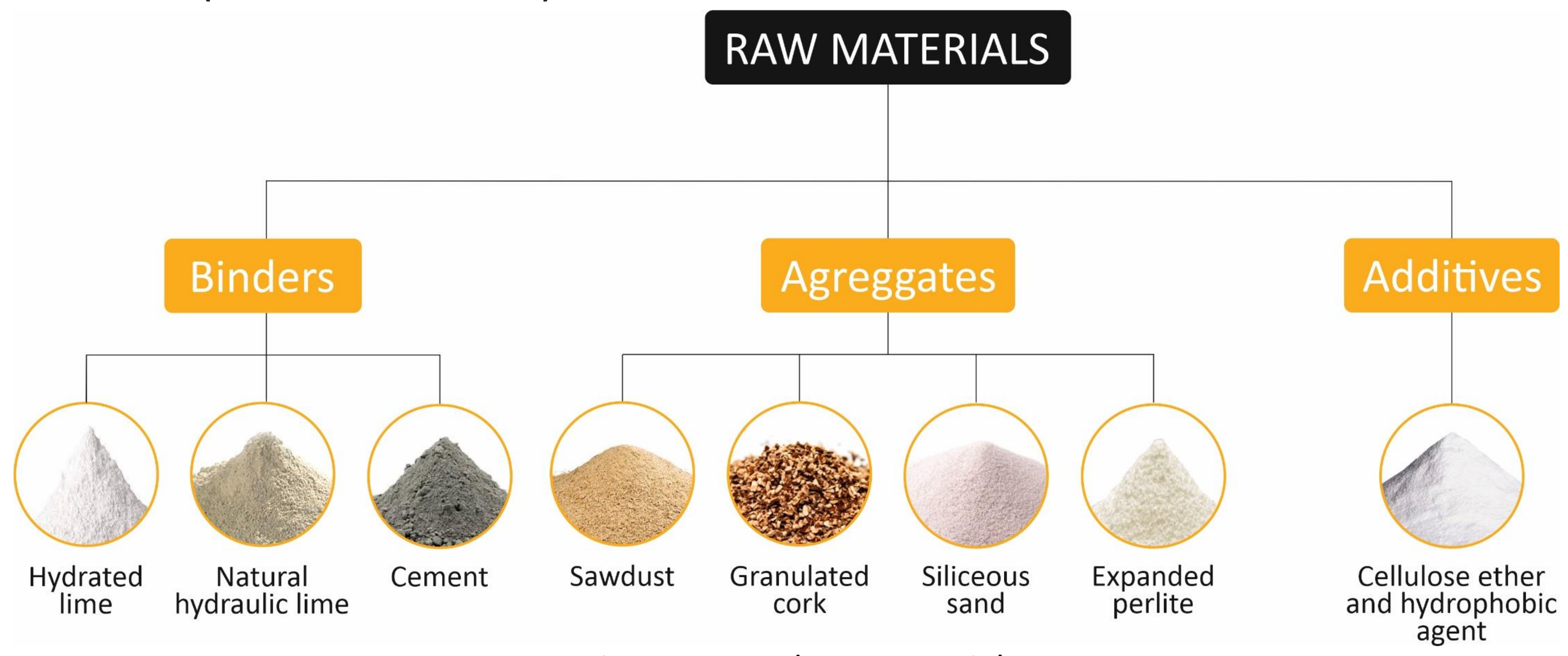


Figure 1: Used raw materials

Were carried out 5 samples: **Standard sample** - without any light aggregate (only sand), **Sample 1** - with a part of sawdust and another of sand, **Sample 2** – with a part of cork and another of sand, **Samples 3 and 4** - with cork and perlite in different proportions, without any sand.

Table 1: Proportions of samples

| COMPOSITION | Standard sample | Sample 1 | Sample 2 | Sample 3 | Sample 4 |
|---|---|---|---|---|---|
| Binders | 50% | 50% | 50% | 50% | 65% |
| Siliceous sand | 49,5% | 29,5% | 41,6% | - | - |
| Sawdust | - | 20% | - | - | - |
| Cork | - | - | 8% | 24,5% | 24,5% |
| Perlite | - | - | - | 25% | 10% |
| Additives | 0,5% | 0,5% | 0,5% | 0,5% | 0,5% |

Were carried out tests to evaluate the essential characteristics, namely the density (hardened product), the compressive strength and the water vapor permeability. In addition to these essential characteristics, some of the samples were tested for thermal conductivity. Below are some photos of some of the tests performed.


Figure 2: A - test specimen for water vapor permeability; B - test specimen for compressive strenght; C - thermal conductivity test

## RESULTS

Below are the results of these characteristics for the different samples, comparing with the target value (which is intended to be achieved).

The results in Figure 3 shows that the density of samples 1 and 2 is high (≈600/700 kg/m³), however it is significantly lower than the standard sample (≈1200 kg/m³), which is advantageous in terms of thermal insulation. As can be seen from the Figure 4, the thermal conductivity of samples 1 and 2 is significantly lower (≈0,15 W/(m.ºC)) than that of the standard sample (≈0,54 W/(m.ºC)). The samples 3 and 4 present the value near to the desired one.

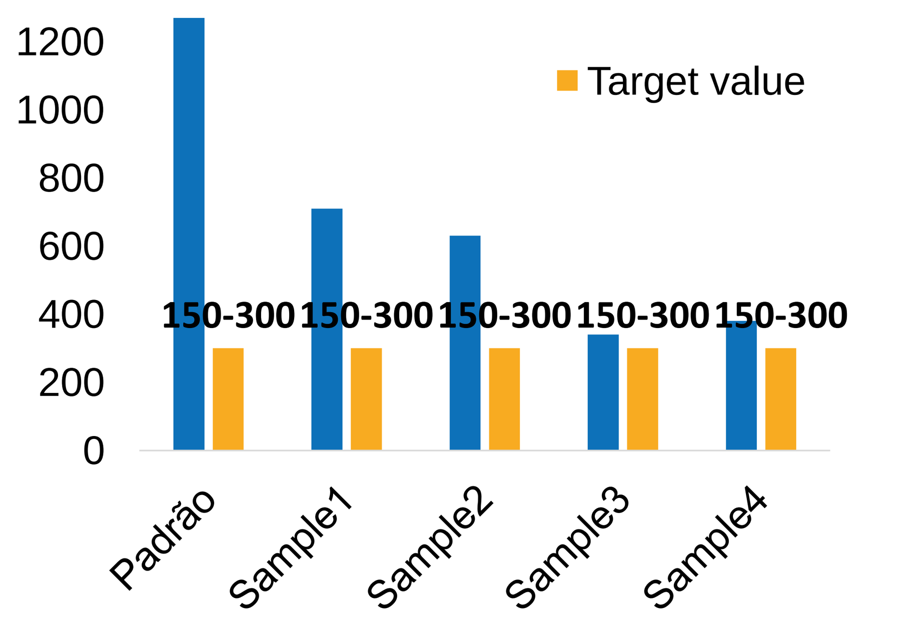


Figure 3: Results of density (hardened product (kg/m³)

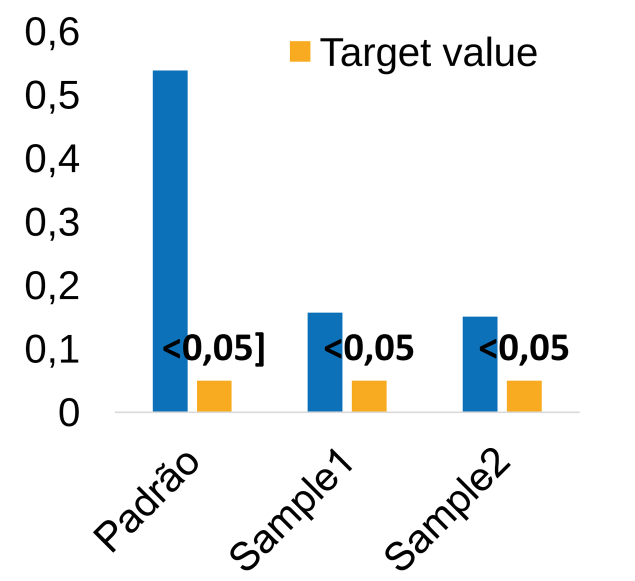


Figure 4: Results of Thermal conductivity [W/(m.ºC)]

Evaluating the compressive strength (Figure 5), the sample 3 proved to be unfeasible, with a very low mechanical strength (≈0,1 N/mm²). In terms of water vapor permeability (Figure 6), both samples 3 and 4 present the desired values.

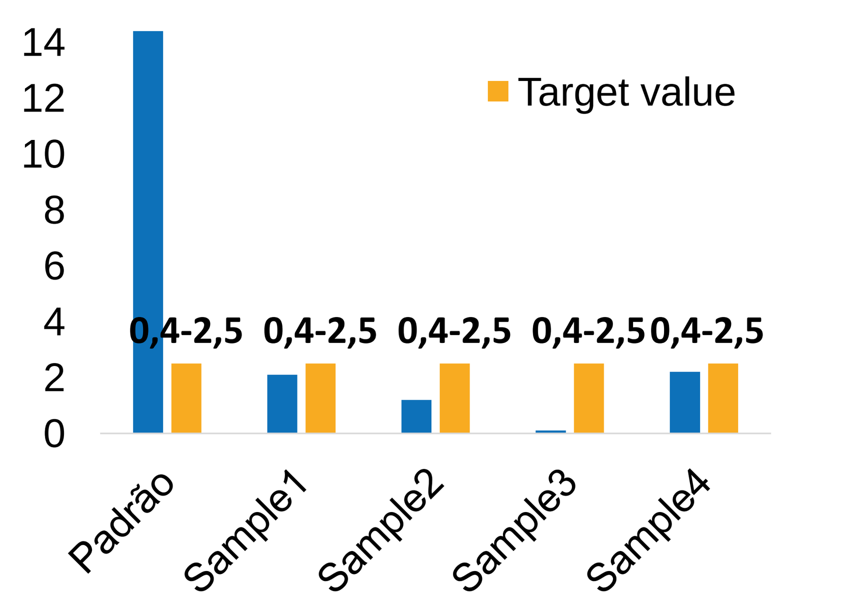


Figure 5: Results of compressive strenght (N/mm²)

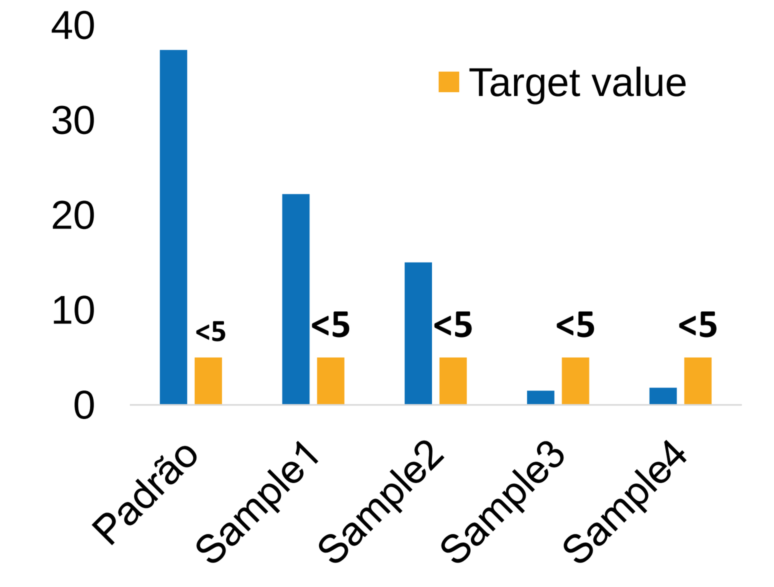


Figure 6: Results of water vapor permeance (μ)

## CONCLUSION

The sample 4 shows to be viable, it guarantees the fulfillment of all essential characteristics, however, the next approaches will evaluate this sample in terms of thermal conductivity, sound insulation and reaction to fire.


Cristiana Bonifácio | cristianabonifacio@lena.pt
LENARGATECNIC, Lda.

Michael Franco | michaelfranco@lena.pt
LENARGATECNIC, Lda.

Joaquim Almeida |valmeida@ctcv.pt
CTCV - Technological Center of Ceramics and Glass



This work was supported by Portugal 2020 under the grant FEDER - CENTRO-01-0247-FEDER-038360