Possible Applications of Corncob as a Raw Insulation Material

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Abstract

Some alternative applications of corncob as a raw thermal insulation material are presented in this research work. Usually, corncob has been treated as an agricultural waste. Finding practical applications of this waste in product manufacturing may preserve the environment and may also allow using more green technologies. Therefore, a corncob particleboard, a lightweight concrete for nonstructural purposes, and a lightweight concrete masonry unit (CMU) are the granulated corncob-based products proposed. These products are studied in terms of thermal performance, and some thermal parameters are delivered. The results obtained through the experimental study allowed to estimate the thermal conductivity of the granulated corncob and of the granulated corncob particleboards. The values obtained were 0.058 and 0.101 W/m°C, respectively. A thermal transmission coefficient of 1.99 W/m^2°C was obtained for the nonstructural corncob lightweight concrete, and it was concluded that the density and the thermal properties of this alternative solution are in accordance with the properties of the currently used expanded clay concrete. For the granulated corncob lightweight CMU, a value of 1.15 W/m^2°C was estimated. This shows that this agricultural waste may have potential as a thermal insulation product.

Keywords: agricultural waste, corncob, lightweight aggregate, raw building materials, sustainability, thermal insulation material

1. Introduction

Sustainable issues are ruling modern society. Development is supported in sustainable parameters. Cities are becoming smart and green. Finding alternative sustainable building materials and low technological building methodologies are solutions to give a contribution in this context.

Sustainable and affordable construction, complemented with the comfort standards required nowadays, may be an objective to achieve in the building industry. CO_2 emissions to the atmosphere, energy and water consumptions, and affordability are some parameters to take into consideration in the perspective of green product manufacturing processes. In addition, there are other aspects that contribute to green building solutions or practices, such as reusing, opting for green building materials (which must be renewable, local, and abundant), retrofitting, and choosing low-technology methods and techniques.

Therefore, in the building industry, a range of several different products or building solutions based on the application of raw organic materials have already been experimented. Among these organic-based building materials, wood and wood-engineered products, bamboo, and cork and cork-engineered products are perhaps the most commonly applied ones. However, different agricultural products have also been reported as possible raw organic building materials [1–5], such as bagasse, cereal, straw, corn stalk, corncob, cotton stalks, kenaf, rice husks, rice, straw, sunflower hulls and stalks, banana stalks, coconut coir, bamboo, durian peel, and palm leaf oil, among others. These raw organic building materials are recommended for the manufacturing of different thermal insulation products [6].

Among the above-identified agricultural products, corncob has an advantage of being an agricultural waste [6]. In fact, the corn production amount has shown an increasing tendency during the last years; therefore, the production of corncob has also shown the same tendency [7]. The corn plant, *Zea mays*, was introduced in Portugal in the mid-16th century, and since then, it has been part of the Portuguese agricultural sector. As far as known, there is still no practical application of this organic product [6]. In other countries, such as the United States, China, and Brazil, the plantation of corn is very relevant in the agriculture context and the corn production per year has been increasing in these countries. Taking into account this context, finding innovative applications for this agriculture waste may result in an alternative and sustainable product that may be relevant, taking into account the overall amount of corncob produced worldwide per year [6].

There are several research works [8–14] that have given particular emphasis to the application of corncob product processing.

This chapter intends to present three different building products based on granulated corncob, such as a particleboard (case study I), a lightweight concrete for nonstructural purposes (case study II), and a lightweight concrete masonry unit (CMU; case study III). These products are described in brief, and their thermal insulation behavior is also studied experimentally.

Thus, apart from this introduction section, this chapter is structured as follows. First, an example of a traditional building application of corncob as a filling material of walls is introduced. Second, some material properties of corncob (such as macrostructure, microstructure, density, water absorption, and fire resistance) are delivered; also, a brief comparison is done with current applied thermal insulation materials. Third, the adopted experimental thermal insulation performance evaluation is described in which the experimental set-up, the facility, the equipment, and the calculation methodology are included. Fourth, the main results are presented and discussed. These results are concerned with the three corncob-based products (case studies I–III). Finally, some remarks are done in the conclusion section.

2. An example of a traditional building application of corncob as a filling material of walls

To exemplify that corncob may be already a building material, **Figure 1** shows an ancient *tabique* wall that presents corncob as a filling material, which also was already reported in [15].

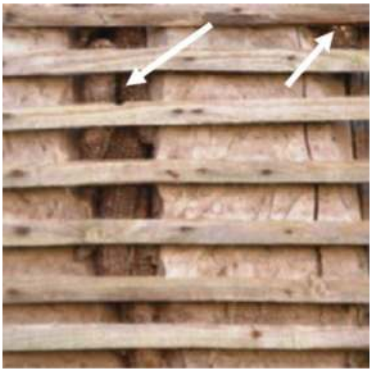

Figure 1. A traditional external *tabique* wall showing corncob as a filling material.

It is worth to explain that *tabique* construction is one of the main Portuguese traditional building techniques that use earth-based building materials. In fact, a common *tabique* building element (such as a wall; **Figure 1**) is usually formed by a regular timber structural frame (made of vertical boards and laths), which is filled and covered by earth or an earth-based mortar. In certain cases, organic filling materials, such as wood pieces, straw, or corncob, are also used and mixed up with earth. In the case of the *tabique* wall presented in **Figure 1**, earth has already been removed, and corncobs and the timber frame are completely exposed.

3. Some material properties of corncob

Corncob is a raw organic material, and therefore a relevant material heterogeneity is expected. Material discontinuity and anisotropy are also two material characteristics of corncob. In terms of macrostructure, corncob tends to show three distinct layers (layers I–III, from inside to outside; **Figure 2**), which are clearly perceived by their colour, texture, shape, and density [15]. Layer I is quite soft, layer II is similar to solid softwood, and layer II is very irregular. **Figure 3** shows the microstructure of layer I of a corn cob, which is a closed cellular structure (alveolar) is similar to a typical thermal insulation material such as extruded polystyrene (XPS) or expanded polystyrene (EPS).

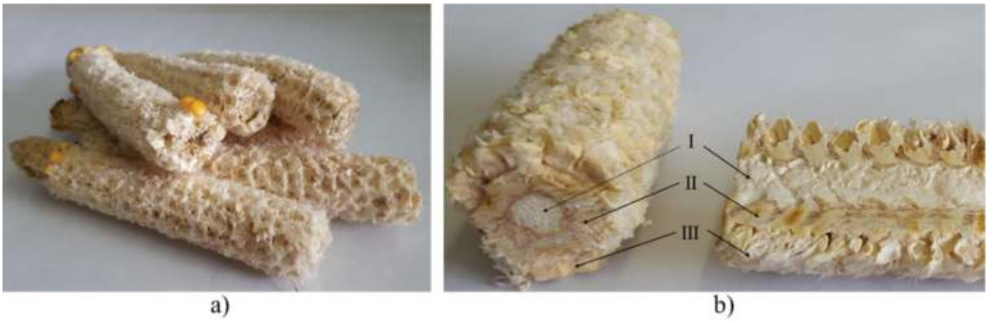

Figure 2. Corncob macrostructure: (a) general view and (b) longitudinal section [15].

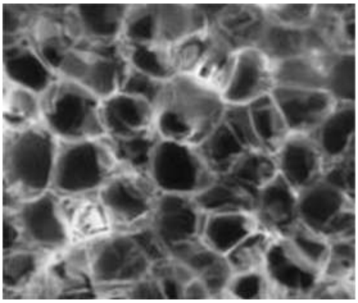

Figure 3. Typical microstructure of layer I of corncob (400 μm).

Meanwhile, the density of corncob was attempted to be experimentally measured [6]. In that study, the average value of the measured density of corncob was 212.11 kg/m^3, with a coefficient of variation of 22.4%, which was expectable considering the material heterogeneity described above. Comparing this evaluated density with the respective property of currently applied thermal insulation materials, it is concluded that corncob density is significantly higher than the densities of the XPS and EPS, which are 25–40 and 10–25 kg/m^3, respectively [16]. The densities of corncob and cork may be considered quite similar, taking into account that the density of the cork varies between 100 and 350 kg/m^3. On the other hand, and in this respect, expanded clay presents higher density values, which may be in between 275 and 430 kg/m^3 [16]. It is worth to remind that most of these materials are processed (i.e. XPS, EPS, and expanded clay). Only corncob and cork are natural and organic materials, and they seem to have similar densities.

In terms of water absorption, corncob seems to have an impressive water absorption capacity (327%), which contrasts with XPS, EPS, and expanded clay that present the approximate water absorption value of 13%, 34%, and 36%, respectively. On the other hand, granulated cork presents a value of water absorption of 244%, which is more similar to the one of corncob. This fact converges to the assumption that corncob and cork may have interesting material property similarities. It was noticed that corncob has a progressive saturating process, which may be related to the microstructure described above [6].

Fire resistance may be other material property that is convenient to assess for a building material and, therefore, for corncob. According to Santos [16], an expedite fire resistance test was performed. Flaming, combustion, gas emission, and the time consumption for total combustion were the data collected during this test. Samples of corncob, XPS, EPS, cork, and expanded clay were exposed to a direct flame for 5 minutes, which was the maximum test duration considered. Expanded clay was not affected by the direct exposure to a flame. On the other hand, corncob and granulated cork showed similarities in what concerns to the fire resistance behavior. In this case, both organic materials showed a slow progressive combustion process characterized by flame and a black gas emission. XPS and EPS were the most vulnerable insulation materials under fire exposure. Therefore, corncob seems to have an acceptable fire resistance when compared with current applied thermal insulation materials [6].

4. Methodology to evaluate the thermal insulation performance

To evaluate the thermal insulation performance of the alternative products processed with granulated corncob, the same experimental methodology was adopted. In this section, the facility, equipment, and calculation methodology are introduced and described.

4.1. Facility

The experimental work to determine the heat transmission coefficient (*U*) of the different case studies using the granulated corncob was carried out in a test room with the dimensions of 4.00×3.00×2.54 m (length×width×height). This test room has one of the façades oriented to the West and the other to the North. The existence of windows on the North façade allowed performing these tests due to the replacement of the window by the different samples analyzed.

The in situ thermal behavior assessment is valid if certain experimental conditions are achieved. These include the fact that the test samples have to be placed in an orientation that does not allow the solar radiation incidence and that allows the protection from the rain. It is also necessary to ensure the existence of a temperature gradient approximately constant between the inside and the outside of the test room to allow that the heat flow always occurs in the same way (from inside to outside during the winter and from the outside to inside the room during the summer). In the experimental procedure used in this research work, both conditions were guaranteed, contributing to the reliability of the results [14].

4.2. Equipment

In terms of equipment, a heat flux meter system was adopted as well as two thermohygrometric devices. A domestic heat device was also used to guarantee a constant temperature inside the test room. Each heat flux meter system is composed of two heat flux sensors (**Figure 4a**, detail I), four superficial temperature sensors (**Figure 4a**, detail II), a data logger (**Figure 4b**), and a computer [17]. The heat flux sensors allow to measure the heat flow through an element if there is a temperature gradient between the outdoor and indoor environments. Two superficial temperature sensors were used as a complement and as a reference to the heat flux sensor data and allowed to obtain the temperature values on the inner surface of the analyzed sample (**Figure 4a**). In **Figure 4c**, the adopted thermohygrometric device, which includes a temperature sensor (**Figure 4c**, detail I) and a relative humidity sensor (**Figure 4c**, detail II), is shown [14]. As mentioned above, two thermohygrometric devices were used, one to measure the temperature and humidity indoor and the other to measure the same parameters outdoor. In **Figure 4a**, a corncob particleboard sample is under this thermal behavior procedure.

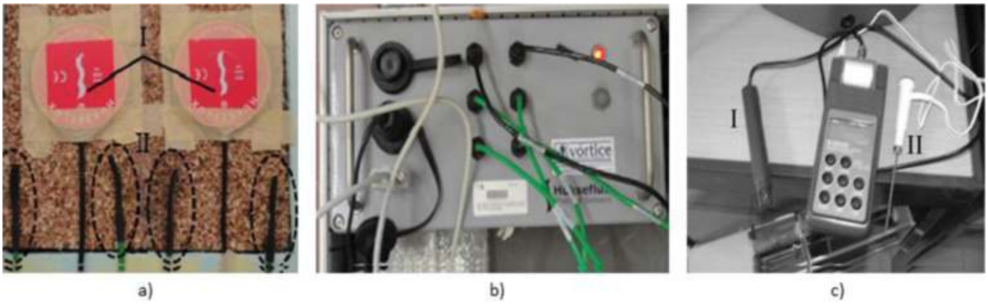

Figure 4. Equipment: (a) heat flux (I) and superficial temperature sensors (II), (b) data logger, and (c) thermohygrometric device: temperature (I) and relative humidity (II) probes.

4.3. Calculation methodology

According to ISO 9869 [17], the thermal transmission coefficient (*U*) of a material or a building system can be quantified given the heat flow that occurs through the element when submitted to a temperature differential, as presented in Expression (1):

$$U(ntotal) = \frac{\sum_{n=1}^{ntotal} q(n)}{\sum_{n=1}^{ntotal} \left(Ti(n) - Te(n)\right)} \tag{1}$$

where $q(n)$ is the heat flow across the element in the moment n; $Ti(n)$ and $Te(n)$ are the interior and the exterior temperatures in the moment n, respectively; $ntotal$ is the total number of moments in which the data were collected [14].

The use of the heat flux meters 1 and 2 allows obtaining the two heat flow values: $q1(n)$ and $q2(n)$. Considering the values of the temperature differential between the interior and the exterior environments, $Ti(n)$ and $Te(n)$, respectively, it is possible to estimate the thermal transmission coefficients, $U1(ntotal)$ and $U2(ntotal)$, respectively, by applying Expression (1). The thermal transmission coefficient of the element, $U'(ntotal)$, is the average value of $U1(ntotal)$ and $U2(ntotal)$, as shown in Expression (2) [14]:

$$U^{`}\left(ntotal\right)=\frac{U1\left(ntotal\right)+U2\left(ntotal\right)}{2} \tag{2}$$

According to ISO 9869 [17], a minimum of 3 days test duration is required if the temperature is stable around the heat flow-meters. Otherwise, the required duration may be 7 days or even more. This requirement intends to stabilize the heat flux that occurred through the element and it depends on the thermal inertia and the heat storage capacity of the building component. In the case of processed products based on granulated of corncob, the thermal inertia may be considered low and, consequently, a minimum of 3 days test duration may be acceptable.

There is a certain error related to the fact that the thermal transmission coefficient is obtained experimentally by the referred methodology. In this case, several aspects require to be taken into account to reduce this error, such as the calibration of the heat flux meters and the temperature sensors (there is ~5% error when these instruments are calibrated), the accuracy of the data acquisition system equipment, the difficulty of guarantying a perfect contact between the sensor and the surface of the sample (a 5% error may arrive), the operational error of the heat flux meter sensors due to the change of the isothermal curves, temperature, and heat flux changes, among others. Additionally, the error can be mitigated by increasing the number of sensors, stabilizing the interior temperature, and using a dynamic analysis. Thus, an error ranging from 14% to 28% is expected when the thermal coefficient transmission is estimated by the experimental procedure. However, in the present study cases, the aspects mentioned above were minimized. Therefore, the assessed $U'(ntotal)$ may be affected by an error of 14%. This error was considered in the analysis of the obtained results.

5. Granulated corncob preparation and its thermal insulation ability

To potentiate the application of corncob (**Figure 2a**) as a raw organic material in a product manufacturing process, it may be convenient to granulate it previously. Thus, it is important to apply an adequate granulating process that has to be able to maintain the important material properties of the corncob, in particular, its alveolar microstructure. For instance, an inadequate granulating process may damage the microstructure of the corncob by crushing or ripping the material. According to Pinto, Paiva and Faustino [18–20], a currently applied hammer mill in farms was the adopted device to granulate corncob (**Figure 5**).

Figure 5. Hammer mill: (a) general view, (b) lateral view, and (c) grid.

However, some difficulties emerged in what concern to obtain the specific granulometries of granulated corncob. Therefore, an alternative device was proposed, which consists of using a cutting mill device. In this case, the cutting mill device is provided with a range of sieves sized from 0.25 to 20 mm (**Figure 6**).

Figure 6. Cutting mill device: (a) general view and (b) cutting blade.

The granulated corncob obtained by this last process is shown in **Figure 7**.

Figure 7. Granulated corncob.

Granulated corn cob was then tested in terms of thermal insulation performance as shown in **Figure 8**, where the sensors used to measure the heat flux and the interior superficial temperatures can be observed.

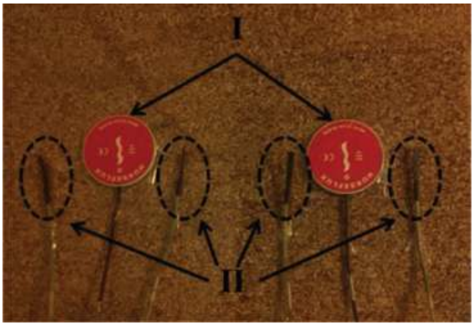

Figure 8. Granulated corncob sample under thermal insulation performance test (I: heat flux sensors and II: superficial temperature sensors).

The measured experimental data (temperatures and heat fluxes) during the test performance is presented in **Figure 9**. The temperature in the interior of the confined room was the temperature that was maintained approximately constant hanging around 25°C using a domestic heating device. The heat flow through the material sample [$q1(n)$ and $q2(n)$] was measured continuously (10-minute timing interval) using two heat flux sensors (**Figure 8**) for approximatly 7 consecutive days (n). The variation of the heat flow curves through the granulated corncob sample was in accordance with the one that characterizes the differential between the indoor and outdoor temperatures (**Figure 9**). Also, the temperature obtained outside was in accordance with the values that are usually obtained in the North of Portugal for this time of the year. These results allowed to conclude that the experimental test occurred as expected. The thermal transmission coefficient (*U*) was determined using Expression (1) and the values of the variables are presented in **Figure 9** [6].

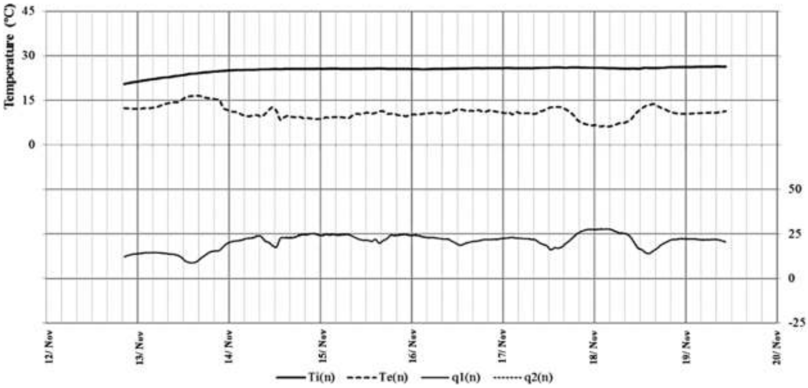

Figure 9. Granulated corncob. Indoor and outdoor temperatures [*Ti*(*n*) and *Te*(*n*)] and heat flow [*q*1(*n*) and *q*2(*n*)]. November 2014.

Figure 10 presents the thermal transmission coefficient (*U*) variation in the end of the measured period after its stabilization. The value of *U* obtained for the granulated corncob sample was 1.45 W/m^{2}°C. Furthermore, the thermal conductivity (λ) of the sample was also estimated based on these experimental results and the value obtained was 0.058 W/m°C. Thus, granulated corncob seems to offer proper thermal insulation because, according to ISO 9869 [17], the thermal conductivity of a conventional industrialized thermal insulation product must be less than 0.065 W/m°C.

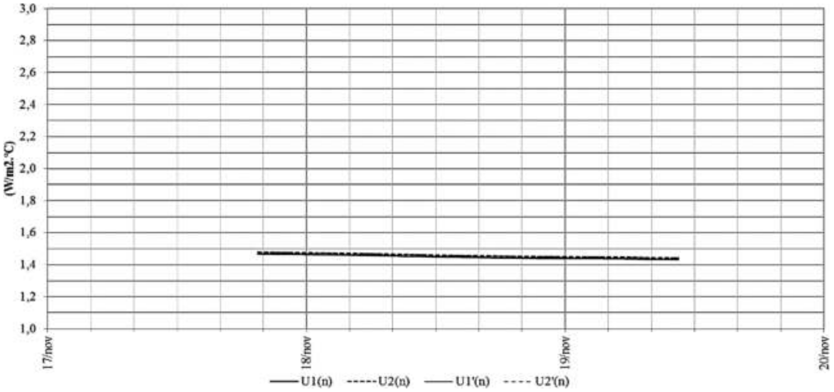

Figure 10. Granulated corncob. Thermal transmission coefficient (*U*) variation during the end of the measured period. November 2014.

6. Case studies of products based on corncob

As stated earlier, three alternative processed products based on corncob are presented here. In this respect, granulated corncob is first introduced followed by case studies I–III, which are related with corncob particleboard, lightweight concrete for nonstructural purposes, and lightweight concrete masonry unit CMU, respectively. The thermal insulation performance of these materials is evaluated by the experimental methodology described in the previous section.

6.1. Case study I – Granulated corncob particleboard

A corncob particleboard is the first processed product presented in this chapter. The particleboards were obtained through a simple manufacturing process that consists of binding the granulated corncob with wood glue [14]. This process included mixing up of the granulated corncob with wood glue, moulding, natural curing and unmoulding. A sample of a 3-cm-thick corncob particleboard (**Figure 11**) was tested in terms of thermal insulation according to the set-up described in Section 4.

Figure 11. A sample of a 3-cm-thick corncob particleboard.

In this case study, the thermal insulation test was performed for 6 consecutive days in March 2011. The measured experimental data (temperatures and heat fluxes) are presented in **Figure 12**. The temperature in the interior of the confined room was also kept nearly constant (23°C) using a domestic heating device. This temperature was always higher than the exterior temperature. These data allowed estimating the thermal transmission coefficient (*U*) by applying Expression (1). The value of *U* obtained for a 3-cm-thick granulated corncob particleboard was 2.14 W/m^2°C. A value of 0.101 W/m°C of the thermal conductivity was estimated. We believe that the thermal insulation performance of this product may be improved by refining its manufacturing process or increasing its thickness.

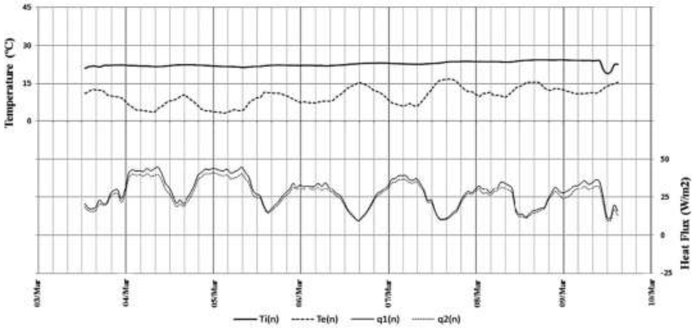

Figure 12. Case study I: corncob particleboard. Indoor and outdoor temperatures [*Ti*(*n*) and *Te*(*n*)] and heat flow [*q*1(*n*) and *q*2(*n*)]. March 2011.

Considering the values of the heat transmission coefficient (*U*) and thermal conductivity (*l*) estimated in the experimental work for the granulated corncob and (**Figure 10**) and for the corncob particleboard (**Figure 12**), it can be concluded that these values are similar to the ones that characterize the thermal insulation materials currently applied in the building industry. In **Table 1**, the thermal conductivity (*l*) is presented for different materials.

Insulation materials	Thermal conductivity (λ; W/m°C)
Granulated corncob	0.058
Corncob particleboard	0.101
EPS	0.04
XPS	0.032
Polyurethane	0.023
Cork (granules)	0.032–0.045
Glass wool	0.039
Rock wool	0.037
Expanded clay	0.103–0.108

Table 1. Thermal conductivity (λ) values of the corncob and current insulation materials.

6.2. Case study II – Lightweight concrete for nonstructural purposes based on granulated corncob

A lightweight concrete for nonstructural purposes based on granulated corncob was studied and proposed [21] (case study II). A weight ratio of 6:1:1 [i.e. lightweight aggregate (LWA) of granulated corncob/Portland cement/water] was applied, as it is the ratio used for the regularization layer of expanded clay concrete in the Portuguese construction. In **Figure 13**, the different stages of the corncob concrete sample processing are presented: adding the components (**Figure 13a**), curing process (**Figure 13b**), and the unmoulding step (**Figure 13c**). **Figure 13b** are also presents some corncob concrete samples used in the compression experimental test (**Figure 13b**, **I**) and corncob concrete samples used in the thermal performance experimental study (**Figure 13b**, **II**, and **Figure 13c**).

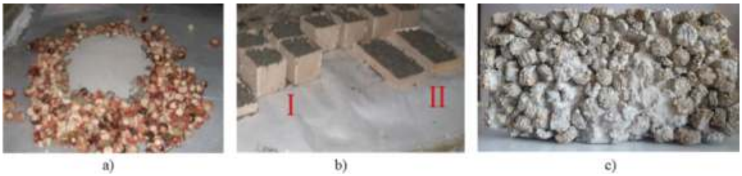

Figure 13. Manufacturing steps of lightweight concrete for nonstructural purposes based on corncob aggregate (case study III): (a) adding, (b) curing, and (c) unmoulding [21].

The experimental data measured during the thermal insulation behavior tests are displayed in **Figure 14**. It is worth to note that, in this case, lightweight concrete for nonstructural purposes based on expanded clay aggregate samples were also manufactured and tested to work as reference in terms of comparison. In this case, the test was performed for 5 days. The temperature of the test room was stabilized at around 20°C after 48 h (ΔT stabilizing; **Figure 14**). In what concerns to be the exterior temperature, it was verified that its values followed the expected oscillation during a day time (e.g. $\Delta Tnight$ and $\Delta Tday$; **Figure 14**). The analysis of the indoor and outdoor temperature values also showed that the outdoor temperature was always lower than the indoor temperature, which was also expected for that period of the year in that Portuguese region. Thus, those results lead to the conclusion that adequate thermal gradients were guaranteed (e.g. details I and II; **Figure 14**) to estimate the thermal transmission coefficient (*U*). Based on these experimental results and applying Expression (1), the *U* value of the lightweight concrete for nonstructural purposes based on corncob aggregate was possible to quantify and the respective value was 1.99 W/m^2°C [21].

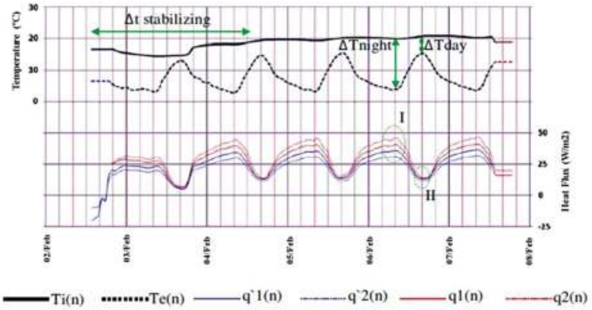

Figure 14. Case study II: lightweight concrete for nonstructural purposes. Interior [$Ti(n)$] and exterior [$Te(n)$] temperatures. Heat flow across the corncob [$q'1(n)$ and $q'2(n)$] and the expanded clay [$q1(n)$ and $q2(n)$] concrete samples. February 2011.

6.3. Case study III – Lightweight concrete masonry unit based on processed granulated corncob

A research work was performed to assess the potential application of PCC as an alternative LWA for the manufacturing process of lightweight CMU [22]. Therefore, CMU-PCC was prepared in a factory using a typical lightweight concrete mixture for nonstructural purposes (**Figure 15a**). Medium sand (MS; 0.0–4.0 mm), coarse sand (LS; 0.8–3.0 mm), gravel (G; 2.0–6.0 mm), Portland cement 32.5 N (C), LWA, and water (W) were the constituents considered in this research for manufacturing lightweight CMU. The respective adopted mixture to manufacture a CMU is presented in **Table 2**.

a) b)

Figure 15. Lightweight CMU: (a) granulated corncob (PCC) and (b) expanded clay (EC).

	LS	G	C	LWA	W
1.530	1.836	3.060	1.326	1.326	1.326

Table 2. Adopted mixture in the manufacturing process of CMU (kg) [23].

In this case, the particles of corncob were previously covered with cement paste. This procedure intended to solve some material limitations, such as high level of water absorption of the granulated corncob, slow drying process, and low compressive strength of the lightweight concrete produced [21].

As adopted in case study II, samples of CMU based on expanded clay (CMU-EC) were also prepared and tested to work as reference in terms of comparison (**Figure 15b**).

The CMU were then tested in terms of thermal insulation behavior and according to the experimental procedure described in Section 4. **Figure 16** shows the CMU under this test. Thus, CMU-PCC and CMU-EC were tested at the same time and under the same thermohygrometric conditions.

Figure 16. Thermal insulation test of CMU (exterior view). March 2014.

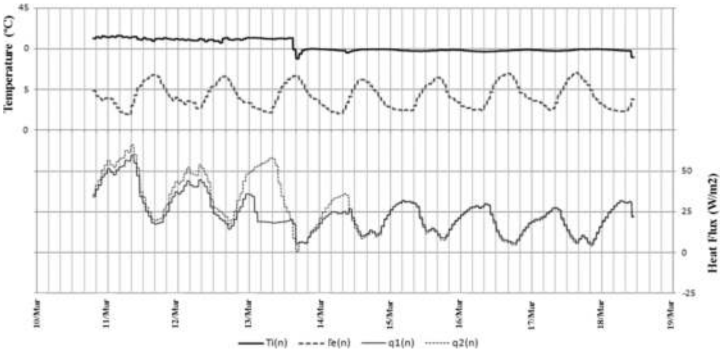

Figure 17. Case study III: CMU-PCC. Interior [*Ti*(*n*)] and exterior [*Te*(*n*)] temperatures. Heat flow across the sample [*q*1(*n*) and *q*2(*n*)]. March 2014.

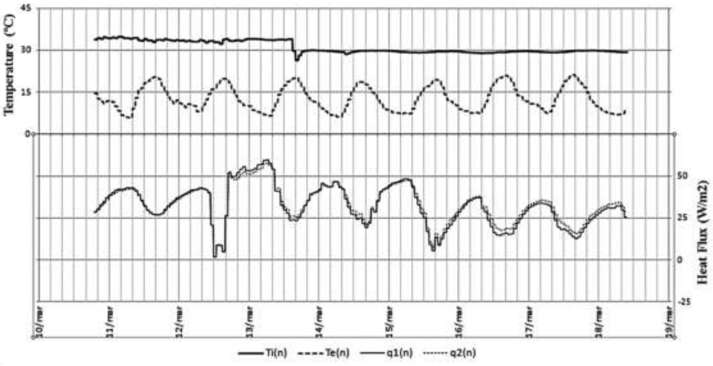

Figure 18. Case study III: CMU-EC. Interior [*Ti*(*n*)] and exterior [*Te*(*n*)] temperatures. Heat flow across the sample [*q*1(*n*) and *q*2(*n*)] March 2014.

The experimental data measured for CMU-PCC is presented in **Figure 17**. The test duration was 8 days.

The quantified thermal transmission coefficient (U) of CMU-PCC was 1.15 W/m^2°C.

Figure 18 presents the heat flux variation obtained during the test period for the lightweight CMU-EC. These values lead to a thermal transmission coefficient of 1.75 W/m^2°C, which is high than the value obtained for the CMU-PCC. The results show that the introduction of the granulated corncob in the concrete unit increases its thermal insulation performance.

7. Conclusions

An example of a Portuguese traditional application of corncob as a building material was presented.

Some material properties, such as the macrostructure, microstructure, density, water absorption, and fire resistance of corncob, were indicated and compared to currently applied thermal insulation materials (e.g., XPS, EPS, cork, and expanded clay). It was highlighted that the corncob material may be very heterogeneous, discontinuous, and anisotropic. It was also stated that there must be interesting similarities between corncob and cork.

Some considerations about the advantages of granulating corncob were done and some information about possible granulating processes was delivered.

An alternative expedite experimental set-up based on ISO 9869 [17] was proposed to evaluate the thermal insulation performance of the different applications of the granulated corncob. A test room with a constant interior temperature and a façade oriented north to avoid the solar radiation intensity and the effect of the rain in the testing sample was necessary. To estimate the thermal transmission coefficient of the different samples, a heat transfer system was used. It was composed of two heat flux sensors to measure the heat flow across the sample and four superficial temperature sensors to obtain the interior superficial temperature of the sample. Two thermohygrometric devices were used to obtain the temperature and the relative humidity values of the indoor and outdoor environments. The research work developed led to the conclusion that this experimental procedure is accurate and allowed to perform thermal performance analysis under real climatic conditions, to use real samples, to test several samples simultaneously, and to monitor the thermal behavior of a construction element continuously for several days [14].

Experimental data concerning the thermal insulation of granulated corncob were given. In addition, the value of the thermal transmission coefficient of this material was estimated as 1.45 W/m^2°C. The respective thermal conductivity value was 0.058 W/m°C.

On the other hand, a corncob product of 3-cm-thick corncob particleboard (case study I) was introduced and its thermal insulation behavior was also studied. A 2.14 W/m^2°C thermal transmission coefficient and a 0.101 W/m°C thermal conductivity for this product based on granulated corncob were quantified.

In addition, granulated corncob is also proposed as an alternative organic aggregate of lightweight concrete and as an alternative to expanded clay, cork, and EPS, among other possibilities. The proposed corncob lightweight concrete (case study II) was processed using the ratio of 6:1:1 (granulated corncob/Portland cement/water) and the results allowed to conclude that the density and the thermal properties of this alternative lightweight concrete are in accordance with the current expanded clay concrete properties [21].

Finally, lightweight CMU-PCC was presented as other product based on the agricultural waste material under this research (case study III). In this respect, the experimental results obtained so far are very promising, in particular, in terms of its thermal insulation behavior. In fact, experimental data concerning this ability are delivered in this chapter and also the thermal transmission coefficient (*U*) of CMU-PCC was estimated as being equal to 1.15 W/m^2°C.

The information presented is a result of several works that were intended to find possible applications of corncob as a raw building material and having a thermal insulation perspective. These research works allowed to conclude that this organic and agricultural waste has the potential to be used as a component of thermal insulation materials, systems, or products.

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