Domestic composting in universities

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INTRODUCTION

Figure 1: Biowaste: a) food, gardens and parks waste; b) food and kitchen waste

Composting is a biological process that occurs under aerobic conditions, consisting in the organic waste's transformation into compost. In this biological process it's important to have adequate temperature and moisture conditions (Azim *et al*., 2018). In Portugal, 5.279 million tons of Municipal Solid Waste (MSW) were produced by 2020. The MSW have around 37% of biowaste (APA, 2021). In Europe the household recycling target is 70% by 2030 (Araya, 2018). The present work intends to analyse and evaluate the domestic composting of the biowaste produced in higher education institutions (IES). To achieve the objective of the present work, a characterization of domestic composting in a IES Campus will be made. Also, analysis of different fractions of biowaste (Figure 1) will be carried out, through the determination of various parameters (e.g. temperature, pH, total and volatile solids - TS and TVS, etc.).

MATERIALS AND METHODS

Composting Tests

The tests were carried out in 8 composters. 7 composters (Figure 2) were set up on the ISEL campus, provided by the Lisbon City Council, with a volume of 320 L each (Figure 3). A preparatory study was carried out with the first 3 composters to receive biowaste from the restaurant spaces in ISEL Campus. In order to complete the composting process this study was carried out for 6 months. Also, a survey was carried out to understand if ISEL users were available to collaborate in the composting.

After 8 months, 4 more composters were installed and after 2 months a new composter was installed, with higher capacity (480 L) and bigger ventilation openings. Layers were assembled (tree and grass + food waste) by alternating layers of brown and green waste. The parameters humidity, temperature, pH, total and volatile solids were monitored over time. In order to deal with the existence of non-organic waste in the composter (Figure 4), awareness-raising actions were carried out, namely webinars, workshops and posters (Figure 5).

Sample preparation

Several waste samples were taken from the composters. The samples were then prepared using the quartile method (Figure 6 a).

pH determination

The pH determination was made based on the method 9045 d (EPA, 2004), the ratio 1:10 (W/V) was used (Figure 6c).

Total and Volatile Solids determination

The TS and VS were determined using the standard method 2540 G (APHA, 2017). 10 g of the sample was weighed. To determine TS, the sample was evaporated and dried (oven) at 103-105 ºC (Figure 6b). Then it was placed in the muffle at 550º C (muffle furnace) for determination of VS.

Temperature

The temperature was checked at three points at 40 cm of depth on the composter including the middle point, using a thermometer.

Humidity

Humidity was monitored weekly through the "sponge test" where a portion of the residue was squeezed and the existence of adequate water was verified.

Figure 2: Domestic composter: a) dismantled; b) assembled and c) brown wastes

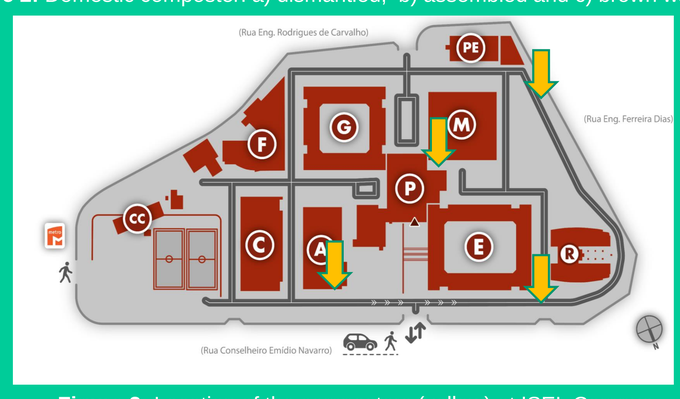

Figure 3: Location of the composters (yellow) at ISEL Campus

Figure 4: Non biodegradable waste in composter: a) plastic and b) masks

Figure 5: Composters campaign with posting of posters

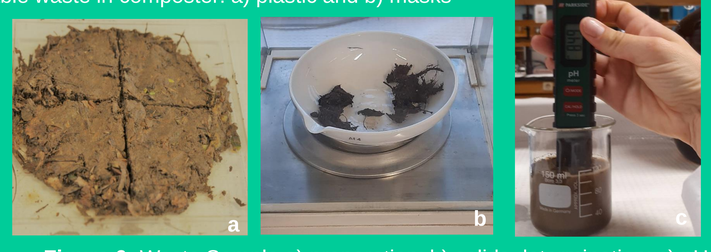

Figure 6: Waste Sample a) preparation; b) solids determination; c) pH determination

RESULTS AND DISCUSSION

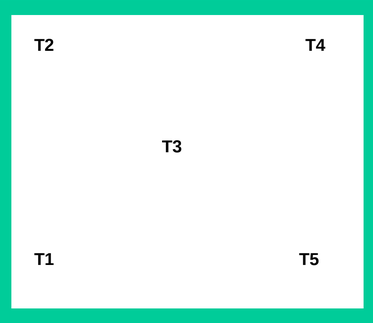

Figure 7: Composter temperature control points

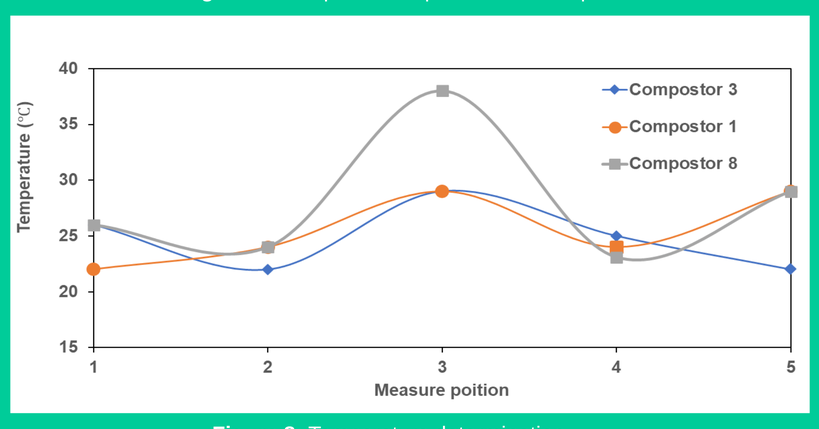

Figure 8: Temperature determination

The survey results indicated that about 31% of participants were available to contribute to composting at ISEL and 51% may be available. Thus, it was necessary to carry out awareness-raising actions on domestic composting and how to correctly separate biowaste in order to avoid the presence of contaminants in composters. The ISEL population is around 5,123 persons that can contribute to composting and the soil available to receive the compost has an area of about 7,500 m^2.

During the composting tests it was observed that the humidity parameter remained adequate, and it was only necessary to perform the weekly watering of the composters in May, given the typical increase in temperature.

The pH measurement in the composters content was between 7.0 and 7.9, which is adequate for the composting process.

The temperature was determined during the composting process at five points in each composter, as can be observed in Figure 7, after 82 days. The highest temperature occurred at point T3 (Figure 8), center of the compost as expected, due to the release of heat from the degradation reactions of organic matter. The other composters showed similar behavior for the same time period.

The preliminary analysis verifies the existence of a TS of 500.9 mg/g in the waste sample taken after 82 days. However, a more careful evaluation of this parameter will be necessary.

CONCLUSIONS

Preliminary results revealed that composting is dependent on participants' availability, it's a relatively slow process and it takes about 6 months to obtain the compost. During the composting process it's necessary control the waste deposition in order to avoid several contaminants, like plastics, paper with ink and masks, due to the high population of ISEL Campus. Nevertheless, it's possible to treat by domestic composting the biowaste produced in the ISEL Campus taking a step forward in the circular economy within the campus.

The present work is still under development.

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