Environmental impact of food waste treatment in an EcoCleaner, a portable accelerated composter

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Introduction

Canteen and catering food waste represent a challenge in waste management since they contain a large part of water and can be subject to biological processes during the waste management chain, especially during storage. Different solutions exist to manage this organic waste, for instance local and centralized composting, anaerobic digestion, or co-incineration with municipal waste. Except for local composting, theses methods need to collect and transport food waste to be processed, which mean transporting a lot of water.

The **Life Cycle in Practice (LCiP)** (LIFE12 ENV/FR/001113) project helps SMEs to reduce the environmental impacts of their products and services through the entire life cycle. Within the frame of this project, the environmental impact of an on-site accelerated composter, the **EcoCleaner® (EC) system** [1] is evaluated with the standardized life cycle assessment (LCA) methodology. EcoCleaner© is a stand alone accelerated system that can transform food waste in valuable dry compost in only 24 hours.

EC technology is based on a permanent control of the ratio of humidity and temperature to optimize fermentation rate of food waste by a patented consortium of more than thirty thermophilic bacteria.

EC can be declined in different capacities, from family size (about 1-2 kg/days of food waste) to large communities of 1300 place settings (up to 700 kg/days).

Material & Method

Goal Definition

The aim of this study is to assess the environmental impact of an EcoCleaner©

Scope

The functional unit (FU) is the accelerated composting of 1 tonne of food waste in an EcoCleaner system (100 kg capacity – EC100, 700 dinners/day)

Methods

- This study is done in accordance with the ISO standards 14040 and 14044 [2].
- CML IA Baseline v3.03 [3] method ; SimaPro 8.1.0.60 ; Ecoinvent 3.1 database [4]

Inventory and borders

- 1 EC100 = 780 kg (92% metals, mostly steel, and aluminum)
- Production and cooking of food are out of borders (“free” waste)
- Refurbishing (at factory) after 12 years: replacement of motor and electronics, seals, plastics (= 1 “12 years kit”) ; replacement of 5 % of metal parts (incl. yields for recycling)
- Process tree is schematized in Figure 1, refurbishing scheme is presented in Figure 2
- Total lifespan = 48 years (4 x “12 years cycles”) ; cradle to grave LCA
- Capacity: 50 t food waste/year (→ 2400 tons treated in 48 years)
- EC compost substitutes chemical fertilizers
- Electricity for use: Belgian mix (55% nuclear, 40.6% fossil fuels, 4.4% renewable)

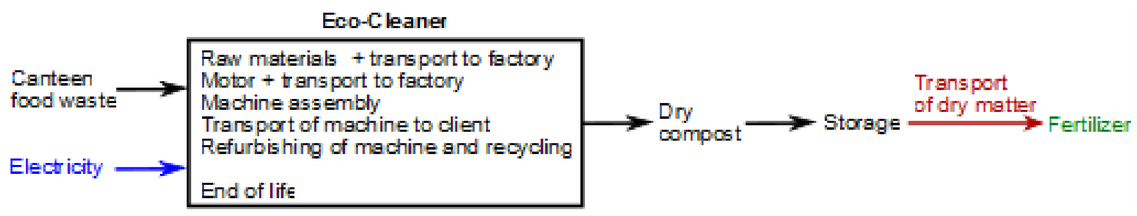

Figure 1. Process tree – inputs/outputs

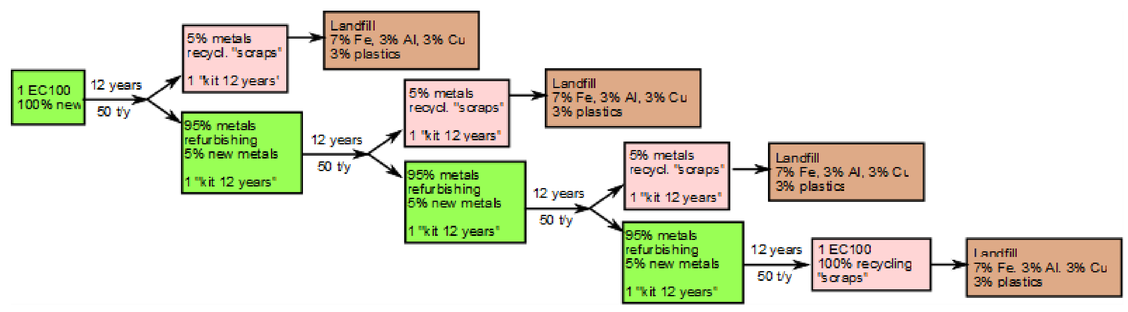

Figure 2. Refurbishing after 12 years, recycling and new raw materials (green = working EC100, pink = recycled parts, brown = landfilling of final waste)

EC input and compost

- Food waste (FW): 30% dry matter
- Reduction of waste: 90% (1 ton of FW → 100 kg of dry compost)
- Compost: 80% dry matter (DM), 5 t/years (N: 2.8% and P_2O_5: 0.6% on DM)

Results

Main results of this study are presented in Figure 3 (characterization – CML-IA [3]).

- EC compost substitution of chemical fertilizers induces negative impact values in most categories (in light blue)
- Electricity for use is the main impacting element in all categories (BE mix) (in orange) [339 kWh/UF or 17 MWh/year for 50 UF, motor: 50% & warming: 33%]
- High impact of metals in Abiotic depletion (92% of the EC100 in weight) (in blue) but gain due to their recycling (in red)

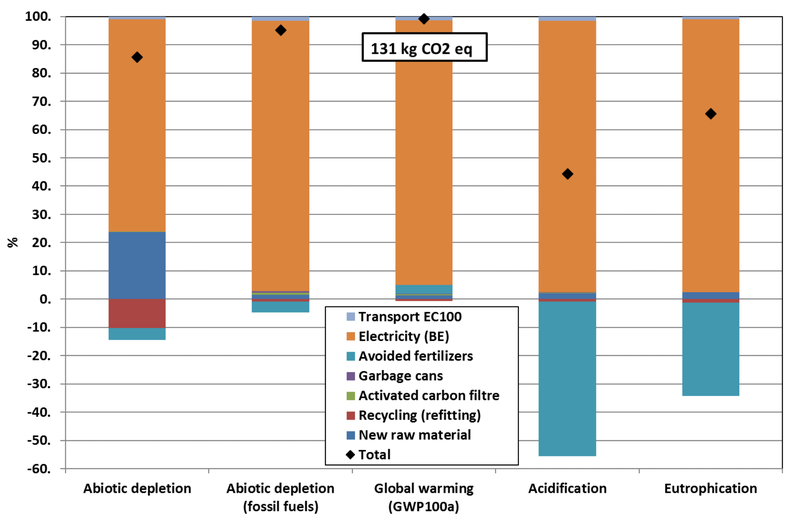

Figure 3. Impact of the treatment of 1 ton of food waste in an EC100 – characterisation CML-IA

Improvement

Since the electricity used for the functioning of the EC100 is the most impacting element, the mix from grid could be replaced by electricity from on-site photovoltaic panels (PV) (Figure 4).

- Except for Abiotic depletion, significant gain is obtained if electricity is coming from PV (in red) instead of from grid (in blue)
- Abiotic depletion burden is due to the materials needed to manufacture the PV

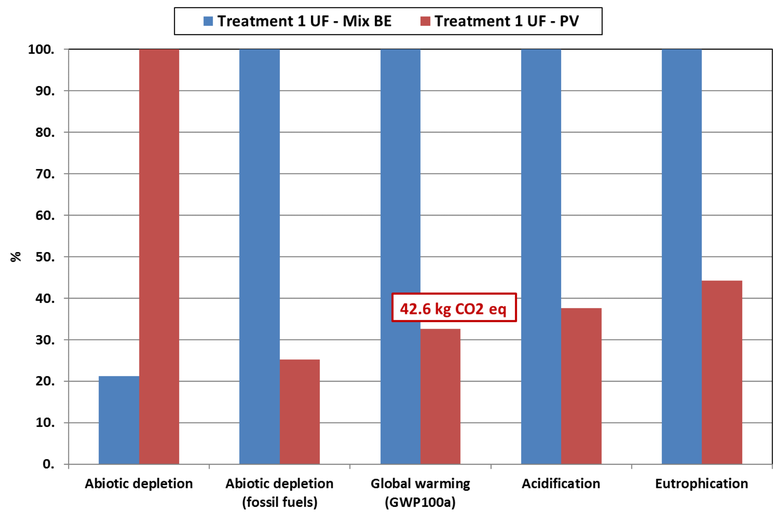

Figure 4. Comparison of the impacts of the treatment of 1 ton of food waste in an EC100 supplied with Belgian electricity mix (in blue) or by PV (in red) – characterisation CML-IA

Conclusions

- **EcoCleaner© (EC)** is a stand alone accelerated aerobic digester that can transform food waste in valuable dry compost in only 24 hours. It helps to lower environmental impact of canteen and catering food waste by an accelerated on-site treatment instead of delocalized large scale composting or anaerobic digestion plants.
- The EC system avoids the transport of water (since the food waste has only 30% of dry matter) and replaces it by the conveyance of dry compost (80% dry matter), without storage inconveniences (odors, insects,...).
- Replacement of the motor, plastics, and some spare parts every 12 years lengthens the lifespan up to 48 years. Metals represents 92% of the system in weight and only 5% are replaced during the refurbishing of the EC100.
- The principal impact comes from the energy used to operate the EC100. The replacement of the electricity source from Belgian grid mix by on-site photovoltaic panels significantly reduces this impact.

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