Introduction to the concept of particleboard production from mixtures of sawdust and dried food waste

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Extended Abstract

Food waste are an underutilized resource and there are very few examples of valorization strategies with a potential to be applied on a large scale. The main reason for the lack of valorization strategies is that food waste degrade within very short time periods. In addition, the very high water content - which is usually in the range of 70 % to 80 % - increase the cost of transportation and storage. Also, the high content of water reduces the applicability of several management methods that require heat transfer, e.g. combustion.

Sotiropoulos et al. (2015), sampled food waste from two municipalities of Athens and dried the material in a centralized drying facility. A commercial GAIA dryer was used which is able to handle 50 kilos of input every 8 hours. The wet food waste are fed to the dryer from the top and the feeding process is fast due to the big ratio of the feeding area in respect to the total surface of the top. The food waste are simultaneously dried and milled in the dryer and the final product is a technically inert material and resembles to sawdust. The drying process advances by means of a heated circulating organic fluid that is described in detail by Vakalis et al. (2016). The process of drying is shown in Figure 1.

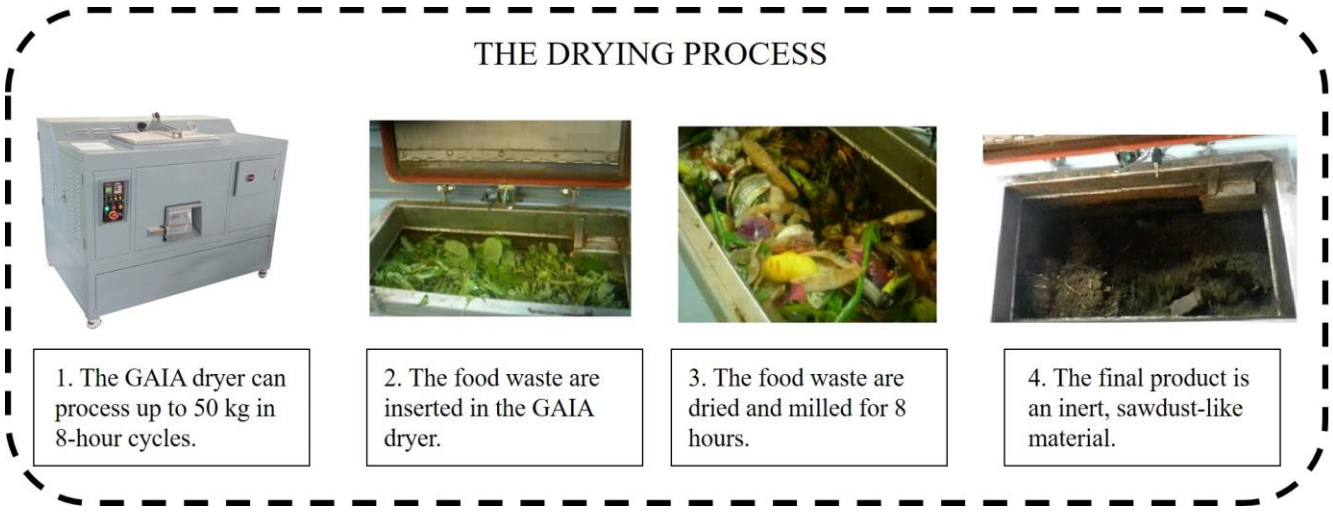

Figure 1. The process of drying and milling of food waste in a commecial GAIA dryer.

The dried material has a moisture content of less than 7 %. Dried food waste have been stored both in opened and closed containers for several months up to a year and the changes in the moisture content are negligible. Vakalis et al. (2017) analyzed the material and the results are shown in Figure 2.

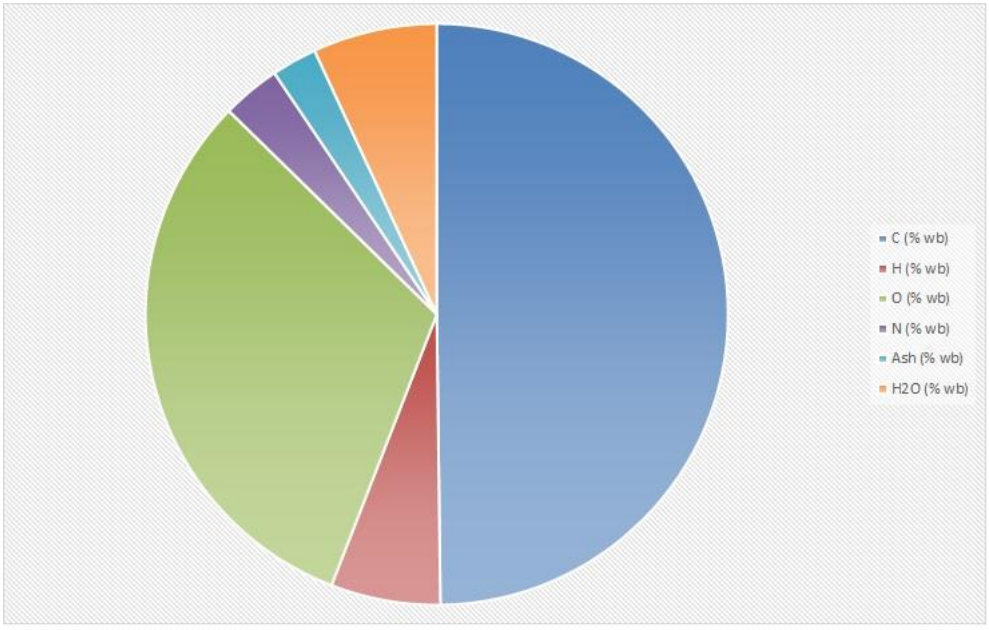

Figure 2. Elemental analysis of dried food waste (Source: Vakalis et al., 2017)

There are several interesting outcomes from this analysis that may assist the decision process for possible utilization strategies of the dried food waste. On one hand, a very interesting result is that the

ash content is relatively high, around 2.5 %. Although this value seems to be low, it is significantly higher than the ash content of woody biomass that is used as fuel for combustion. Thus, the production of fuel-pellets is a possibility that does not appear to be favorable due to the high amount of ash residues that would accumulate in the boilers. Also waste of organic origin tend to have high contents of potassium which may be very corrosive for the grates of the boilers. On the other hand, another interesting result is the high sugar content of the dried food waste. The results from HPLC analysis are shown in Figure 3.

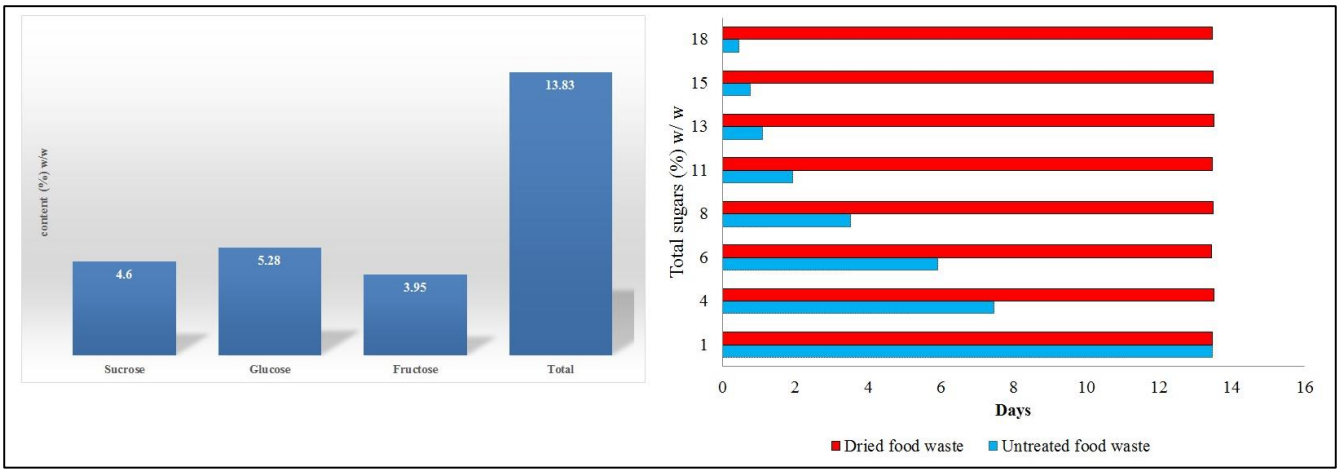

Figure 3. Content of sugars in dried food waste (left) and degradation of treated and untreated food waste in 20 days (right). (Source: Vakalis et al., 2017)

The high content of sugars, which is in the range of 14 %, is a significant result that opens a potential novel utilization pathway. Also, the experiments that are shown in Figure 3 show that the sugar content of dried food waste is not reduced with time, contrary to the sugar content of untreated food waste. This means that even after several months of storage the dried materials tends to maintain this property.

This study takes into consideration the following parameters about food waste:

- They are practically inert
- They have small particle size and they resemble to sawdust
- The have high sugar content which is preserved through time

Thus, the study proposes the concept of utilizing mixtures of dried food waste material along with wood sawdust for the production of particleboards. The concept is introduced and presented in Figure 4.

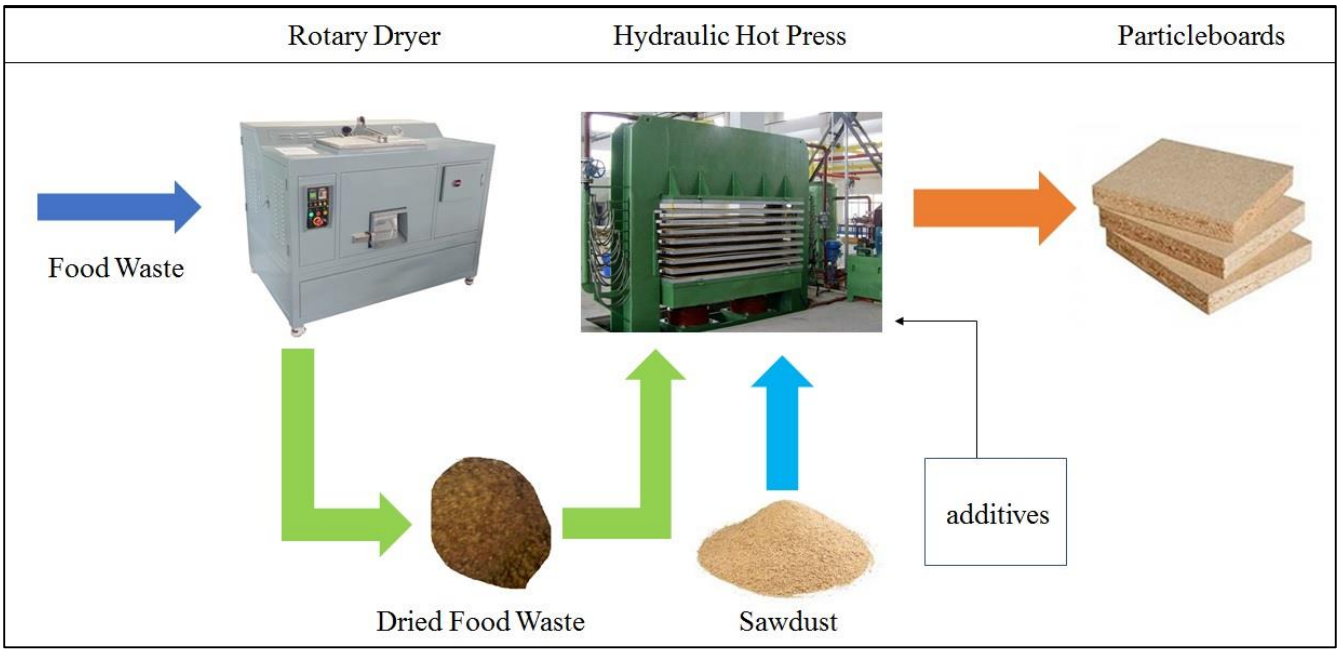

Fig. 4. Proposed concept for particleboard production from mixtures of wood sawdust and dried food waste (Source: Vakalis et al., 2017)

The production of particleboards is proposed to be done by means of compression in a hydraulic press under high temperature, i.e. 160 ° C. The contained sugars will be thermally converted and partially plasticized in a process similar to the one that takes place during pelletization. This will increase the adhesive properties of the products and may potentially reduce the required amount of additional

adhesives like Urea-formaldehyde. The utilization of food waste for particleboards production will reduce the use of wood. Also this strategy is in accordance with the waste management strategies hierarchy since it promotes the reuse of the materials, i.e. food waste will be directly used for the production of an upgraded product. The next steps of this work is the development and the analysis of the physical and mechanical properties of particleboards with dried food waste content of up to 20 %.

Acknowledgments

This work has been developed in the framework of the project “Particleboards from dried food waste” and has been supported by the funding of the IKY-Siemens scholarship with the title "EXCELLENCE SCHOLARSHIPS FOR POSTDOCTORAL ACADEMIC RESEARCH IN GREECE BY THE IKY – SIEMENS PROGRAM 2015-2016".

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