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Packaging glass contained in the heavy residual fraction refused by Portuguese Mechanical and Biological Treatment plants

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ABSTRACT

Mechanical and Biological Treatment (MBT) is an important strategy to manage Municipal Solid Waste (MSW) in Europe. The presence of recyclable materials on MSW depends on different factors such as inefficiencies in the Municipal Solid Waste collecting schemes and to the low level of citizenship environmental education. Among other products, MBT plants produce a residual fraction, named here as heavy residual fraction, that contains a significant amount of packaging glass which in Portugal is currently landfilled. This material is not recycled because it is heavily contaminated with other materials, preventing its processing in Material Recovery Facilities (MRF).

In this paper the characterization, including particle size and composition, of the residual fraction of six Portuguese MBT plants is presented. The relevant variables that determine the heavy residual fraction characteristics were identified. It was observed that the MBTr particle size distribution is different and depends mainly on the place on the flowsheet where the MBTr exits the process, which is determined by the type of biological process and by the aperture of the last screen where the product passes through. The content in glass varies from 33 to 83%. These values are mainly related with the upstream glass sorting and with the efficiency of the recovery of the organic fraction which is the glass main contaminant. The second main contaminant is "stones".

The quantity of glass contained in this product in all the plants that will be in operation in Portugal in 2014 was estimated. The work shows that if all the 48,000 of glass could be recovered the Portuguese recycling rate would increase by 4.4%.

1. Introduction

In Portugal, as in many other countries, selective deposition and collection of specific streams of waste like packaging, green waste, waste from electrical and electronic equipment, etc., are common practices. Therefore, the undifferentiated stream – Municipal Solid Waste (MSW) should be almost solely constituted by organics with a very minor content of a mixture of different items and materials for which there is no specific recycling stream today in place. Nevertheless, in some cases, a considerable amount of recyclable packaging waste, as defined by the directive 75/442/EEC, ends up in the MSW – and this happens mostly because recycling is highly dependent on the community effort (Halvorsen, 2012).

The characteristics and also the quantity of MSW depend of different factors, such as standard of living and environmental education (Dong et al., 2003). In Europe, the landfill directive (Directive 1999/31/EC), the landfill taxes and the targets regarding packaging waste (such as wood, plastic, metal, paper and cardboard, and glass) established by Directive 2004/12/EC on Packaging and Packaging Waste are the main tools to push the companies and citizens to reuse and recycle materials (WRAP, 2008).

The recycling not only reduces the quantity of raw materials used but it minimizes the quantity of waste landfilled too with consequent economic saving with landfilling, increases the lifespan of landfill and reduces the soil, water and air contamination. It is clear that all the chain generates a cost but the extended producer responsibility (EPR) principle helps to support recycling and also encourages the industry to recover packaging waste (Da Cruz et al., 2012).

Portugal, with 59.66% of glass recycling rate in 2011 (FEVE, 2013), almost attained the EU target for glass (60%), although this value is still below the European average – 69.59% (FEVE, 2013). On the other hand, Portugal did not attain the national targets established on the Strategic Plan for MSW (PERSU) for 2011. The target was 227,060 tonnes of glass while actually only 210,422 tonnes were collected (APA, 2013). Regarding the deposition of glass outside the specific stream, in 2011 according to the Environmental Portuguese Agency 5.8% of Portuguese MSW is glass (APA, 2013).

In Portugal in the same year, 59% of the domestic waste was landfilled, 21% was incinerated, 9% was sent to recycling and 11%

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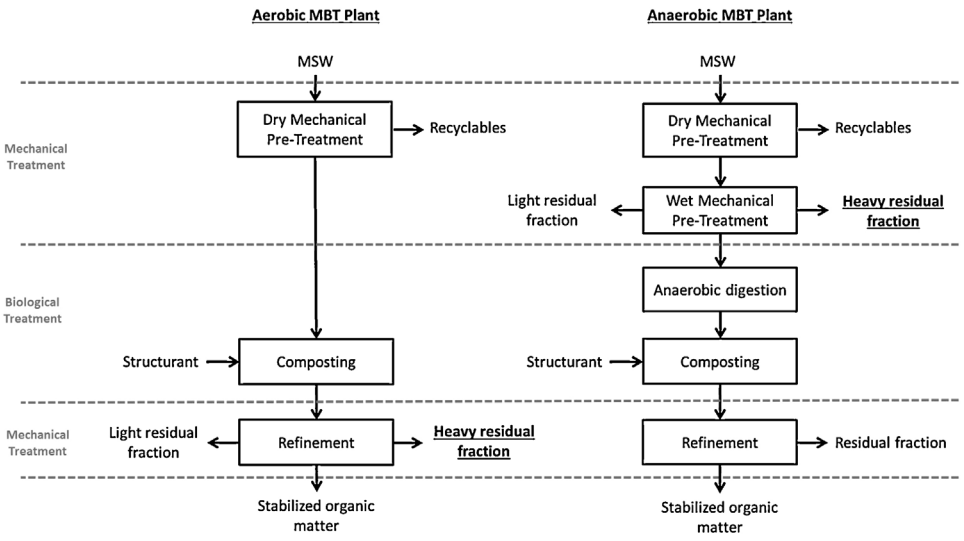

Fig. 1. Simplified flowsheets of solids in anaerobic and aerobic MBT plant types.

was sent to Mechanical and Biological Treatment (MBT) plants (APA, 2013). MBT is an important strategy used in Europe to treat MSW, mainly to minimize the quantity of biodegradables landfilled (Lornage et al., 2007; Montejo et al., 2010; Pires et al., 2011; Tintner et al., 2010; Vellini and Savioli, 2009). In what concerns MSW, in Portugal, there has been a great effort in the construction of MBT plants. While in 2012 only 6 MBT plants were in operation, in 2014, 8 other will be operating.

The biological process in the MBT plants can be aerobic or anaerobic (the stabilization of organic matter occurs in the presence or absence of oxygen, respectively). There are two main flows in a MBT facility, named as upstream, which is the feeding of the process (MSW or selective collection of organic waste), and downstream, which is the final product, such as biogas, compost, air emissions, residual fraction, leachates and recyclables. The recovery of recyclable materials in the MBT facilities that treat MSW highly depends on the existence of a market for each material. Besides the benefits collected from selling recyclables, important costs related with final disposal and negative impacts are avoided (Massarutto et al., 2011).

In the process of organic fraction decontamination there are two main solid waste streams. The light residual fraction, which is mainly composed by plastic film and paper, in some cases, is used to produce Refuse Derived Fuel (RDF). The heavy residual fraction (MBTr), represented in bold and underlined in Fig. 1, is mainly composed by inert materials, mainly glass, being currently landfilled because there is no viable technology for its recovery.

It was observed in the analysis of one Portuguese plant (TRATOLIXO) that the MBTr is mainly composed by packaging glass (Dias et al., 2011). It was found that it is composed by a significant percentage of glass (83%) being the organic matter and stones the other main components with about 7%. This MBTr presented a moisture content of 4% and the particle size did not exceed 10 mm.

Nevertheless, up to now the packaging glass occurring in MBTr is not recycled in Portugal because the glass content is lower than the specifications imposed by the plants that decontaminate the selectively collected packaging glass for recycling – Material Recovery Facilities (MRF). Even when the content in organics is low, the organic contamination of glass particles, which have a small size reduces the efficiency of optical sorting process which is commonly used in the glass MRF (VIDROCICLO, 2011).

Dias and Carvalho (2012) developed a simple and cheap process based on the difference in particle shape able to upgrade the content in glass of MBTr. Using a sample of MBTr from one MBT plant they showed, that it is possible to concentrate the glass by removing almost 60% of the stones, the main and most problematic contaminant due to its circularity that decreases the efficiency of the optical sorting currently used in MRF. Approximately 80% of the glass was recovered in the final concentrated product (Dias et al., 2011).

So, the objective in recovering the packaging glass present in MBTr is not only to help to increase the glass recycling rate, but also to avoid the cost of landfilling it. Besides, the value of the recyclables materials such as glass and also the existence of an economic incentive from Green-Dot System, a common practice in Europe as a result of the EPR (Extended Producer Responsibility) principle,

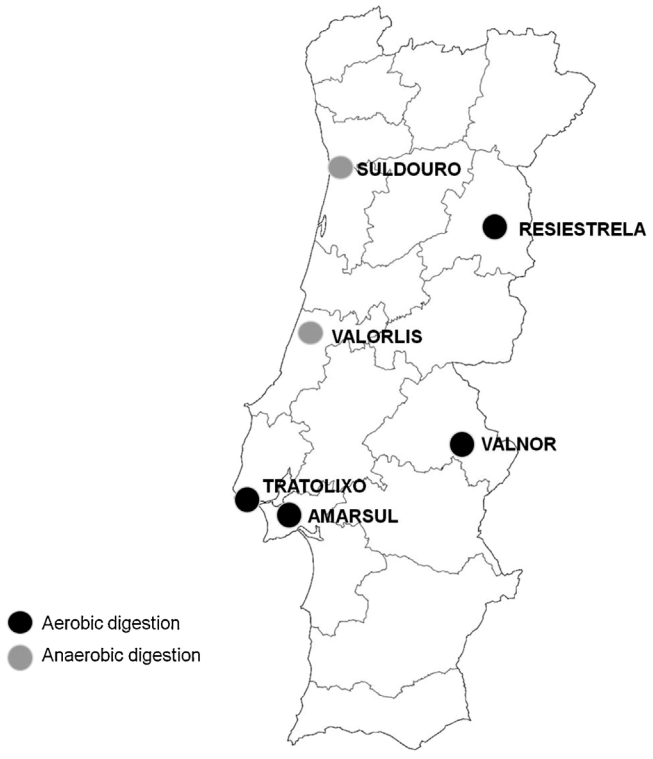

Fig. 2. Localization of the Portuguese MBT plants treating MSW in 2012.