Could MBT Plants be the Solution to Fulfil Landfill Directive Targets in Portugal?

Ana Pires, Maria da Graça Martinho, Ana Silveira

Department of Science and Environmental Engineering
Faculty of Science and Technology, New University of Lisbon, Caparica, Portugal

Kann MBA die Lösung zur Einhaltung der EU-Deponierichtlinie in Portugal sein?

Abstract

To treat the biodegradable fraction present in municipal solid waste, Portugal will implement more 15 mechanical-biological treatment plants, using aerobic and anaerobic treatment. Reaching EU Directive 99/31/EC of 26 April on the landfill of waste seems to be possible, but not enough. The problems and constraints regarding the outputs and the pollution resulting from operational aspects are issues that must be taking into account to guarantee the economical viability of the plants and the reduction of environmental impact of mechanical-biological treatment plants in Portugal.

Keywords

Mechanical-biological treatment, Landfill Directive targets, environmental pollution

1 Introduction

Since the 90s, Portugal started to organize the waste management infrastructure in several systems, composed by municipalities. Such systems allowed waste management to decrease from 308 to 31 municipal companies, *i.e.* waste management systems, which contributed to a better management of waste, from the environmental and economical point of view. The 31 waste management systems are responsible to manage waste from 10 million inhabitants, which produced, in 2005, more than 4.5 millions of tonnes of municipal solid waste (MSW) (MAOTDR, 2007).

The waste management in Portugal also started to improve with the entry in the European Community, which imposed legislation to be applied in European Community countries. For example, with EU Directive 94/62/EC of 20 December (Packaging Directive), Portugal could recycle 25% of packaging waste. But Portugal has new challenges to reach, not only related to packaging waste but also to landfill management.

Through the transposition of EU Directive 99/31/EC of 26 April (Landfill Directive), Portugal had to comply with deviation targets of biodegradable municipal waste (BMW) for 2006, 2009 and 2016. To do that, Portugal had created the Strategic Plan for Biodegradable Municipal Waste, where a range of actions like backyard composting, selective collection of organic materials, composting units, anaerobic digestion units and mechanical-biological treatment units are predicted (MESPRD, 2004). However, this Stra-

tegic Plan was not implemented on time to fulfil Landfill Directive 2006 target. Portugal only complied with it because of incineration plants. The BMW content in incinerated MSW was enough to comply with the target.

In the meantime, Portugal reviewed the Strategic Plan for MSW (PERSU II, in Portuguese), where other driving forces to fulfil Landfill Directive and to review Strategic Plan for BMW were established. One of the most important issues presented in PERSU II is the promotion of mechanical-biological treatment (MBT) as the technology capable to reach the targets established in Landfill Directive. Because of scale issues, the 31 municipal systems had to be grouped to increase the quantity to be treated, promoting economical viability, resulting in the same 31 systems, but in 19 areas.

The waste production per inhabitant in Portugal is 1.24 kg/day and the provisions are showing that only in 2012 the quantity of waste produced is going to decrease (MAOTDR, 2007). With the targets established in several European Directives like Packaging and Landfill Directives, it is necessary to understand how it will be possible to manage such MSW quantity at the same time to fulfil such targets.

2 Past situation

To fulfil first EU Directive 99/31/EC of 26 April target in January 2006, Portugal had created in 2003 the National Strategy for the Reduction of Biodegradable Municipal Waste to Landfill Deposition (ENRRUBDA, in Portuguese), where were defined the necessary guidelines to reach targets until 2016 through technology implementation, BMW quantities to divert from landfill and BMW separate collection. Such guidelines were developed because of the transposition of the Landfill Directive to the national law, in 2002 (Decreto-Lei n.º 152/2002, 23 Maio). The only document used to regulate waste characterization prior to landfilling is the EU Council Decision 2003/33/EC of 19 December.

The ENRRUBDA had predicted to treat BMW through technologies already existing in the country, such as MBT and incineration, and also composting and anaerobic digestion technology, specifically for BMW from separate collection.

The first MBT plant in Portugal started to work in 1991. Its technology was very simple, being at the time named as MSW composting, because the input material was mixed MSW. Figure 1 shows the diagram of a typical MBT in Portugal.

Until 2001 three more MBT plants started to function. These units use biological treatment in-vessel composting, closed system. The mechanical operation is made through screening, magnetic and Foucault current separation, and it was also common to use manual sorting, especially to recover non-metal recyclables.

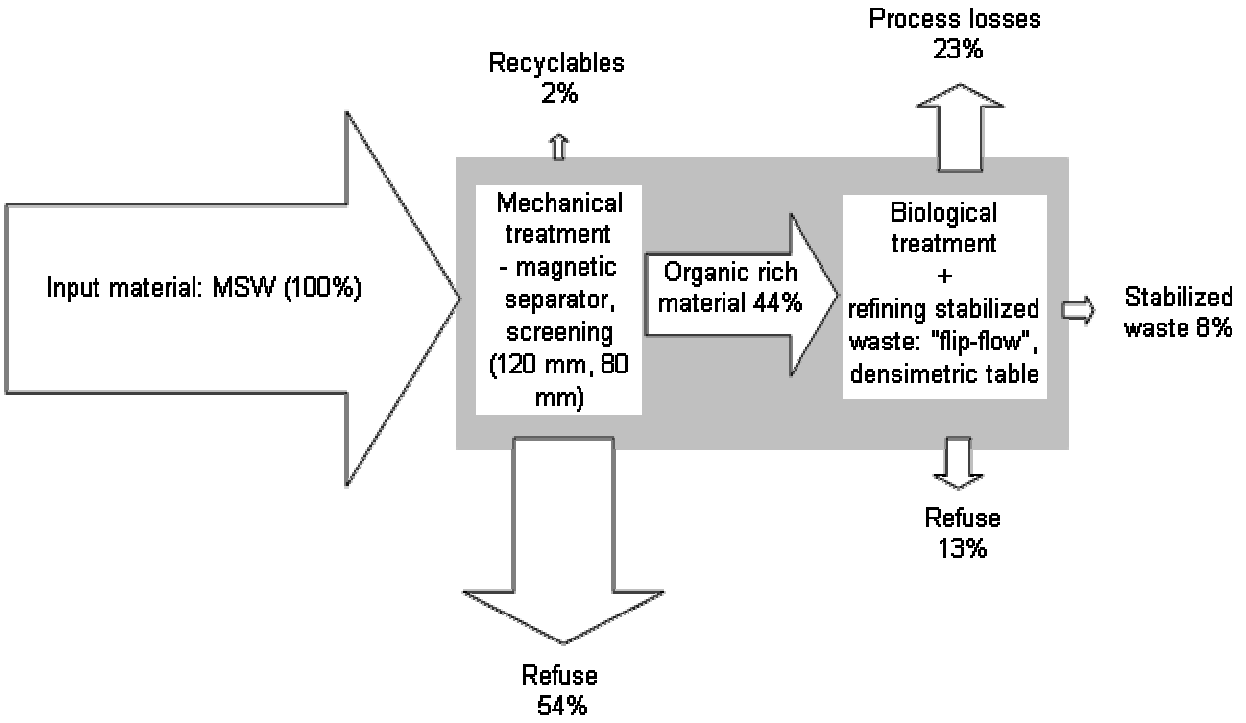

Figure 1 Typical MBT plant until 2007 (based on DIAS *ET AL.*, 2006)

In 2002 the composting plants to treat green waste started to work. These two units are located in Algarve, and use the windrow composting process. Two more composting plants started to work in 2004 and 2005 to treat BMW from big producers (*i.e.* restaurants, hotels, markets), from separate collection, both in-vessel composting, and one anaerobic digestion unit started the test phase in 2005. Such unit uses a wet two-stage thermophilic anaerobic digestion process (VALORSUL, 2003).

The treatment capacity of these plants (composting, anaerobic digestion and MBT) could only treat 20% of total BMW to be diverted from landfill in 2006. When Portugal had to comply with the Landfill Directive target, the three incineration plants allowed to reach it. Also, paper recycling contributed with 18% to the diverted target, as shown in Figure 2. The total quantity diverted from landfill was 1,027,000 tonnes of BMW (MAOTDR, 2007).

As it can be seen in Table 1, incineration and MBT plants do not coexist in the same waste management system, because MBT are usually located close to large landfills with huge vacant volumes and in rural areas, while incinerators are mainly used in dense populated areas (KÜHLE-WEIDEMEIER, 2005). Notwithstanding, the systems where the management waste option was incineration, composting plants and anaerobic digestion plants to treat BMW were also implemented.

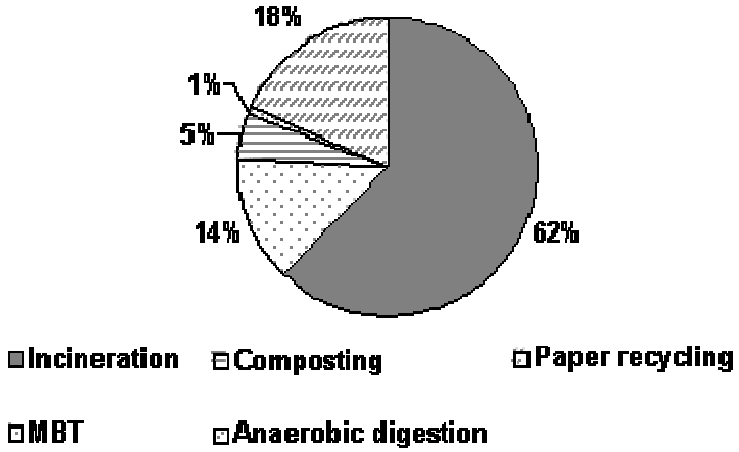

Figure 2 Biodegradable municipal waste treatment capacity in 2006 (based in MAOTDR, 2007)

The only exception is the waste management system Algar (Table 1), with composting plants for green waste but such waste is supplied by private owners, not by the waste management system.

Table 1 Organic matter treatment capacity (based in MAOTDR, 2007)

Waste management systems	Population served (inh.)	Incinerator (tonnes)	MBT (tonnes)	Composting (tonnes)	Anaerobic digestion (tonnes)
Amave (North region)	472,472	-	53,000	-	-
Lipor (North region)	971,931	224,000	-	60,000	-
AdZc (Center region)	221,191	-	20,000	-	-
Amtres (Lisbon western area)	750,180	-	60,000	-	-
VALORSUL (Lisbon centre area)	1,196,343	336,000	-	-	40,000
AMARSUL (Lisbon south area)	714,589	-	20,000	-	-
Algar (Algarve region)	395,128	-	-	10,000 (only green waste) (2 units)	-
Valor Ambiente (Madeira region)	250,000	71,000	-	23,000 (only green waste)	-
Total	4,972,572	631,000	153,000	93,000	40,000

3 Actual and future situation

With the publication of PERSU II, in February of 2007, new targets and new driving forces were defined and it was possible to restablish the BWM management strategy. The challenge is quite relevant: divert away from landfill about 1,689,000 tonnes of BMW, thus allowing 46% BMW to be landfilled in 2009 (MAOTDR, 2007). The most important guidelines defined in such strategy are:

- Pay-As-You-Throw system implementation;
- separative collection of BMW;
- MBT plants enforcement with production of compost/stabilized residue and refuse derived fuel (RDF).

The new National Waste Law (Decreto-Lei n.º 178/2006, 5 de Setembro) also predicted global actions, like creating new waste management taxes (€2 per ton of landfilling municipal waste) and a waste exchange market.

The technologies that Portuguese waste management systems will apply to fulfil the next Landfill Directive targets are the same as the existing ones. The biggest changes will be RDF production and more anaerobic digestion treatment in MBT plants. The biggest investment will be made in the construction of new MBT, composting and anaerobic digestion plants and they will cover all the country (Figure 3).

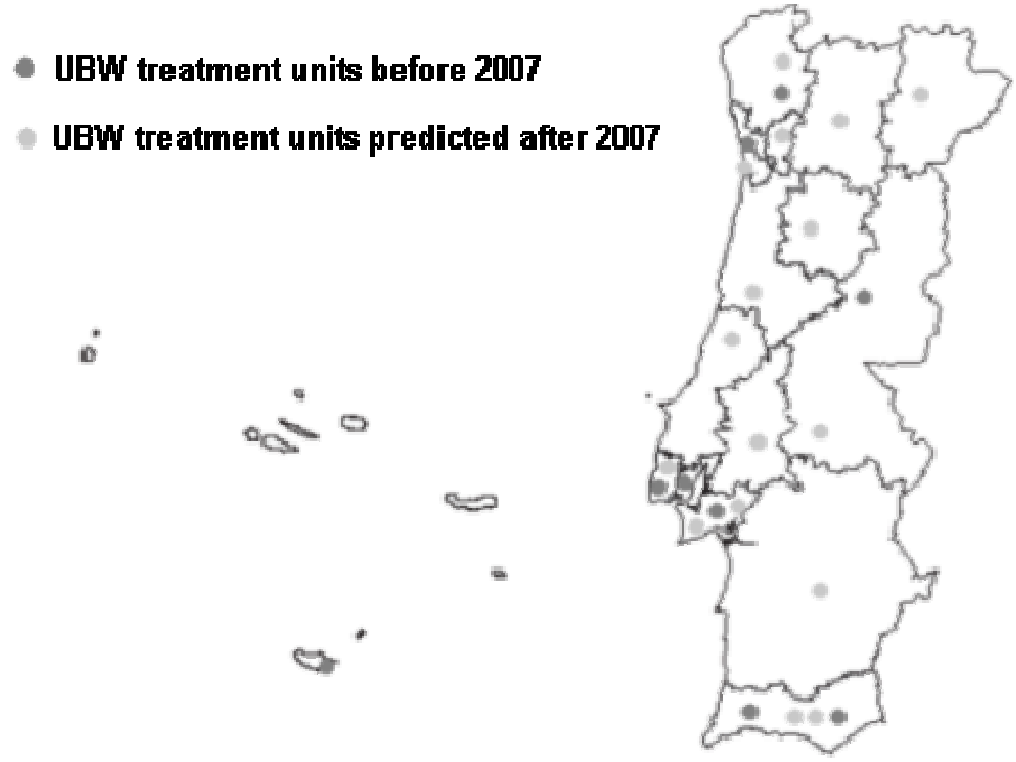

Figure 3 Existing and future BMW treatment unit's location in Portugal (based on INR, 2006)

The first RDF production will be conducted in MBT existing plants. For that, some units are already, or going to be, updated to maximize RDF production. For the example showed in Figure 1, the RDF production will be around 49% of total mixed MSW, resulting in only 23% of total refuse going to landfill.

Because MBT plants are a modular process, the new MBT plants will be designed to have two operation lines: one to process BMW from separate collection, and another line to process mixed MSW. It is expected that, in 2016, 50% of BMW will be collected separately. Also, the treatment capacity will be increased through time, as it is shown in Table 1. The most common units will be small MBT plants, with biological capacity treatment below 50,000 tonnes.

The capacities showed in Table 2 only concerns total BMW. This represents only the input to the biological treatment. The mechanical treatment, that will produce RDF, is about 10,000 tonnes average for each plant.

Table 2 MBT plants treatment capacity in 2009 and 2016

	2009		2016	
Treatment capacity (tonnes of BMW)	**Aerobic**	**Anaerobic**	**Aerobic**	**Anaerobic**
10,000	1	3		1
20,000	2	1	3	4
30,000		1		
40,000		2		3
50,000	1		1	
60,000	1		1	
>100,000		1		2
Total	5	8	5	10

4 Discussion

4.1 Fulfil targets

As it was showed above, the MBT plants will be designed to produce compost/stabilized residue, RDF, methane (the ones that will have anaerobic treatment) and will also contribute with about 10% to the Portuguese target defined by the Packaging Directive for 2011 (55% of packaging recycling target) (MAOTDR, 2007).

Because of the choice made by government to invest in MBT technology that could increase energy production with neutral carbon emission, the most significant product

resulting is RDF (71% MBT outputs). Compost/stabilized residue will only represent 10% and recyclables 6%. The refuse fraction resulting from waste processing (Figure 4) will be 13% of total output.

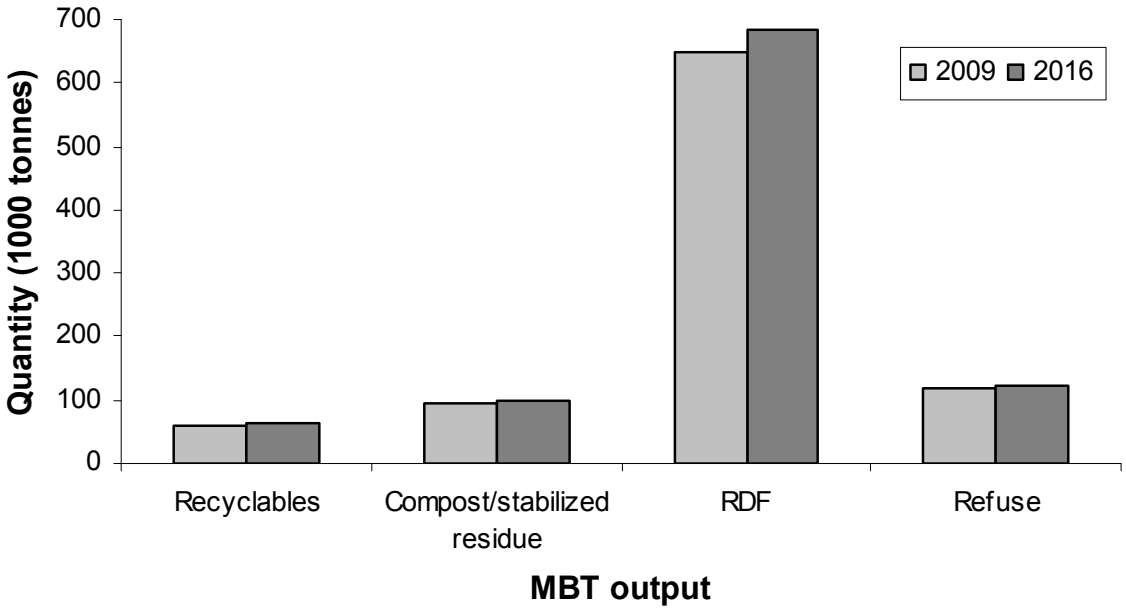

Figure 4 MBT output quantity predicted in 2009 and 2016

The contribution of MBT to comply with EU Directive 99/31/EC of 26 April targets is in Figure 5. In 2009, MBT plants will contribute with 38% to the diverted biodegradable fraction of MSW, and in 2016 this will be 48%, being the most important technology to fulfil Landfill Directive targets. Other relevant technology used to divert BMW will be incineration (MSW burning), and RDF co-incineration, to be used in incineration plants and industrial kilns, like cement kilns.

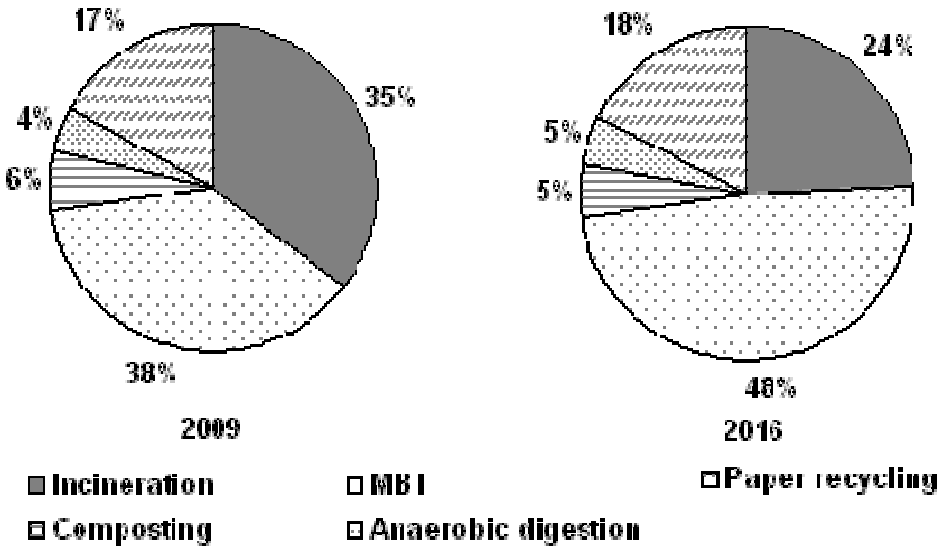

Figure 5 BMW diverted from landfill in 2009 and 2016

4.2 Problems and constraints

EU Directive 99/31/EC of 26 April was created to meet the requirements of EU Directive 75/442/EEC of 15 July, but also to lower the production of methane gas from landfills, in order to minimize global warming through the reduction of landfilling of biodegradable waste and to prevent or decrease potential adverse effects on the environment and risks to human health. Technologies like composting, anaerobic digestion and MBT presented as an alternative to incineration to fulfil Landfill Directive, are capable of minimizing landfill environmental problems and incineration environmental impacts. European legislation to minimize and control pollution problems from such plants, especially MBT plants, was not created. If, on one hand, it is true that this units are more environmental friendly that incineration, on the other hand there are still environmental and health issues that must be controlled, like odours, bioaerosols, wastewater, noise and the outputs of treatment process.

In countries, like Austria, Belgium, Germany, Italy, the composting, anaerobic digestion and MBT plants have environmental requirements to fulfil. In Portugal there is no control of plants, except in case of water and noise, and this can lead to significant environmental, economical and social problems.

The only document capable to indicate the possible control of this units in Portugal is a monitoring programme proposed to the authorities by Silveira *et al.* (2005), that could be adapted to the environmental performance of the unit, benefiting the less pollutant units. Such monitoring programme was based on the most measured parameters, control frequency and methods applied in European countries.

Nevertheless, such document is not enough. Minimization of pollution issues should start with the application of environmental requirements to the construction and operation of the MBT unit, being established at the European level, in such a way that it would promote MBT as an environmental friendly technology.

Regarding the control of the environmental problems of MBT outputs, Portugal is still developing a norm to control the compost/stabilized residue. Presently, there is no difference between compost and stabilized residue, and both can be applied in agriculture, without being guaranteed the environmental and agricultural quality. There is any European norm that could regulate compost quality, but in RDF case, this does not pose any problem, since the European norm has been published. For recyclable materials, their payment and utilisation by the recycling industry is guaranteed by the Green Dot System (in case of packaging waste) and the recycling industry (non-packaging waste).

The lack of control and minimization of the environmental problems of MBT plants and their products can be harmful and do not comply with the Landfill Directive targets. On one hand, if MBT plants are not controlled it is probable that problems, like odours,

could lead to a NIMBY syndrome (Not In My Back Yard syndrome), as it happens with landfills. On the other hand, if the quality of the output cannot be guaranteed, specially for the compost/stabilized residue, the market for this product can not be created, and it will be deposited in landfill. Choosing MBT plants to maximize RDF production with organic matter content could be a solution to the market problem, since the users are incinerators and some cement kilns interested in neutral carbon fuel. But if RDF quality cannot be guaranteed, the problem will remain.

The outputs unsale or fee payment can be a serious disadvantage to MBT owners, as well as to composting and anaerobic plants owners. This will make them pay the landfill tax, an extra cost that would be reflected in higher taxes charged by the municipalities. Solving the referred issues would be very useful to guarantee the economical viability of the plants and the lower environmental impact of MBT plants in Portugal.

5 Conclusion

MBT plants will be the most important technology in Portugal to fulfil Landfill Directive targets, being responsible for almost 50% of the diverted biological municipal waste. But some constraints are still remaining, such as operational control to avoid pollution issues, output control and regulation, namely stabilized residue or compost, that should be solved in a near future.

6 Literature

Dias, S., Silva, R., Barreiro, F., Costa, M.	2006	*Evaluation of potential production and utilization of RDF in continental Portugal* (in Portuguese: Avaliação do potencial de produção e utilização de CDR em Portugal continental), Centro de Engenharia Biológica e Química do Instituto Superior Técnico, Lisboa. p. 88.
INR	2006	*MSW management system*. Waste Institute (in Portuguese: Sistemas de gestão de RSU. Instituto dos Resíduos). http://www.inresiduos.pt/sistemas/default.html. Accessed in March 4, 2007.
Kühle-Weidemeier, M.	2005	Basics of MBT and the waste management system in Germany. *Proceedings International Symposium MBT 2005*, 23-25 November 2005, Cuvillier Verlag, Hanover, Germany, 1-14. ISBN 3-865737-665-7.
MAOTDR	2007	*Strategic Plan for Municipal Solid Waste 2007-2016* (in Portuguese: PERSU II – Plano Estratégico para os Resíduos Sólidos Urbanos 2007-2016). Ministério do Ambiente, do Ordenamento do Território e do Desenvolvimento Regional. Lisboa. ISBN 978-989-8097-01-9.

MAPTDR	2004	*National Strategy for the Reduction of Biodegradable Urban Waste Landfilling* (in Portuguese: Plano estratégico para a redução dos resíduos urbanos biodegradáveis destinados aos aterros). Ministério do Ambiente, do Planeamento do Território e do Desenvolvimento Regional, Lisbon.
Silveira, A., Ganho, R., Martinho, M., Santos, A., Pires, A.	2005	*Environmental monitoring programme for organic valorisation units of biological municipal waste* (in Portuguese: Programa de monitorização ambiental das unidades de valorização orgânica de resíduos urbanos). Department of Science and Environmental Engineering, Faculty of Science and Technology, New University of Lisbon, Caparica.
Valorsul	2003	*Main characterisitcs of the project.* Valorsul. http://www.valorsul.pt. Accessed in March 4, 2007.

Author's address

Dipl.-Ing. Ana Lúcia Lourenço Pires
Department of Science and Environmental Engineering, Faculty of Science and Technology, New University of Lisbon
Quinta da Torrre
2829-516 Caparica
Portugal
Telephone +351 21 294 83 00
Email alp11931@fct.unl.pt
Website: www.dcea.fct.unl.pt