COMPOSTING OF GREEN WASTE THE EXPERIENCE OF ALGAR, S.A.

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1 INTRODUCTION

In the last decade in Portugal, the adoption of technical solutions appropriate for the management of Municipal Solid Waste (MSW) induced the construction of front-line facilities for reducing the serious burden on the environment that existed at the time.

Indeed, where MSW is concerned, there has been an important change due to the implementation of 30 solid waste management systems (16 municipal and 14 multi-municipal – "EGF") and to the closure of the 341 listed rubbish tips, resulting in the adequate, nationwide treatment of the waste produced.

In light of the prevailing circumstances in the early 1990s and the need for the rapid planning, projection, execution and exploitation of technically adequate waste management systems, technical containment was the most frequently used method, with the exception of the thermal treatment method employed in the two large metropolitan areas of Lisbon and Oporto.

In the specific case of the Algarve, the strategy used was the creation of a multi-municipal system involving the region's 16 municipalities and the *Empresa Geral do Fomento* (EGF), which gave rise to *ALGAR – Valorização e Tratamento de Resíduos Sólidos S.A.* Here, too, technical containment was chosen as the initial method of treating SUW; this was done by building two sanitary landfills and eight transfer stations, which were necessary because of the extensive area to be covered. A system for the recovery and reuse of recyclables was also implemented through the provision of eco-bins in which people could voluntarily deposit their recyclable waste.

However, ALGAR considered it essential from the very outset that different types of waste should be treated in different ways depending on their nature and characteristics, so that they can benefit the environment, always as an integral part of economic sustainability.

Thus, the company's integrated management diagram (see figure 1), has been, and will undoubtedly continue to be, regularly adapted to legal and technical realities with a view to achieving the greatest degree of environmental adequacy.

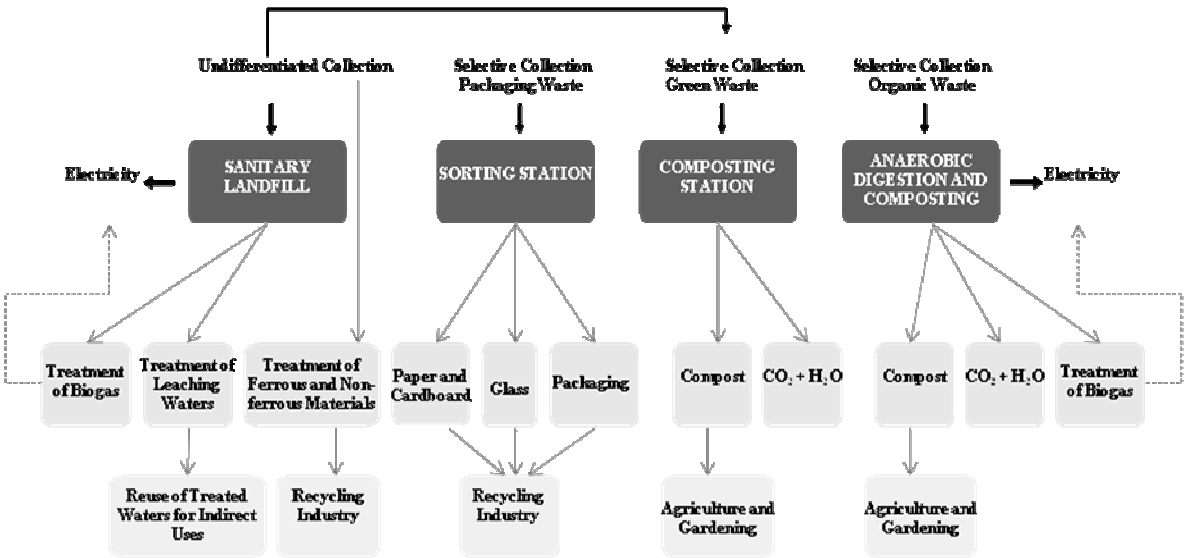

FIGURE1 **Diagram of ALGAR'S integrated waste management system.**

2 ORGANIC RECYCLING

The differentiation of biodegradable urban waste is currently one of the most widely expanding areas in the company. It was introduced as a result of Decree-Law 152/2002, of the 23rd of May, which transported European Directive 1999/31/CE, of the 26th of April, governing the landfill of waste, into Portuguese law, and which defines timelines for the admission of biodegradable waste to sanitary landfills. This requires a reduction in the quantity of biodegradable waste deposited in landfills and consequent recycling of the remainder, using methods such as composting, anaerobic digestion or some other form of recycling.

Obviously, the technical methods used to recycle the organic part of the urban waste must be appropriate to local and regional realities otherwise the solution may not only be unsuitable but may actually create problems rather than resolving them. In light of this, and due to the region's intrinsic characteristics with regard to waste production, the decision to go ahead with the organic recycling of one of the MSW components – green waste – was a natural step to take.

3 GREEN COMPOSTING AT ALGAR

Given the considerable potential of the raw materials and future legal requirements, the decision to develop a technical solution suitable for the organic recycling of the urban waste produced was almost instinctive and two green waste composting plants with an annual capacity of 5000 tonnes have been operating since 2003.

Composting is the controlled aerobic decomposition of organic waste by a heterogeneous population of microorganisms until the waste stabilises, producing a humic substance (compost) used as a soil corrector (Lobato *et al*., 1997 in Martinho & Gonçalves 2000).

During composting, the microorganisms aerobically decompose part of the organic waste into carbon dioxide, water and mineral salts, while another part humifies, resulting in a stable compost suitable for use as a bio-fertiliser (Bertoldi & Schnappinger, 2001).

At ALGAR, the process starts with the shredding of the green waste that has been deposited, usually by gardening companies, at its facilities. The aim of this initial stage is to obtain particles that are smaller in size, with the purpose not only to accelerate the composting process but also facilitating the handling.

Next, the raw material is transported to the proper composting area, which consists of slabs of concrete that have been reinforced with additives to make them resistant to mechanical impacts, corrosion by the leaching waters and abrasion by machinery in operation. There, it is placed in homogenous piles where the decomposition will occur.

After a first cycle involving the metabolisation of the organic matter, the temperature drops (cooling stage), resulting in the reappearance of microorganisms in the composting matter. At this stage, there is only a very small variety of bacteria; mesophilic/heat resistant actinomycetes and fungi are more common.

Immediately thereafter comes the maturing stage where compounds such as lignin, hemicellulose, cellulose, starch and other polymers are slowly decomposed by the action of these microorganisms.

The piles are turned over by machines at regular intervals to encourage oxygenation and to ensure uniform decomposition, thus accelerating the composting process. At the same time, water is injected in order to control the moisture content of the composting matter.

Once the stabilisation phase is reached (after 2 to 3 months), the material is passed through a rotating sieve, where the compost proper is obtained along with another coarser product known as "mulch".

Figure 2 shows the areas and operations associated with the green composting facilities and the percentages inherent to each stage of the process.

The green composting facilities generally result in a return of around 30% of the initial weight, depending on the amount of moisture in the final product and the amount of rejects and scrap, which is kept small due to the increasing quality of the materials entering the process from the outset.

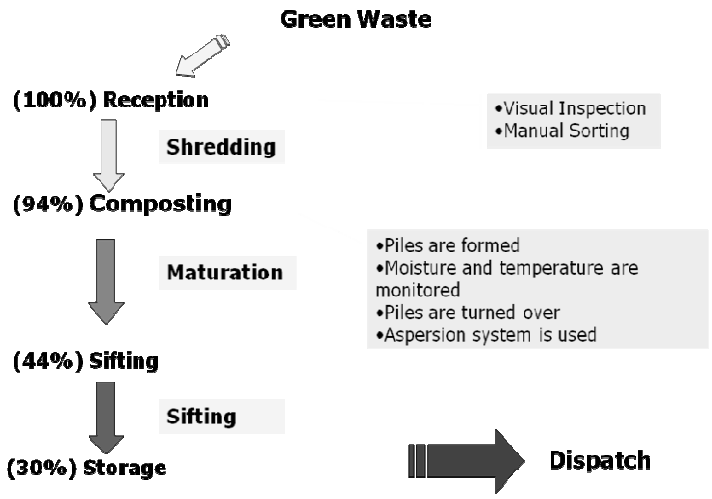

FIGURE2 **Graph showing the percentages achieved by ALGAR'S green composting system.**

3.1 Control and Monitoring of the Process

The production process in the composting facilities is subject to regular six-monthly quality controls tests of the final product, which is done by means of analyses carried out in accredited laboratories. The schedule of analyses used for quality control purposes covers every type of parameter relevant to the verification of the final quality of Nutriverde® products.

The quality control of the final compost obeys the parameters defined in the document "Proposed Technical Norm governing the Quality and Uses of Compost". Where quality is concerned, and still based on the contents of the aforementioned document, it should be noted that the final compost meets all the required standards for Class 1 composts, in other words, there are no restrictions upon its use.

TABLE 1 **Summary of the quality control checks carried out on the compost produced at ALGAR Composting Units and comparison with reference values.**

		NUTRIVERDE (2008)		NUTRIVERDE (2009)		Proposed Technical Norm governing the quality and uses of compost – Class 1	Organic Agriculture
		Barlavento Composting Station	Sotavento Composting Station	Barlavento Composting Station	Sotavento Composting Station		
Parameter	Results expressed in:	Result	Result	Result	Result		
Humidity	%	37	19	26	25	<40	-
Organic matter	% (m/m)	38	23	42	28	>30	-
pH (1:6) at 19ºC	Units of pH	8.5	8.5	8.8	8.65	5.5-8.5	-
Conductivity at 20ºC (1:5)	µS/cm	1121	1717	1855	941,5	1-10(1)	-
Total Nitrogen	% (m/m)	0.6	0.6	0.845	0.555	0.5-2.5 (1)	-
Ratio C:N	-	19:1	21:1	29:1	28:1	<20(1)	-
Total Copper	mg/Kg Cu	14	12	16.5	17	≤100	≤50
Total Zinc	mg/Kg Zn	64	63	68.5	61	≤200	≤150
Total Lead	mg/Kg Pb	3	29	3	23	≤100	≤45
Total Cadmium	mg/Kg Cd	0.1	0.1	0.095	0.09	≤0.7	≤0.7
Total Chromium	mg/Kg Cr	4	5	55	47.5	≤100	≤50
Total Nickel	mg/Kg Ni	4.6	6.7	22.8	21.85	≤50	≤25
Total Mercury	mg/Kg Hg	0.06	0.5	0.1	0.1	≤0.7	≤0.4
Salmonella sp	Present or absent / g	Absent	Absent	Absent	Absent	Absent in 25g of compost	Absent in 25g of compost
Escherichia coli	N/g	0	$9.5x10^2$	0	10	<1000	<1000
Degree of maturity	ºC	25 (Degree V)	24 (Degree V)	23 (Degree V)	22 (Degree V)	(Degree V)	-
Inert and anthropogenic materials	%	0.22	0.21	0.165	0.315	<0.5	-
Stones >5 mm	%	3.1	7.6	3.4	3.4	<5	-
Weeds	No. of propagules or seeds / L	<1	<1	<1	<1	-	-

(1)US Composting Council

The figures shown in the table above correspond to the average values obtained in analyses carried out at the Portimão and Tavira Composting Units.

Regarding the analytical characterization presented above, the values are always within the limits considered for Class 1 compost (Portuguese Proposal of Technical Standard for the Use of Composts and Biological Treatment of Biowaste - 2nd draft)**.** Note also that the values shown fall under the normal range for this type of composts. Regarding heavy metals, it does not have levels that limit the use for the purposes for which it is intended.

4 CONCLUSIONS

Concerning the above, the green composting project developed by ALGAR is clearly a success story, demonstrating that local and regional specifications should be taken into account in solid waste management systems, rather than simply applying existing systems and technologies that will normally have an adverse affect on operational capabilities to a greater or lesser degree.

Thus, ALGAR'S experience of green composting allows us to conclude that: organic recycling of green waste through composting ***works;*** it is simple and economical in comparison to the composting of the fraction of organic waste contained in SUW; the compost obtained is high in quality; the process is very useful as a means of diverting organic matter from the landfill; the potential for using the compost at regional level is excellent.

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