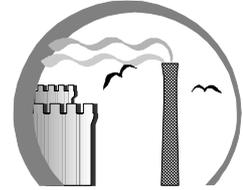




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Project

“Integration of Solid waste management Tools into specific settings of
European and Asian Communities”

Activity 3

Organic waste characterisation

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1. Introduction

The quantity of municipal solid waste in Greece amounts in roughly 4.600.000 tones per year. About 47% from this quantity, that is 2.162.000 tones, are organic wastes [1]. Additionally to the organic waste production there is an important amount of sludge production in Greece. Data from the Hellenic Ministry of the Environment concerning the sludge production in Greece, shows that the waste water treatment facility in Athens, which is located in an area called Psitallia, produces 300 tones of sludge per day. The estimated sludge amount from the same facility, after the completion of the project's 2nd phase, would be 800 tones per day. In Thessaloniki, the 2nd largest city in Greece, the sludge production is 60.000 tones per year (roughly 167 tones per day), whereas an amount of 10.000 tones per year are also produced from industrial activities [2]. Until now, there are no national schemes for the sludge management in Greece and the biggest amount is destined for land disposal.

2. Waste quantities and source separation in EU member states

The collected and treated amounts of organic material differ much among the EU countries. Roughly 35%, that is 17.000.000 tones (table 1), of the estimated total recoverable potential (of the 49.000.000 tones bio- and green waste), are separately collected. This results in a compost production of around 9.000.000 tones in Europe.

The new trend on composting provides separate collection and the mixed municipal solid waste (MSW) becomes more and more unusual as an input to composting plants, which can be seen only in a few countries in southern Europe. Compost products based on source separated organic waste show only 10-20 % of the heavy metal contents compared to MSW compost. In the countries without separate collections schemes, a change in the waste management should begin because it is obvious that in the future there will be no market for composts with bad qualities, such as compost from mixed MSW [3].

Table 1: Amounts of separately collected and composted bio- and green waste in EU-15 [3]

Country	Separate collected & treated organic waste [in million tones]		Recovery potential of organic waste [in million tones]		Theoretical potential ¹
	Biowaste	Green-waste	Biowaste	Green-waste	Total [million tones]
Austria (2000)	0,45	0,20	1,22	0,97	2,19
Belgium Flanders (2000)	0,34	0,39			1,3
Belgium Wallonia (1994)	0,12				0,16 in 2002
Germany (1999)	7,0				9,0
Denmark (1999)	0,037	0,65	0,1	0,66	0,76 in 2004
France (2000)	0,05	1,5	5,25	3,5	8,75
Finland (1998)	0,1				0,6
Greece (1995)	-	-			1,8
Italy (1999)	1,5				9
Ireland (1998)					0,44
Luxembourg (1998)	0,03				0,06
Netherlands (2001)	1,6	1,5	1,7	1,5	3,2
Portugal (1995)		0,01			1,3
Spain (2000)	0,03 Catal.)	0,02 Catal.)			6,6
Sweden (1999)	0,14	0,15	1,0	0,65	1,65
United Kingdom (2000)	0,039	1,0			3,2 in 2006
Total	11,4	5,42			48,7
Treated Bio- & Greenwaste 16.900.000 t			Theoretical recovery potential 49.000.000 t		

¹ In most of the EU countries, no statistical data on composting are available, so the estimation about of the full extent of organic waste potential is very difficult.

3. Composting schemes in Europe

With reference to activities in the field of source separation and composting of biowaste, European Countries can be grouped into 4 categories (see also Figure 1), as follows:

- 1st category: In **Austria**, Belgium (**Flanders** in particular), **Germany**, **Switzerland**, **Luxembourg** and the **Netherlands** strategies and policies are already fully implemented nationwide. The contribution of these countries – and

Germany in particular - to the overall recovery of biowaste in the EU is fundamental and was around 80% in 1999.

- 2nd category: In the second category we find **Denmark, Sweden, Italy, Spain (Catalunya)** and **Norway**. In these Countries policies, are fully outlined, but there is still an ongoing development of schemes, of the needed composting capacity and of the marketing framework.
- 3rd category: **Finland, France, the United Kingdom** and **Wallonie** belong to a separate category, where programs are at the starting point, although policies have been sometimes fully laid out.
- 4th category: In the fourth category belong countries, where no effort on composting of source separated organic waste can be detected as yet; these include most Regions in **Spain, Greece, Ireland** and **Portugal**. In these Countries, we can also still find composting from mixed urban waste that sometimes plays an important role (e.g. many local strategies in Spain and Portugal) [4].

The development of source separation and composting in Europe is illustrated in figure 1.

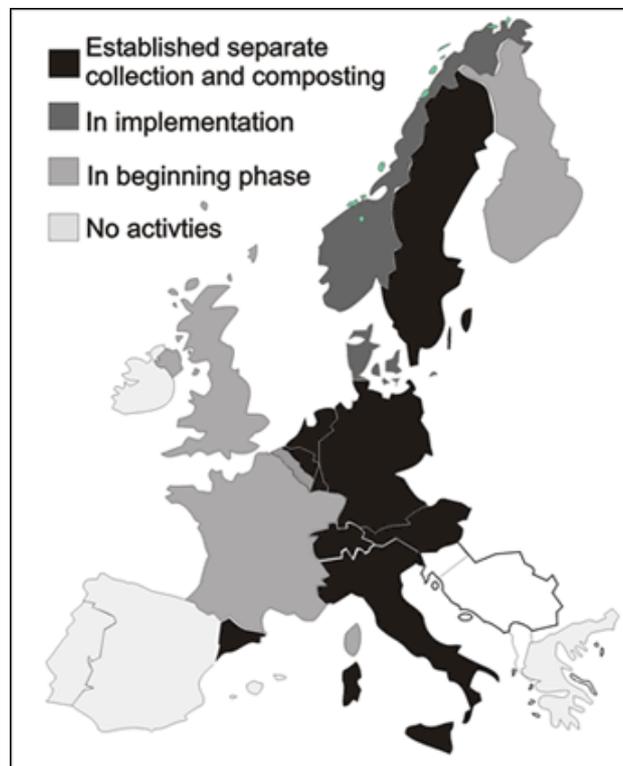


Figure 1. Development of source separation and composting in Europe [5]

4. The proposed EU directive on the biological treatment of biowaste

The Working Document of the European Commission on the Biological Treatment of Biowaste has been intended as a basis for preliminary discussions on the subsequent directive on biological treatment of biowaste [6]. In accordance with this document, the mechanical/biological treatment of biowaste should have the purpose of stabilising and reducing the volume of the biowaste, in order to ensure that the stabilised biowaste can either be used for ecological improvement or has reduced negative environmental impacts, when landfilled. It should be carried out in such a way as to minimise the impact on the environment of air emissions and leaching to surface or groundwater, as well as to minimise the health impact on the workers at the plant [6]. The general principles of the proposed directive, as included in the working document are the following:

- prevention or reduction of biowaste production (e.g. sewage sludge) and its contamination by pollutants,
- reuse of biowaste (e.g. cardboard),
- recycling of separately collected biowaste into the original material (e.g. paper and cardboard), whenever environmentally justified,
- composting or anaerobic digestion of separately collected biowaste, that is not recycled into the original material, with the utilisation of compost or digestate for agricultural benefit or ecological improvement,
- mechanical/biological treatment of biowaste,
- use of biowaste as a source for generating energy.

According to the proposed directive Member States should encourage home composting activities, especially in rural areas and houses with gardens. Member States should also start and encourage information campaigns on the composting process and on the benefits of biowaste recycling [6].

5. Hellenic policy on composting

There is no specific national policy in Greece regarding collection and treatment of organic waste. However, there is a regulation about compost application: CMD

114218/97 (HOG 1016B/17-11-1997) is a Common Ministerial Decision (i.e. a national law), published in the Official Journal of the Hellenic Republic. The key European legislation, to which this national law refers, is the Waste Framework Directive (75/442/CEE) and Directive 86/728/CEE on the Use of Sewage Sludge in agriculture. Generally there are no regional regulations, as Greece is a fairly small country. Licensing in many cases may be on a regional basis but the law is national. CMD 114218/97 is signed by the Ministries of Environment, Interior and Public Health [7].

The Council Directive 99/31/EC on the landfilling of waste has as main objective to prevent or reduce the possible negative effects on the environment from landfilling. This directive has been incorporated in to the Hellenic legislation on December 16, 2002 through CMD 1572/02 and includes (article 4) the current national strategy on the reduction of the organic municipal waste that are disposed of in a landfill. Article 4 imposes a gradual decrease of biodegradable municipal waste going to a landfill, starting from 25% decrease, going to 50% and reaching a 65% decrease at time periods of 5, 8, and 15 years, respectively, after 2002 when the above EU directive was brought into force in Greece.

There is no debate regarding changes in compostin standards, or the need to introduce different quality classes, mainly because experiences with composting in Greece are still in the very early stages, and many decision makers have little awareness about composting and its implications.

The Hellenic CMD regulation (CMD 114218/97) on compost is typical of provisions aiming at defining conditions and constraints on the use of low-quality composted materials from mixed waste [7]. It covers the maximum allowable concentration of heavy metals in soils (where the sludge will be disposed of) which have been set following the limit values of the EC Directive on sludge (table 2), the load of heavy metals for soils and the heavy metal limit values for composts and sewage sludge (table 3), as well as the chemical-physical features of compost (table 4).

Table 2. Maximum allowable concentration of heavy metals (mg/kg of dry weight) in soils [8].

	Cd	Cr	Cu	Hg	Ni	Pb	Zn
Upper limit	3	150	140	1,5	75	300	300
Lower limit	1	100	50	1	30	50	150

Table 3. Maximum admissible loads of heavy metals per year for cultivable soils (average of 10years in total) and heavy metals limit values for composts and sewage sludge [8].

Heavy metal	Cultivable soils	Composts and sewage sludge
	Limit value (kg/ha/y)	Limit value (mg/kg dry weight)
Cd	0.15	10
Cr _{tot}	5	510
Cr VI		10
Cu	12	500
Hg	0.1	5
Ni	3	200
Pb	15	500
Zn	30	2000
As		15

Table 4. Chemical-physical requirements of compost [8].

Characteristic	Permissible range
pH	6 – 8
Moisture	<40%
Plastics	<0.3% dry weight
Glass	<0.5% dry weight
Particle size for 90% in weight	<10 mm (mesh size)
Enterobacteria	Absent

6. Compost quality and standards

Table 5 shows that each country classifies the compost according to different statutory or voluntary standards.

Table 5. Existing classification of composts in statutory and voluntary standards [9].

Category that is classified	Country
Heavy metal contents	Austria, Canada, Germany, Netherlands, Spain, Sweden, the Netherlands, Canada and USA
Type of raw material	Austria, Belgium, Denmark, Germany, Italy, Spain and Sweden
Degree of maturity	Australia, Germany, Luxembourg and Spain (and to some degree in Canada)
Compost types based on application	Austria and Germany

The quality requirements of compost differ widely from country to country, even within Europe. General target for compost production is the soil protection (especially, the agricultural soil) against heavy metals. Tables 6 and 7 show that some countries opted for a complex system, integrating levels of quality classes with categories of admissible input materials and differentiated restriction of application areas.

Table 7 shows that, within the regulations for biowaste in different countries, a considerable variation is found. Some countries, like Austria, have very strict limits for the concentration of the heavy metals and on the other hand, there are EU countries, like Portugal, Greece and Italy with very low standards.

It becomes evident, that in those countries where source separation for organic household waste has not been implemented so far, concentration limits for compost are still orientated at MSW compost or sewage sludge regulations.

Table 6. Number of classes in compost standards and rationale for differentiation [7]

	Number of Classes	Description of Classes
Austria	Three	Class A+ (top quality; limit values taken from Council Regulation Class A (high quality; suitable for use in agriculture) Class B (minimum quality; suitable for non-agricultural use)
Belgium <i>Flanders</i>	One Two	Bio-compost (compost from source-separated biowaste) Humotex (compost from aerobically composted digestion residuals) Green waste (compost from source-separated garden waste)
<i>Brussels</i>	One	Source separated biowaste and green waste.
Denmark	One	Product standard
Finland	One	Product standard
France	One (N FU 44 051) Two (Compost Urbain)	Two (Compost Urbain - standards with same limit values for heavy metals and different standards for physical contaminants - Class A and B) – voluntary marketing standards
Germany	Two	Two classes defined with respect to heavy metals
Greece	One	Only mixed waste composting
Ireland	Two	
Italy	One set of limit values Two categories of soil improver	Composted green soil improver (only from vegetable waste); and composted mixed soil improver (from vegetable waste, plus sewage sludge and/or food leftovers, etc.) (differentiated by organic carbon content, C/N ration and humic /fulvic acid content)
Luxembourg	Two	As German standard – also differentiation between fresh and mature compost
Netherlands	Two	Limit values distinguish between very good compost and good compost (through heavy metals).
Portugal	One standard ‘adopted’ (no law)	Through heavy metals
Spain	One rest of Spain	Catalonia classes defined through reference to heavy metals

	Two in Catalonia	
Sweden	One	Product standard
UK	One	Product standard
Australia	One class of PTE limits Four classes	Four different products defined by the various limit values in the standard. These four products are divided into the two classes, 'composted product' and 'pasteurised product', each of which contains two sub-classes, 'soil conditioners and fine mulch', and 'mulch'.
New Zealand	One	Product standard
Canada	Canadian Food Inspection Agency (AAFC): 1 class Canadian Council of Ministers of the Environment (CCME): 2 classes (A, B) Bureau de Normalisation du Quebec (BNQ): 3 classes (AA, A, B)	<p>The AAFC recognizes only one class of compost, reflective of product safety criteria. It is based on the limits of CCME's Category B and BNQ's Type B compost for trace elements. It reflects the requirements for product maturity, absence of pathogen content and the limits on the presence of sharp objects as part of the foreign matter criteria.</p> <p>Within the CCME Guideline, two compost categories have been established (Category A; and Category B). The difference between the two categories reflects limits set for trace element concentrations. Category A compost may be used for all types of applications: on agricultural lands, in residential gardens, in horticultural operations, in nurseries or other enterprises. Category A criteria for trace elements are achievable using source separated municipal solid waste feedstock. Category B compost has restricted use. The controls established for its use are determined by each province or territory individually.</p> <p>Under the BNQ Standard, compost may be classified in three ways (Type AA; Type A; and Type B). The requirements for Type B compost are considered to be the minimum necessary, in order to obtain good compost. Compost classified as Types AA and A is of higher quality. Total organic matter content and foreign matter content are the distinguishing factors between the three types. Trace element content is the classification feature that differentiates Type AA and Type A compost from that of Type B compost.</p>
USA	One	Product standard (bio-solids)

Table 7. Heavy metal limits for European compost standards [9]

Country		Type of standard	Cd	Cr tot	CrVI	Cu	Hg	Ni	Pb	Zn	As
Austria	Comp.ord.:Class A+ (organic farming)	statutory decree	0.7	70	-	70	0.4	25	45	200	-
	Comp.ord.:Class A (agric.; hobby gardening)		1	70	-	150	0.7	60	120	500	-
	Comp.ord.:Qu-Class B limit value (landscaping; reclam.) (guide value)*		3	250	-	500 (400)	3	100	200	1800 (1200)	-
Belgium	Royal Decree, 07.01.1998	statutory decree	1.5	70	-	90	1	20	120	300	-
Denmark	Statutory Order Nr.49; Compost after 01 06 2000	statutory decree	0.8	-	-	1000	0.8	30	120/	4000	25
Finland	Decisions of the Ministry of Agriculture and Forestry (46/94)	statutory decree	3	-	-	600	2	100	150	1500	50
France	NF COMPOST URBAIN	standard	3				8	200	800		
Germany	Quality assurance RAL GZ - compost /digestion	voluntary QAS	1.5	100	-	100	1	50	150	400	-
	Bio waste ordinance (Class I)	statutory decree	1	70	-	70	0.7	35	100	300	-
	Bio waste ordinance (Class II)		1.5	100	-	100	1	50	150	400	-
Greece	-specifications framework and general programmes for solid waste management	statutory decree	10	510	10	500	5	200	500	2000	15
Ireland	Licensing of treatment plants as agreed with EPA	voluntary	1.5	100	-	100	1	50	150	350	15
	(Class I)		1	100	-	100	1	50	100	200	
	(Class II)		1.5	150	-	150	1	75	150	400	
Italy	Technical regulation, DCI 27/07/84 (MSWC)	statutory decree	10	500	10	600	10	200	500	2500	10
	Draft Decree on the use of MBTC 1st quality (land reclamation)	DRAFT - statutory	3	-	3	300	3	100	280	1000	-
	Law on fertilizers (L 748/84; amd: 03/98) BWC/GC/SSC	statutory decree	1.5	-	0.5	150	1.5	50	140	500	
Luxembourg	licensing for plants		1.5	100	-	100	1	50	150	400	-
Netherlands	BOOM Compost	statutory decree	1	50	-	60	0.3	20	100	200	15
	BOOM very clean Compost		0.7	50	-	25	0.2	10	65	75	5
Portugal	Decree on sludge (limit values utilised also for MSW)	statutory decree	20	1000		1000	16	300	750	2500	-

Spain	B.O.E.n'm.131.2 June 1998	statutory decree	10	400	-	450	7	120	300	1100	-
	Spanish draft on composting Class AA	DRAFT statutory decree	2	250	-	300	2	100	150	400	-
	(Stabilised Biowaste) Class A		5	400	-	450	5	120	300	1100	-
	Catalonia draft on composting Class A		2	100	0	100	1	60	150	400	-
	(Stabilised Biowaste) Class B		3	250	0	500	3	100	300	1000	-
Sweden	Guideline values of QAS	voluntary	1	100	-	100	1	50	100	300	-
Switzerland	Verordnung über umweltgefährdende Stoffe Nr. 814.013; 9. Juni 1986; rev.. 28.12.01)	statutory decree	1	100	-	100	1	30	120	400	-
UK	UKROFS fertil.org.farming, 'Composted household waste'	statutory (EC Reg. 2092/91)	0.7	70	0	70	0.4	25	45	200	-
	Composting Association Quality Label	voluntary	0.5	100	-	200	1	50	150	400	-
EU ECO Label	Soilimprovers and growing media	voluntary	1	100	-	100	1	50	100	300	10
(EC Reg. 2092/91)	Compost from source separated Biowaste	statutory	0.7	70	-	70	0.4	25	45	200	-
Canada			20	-	-	-	5	180	500	1850	75
USA	EPA CFR40/503 Sludge Rule		39	no ceiling	-	1500	17	420	300	2800	41
	NY State DEC* Class I		10	100	-	1000	10	200	250	2500	-
	WA State Dept of Ecology, Grade A		10	600	-	750	8	210	150	1400	20
	WA State Dept of Ecology, Grade AA		39	1200	-	1500	17	420	300	2800	20
	Texas TNRCC Grade 1 Compost		16	180	-	1020	11	160	300	2190	10
	Texas TNRCC Grade 2 Compost		39	1200	-	1500	17	420	300	2800	41
	Rodale Organic Seal of Compost Quality		4	100	-	300	0.5	50	150	400	10
New Zealand			15	1000	-	1000	10	200	600	2000	-

The environmental quality classes for compost and stabilised biowaste, according to the proposed EU directive on Biological Treatment of Biowaste are presented in table 8.

Table 8. Environmental classes for compost and stabilised biowaste [6], [8]

Parameter	Compost/digestate ¹		Stabilised biowaste ¹	Hellenic limits CMD 114218/97
	Class 1	Class 2		
Cd (mg/kg dm)	0.7	0.5	5	10
Cr (mg/kg dm)	100	150	600	510
Cu (mg/kg dm)	100	150	600	500
Hg (mg/kg dm)	0.5	1	5	5
Ni (mg/kg dm)	50	75	150	200
Pb (mg/kg dm)	100	150	500	500
Zn (mg/kg dm)	200	400	1500	2000
PCB's (mg/kg dm) ²	-	-	0.4	15
PAH's (mg/kg dm) ²	-	-	3	-
Impurities > 2mm	<0.5%	<0.5%	<3%	-
Gravel and stones > 5mm	<5%	<5%	-	<0.8 (plastic and glass)

¹ Normalised to an organic matter content of 30%

² Threshold values for these organic pollutants in consistence with Sewage Sludge Directive.

The comparative evaluation of Hellenic and EU standards shows the Hellenic trend to the mechanical-biological treatment systems, for non source separated MSW. As a result, the compost production has low quality and it is mainly suitable for land use reclamation projects.

The status of the national compost guidelines and an overview of the existence of standards and definitions in various countries are presented in table 9.

Table 9: Survey on compost quality efforts in various countries [4], [10]

Country	Status of quality assurance/certification of compost
Austria	Fully established quality assurance system
Belgium	Fully established quality assurance system in the Flanders region, the Wallonia and the Brussels region will probably follow the Flanders example.
Denmark	Just started with quality assurance system for compost (Criteria, standardised product definition, analysing methods)
France	Proposal for quality criteria. Research program for a quality management system
Germany	Fully established quality assurance system for compost and digestion residuals. Private Association maintains standards
Italy	Proposal by the Composting Association (CIC) for quality assurance system. Successful source separation system
Luxembourg	Some plants according to German Quality Assurance System
Netherlands	Fully established quality assurance and certification system
Spain	Compost guidelines established and proposal for quality certification system in Catalonia
Sweden	Recently implemented standards and compost declaration system
UK	Proposal of quality standard by private Composting Association
Finland	No official efforts until now
Greece	No official efforts until now
Ireland	No official efforts until now
Portugal	No official efforts until now
Norway	Criteria and requirements for 3 quality classes
Switzerland	Established minimum quality standards. Product definition and analysing methods
USA	Published analysing methods - Plans for product definitions for MSW compost
Canada	Final step of discussion of a quality assurance system for source separated organic waste
Australia	Proposal of quality criteria and analysing methods

The central role of quality assurance is seen in countries with a developed composting system like Austria, Germany, Denmark, the Netherlands and Belgium (Flanders). These countries have established an extensive quality management system for the composting plants. Several others like Sweden, Norway, UK and France are at the stage of the conceptual design.

Acronyms

EC	European Commission
EU	European Union
HOG	Hellenic Official Gazette
CMD	Joint Ministerial Decision
MSW	Municipal Solid Waste
QAS	Quality Assurance System
PTE	Potential Toxic Elements

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