



SEWAGE SLUDGE TREATMENT AND USE 2002

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Biosolids composting in the European Union: 2002 State of the Art

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Biosolids composting in the European Union: 2002 State of the Art

SUMMARY

- 1.- Biowaste in the E.U. : current situation and prospective
- 2.- Composting vs. other technological alternatives
- 3.- Reviewing composting systems
- 4.- Reviewing commercial technologies
- 5.- Biosolids Composting in Spain and the E.U.-15
- 6.- Practical aspects of composting and Conclusions

ABSTRACT

The current situation of biowaste in the E.U. countries: generation, treatment and recycling statistics is analysed. It is also reviewed by groups of countries the legal situation and tendencies for treatment and land application of sludge and its by-products. It is also reviewed the prospective for the next decade, so dependent on the legal frame that is being designed from "D.G. Environment" and the relative position of composting versus the other technological or end use alternatives. Then a quick overlook is made on different composting systems as Windrow, Agitated bed, Tunnel or In-vessel. There are also shown many practical references of composting installations in Spain and other EU and foreign countries. Finally the operational and practical advantages and inconveniences of composting are summarized, as well as economic, hygienic, quality, acceptance and marketing and distribution issues.

1.- Biowaste in the E.U. : current situation and prospective

When analysing figures of biowaste generation in the E.U. and Spain (Manure, M.S.W organic fraction and Biosolids), it is quite surprising that Spain accounting 92% of the population served by wastewater treatment plants, reach only 50% "population-equivalent" served, with still a great lack of wastewater treatment capacity and consequent increase potential of biosolids generation from today figures(1.000.000 ton/year d.m.)

Regarding E.U.-15 statistics there is a lack of data related to Biosolids and Sludge "post treatment" facilities (Composting, Alkaline Stabilization and Thermal drying as the main techs), directly linked to agricultural application of "sludge-derived" products.

The available data use to be limited to give total agricultural application figures, comprising all sludge-derived products together with land applied dewatered sludge, practice of primitive kind that is still predominant in many places.

- Regarding biosolids / sludge social and legal frame in the E.U. -15 , it is relevant although minority the number of countries where sludge recycling is banned or impracticable due to legislation or social opposition: Luxemburg, Belgium, Flanders, Netherlands and Sweden. In other countries, even with notable recycling rates, the tendency is a rapid diminution, due to legal requirements and social and environmental factors: Finland, Denmark, Germany and Austria.
- It is also relevant the situation in certain countries that has completely banned sludge landfilling, like Netherlands, France and Sweden by the year 2005(all the organic matter), forcing active treatment solutions, before recycling or disposal.
- There are countries like Ireland, Portugal and Greece, have still very low sludge generation with respect to its theoretical potential, due to the scarce development of its sanitation and wastewater treatment infrastructure.
- The leading recycling countries are France, Denmark, Great Britain and Spain, with land application rates near 50%.
- Italy and Greece, placed in the mediterranean area, show very low recycling rates, obeying diverse factors: orography, structure of farmland property and characteristics of

the structure of the recycling industry in Italy; and a marked social and sectorial disinterest in Greece.

2.- Composting vs. other technological alternatives

There is a very wide and complex sets of technological combinations for designing “the sludge treatment line” in Waste Water Treatment Plants” combinations that still amazingly increase when considering Sludge / Biosolids post-treatment y and final destination.

Without entering into a deep analysis of technological alternatives to composting, here there are the most relevant:

- I. Direct land application
- II. Anaerobic Digestion / Pasteurization / Direct land application
- III. Alkaline Stabilization
- IV. Composting
- V. Thermal drying
- VI. Thermal and critical destruction

Composting as a sludge post-treatment method, occupies a significant, but still secondary position, around 10% of total sludge generation, in the following countries: *Denmark, Austria, Germany, France and Spain.*

In Great Britain, there is a trend to increased use of Alkaline Stabilization, because its advantages concerning reduced cost, space savings, independence on climatic conditions and low pH of agricultural soils. Composting is not commonly used.

3.- Reviewing composting systems

Regarding composting systems, the following classification could be suggested:

OPEN SYSTEMS

- DYNAMIC
 - Windrow or piling and turning
 - Windrow with forced aeration
- STATIC
 - Aereated piles
 - Aereated piles in bags

CLOSED SYSTEMS

- DYNAMIC REACTORS
 - VERTICAL
 - Silo or "in vessel" with agitation
 - Silo or "in vessel" with continuous flow
 - HORIZONTAL
 - Rotating drum
 - Agitated bed (in channels)
 - In vessel with continuous flow (mobile ground, piston, etc)
- STATIC REACTORS
 - Silo or "in vessel" static
 - Tunnels
 - Containers
 - Cells

4.- Reviewing commercial technologies

(See Table II)

5.- Biosolids Composting in Spain and the E.U.-15

Some data can be rendered from the investigation and gathering work that is currently being performed by BIOMASA PENINSULAR together with other consulting companies, in order to describe the 2002 State of the Art of Biosolids/ Sludge composting in the European Union.

Tables III and IV show the results of the state of the art of biosolids composting in Spain:

- Plant classification by the type of technologies,
- Capacity and operational situation from the already finished inventory .

Figures show a total number of 38 facilities. Total treatment capacity is around 800.000 ton/year (as dewatered sludge 20-25% dry matter), representing 16% of total sludge generation figure in 2.000. This is the highest relative biosolids composting capacity in E.U.-15. Compost production reached 240.000 ton/year in 2.000.

It is also convenient to say that some of the biggest plants, placed in Madrid are obsolete when evaluating the applied technology and environmental protection measures. They could be substituted by Thermal drying facilities, if showing efficacy to perform at high rates of operational capacity, or new Composting or Stabilization facilities, requiring important investment and increased treatment costs.

Only Germany in absolute figures has more number of biosolids composting plants (65), bigger treatment capacity (1.300.000 ton/year) and highest compost production (350.000 ton/year).

Agricultural application rate is higher in countries like France, Great Britain or Denmark), but the more commonly adopted solution is la Direct land application. Table I.4.)

6.- Practical aspects of composting and Conclusions

- *Advantages of composting.* Low energy consumption vs. thermal drying. Good complement for anaerobic digestion. Versatility for integrating other organic residuals and by-products.

- *Disadvantages of composting.* Loss of organic matter and Nitrogen across the process with emission of N_2 and NH^+ (like in Alkaline Stabilization). High surface occupation and length of the process. Need of strong emission and impact control measures in the vicinity of inhabited areas. Need of bulking agents.
- *Composting and quality of compost.* Good availability of N, P and other nutrients y proven agronomical effects. Biosolids hygienisation, but at what reasonable operative limit?. Is it sterile better than rich in biology?. Need of a positive vision of microbiological quality of compost versus “the sterile is safe complex”.
- *Conclusions*
 - Priority interest of reducing water content in sludge coming from mechanical dewatering in order to optimise design and reduce composting costs.
 - In southern European countries is a technology with a great growing potential because its simplicity and reliability and substituting direct application, limited due to legal constraints and nuisances and impacts associated.
 - The trend in central and northern European countries is oriented to the Ban -limitation in sludge agricultural use, Co-Incineration or Alkaline Stabilisation, with the exception of the measures and policies looking for Phosphorus recycling.
 - There are many technological alternatives and combinations in designing and sludge line in WWTPs, but finally very few reliable and feasible sludge post-treatment technologies, as composting can be.

References and Bibliography.

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- (3) *EU-Symposium “Compost-Quality Approach in the European Union”* Austrian Ministry for the Environment, Youth and Family Affairs Vienna, October 1.998
- (4) *5 European Biosolids and Organic Residuals Conference* Aqua-Enviro, Wakefield (GB), November 2000
- (5) *Composting of sludges of Sewage Water Purification* Dr. Joachim Muskey. Alemania, 2.001

Table I.1.- EVOLUTION OF SANITATION INFRASTRUCTURE IN SPAIN

SEWAGE TREATMENT	1984	1991		1996		2000	
- POPULATION CONNECTED TO SEWAGE TREATMENT PLANTS (000 h-eq)	---	22.700		35.000		39.000	
- POPULATION SERVED BY SEWAGE TREATMENT PLANTS(%)	---	59	29 p.e.	89	41 p.e.	92	42 p.e.
- NUMBER OF BUILT PLANTS	---	---		3.523		3.800	

Source: EUREAU

Table I.2.- BIOSOLIDS GENERATION in EU-15

AREA	COUNTRY	BIOSOLIDS GENERATION (ton/ y) d.m.		PRODUCTION RATES SL/BIO
		1995	2.000	Kg per capita/y
I	G. BRITAIN	1.158.000	1.583.000	24
	IRELAND	40.000	113.000	28
	SWEDEN	236.000
	FINLAND	158.000	160.000	29
	DENMARK	185.000	200.000	38
II	GERMANY	2.512.000	2.787.000	34
	BELGIUM	78.000	159.000	13
	NETHERLANDS	366.000	401.000	26
	LUXEMBOURG	10.000	14.000	31
	AUSTRIA	190.000	195.000	24
III	SPAIN	751.000	1.088.000	26
	FRANCE	764.000	1.172.000	17
	ITALY	550.000	648.000	14
	GREECE	66.000	99.000	9
	PORTUGAL	147.000	359.000	35

Table I.3.- BIOWASTE GENERATION in EU-15 and SPAIN (Year 2000)

BIOWASTE (000 ton/y)	DRY MATTER	WET MATTER
SLUDGE / BIOSOLIDS		
- SPAIN	1.000	3.500
- E.U.	8.900	25.430
MANURE		
- SPAIN	----	80.000
- E.U.	----	1.020.000
URBAN WASTE (ORGANIC FRACTION)		
- SPAIN	----	6.895
- E.U..	----	61.100

Source: DG Environment

Table I.4.- EU-15 SLUDGE to SOIL APPLICATION and LEGAL SITUATION

AREA	COUNTRY	SOIL APPLICATION d.m. 1998	SITUATION SLUDGE & COMPOST SOIL APPLICATION
I	GREAT BRITAIN	46% 506.000 t	- Treatment Tendency Pasteurization and Alkaline Stabilization - 40% application in grasslands of liquid sludge - SAFE SLUDGE MATRIX (DE / WATER UK / British Retail Co)
	IRELAND	12% 5.160 t	- 35% Sea dumping & 42% Landfill - Very small production still, future limitation P in soil
	SWEDEN	35% 85.000 t	- Strict legal limitation in trace elements. P limit in sludge, ashes - SLUDGE AGREEMENT (FARMERS/EPA/WATER Ass), stand still by farmers at the moment. Ban of a.m. landfill by 2005
	FINLAND	31% 46.500 t	- Statute of compost as a fertilizer and revegetation use - Tendency to reduce land application of sludge - Strict limitation of trace elements and P addition to the soil
	DENMARK	67% 134.000 t	- Ecotax 20- 25 E/t for Landfill and Incineration, despite this tendency to reduce land application - integrated Plans of application with manure - Strict limitation of trace elements and organic matter - Integrated National Control System
II	GERMANY	40% 1.080.000 t	- Complex management requirements (Länder) - Forbidden in Forest Soils and Grasslands Nov 15th - Jan 15th - Strict limitation of trace elements and organic matter - Soil Protection Law 1998
	BELGIUM	F-20% 9.000 t W-90% 13.500 t	- Forbidden land application in Flanders - In Walloon, legal conditions very similar to France
	NETHERLANDS	4% 14.000 t	- Forbidden Landfill dumping of sludge/organics in 2.000 - Sludge minimal application, just as compost - Big environmental pressure of manure and animal waste

	LUXEMBOURG	70% 5.250 t	- Total prohibition of land application in 2.000
	AUSTRIA	22% 44.000 t	- High quality sludge, classes I & II authorized (60% are included) - New Compost Ordinance 2.000 - Guarantee fund compulsory for environmental risk 0-20 E/t dm - Quality control label by Länder (KONROLLSIEGEL)
III	SPAIN	46% 324.000 t	- Soil application in established conditions D. 86/278 - 35% compost content limit and registered fertilizers
	FRANCE	60% 510.000 t	- Prohibition of landfill dumping of sludge 2002 - Sludge National Committee (Agriculture and environment) - Limit of trace elements equal to inferior limit D. 86/278 - SYPREA, Sludge recycling Companies Association
	ITALY	18% 144.000 t	- 81% of produced sludge to landfill - Soil application in established conditions D. 86/278 - Land application limit because of small size of parcels
	GREECE	10% 6.000 t	- 90% of produced sludge to landfill - No interest in land application of sludge
	PORTUGAL	11% 2.750%	- Very limited coverage of Sewage Treatment Services - Sludge land application in Lisbon area and compost in Oporto

Table II.- COMPOSTING TECHNOLOGIES AROUND the WORLD

COMPOSTING SYSTEM	TECHNOLOGY	COUNTRY
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OPEN SYSTEMS	WINDROW	Natural aeration	<ul style="list-style-type: none"> - Kelcor Environmental - Dean Environmental - EKO systems Inc. - Synagro technologies - Terra Gro - Wheelabrator WTI - One Stop Landscape Supply - Waste Management of Colorado - Triple M Land Farms - Full circle compost - Environmental solutions Inc. - Compost Systems Company - Reuter Resource Recovery - Buhler Inc. - CMC 	<p>Germany USA USA USA</p> <p>USA USA USA USA</p> <p>Switzerland Germany</p>
		Forced aeration	<ul style="list-style-type: none"> - Northwest Arkansas Recovery Inc. - A-1 Organics - Agresource 	USA
		Natural aeration	<ul style="list-style-type: none"> - Brikollari (Caspari, Briquetting) 	Finland
	STATIC PILES	Forced aeration	<ul style="list-style-type: none"> - Golden Heart Utilities - Ag-Bag - Twin Landfill Corp. - EKO Systems - Glacier Gold Compost - LBD Enterprises - Mc Gill Environmental Systems - J.P. Mascaro - New Earth - GroCo Inc. - South Sound Soils - Daneco Inc. - Buhler Inc. - Gore (Bags) 	<p>USA USA</p> <p>USA</p> <p>Switzerland Germany</p>

Table 11.- (Continuation)

COMPOSTING SYSTEM		TECHNOLOGY	COUNTRY
CLOSED SYSTEMS	VERTICAL REACTORS	<ul style="list-style-type: none"> - Earp-Thomas - Ebara MPF (Ebara Corp.) - Dambach Schnorr "Biocell" (Dambach Ltd.) - Krupp-Varro (Krupp Industrie) 	Germany Japan Germany Germany Germany
		<ul style="list-style-type: none"> - Triga (Hallert Triga) - BAV - American Biotech - Knerr (Taulman-Weiss en USA) - ABV Purac System (Purac AB) 	France, Brazil Germany USA Germany USA, Europe
	HORIZONTAL REACTORS	<ul style="list-style-type: none"> - Lescha - Bedmister - Dana (Dana Ltd) - Ruthner (Ruthner Industrie) - Voest-Alpine - Buhler Inc. - Masias 	Germany USA Holland Austria Austria, E.A.U. Switzerland Spain
		<ul style="list-style-type: none"> - Smogless - Newhold - KWM - Paygro (Compost Systems, co.) - IPS - KOCH - Ebara RDF (Ebara Corp) - Sorain Cecchini S.p.A. - Silada Process (OTV OTVD) - Wright Environmental Management Inc. - TVR - Ros Roca 	Italy Germany Germany USA USA Germany Japan USA Canada USA Spain Spain
		<ul style="list-style-type: none"> - BAV Tunnel Reactor (Ashbrook-Simon- Hartley Tunnel Reactor) - Dynatherm (Compost Systems Co.) 	Germany USA USA
		<ul style="list-style-type: none"> - BIOMATE TECH - Gicom - Ros Roca 	USA Holland Spain
	STATIC REACTORS	<ul style="list-style-type: none"> - Naturstech - Her/hof "Box" - ML Biocontainer 	USA Germany Germany
		<ul style="list-style-type: none"> - TEG Environmental 	Great Britain

Table III.- COMPOSTING PLANTS in SPAIN by TECHNOLOGY

CLASSIFICATION by TECHNOLOGIES		
I. WORKING	<i>Windrow</i>	10
	<i>Aerated piles</i>	4
	<i>Agitated Channels</i>	6
	<i>Tunnels</i>	7
	<i>Drying in threshing floors</i>	2
	TOTAL	29
II. IN CONSTRUCTION	<i>Windrow</i>	--
	<i>Aerated piles</i>	--
	<i>Agitated channels</i>	--
	<i>Tunnels</i>	5
	<i>Drying in threshing floors</i>	--
	TOTAL	5
III. DESIGN, LICENSES	<i>Windrow</i>	--
	<i>Aerated piles</i>	1
	<i>Agitated channels</i>	--
	<i>Tunnels</i>	--
	<i>Drying in threshing floors</i>	--
	TOTAL	1
IV. PLANNED	<i>Windrow</i>	2
	<i>Aerated piles</i>	--
	<i>Agitated channels</i>	--
	<i>Tunnels</i>	1
	<i>Drying in threshing floors</i>	--
	TOTAL	3
COMPOSTING PLANTS GRAND TOTAL		38
TREATMENT CAPACITY (ton/year)		800.000

Table IV.- COMPOSTING SUMMARY SPAIN, FRANCE and GERMANY (year 2000)

	SPAIN	FRANCE	GERMANY	E.U.
-SLUDGE GENERATION (t/y d.m.)	1.088.000	1.172.000	2.787.000	
- SOIL APPLICATION (% S.Tot.) (t/y d.m.)	46% 500.480	60% 703.200	40% 1.114.800	
- SLUDGE COMPOSTING (% S.Tot.) (t/y w.m.)	16% 174.080	4,7% 55.000	10,26% 286.000	
-TREATMENT CAPACITY (ton/year w.m.)	800.000	250.000	1.300.000	
- BIOSOLIDS COMPOST PRODUCTION (ton/year w.m.)	240.000	85.000	350.000	
- PLANTS TOTAL	29	19	65	