LIFE BIOBEST

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Steffen Walk | European Compost Network ECN e.V.

Guideline to promote quality compost and digestate

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Technical guideline

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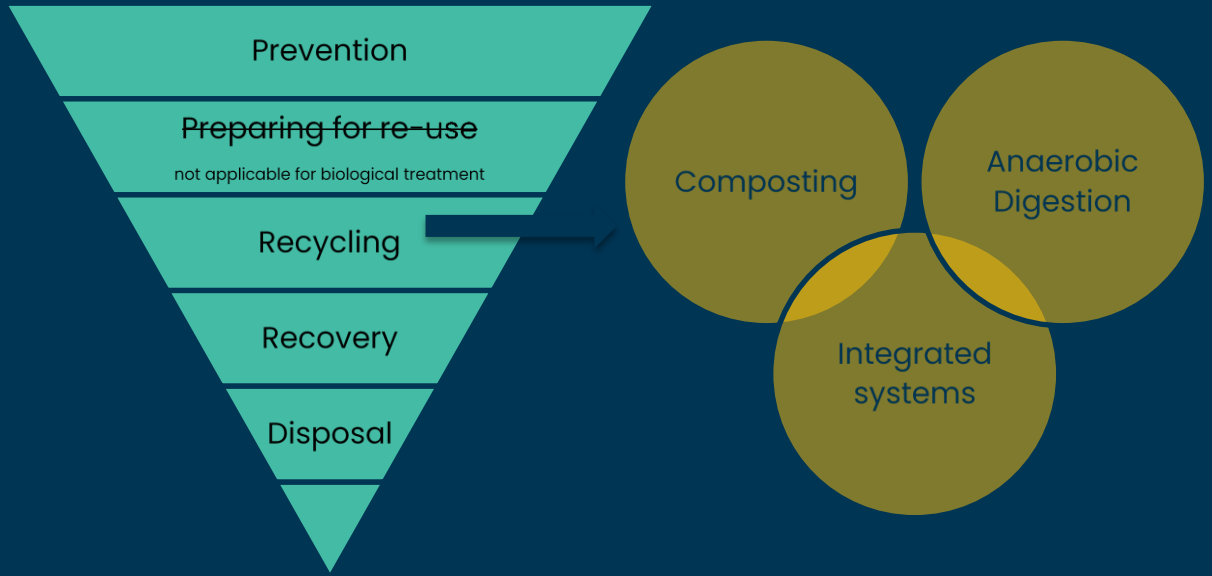
Process options for municipal bio-waste

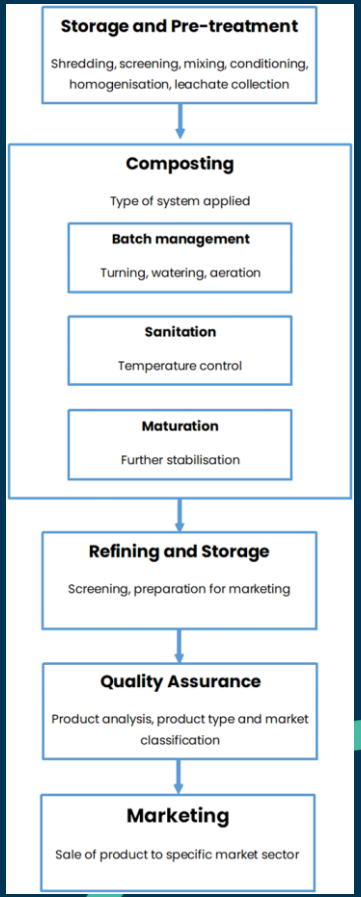


Biological treatment

Composting	Anaerobic digestion	Combination
General information: What is which process for?		
Requirements for feedstock: Which type of feedstock to consider?		
Expected outputs: Typical mass balance including % of product(s), process water, evaporation losses and reject fractions		
Technical requirements	pro&con comparison among all process options	
Capex & Opex		
Technical robustness		
Scaling potential		
Common areas of process and product application		

Biological treatment – Composting

- Description of composting process steps and their (technical) requirements
- Process requirements
- Existing technologies and their specifications
  - Static open systems, e.g. open windrow
  - Encapsulated systems, e.g. tunnel composting
  - Optional equipment
- Similar procedure for AD processes
- Potentials for process scaling



Biological treatment

Composting

Static·and·quasi-static·systems¶

Long·triangular·static·piles·(windrow·shape);·System·can·be·passively·or·actively·aerated,·varying·turning·frequency·and·limitations·in·windrow·shape·and·size¤

Open·windrow·composting¤

Open·windrow·(Siebert,·2014)¤

+·Low·investment·costs¶
+·Turning·compost·possible·→·allows·proper·composting·of·all·material¶
+·easy·to·increase·capacity·if·sufficient·space¶
¶
-·No·weather·protection·–·risk·of·too·dry·or·wet·batches·and·therefore·weak·processing¶
-·adjustment·of·aeration·and·moisture·difficult¶
-·Risk·for·fumes¤

AD

Continuous dry anaerobic digestion

Plug-flow digester under construction (Wilken, 2019)

+ Plug-flow technology allows continuous mode of rather dry and heterogenous feedstock (15-45% DM)
+vertical (by gravity) and horizontal (by stirrer) set-up possible
+ transport from inlet to outlet
+ require less energy per feedstock compared to wet AD
+ reduced risk for shortcuts of feedstock and therefore stable retention time

- high solid content can lead to clogging of system
- difficulties in system cleaning

Mechanical pre- and post-treatment

- Technologies during collection process
- Pre- and post-treatment technologies
- Images of sorted (reject) fractions

Drum screen	
 Drum screen for coarse material removal (Siebert, 2014)	• separates coarse and fine material + continuous operation (has to be cleaned sometimes) + different mesh sizes can be applied + feasible for pre- and post-treatment - does not distinguish between native organic materials and others - requires "bag-opener" as pre-step (if bags used for the collection of kitchen waste)

Bin controls	
Requirements	**Cost**
Separate bio-waste collection, ideally door-to-door, Staff, Legal mandate to allow for controls (open bin, enter private property)	3-5 €/t bio-waste collected
 Bin sticker (#wirfuerbio, 2023)	This activity can be performed to spot households which do not comply with sorting regulations, either prior or during collection. An option is the use a traffic light card or sticker system, to inform the households about their sorting behaviour. Measures reach until the non-collection of bio-waste including an extra fee to collect it as residual waste. Studies showed, that bin controls can increase quality but need to be performed repeatedly to keep it high.

Product characteristics

- Qualitative and quantitative comparison of bio-waste compost, green waste compost and bio-waste digestate

Characteristic	Bio-waste compost	Green waste compost	Bio-waste Digestate
Nutrients	**	*	***
Nitrogen availability	**	*	***
Salt content[1]	**	*	***
Physical impurities (% DM)[2]	***	*	***
Heavy metals	Depends on feedstock	Depends on feedstock	Depends on feedstock
Stability and organic matter[3]	*** - **	***	*
Transportability	***	***	*[5] / **[6]
Odour release[4]	**	*	***

Product characteristics

	Sample size	pH	Electrical conductivity[d]	Bulk density	Dry matter	Total impurities >2mm[e]	Nutrients		
	[n]	[-]	[dS/m]	[g/L FM]	[% FM]	[% DM]	Tot. N [% DM]	P_2O_5 [% DM]	K_2O [% DM]
Reference year: 2022					**Italy (CIC, 2024)**				
Bio-waste compost	212	6.0 - 8.8	1.3 - 11.0	NA	50.6 - 94.9	<0.05[g] - 0.5	1.30 - 3.20	0.43 - 3.50	0.66 - 3.27
Green waste compost	48	6.1 - 8.5	0.5 - 6.0	NA	50.0 - 94.5	<0.05[g] - 0.5	1.10 - 2.60	0.39 - 1.50	0.57 - 2.10
Digestate[a]	-	-	-	-	-	-	-	-	-
Reference year: 2022					**Germany**[f] **(BGK, 2024)**				
Bio-waste compost	1890	7.2 - 9.0	1.1 - 3.3	480 - 770	51.0 - 76.5	0.00 - 0.25	1.11 - 2.13	0.50 - 1.09	0.58 - 1.74
Green waste compost	1985	7.1 - 9.0	0.5 - 1.5	440 - 776	49.0 - 76.6	0.00 - 0.12	0.76 - 1.70	0.31 - 0.76	0.88 - 1.93
Digestate	1249	8.14 - 8.74	3.9 - 9.3	990 - 1,047	2.3 - 14.0	0.00 - 0.01	4.17 - 21.54	1.20 - 5.91	2.9 - 10.4
Reference year: 2021					**Flanders (VLACO, 2024)**				
Bio-waste compost	53	7.8 - 9.1	1.5 - 4.2	NA	53.4 - 78.1	<0.05[g] - 0.40	1.7 - 2.4	0.69 - 1.39	1.0 - 2.1
Green waste compost	153	6.3 - 9.1	0.5 - 1.6	NA	48.5 - 69.9	<0.05[g] - 0.16	1.0 - 1.9	0.35 - 0.62	0.59 - 1.40
Digestate[b]	106	8.3 - 8.8	4.6 - 10.0	NA	4.3 - 12.9	<0.05[g] - 0.10	5.2 - 10.3	2.9 - 5.5	3.5 - 8.2
Reference year: 2023					**Austria (KBVÖ, 2024)**				
Bio-waste compost	166	5.9 - 8.8	0.5 - 5.7	NA	40.1 - 98.2	0.00 - 0.91	0.5 - 2.7	0.01 - 8.20	0.25 - 13.2
Green waste compost[c]	-	-	-	-	-	-	-	-	-
Digestate	131	7.2 - 9.0	NA	NA	0.5 - 81.0	0	0.5 - 18.4	0.1 - 7.1	0.4 - 22.9

[a]No digestate produced under CIC quality assurance, [b]Includes manure and other sludges, [c]not separately assessed, [d]In Germany measured as salinity in g/L, [e]In Germany >1 mm, [f]Values represent lower 10% and upper 90% percentiles, [g]Below determination limit

Regulatory guideline

02

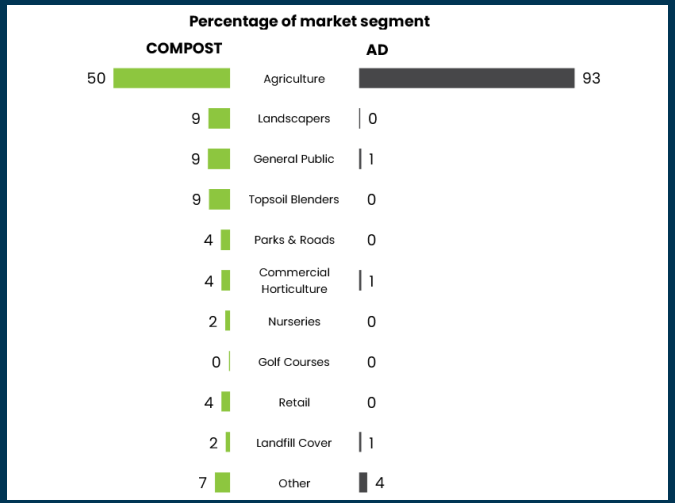
Regulatory guideline

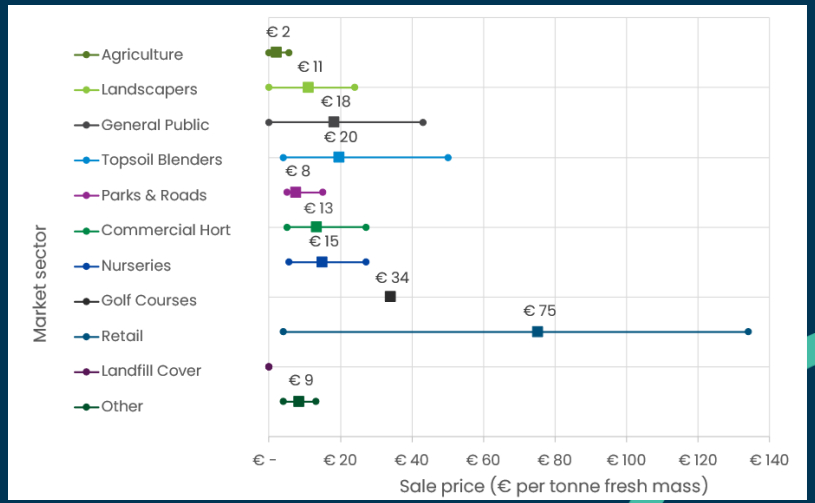
1. Quality assurance scheme for compost and digestate
2. Compost and digestate within EU legislation
3. Description of existing product quality standards
    1. ECN-QAS
    2. National and regional QAS in conformity with ECN-QAS

QAS for compost and digestate

QAS for compost and digestate – Product use

- A concept for bio-waste recycling requires the development of a market for its products





Compost and digestate within EU legisation

- EU Fertilising Products Regulation (FPR)
  - Product function categories
  - Minimum nutrient content requirements
  - Organic soil improvers criteria
  - Limiting values of heavy metals
- Animal By-Product Regulation (ABPR)
  - Regulates requirements for bio-waste including animal products
  - E.g. reduction of particle size to 12mm for homogenous hygenisation

Description of existing product quality standards

- ECN-QAS

Quality criterium	Parameter	Limit value
Soil improvement	Organic Matter (% d.m.)	≥ 15
Inorganic pollutants	Pb (mg/kg d.m.)	≤ 130
	Cd (mg/kg d.m.)	≤ 1,3
	Cr (mg/kg d.m.)	≤ 60
	Cu (mg/kg d.m.)	≤ 300
	Ni (mg/kg d.m.)	≤ 40
	Hg (mg/kg d.m.)	≤ 0,45
	Zn (mg/kg d.m.)	≤ 600
Undesired ingredients and properties	Impurities (% d.m.)	≤ 0,5
	Weed seeds (liter)	≤ 2
Hygiene	Salmonellae (25g/d.m.)	Absent

- National product quality standards in conformity with ECN-QAS: Austria, Germany, Flanders region (Belgium), Italy

Take home messages

- High-quality feedstock eases the production of high-quality product
- Pre- and post-treatment is important for improving the quality
- Local circumstances are important to consider when developing a bio-waste recycling concept
- On a regional and national level, the creation of a market for products of biological treatment is required → Be aware of different market options
- Quality standards are a MUST to produce high-quality compost or digestate → Make use of existing ECN-QAS (and EU regulation) when developing product quality standards in a region where it does not exist yet

Thank you!

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