Composting and Compost use in Organic Farming
Tartu & Tallinn - 4 & 5 October 2017

How to do COMPOSTING in a SIMPLE & SMART way?

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Compost – Consulting & Development
1ooNGO
The characteristics of organic waste materials show a wide variability:

- Structure/porosity
- Bulk density
- C/N ratio
- Humidity
- Fermentability
Key elements of the **Art of Composting**

- **Organic feedstock & additives**
  - non-compstables / impurities
- **Humidity**
- **Oxygen**
- **[Temperature]**

Foto: Amlinger
What compost do we want to achieve?

Compost from an in-vessel industrial bio-waste treatment facility

Compost from an open windrow composting plant
Green waste composting in big table piles turned only with loader …

This does not allow for homegenous and efficient aerobic process conditions !!!
The two contrary digestion processes in nature

**AEROBIC**

- CO_{2} Carbon dioxide
- NO_{3} Nitrate
- PO_{3-4} Phosphate
- SO_{2-4} Sulfate
- BO_{3} Borate

**ANAEROBIC**

- CH_{4} Methane
- NH_{3} Ammoniak
- PH_{3} Phosphine
- H_{2}S Hydrogen sulfide
- BH_{3} Borane
Windrow Composting ...... Natural Aeration

Sufficient material structure & pore volume + FREQUENT turning

Oxigen supply by diffusion & convection

Drawing: Urs Landmanagement, Austria
The main task: create and maintain the optimum environment for the transformation & humus build-up process

- C : N ratio 25 - 35 : 1
- **Addition of clay SOIL** 10 - 15 %
- **Addition of COMPOST** 10 - 15 %
- Fresh 'green' residues min. 15 %
- Bulking agents 30 – 40 %
  - ligneous /hemi-celluloses /C source
  - Structure .. Air filled pore space
- Temperature max. 60-65 °C
- Sufficient OXIGEN min. 5 %
- Maximum CO₂ max. 10 – 12 %
- Humidity 55 – 60 %

Source: Urs Landmanagement, Austria
N-losses depend also on C/N

![Graph showing the relationship between N-loss and C/N ratio in initial feedstock mix.](image)
Mixing the „Ingredients“

Fotos: Angelika Lübke-Hildebrandt, Urs Hildebrandt / Urs Landmanagement
Fotos: Amlinger
Coprinus - species

Typical fungal stabilisation zones in standard

Thermoactinomyces vulgaris

Streptomyceten Actinomyceten

Aspergillus niger
Managing - Adding Water

- Add water during turning
- Add water slowly
- Ideal 50 – 60%
- Squeeze test
- Too wet = anaerobic/leachate/odour/GHG
- Too dry = no decomposition
Watering with a hose pipe or water tank mounted to the turning machine:
the water is sprayed directly into the turned material

OR

by spraying on top of the compost piles with a vacuum water tank before turning
**Optimum Temperature Ranges for Different Requirements of the Composting Process**

<table>
<thead>
<tr>
<th>Process Optimum for</th>
<th>Temperatur Range</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Hygienisation</strong> ... [Ordinance: 10 days]</td>
<td>&gt; 55 °C</td>
</tr>
<tr>
<td><strong>Maximum Decomposition</strong></td>
<td>45 - 55 °C</td>
</tr>
<tr>
<td>Start of formation of fumic substances</td>
<td></td>
</tr>
<tr>
<td><strong>Max. Biodiversity</strong> + decomposition of microbial biomass; max. Formation of humic substances</td>
<td>35 - 40 °C</td>
</tr>
</tbody>
</table>

*Foto: Courtesy of Seiringer Umwelttechchnik GmbH*
N-Überschuss, feucht, hohe Reaktivität

Temperaturverlauf, Umsetztermine und Wassergaben

Tagesmittel Außentemperatur
Tagesmittel Sensor 1 (Scheitel Zuluft)
Tagesmittel Sensor 2 (Scheitel Abluft)
Tagesmittel Sensor 3 (Kern Zuluft)
Tagesmittel Sensor 4 (Kern Abluft)

Aufsetzen/Umsetzen
Gießen

Wasserzugabe 65 l t⁻¹

26.09.2001
30.01.2002

Tage

Folie 21
Gartenabfall mit C-Überschuss, trocken, geringe Reaktivität

Temperaturverlauf, Umsetztermine und Wassergaben

Wasserzugabe 910 l t\(^{-1}\)

- Tagesmittel Außentemperatur
- Tagesmittel Sensor 1 (Scheitel Abluft)
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- Aufsetzen/ Umsetzen
- Gießen

14.05.2002 02.10.2002

<table>
<thead>
<tr>
<th>Tage</th>
<th>Temperatur [°C]</th>
</tr>
</thead>
<tbody>
<tr>
<td>14.05.2002</td>
<td>52</td>
</tr>
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</table>

| Wasserzugabe | 910 l t\(^{-1}\) |
Hygienisation of kitchen and food waste
(Catering Waster / Former Foodstuff)

- **ABP-Regulation (EC) 1069/2009**
  - Does not apply for *green waste*
  - **National rules** for *catering waste* (households, restaurants)
    - Exception from 70 °C / 1hr / at 12mm particle size
  - **OPEN WINDROW Composting** ➔ OK
    - ... if all the material in the system is exposed over the required time to a defined temperature level
      ➔ TURNING // MONITORING
# FLEXIBLE Time–Temperature profile for COMPOSTING – as required e.g. in Austria

<table>
<thead>
<tr>
<th>Minimum Temperature</th>
<th>Duration - Records</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Open and enclosed Windrows (including halls) +/- forced aeration</td>
</tr>
<tr>
<td>55 °C</td>
<td>Automatic, continuous recording with probe; minimum temperature to be met over a time span of 4 hours, each after 5 mechanical turnings; total recording period: 10 days</td>
</tr>
<tr>
<td>55 °C</td>
<td>Discontinuous recording at least once per working day*; minimum temperature to be met on all recording days, within a total recording period of 10 days; at least 3 mechanical turnings</td>
</tr>
<tr>
<td>60 °C</td>
<td>Discontinuous recording at least once per working day*; minimum temperature to be met on 3 x 3 recording days, within a total recording period of 14 days; at least 2 mechanical turnings</td>
</tr>
<tr>
<td>65 °C</td>
<td>Discontinuous recording at least once per working day*; minimum temperature to be met on 2 x 3 recording days, within a total recording period of 14 days; at least 1 mechanical turning</td>
</tr>
<tr>
<td></td>
<td>Enclosed and in-vessel systems with forced aeration (e.g. boxes, tunnels)</td>
</tr>
<tr>
<td>55 °C</td>
<td>Automatic continuous recording with probe; minimum temperature to be met over a time span of 4 days within a total period of 10 days</td>
</tr>
<tr>
<td>65 °C</td>
<td>Automatic continuous recording with probe; minimum temperature to be met over a time span of 3 days within a total period of 10 days</td>
</tr>
</tbody>
</table>

* The automatic, continuous recording with probes is permitted

The controlled process: °C & CO₂

- °C: Break-down to build-up
- CO₂: Graph showing variations over weeks
Hygiene Aspects in Process Management

- **Further Measures & Records (as part of the QM)**
  - watering, turning, aeration, material additions, screening…
  - & …… separating / working from **DIRTY** to **CLEAN** zone

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![Intensive Composting HYGIENISATION Phase]

![Delivery/tipping of Bio-waste]

![Ready made COMPOST STORAGE]

![MATURATION Phase]

Foto: Courtesy of Seiringer Umweltaschtechnik GmbH
Sealed /paved surface for the main rotting area draining of rain and waste water

2 to 5 % slope
Composition
- 40% shredded bush and tree cuttings
- 30% fine garden waste
- 10% rotted cattle manure
- 10% loamy soil

On-Farm Field Composting

Composting
- 8 to 12 weeks (summer)
- 12 to 20 weeks (winter)
- Turning: 5 to 3x/week
- Screening: 10 to 20 mm
Bäuerliche Kompostierung
OPEN WINDROW composting
Managing Impurities
Composting Training:  

… Temperature and CO₂ measurements
Composting Training:

... what is compost quality?
Quality Criteria for COMPOST

- **Plant response / germination test!**
  - **growing media, bagged** ... 25% compost ➔ 90% - 100% performance
  - **private gardening** ... 50% compost ➔ 80% - 90% performance

Cress (Lepidium sativum) & Chinese cabbage
The Technical Guideline on Composting

- National **TECHNICAL REQUIREMENTS FOR COMPOSTING PLANTS**
  - A guidance to good practice
  - Detailed handbook
  - Manual for engineering
  - Basis for waste license
  - Best practice / range of technologies
  - Criteria for construction, operation and documentation
  - Environment & health protection

QM: the principle of a traceably documented process

Registered Composting Plant

- Storage
- Mixing
- Conditioning

batch composition ...
batch monitoring ...
°C, turning, watering ...

C1
C2
C3

Compost = Product

INPUT

Residues

Receipt Control
International QAS for compost  [http://eu100ngo.net/qas/]

provided by: “100 NGO” / “Compost & Biogas Association Austria Austria”

MUNICIPAL ENTERPRISE FOR WASTE TREATMENT - SOFIA
Compost Plant Han Bogrov
Gorni Bogrov village, Malo livade

on behalf of arge kompost & biogas has been inspected and controlled by its partner organisation
“100 – First Zero Waste & Organic Cycle Organisation”
for compliance with:

Ordinance on the Treatment of Biowaste from 15 October 2013, Technical Regulation ÖNORM 192208 Implementation of quality assurance on composting plants; ÖNORM S 2206-1: Requirements for a quality assurance system for the production of composts - Part 1: Principles for quality assurance of a company and of the internal technical processes; ÖNORM S 2206-2: Requirements for a quality assurance system for composts - Part 2: Determination of tasks and conditions for a quality assurance organisation

The enterprise is eligible to refer to this certificate in the declaration and labelling of compost products that have been tested in compliance with the Ordinance on the Treatment of Biowaste from 15 October 2013 and to use the label „Kompost Qualitätssicherung“ as sign at the facilities premises and official documents issued by the composting plant in electronic and printed format.

Last inspection: 03.06.2015
Validity: until the next inspection, at maximum until 31.12.2016

Conditions of the validity of the certificate:
- Compliance with all relevant legal obligations, including the plant’s permits
- Fulfilment of the requirements of arge kompost & biogas

Vienna, Sofia, 04.11.2015

For the Quality Assurance Organization
Vorstandes S. Schütter bytes

For the Quality Assurance Organization
ÖMÖG Austria
First International Certification Exercises

**BULGARIA**

- **SOFIA Composting plant 2015**
  - Capacity: 24000 t/y **GREEN WASTE**
  - Actually treated: ca. 10000 t/y
  - Reference standard: BG Biowaste Ordinance
  - Compost analyses: Laboratory in Austria

- **BOURGAS Composting plant 2016**
  - Capacity: 10000 t/y **GREEN WASTE**
  - Actually treated: ca. 2000 t/y
  - Reference standard: BG Biowaste Ordinance
  - Compost analyses: Laboratory in Austria

**POLAND**

- **Pila: GWDA Composting plant 2017**
  - Capacity: 85000 t/y **SEWAGE SLUDGE; STRAW; GREEN WASTE**
  - Actually treated: ca. 85000 t/y
  - Reference standard: 100NGO QAS Manual
  - Compost analyses: Laboratory in Poland & Austria
The Key = **Biodiversity**!
Many Thanks!

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