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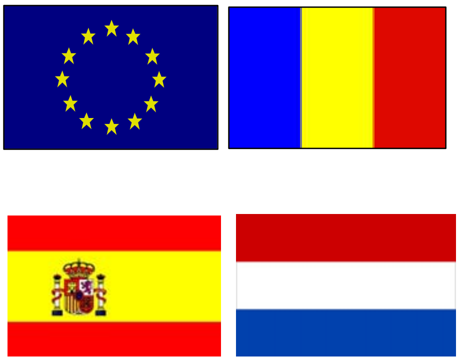

Implementation and application of the environmental acquis focused on domestic waste management

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Guidelines on compost quality standards and compost marketing

Author: Adrie Veeken (SenterNovem, Waste Management Department)

Content

1 General aspects of compost quality and marketing

1.1 Introduction

Many investigations in Europe indicate that quality and marketing of the end product is the most crucial composting issue. Both producers and users are of the opinion that a sustainable recycling of organic wastes demands clear regulations regarding what is suitable to be recycled and how it should be managed and controlled. A well-founded quality assurance programme would definitely increase sustainable recycling of organic wastes.

Marketing analysis over recent years show that all users of compost demand a standardised quality product that is supervised by independent organisations. A study in the south of Germany showed that 94% of the commercial users made this a precondition. In another German study among citizens of Cologne and Düsseldorf 80 % of the participants would have a more positive attitude towards compost and food grown on arable land with compost application, if they were sure that a quality control system for compost exists.

The introduction of separate collection and composting must therefore go hand in hand with the introduction of a quality assurance system. Assuring compost quality is more than just fulfilling a number of heavy metal limit values. It plays a central role and influences all stages of the treatment of organic residues:

- Separate collection. Quality assurance can be used to draw conclusions on the quality of the source separation and can introduce measures for improvement.
- Plant engineering. Errors in the plant engineering can be quickly identified via quality controls. In the hygienic sector quality assurance also serves to guarantee worker protection.
- Compost production. Only constant quality and product checks avoid errors in compost production.
- Marketing. Consumers want a standardised quality compost. Only a quality assurance system guarantees this. The quality sign as a symbol helps the marketing efforts.
- Public relations work. A good image for compost can be built up with assured quality and a quality label.
- Application. The analytical results form the basis for the declaration and the recommendations for use and consequently for the correct and successful application of compost.
- Product range. Only by precisely knowing the constituents and their width of fluctuation several compost products can be developed.
- Politics/legislature. Through statistical evaluation of the test results the legislator is familiar with the present standard of compost and the possibilities of the composting plants and he can issue directives that are appropriate for the current practical situation of the compost quality.
- Certification. A quality assurance system is a pre-condition for certifying the composting plants to e.g. the EU-Standard EN ISO 9002.

The central role of quality assurance is seen in the countries with developed composting system like Austria, Germany, Denmark, the Netherlands and Belgium. These countries have established an extensive quality management for the composting plants, in which around 400 composting plants take part at the moment. Several other countries like Sweden, Norway, Italy and France are in the status of the conceptual design.

1.2 Elements of quality assurance systems

Depending on intention, philosophy, political or functional approach, the quality assurance systems for compost comprise different elements:

- Raw material
- Intake control
- Limits for harmful substances
- Quality criteria for the valuable constituents in the compost
- Composting production
- External control (product and/or production)

- In-house monitoring
- Quality label for the product
- Certificate for the plant and/or the product
- Declaration of the properties of compost
- Recommendations for use and application
- Training and qualification of the operator
- Management and operation of plants (plant assessment)
- Annual certificates

When considering the introduction of composting, the end product should merit equal or even more attention than the composting process and the composting technique. Quality assurance of compost plays hereby a central role. It links the end product to all the elements of the organic treatment and cycle and forms the first step to a comprehensive quality management of the composting plants.

The central role of quality assurance is seen in countries with a developed composting system like Austria, Germany, Denmark, the Netherlands and Belgium. These countries have established an extensive quality management system for the composting plants, in which around 500 composting and 30 digestions plants take part at the moment. Several others like Sweden, Norway, UK and France are at the stage of the conceptual design (see Table 1).

Table 1 **Survey on compost quality efforts in various countries**

Country	Status of quality assurance/certification of compost
Austria	Fully establish quality assurance system
Belgium	Fully establish 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
Italy	Successful source separation system
Luxembourg	Some plants according to German Quality Assurance System
Netherlands	Fully established quality assurance and certification system
Spain	Proposal for “Bill on the Quality of Compost” in Catalonia
Sweden	Just started with quality assurance system for compost and for digestion residuals
UK	Proposal of quality standard by the Composting Association TCA
Finland	No official efforts until now
Greece	No official efforts until now
Ireland	No official efforts until now
Portugal	No official efforts until now

1.3 Status of Quality assurance in EU

Statutory quality standards including a continuous monitoring or a voluntary quality assurance system exist in most of the European Countries. In Austria, Belgium (Flanders), Germany, Luxembourg, The Netherlands and Sweden 520 large composting and digestion plants - controlled by a quality monitoring system - treat around 70 % of the source separated organic waste in Europe. In Norway, Denmark and UK similar quality assurance systems are in development. In Portugal, Italy, Spain, France and Ireland developments for quality standards are in progress (see Table 2).

Table 2 **Status of quality assurance of European composting and digestion plants (status 2002)**

Country	Plants with quality assurance1)	Plants with quality sign or certificate
AT	10	2
BE (Fl)	22	10
LUX	3	3
NL	22	4
D	429 composting, 16 digestion	400 composting, 10 digestion
SWE	2 composting, 8 digestion	-
DK	(draft of quality assurance system)	-
NO	(quality assurance system exists)	-
UK	(quality assurance in introduction)	-

An essential difference between the European countries lies also in the amount in which the compost production is included into quality assurance. The RAL-quality sign of Germany has the philosophy to assess the quality of the end product. In the Netherlands and in Belgium there is an aspect of two different attitudes. Here the control of the end product is combined with a production control. In Belgium the period for application of a new compost plant for the quality sign is two years, whereas in the first year a continuous production monitoring is made. The second year of application follows only the control of the produced compost.

The certification for the quality sign in the Netherlands describes a very large internal quality monitoring of the compost production with weekly tests of parameters from each compost charge. Similar tendencies can be observed in Austria where the quality sign demands a product/process diary with nearly hundred positions (see Table 3).

Table 3 **Range of control systems for composting plants in Europe**

Country	Production monitoring	Product control
Austria	Compost Ordinance	Compost Ordinance and KGVÃ–
Belgium/Flanders	VLACO - during the first year of operation	VLACO – beginning with the second year
Denmark	-	Plant Directorate
France	According to ISO 9000 principle in the Qualorg research project	According to ISO 9000 principle in the Qualorg research project
Germany	BGK 1)	BGK
The Netherlands	KIWA	KIWA
Sweden	RVF Certification	RVF Certification

1.4 Quality criteria

The quality criteria for compost vary in the European countries concerning the amount, the requirements and the limited values (see Table 4). Direct quality classes based on heavy metal limits exist only in Austria (class I and II such as the types "A" fresh and "B" matured compost) and in the Netherlands. The Dutch requirements for the class "very good compost" are so high that they can only be reached in exceptional cases; thus the compost plant association is trying to obtain an alteration of the parameters. A quality standard with two steps in Belgium, with composts for arable land and for other areas, did not prove to be practicable, thus composts can be distinguished only on a raw material basis.

Evidence has been made by diversified compost qualities based on heavy metal content that only the best will be asked for. The large quantity of good quality compost which is sufficient for various uses will fail to be used in most cases.

Quality classes based on raw material (Belgium/Fl), on the properties or the ranges of utilisation (Germany) will more effectively meet the requirements of the compost market.

At the moment only Denmark is worried about organic pollutants in compost and has fixed limits. The other countries have detected very low levels, so they don't analyse the contamination (Netherlands, Belgium) or they do a kind of observation in suspicious cases (Austria) or on a voluntary basis (Germany).

Table 4 **Classification of compost and digestate quality in Europe**

Country	Type of compost/quality class
Austria	Quality Class A+ (organic farming), Class A (high quality) and Class B (minimum quality/noon food production areas)
Belgium/Fl	Yard and Vegetable, Fruit and Garden VFG Compost
Denmark	Organic household waste compost with no classification up to now. No quality criteria for green/yard waste compost necessary
Germany	Fresh and matured compost, mulch and potting soil compost solid and liquid digestion residues
Netherlands	Compost and very good compost
Sweden	Very fresh, fresh and matured compost

Heavy metal contents
With the stipulation of the quality criteria various philosophies are to be observed. Here we have countries such as Austria or the Netherlands with relatively severe guidelines e.g. concerning heavy metals on the one hand and on the other hand relatively high deviations (40 to 50 %) from the guide values which are allowed for the single case. These are confronted with the German guide values with relatively moderate values, but relatively little deviations of only 15 % (see Table 5).

Table 5 **Heavy metal limits and allowed deviations in the EU(mg/kg dry matter)**

Country	Quality Standard of	Cd	Cr	Cu	Hg	Ni	Pb	Zn
AT	Biowaste Ordinance Class A	1	70	150	0,7	60	120	500
BE (Fland.)	Agricultural Ministry	1,5	70	90	1	20	120	300
DK	Agricultural Ministry	0,4	-	1000	0,8	30	120	4000
D	Biowaste Ordinance Type II	1,5	100	100	1	50	150	400
IRE	Draft	1,5	100	100	1	50	150	350
LUX	Environmental Ministry	1,5	100	100	1	50	150	400
NL	Second Class Compost	1	50	60	0,3	20	100	200
ES (Cata.)	Class A (draft)	2	100	100	1	60	150	400
SWE	Quality assurance organisation	1	100	100	1	50	100	300
UK	TCA Quality Label	1,5	100	200	1	50	150	400

The guide values have been proved in practice to be more efficient than the stipulation of absolute limited values. Compost plants have little influence on the input material so that a certain deviation of the quality criteria in the single case and after control should be allowed. Especially with very low limited values the compost plants are producing a compost quality which is ranging at the limit. After the composting his finished it can be analysed finally whether the compost end product fulfils the requirements or not. Only a possible deviation for the single case gives the compost plant a certain security for their production.

Organic pollutants
At the moment only Austria and Denmark are worried about organic pollutants in compost and have fixed limits. The other countries have detected very low levels, so they don't analyse the contamination (Netherlands, Belgium) or they do a kind of observation in suspicious cases or on a voluntary basis (Germany).

Hygienic requirements
In Austria the composting process has to be controlled after the first running of the plant and after each essential change of the equipment. During the regular decomposition process the temperature in the composted material has to reach 64°C over 4 days. In Germany the selected decomposition process must lead to a sanitized, hygienically irreproachable product and assure the exclusion of germs. The compost plant must be able to prove the hygienic effectiveness which is normally done by a daily temperature recording. The temperature level has to show in open composting systems more than 55°C over two weeks or 65°C over one week, in closed systems one week with more than 60°C is sufficient. With the new German Biowaste Ordinance the epidemic and phytohygienical clearance of products from biological waste treatment are stated by a direct and an indirect process control together with end product tests (on salmonella).
No hygienic standards exist until now in Belgium. Denmark defines two standardised process types which should guarantee sanitation. Controlled composting has to show the over 55°C during more than two weeks, controlled deactivation takes place after one hour at 70°C. Because of the variations in the technology of the composting plants a new regulation for hygienic aspects was laid down in the Netherlands in 1998. The former standardised general process parameters (minimum 8 weeks composting, and from these 4 weeks intensive with aeration and re-stacking twice, 50 - 60°C temperature) which guarantee hygiene efficiency are replaced by an individual solution for every composting plant. The Dutch independent certification organisation KIWA strongly supervises the strict adherence to the therefore required process parameters.
In future an extension of the hygienic requirements in Europe can be expected. Thus the latest draft of the new German compost ordinance asks for a hygienic process test of the total compost plant every two years. Austria is likely to follow this example and plans according to a draft version of the new Austrian compost decree an additional hygienic control of compost bags at the point of sale.

Additional quality aspects
The fulfilment of the requirements for heavy metals, organic pollutants, hygienic requirements and further characteristics are the preconditions for the award of a certificate (Netherlands) or of a compost quality label (Austria, Belgium/FL, Germany, Sweden).
These additional quality criteria concern impurities (plastics, metals, glass, stones), organic matter, plant compatibility, degree of decomposition, salt and water content. The detailed declaration of the contents of the compost to be sold is of a great importance in all countries. Only with the exact knowledge of the characteristics compost can be used successfully.
The quality of composts cannot be improved that much in these countries. Statistical data from the German Compost Quality Assurance Organisation FCQAO show a reduction of e.g. the heavy metal content of zinc and cadmium only of two or three percent over the last 10 years despite of a lot of efforts of the composting plants. So it can be expected that the compost quality has reached the inevitable background level.

2 Physical and chemical aspects of compost quality

At least it is important to consider the perception of the farmers and the potential market of the composted product and their requirements. To ensure a continuously high quality product, several characteristics should be measured regularly. Mentioned characteristics are stability, pH, moisture content and contaminant concentrations. Dependent on the agricultural application the nutrient content should be measured too.

The critical compost quality factors depend on the planned compost end use. Because there are different types of soils, crops, weather, location and farming methods, there is a need for different composts. For most applications, plant growth response is the ultimate indicator of compost quality. Chemical and physical parameters define the quality: concentrations N, P, K and organic matter, particle size and stability. Other parameters are the pH, salt content, the presence of man-made impurities (e.g. glass, plastics, stones, metals), pathogens and contaminants as heavy metals. In the Netherlands and other European countries a compost quality system is set up to maintain a high product quality.

2.1 Stability and maturity

The terms compost stability and compost maturity are used frequently in scientific literature. While stability and maturity were sometimes treated as different terms for the same compost property with no real distinction, some have tried to differentiate them. Generally, the term stability is more consistently understood, and a well-accepted definition is the ‘rate or degree of organic matter decomposition’. As such, compost stability can be expressed as a function of microbiological activity and it can be determined by O_2 uptake rate, CO_2 production rate, or by heat released as a result of microbial activity. Maturity is a more elusive concept, and generally refers to the degree of composition of phytotoxic organic substances produced during the active composting stage or defines stability aspects like colour, friability and odour. The stability of the organic materials is varying from stable to unstable, from mature (composted material) to immature (fresh material). For most agricultural uses, stability is required because of the relation between stability and the presence of pathogens and weed seeds.

One way of improving the quality of applied wastes is composting, which yields an excellent product due to the accumulation of humus like substances produced from biochemical processes that take place during composting. In general, soil organic matter components can be divided into humic substances and non-humic materials, where as the humic substances are subdivided into humic acid, fulvic acid and humin, varying in their reactivity, solubility and decomposition rate. During composting the concentration of the reactive and easy decomposable fulvic acids decreases, whereas the humic fraction increases. Non-humic soluble substances are mainly composed of soluble polysaccharides, peptides and amino acids, fats, waxes and low molecular weight acids. These compounds are easily attacked by micro organisms and persist only for a brief time. Additional advantages of well-decomposed stable material are commonly the elimination of weed seeds and pathogens.

One of the important properties of the stable humic substances is the large buffer capacity in a wide pH range. The buffering capacity of soil is of considerable practical importance in that most processes controlling the optimum supply of nutrients to crops act within a narrowly defined pH range. Furthermore, application of stable organic matter is more suitable to increase the soil organic matter: when composted material is added to the soil it is relatively more resistant to further breakdown than fresh. However, stable compost contains fewer nutrients than raw organic waste and in some cases it even may not result in net N mineralization after soil incorporation.

The use of unstable compost may present an agronomic problem since it may become toxic to plants. The degradation of the wastes continues in the soil after application of the compost, releasing several toxic intermediate elements, which may be possible inhibitors of seed germination and having phytotoxic effects of plants. When immature composts are used, the risks inherent in increasing soil temperature, the competition between plants and micro-organisms for available soil nitrogen and a reduction in the level of soil oxygen are equally important unfavourable for plant growth. Furthermore, the bio-availability of heavy metals is a function of the degree of maturity of the compost, since the humic material is capable of binding them. This limits the risk of spreading and the contamination of the food chain and the entire environment. Composting and maturation processes increase insolubility of metals that become less available to plants. But it should be noticed that the major negative impact of unstable compost depends on the application rate. With low application rate, as common in most developing countries, the mentioned toxic effect and unfavourable crop conditions are low.

The major positive effect of stable compost include the ability to increase soil organic matter with its related benefits as increasing cation exchange capacity, buffering and physical improvements. The stability can be measured with a respiration test, a simple and accurate test method that gives an indication of the stability of the organic matter. Other possible stability measurements are the Dewar Self-Heating test, the Solvita® Test and other indicators as the ammonium/ nitrate ratio, the ammonium concentration, the percentage seed germination and others. The most common parameter used for stability is self-heating (Dewar Test), followed by oxygen demand or CO_2-respiration (Solvita Test). The OxiTop® system and the Solvita® test are both suitable by their capacity to classify organic matter as stable or unstable. Self-heating is widely used in Europe and North America, but it is the least direct method and is recognized to give unreliable results.

2.2 Nutrient content

The nutrient content of composts can vary substantially based on feedstocks, processing conditions, curing and storage. The contents vary in the range of 0.1-3.6, 0.1-4.1 and 0.1-1.8 for nitrogen, phosphorus and potassium respectively Compost made from biosolids (sewage sludge) often has a higher nitrogen and phosphorus concentration than compost made from animal manures and yard trimmings. It is recognized that this nutrient content cannot satisfy the nutrient demand of agricultural crops, except for situations with very high application rates. Amendment is more interesting for the improvement of soil characteristics than for the fertilizer value of the compost.

Although these composts should not be considered as ‘true fertilizers’ but rather as organic amenders, it must be admitted that they do have a certain fertilizing value because of their nutrient content. The main nutritional advantage of compost application instead of mineral fertiliser is the ability of stable organic matter to serve as a slow release fertilizer, which will provide nutrients not only for the first year, but also in the following years, resulting in increasing soil nutrient content. Compost can supply micronutrients required by plants and use of them can replace other forms of microelements used as fertilizers although high rates and frequently application can produce undesirable effects.

Generally, mixtures of organic and inorganic fertilizers are more efficient than the separate applications of compost or mineral fertilizers. The optimal nutrient content depends on the application rate, the soil characteristics and crop demand.

The carbon: nitrogen ratio of the composted product influences the mineralization of nitrogen. C/N ratios in commercially acceptable compost are lower than 20. Applications of compost with a higher ratio may result in the immobilization of nitrogen during the decomposition. This effect is mainly important in the first days after incorporation resulting in nitrogen deficiencies, but on the longer term the net mineralization is positive. Furthermore, when the compost is applied together with manures or fertilizer nitrogen, there is sufficient nitrogen available. In that case, a higher ratio can even be considered as positive, reducing the nitrogen losses. This is only the case if there remain sufficient amounts for plant growth. But in general, it is assumed that a ratio below 20 is acceptable for most cases.

2.3 Organic matter content

Volatile solids, an estimate of compost organic matter, decrease during composting. Typically, about half of the initial organic matter is lost during composting. The organic matter content of a compost product seems not to be very indicative for compost quality. Compost analyses in literature commonly include the organic matter content, but very few recommended values be given. Generally, high quality compost is characterized by organic matter contents higher then 20%. Measured contents vary between 10 and 80%.

The organic matter content of the compost is responsible for all mentioned positive impact on soil properties. Higher contents allow lower application rates with the same effect. Several countries have established minimal contents, but in general no limits are required.

2.4 Moisture content

Compost moisture content is easily determined, but may fluctuate widely due to differences in feedstocks, processing and storage conditions. Moisture is often expressed as a fraction of total compost weight. As moisture content increases, dry matter per unit weight decreases. Literature investigations show a variation between 25-72% where moisture content between 40-50% is preferred.

The moisture content of the compost has no impact on the qualitative characteristics of the compost product. It is only important in relation to possible final processing and application methods. For example, MAP Agro in Bangladesh requires a minimal moisture content of 12% because of the blending with nutrients. A minimal moisture content of 35% is recommended because composts with lower contents are often dusty and unpleasant to handle. It should be noticed that some countries have established some limits but in general no requirements are given.

In the South most screening is done with an inclined manual screen, which is inexpensive and easy to build by hand. Screening works best when the moisture content is below 45%. Conversely, too dry materials (<30%) can lead to dust problems and loss of product especially in situations where prevailing winds are present.

2.5 pH

The final pH of the compost is highly dependent on the feedstock, the compost process and the addition of any amendments. Most municipal composts have a neutral or slightly alkaline pH ranging from 6.0 to 8.5 and a marked buffering capacity. These properties appear to be extremely useful in the case of application on acid soils where compost acts as a pH corrector, avoiding the risk of toxicity by Al and Mn which takes place when pH values are below 5. Excessive acidity or excessive alkalinity can injure plant roots, inhibiting plant growth and development. Compatibility of pH values with plant growth is within the range of 5.5 to 8.0. Related to the mentioned pH variety of composts, it suggests that addition of composts do not influence plant growth negatively. On the other hand, amendment of composts can substantially improve soil pH and the related nutrient availability and metal-complexes solubility for example.

The supply of compost generally leads to an increase or stabilization of the pH in cultivated soil. In function of its quality (level of carbonates), the use of compost can result in savings of non-negligible quantities of lime amendments. However, the efficiency of these materials in correcting pH values is slightly lower than that of lime while the improvement of crop yields obtained with compost is considerably better.

Enriching the nutrient content of the compost with chemical fertilizers can change the pH effect of compost on soil. All nitrogen fertilizers, whether applied in the ammonium, amide or organic form, are ultimately converted into nitrates. This nitrification leads to lowering of the pH due to releasing protons.

However, it should be noticed that the impact of compost on the soil pH only occurs when it is applied at high application rates. Compost has been found to affect soil pH even when applied at quantities as low as 22.4 to 44.8 ton/ha. Poor farmers never apply these application rates in developing countries. Therefore, the influence of compost application on soil pH is of minor importance.

2.6 Particle size

The importance of the particle size distribution depends on the potential application. Particle size distribution affects materials handling and the void ratio and resulting particle size distribution of soil mixed with compost. Large particles prevent efficient spreading for some field applications. Screening can remove larger compost particles, but it is difficult to remove smaller particles. Small particle size may also limit use for applications such as potting mixes or golf greens, where rapid drainage is important. Too many fine compost particles are undesirable in a mulch product, because they can retain enough water to promote weed seed germination.

In general, coarse compost applied in relatively high application rates can used for reducing erosion risk. The coarseness of the particles absorbs the energy of the rain and reduces the flow velocity. Furthermore, coarse particles are heavier and are therefore more difficult to erode than smaller particles.

In some countries limits were established concerning the particle size distribution, but it seems to be an exception.

2.7 Contaminants content

Compost may contain a number of contaminants with health or environmental risks. Heavy metals in compost are a concern to all commercial composting operators and play a role in determining compost quality. In fact many countries have established, or are establishing compost quality standards that limit the permissible concentrations of heavy metals (see Table 6).

Table 6 Heavy metal limits for composts for several countries (in mg/kg TS)

Country	As	Cd	Cr	Cu	Pb	Hg	Ni	Zn
USA	41	39	-	1500	300	17	420	2800
Netherlands	15	1	50	60	100	0.3	20	200
European Union	-	1,5	150	150	150	1	75	400
India	20	20	20	500	500	10	100	2500

It is obvious that the legislation concerning the heavy metals concentrations in compost vary strongly. The Dutch legislation has the lowest mandatory limits, but in general all legislation suggests the same pattern. The lowest mandatory concentrations were recommended for Hg, Cd, As and Ni, where the limits for Cr, Cu, Zn and Pb were obvious higher. The differences in standards are due to the fact that different approaches are applied to set up the heavy metal standards, namely the metal balancing approach and an approach based on toxic effects on soil micro organisms under field conditions. Comparison between the standards in the Netherlands and the EU shows that the Dutch limits are too strict and should be re-examined.

Most compost contains higher levels of many trace elements than most soils. Because metals are conserved in the soil compost mixture, application of composts to cropland cause an increase in the concentration of potentially phytotoxic heavy metals in soils and cause potential problems. However, the potential for adverse effects of heavy metals should be the basis for concern and not the simple presence in soils. Studies have shown that it is the chemical form of a heavy metal, rather than its presence, that is important in determining compost quality, because the chemical form determines the metals availability for plant uptake or leachability into the groundwater. Phyto-availability and bio-availability of trace elements in compost amended soils are low compared to assumptions of toxicologists. These investigations suggest that although some MSW composts may contain heavy metals that exceed regulatory limits, only a small percentage may actually be bio-available and pose health risks. However, this approach of bio-availability does not taken into account the influence on the long term. In the Netherlands, the metal balancing approach is applied that tries to match the metal inputs to soil to the small losses of metals due to crop removal, soil erosion and leaching.

Most composts show heavy metal contents below critical levels when in the composting process contamination is avoided and the hazard associated with chemical contamination of the food chain during agricultural use of composts seems very low unless extreme circumstances, such as very high application rates or very acidic pH values.

In recent years, increasing attention has been drawn to the import of organic pollutants like AOX, PCBs, PAKs and phenols. Very few threshold values based on toxicological studies are available and caution must be used in their application to soils. But toxic organic substances are of minor concern in compost from domestic wastes. Generally, potentially toxic organic compounds are either destroyed during composting, or bound very strongly by the compost so that plant uptake is trivial. Persistent organic materials could under certain circumstances give problems because of their potential to bio-accumulate.

2.8 Presence of inerts

Inerts are defined as the foreign solid matter including mineral elements (stones, bricks) and other elements including glass, plastics and metals. The acceptable quantity of foreign matter in compost has been a subject of some debate, but generally there is greater agreement on these standards. Normally, stones are distinguished from non-decomposable foreign matter that includes glass, plastic and metal. The limits pertain to a percentage at a specific screen size and vary between countries. Valuable materials can be recycled before composting, where as others can be removed before or after composting. The percentage of stones has no negative impact on the compost advantages, but the presence of other materials can lead to environmental or healthy risks. In most cases, governmental legislation limits the percentage inerts, present in the composted product.

It is important to determine the optimal mesh size. Decreasing mesh size improves the quality of the product, but also decreases the efficiency of the composting process because more material goes back into the composting process. In the Netherlands the mesh size is about 8-10 mm and is considered to be sufficient.

2.9 Salt content

Salt in the form of mineral ions are naturally present in all composts and their concentration may increase during composting. Incorporation of composts into soil increases the salt content as well as soil electrical conductivity, especially if high doses are applied, because of the high salinity of composts. An exceedingly high salinity may adversely affect plant and crops. High values of electrical conductivity (EC) can sometimes make certain wastes unsuitable for their use as organic amendments. Damage is proportionally greater in non-calcareous soils. For composts that contain higher levels of soluble salts (over 5 $dS.m^{-1}$), one should not exceed a 20% inclusion rate in a soil mix where salt sensitive species are to be established. Application methods that reduce the risk include controlled water management, repeated applications with lower rates and application before crop planting.

Salt may pose limitations for soil application, since plants have varying sensitivities, and accumulation in soils is variable. However, in most investigations in temperate zones, winter rainfall lowered the content to a level close to that of the control. Excess salts will tend to be leached by rainfall and irrigation water thus reducing potential salinity and soil physical problems, but contributing to pollution of groundwater. On the other hand, it is expected that in humid climates the higher salt content of composts give no risks for agricultural use and environment because of the high precipitation excess.

When waste is applied at high rates (> 100t/ha) monovalent cations may become the dominant cations and dispersion of soil colloids occur. But, in most agricultural practices this high application rates are never reached.

Dependent on the use, most countries regulated the amount of salts present in composts. But there is little agreement on how to classify salts in composts and what limits should be established.

3 Compost marketing

3.1 Marketing and public relation

Marketing and public relation of compost requires a standardised quality product too. Composts which have been tested in a quality assurance system meet these requirements because:

- Quality assurance is a good basis for sales promotion, for public relations work and a good argument for the building up of confidence in compost.
- The quality label allows the establishment of a branded "quality-tested compost" and a positive compost image.
- Regular analyses during compost production guarantee a quality-assured product.
- Standardised analyses carried out in accordance with specified methods enable a nation-wide objective assessment of the compost.
- The investigation results form a basis for the product declaration and the application recommendations.

The result is a compost of defined quality which is therefore marketable and saleable on a large scale.

Further marketing activities are necessary, as compost with a quality label or a quality certificate will not be sold by itself. With this qualification, however, the compost plants have an excellent start because quality products always have advantages in the market. In order to compete with the activities of the peat-, soil- and bark industries the compost plants need to undertake common efforts in their marketing activities on a similar level.

The quality assurance organisations (e.g. the compost quality assurance organisation in Germany, KGVÖ in Austria, VLACO in Belgium, VA in the Netherlands) support the compost plants in their joint marketing activities. It is neither necessary nor financially sensible that each compost producer develops its own marketing instruments.

The marketing measurements in the individual EU countries vary decisively in size and volume. There are only actions in countries with a developed compost management. An advantageous start of a marketing strategy is to build up a quality assurance/certification with recommendations for the use of compost for the most important ranges of product sales. Examples: user brochures of the German Compost Quality Assurance Organisation, 2-volume guidelines for practical use of compost of VLACO in Belgium, 6 user information sheets of the KGVÖ in Austria. The Belgium VLACO supports additionally a row of tests for the use of compost.

3.2 Compost use and markets

Significant differences on the market situation are to be recognised also in the EU countries. Generally it can be recognised that even in the developed countries with a circumstantial compost production like Germany the feared problems with compost sales did not occur. In all countries hobby gardening, horticulture and landscaping are successful markets and has good developing chances.

Table 7 **Market shares of compost sales in EU (in %); status 1999 to 2001**

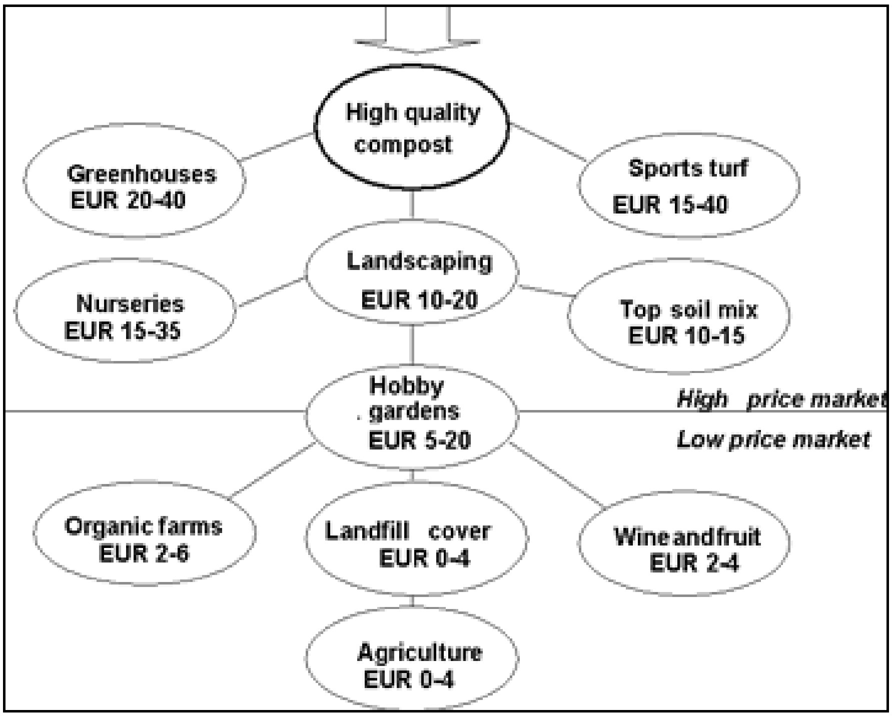
Market	AT 2000	BE (Fl) 2000	D 1999	DK 2000	NL 2001	IT 2001	LUX 2000	FR 2000	AT 2000
Landscaping	30	26	25	13	10	15	28	19	30
Landfill + Restoration	-	2		14	-				-
Agriculture + Special cultures	30[1]	9	43	12	75	33	43	52	30[1]
Horticulture	10		5	8	-			5	10
Earth works	5	35	10	-	-	48		15	5
Private gardens	20	19	14	43	10		18		20
Export		5	-	-	5				
Miscellaneous	5	4	3	10	-	4	11	9	5

[1]60 % of the Austrian VFG and green waste is on-farm-composted

Compost marketing shows several trends in Europe (see Table 7). Green compost, i.e. compost made from green waste, is an organic fertiliser and soil conditioner accepted by the markets all over Europe. It can be produced in a good quality without much technical equipment. The biocompost, i.e. compost made from biowaste, market shows two contrary developments: By means of the decreasing or low tipping fees, some of the composting plants try to minimise their treatment and marketing costs which results mostly in delivering the compost free of charges to farmers without additional marketing efforts. On the other hand a lot of composting plants start to add value to their compost products and produce mixtures or special products according to customer's needs and market requirements. They co-operate with earthworks or build one by themselves. The quality assurance organisations support these tendencies in organising research projects for compost application and for new compost products.

Figure 1 gives a European perspective on ranges of value (and market size) for composted materials. It can be seen that there are a variety of uses for compost with different potential market sizes.

Figure 1 **Compost Marketing Hierarchy Indicating Market Prices and Volumes**



Note: Prices are known ranges for compost products within the market segment (in €/m³)

3.3 Final remarks

A Concept for Quality Assurance for Compost in Europe

Quality assurance schemes for compost and digestion residuals established themselves in the last 15 years successfully in various European Member States and contributed well for the sustainable recycling of organic waste. Nevertheless the running revisions of various environmental and agricultural directives at the Commission and the EU's free trade principle advice to develop consistent quality standards for compost and digestion residuals.

The example of the advanced countries clearly shows that effective biowaste treatment has to include quality standards and their control in order to guarantee environmentally safe application and successful marketing and markets. On the basis of existing experiences in countries with running quality assurance schemes the European Compost Network (ECN)/ORBIT develops at present a European Quality Assurance Scheme (ECN-QAS) for compost.

From: http://www.compostnetwork.info

An example of a Quality protocol is given for UK in a separate publication: Quality Protocol Compost - The quality protocol for the production and use of quality compost from source-segregated biodegradable waste. WRAP (www.wrap.org.uk) and Environmental agency (www.environment-agency.gov.uk) of UK.

Literature

The following books and papers were consulted (several parts of this report are adapted or integrally taken from these references).

Joint Research Centre (2008). End of Waste Criteria, methodology and case studies. Available at: http://susproc.jrc.ec.europa.eu/publications.html

European Compost Network http://www.compostnetwork.info

Quality Protocol Compost (The quality protocol for the production and use of quality compost from source-segregated biodegradable waste). WRAP 2008. Available at: http://www.wrap.org.uk/composting/

Barth Josef, Amlinger F., Favoino E, Siebert S. Kehres B, Gottschall R, Bieker M, Löbig A and Bidlingmaier W. (2008). Compost production and use in the EU. ORBIT e.V. / European Compost Network ECN.

A Powerpoint presentation on compost application and quality produced within this Twinning Project is available in Romanian language, in the following link: http://www.twinning-waste-bacau.ro/waste-1/gestiunea-deseurilor/implementarea-sistemului .