SEPTEMBER 2005

Proceedings of the Horizontal workshop

BIOLOGICAL PARAMETERS

Vienna

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B. Cooper

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Background of the workshop

The framework of Project HORIZONTAL, which aims at the development of horizontal and harmonised European standards in the field of sludge, soil and treated biowaste relevant for EU Directives, desk studies were carried out dealing with sampling, hygienic and biological parameters, methods for inorganic and organic contaminants, leaching and mechanical properties. The desk studies on biological parameters revealed the need for discussion with interested parties. This could best be developed within a workshop to deal with specific issues as highlighted in the desk studies and not a paper presentation forum.

The Steering Committee of Project HORIZONTAL, in its meeting on May 12, 2004 agreed with the proposal that a workshop be organized for biological parameters in an attempt to agree specific methods for further development.

Experts from trade and industry, National Standards bodies and academia were invited to the workshop.

Overview and discussion

Some 50 plus experts were identified and invited to attend a workshop to be held in Vienna on 13 – 15 December 2004 hosted by the Austrian Standards Organisation. From these invites over 40 attended with the majority of those invited but not attending offering their apologies and asking to be kept informed.
The fact that so many people from all over Europe attended and also an interest from the USA show that there was and is a need for this workshop to be undertaken. One delegate commented that "we were bravely treading where no man had tread before" (A poor quotation from *Star-track!).*

The workshop was divided into two distinct parts the first being presentations by the work package writers, the second giving all a chance to comment and to guide the writers onto the next stage(s).
There was full participation from all who attended both during the actual meeting and also at the meal breaks and evening get-togethers. All the discussions were conducted in a positive manner. As expected not everybody had the same degree of interest in all of the parameters, a few had a personal interest in ensuring that specific methods were kept to the fore.

There was some confusion and dissent from some delegates over the fact that the words "soil improver" and or "growing media" had not appeared in any HORIZONTAL documentation. From this, some had concluded that these specific areas of interest were not included within the HORIZONTAL framework.
Those involved in the HORIZONTAL project considered that soil improvers and growing media were included under the general heading bio-waste.

It is accepted that the term ”waste” can have serious implications in traded materials and that alternative must be found. It is also recommended that the omission of the words “soil improver” and “growing media” be addressed in future communications.

The agreed outcome of the workshop was that two subjects (impurities and weed content) should proceed with a small amount of additional research. This having been completed it should then be possible to present a final method for comment before the final validation phase.
Phytotoxicity and stability (biodegradability) will require considerably more practical research before Phase II with robustness and ruggedness testing can be performed.

Small working parties were agreed for impurities, weeds and phytotoxicity whereas all would be kept informed and invited to comment on any progress with the stability method.

Weeds

Presented by Andreas Baumgarten

General discussion

The general definition of a weed is a plant growing in the wrong place. The source of a weed is either from the parent material or wind blown. For the purposes of this topic weeds are considered to be from the parent material. The definition also includes plant propagules i.e. small traces of roots that can develop into the parent plant.

Why is it necessary to know the weed content?

Soil is moved from its original site and is used in very many situations from horticulture to landscaping, sports grounds and reclamation sites to name but a few. Green waste composts and sewage sludge's are also used in similar situations. There are other materials not listed above that may also contain weeds.
The end user of the material may be able to remove any germinating weeds by the use of herbicides or heat process controls but in many cases this will not be practical therefore in the end what the user wants to know is "is the material that is being used weed free or alternatively what weeds are present and will they cause a problem".
Some weeds are particularly pernicious (e.g. Japanese knot weed) and their spread would be an environmental catastrophe. Weeds present in traded materials could have serious financial consequences, especially within the horticulture industry.

From the above it is obvious that a method or methods are required to determine the weed content in a range of materials.

The proposed method of test requires the test material to be brought to optimum conditions for seed germination and plant growth. It is highly unlikely that any proposed method will be able to answer all questions, some seeds require heat or freezing to stimulate germination, it may therefore be necessary to have several techniques based on a similar theme.

Synopsis of the method

The test material is, if necessary, diluted with inert materials in order obtain a final electrical conductivity acceptable for best plant growth. In some instances it may be necessary to add various nutrients again to ensure adequate plant growth conditions. The amended test sample is placed into shallow trays and maintained at optimum temperature and moisture for seed germination.

Discussion points

1) Limitations of the method
Conclusion:

It was agreed that the method of test was not applicable to liquid sludge and this fact to be inserted into the scope of the method. It should be applicable to sludge amended soil. (A subsequent question has asked “If the liquid sludge is applied to an inert material or plastic is there a problem?” This question can only be answered by undertaking the necessary tests.)

2) Material of dilution
Discussion took place as to what material should be used to dilute the test sample. It was generally agreed that dilution was necessary as the most composted wastes and sludge’s would not support plant emergence due to high conductivity and a possibility that the pore structure would not be satisfactory. Various diluents (inert or reactive?) were suggested for example soil, peat, perlite and vermiculite but no agreement was reached as to the most appropriate – it may be that more than one diluent is required.
Conclusion:
Research is required into the effects of various diluents and ways of ensuring that the diluents are weed free. A further question was raised, if a sample is diluted should the entire original sample be tested or only a portion. It was agreed that all the original sample should be tested hence a possible large increase in sample size – see 7) below.

3) Electrical conductivity (EC) threshold
No agreement was reached as to the “best” EC threshold. There is some knowledge of threshold values for plants but no one was sure that all weeds would germinate under the same conditions. Normal EC levels in soil could be taken as a reference
Conclusion:
It is necessary to undertake a trial with various EC’s and weed seeds. The discussion in 2) above may also have an influence on plant emergence.

4) Additional treatments
It is an established fact that some seeds require either cold or heat to stimulate germination. In view of the wide range of climatic conditions within the EU both aspects must be considered. It may be possible to list the known plants species and consider the possibility of that plant species being in the sample to be tested and as such whether any additional treatments are necessary. The method will require the facility for such treatments to take place. In some cases additional fertilisation will be a requirement, the question to be answered is how best to apply in order to achieve a homogeneous final mix? The need for these treatments depends in part on the material pretreatment.
Conclusion:
Establish the best methods for additional treatment

5) Moisture and watering regime
This may appear a simple subject but over or under-watering can have a significant impact on the result. As so many different sample types are to be included this area

needs investigating – different regimes may be required for different matrices. Sample preparation appears to be a crucial preliminary step. If a material does not behave as a soil or soil like material, it is unlikely it will give a proper response.
Conclusion:
Investigate the watering regimes necessary to give the seeds the best chance of emergence.

6) Thickness of layer
How thick should the test sample be? The thicker the layer the longer it will take for a seedling to emerge - what is the optimum thickness? Permeability of the material may become low and thus hamper development.
Conclusion:
Trials are necessary to determine optimum thickness.

7) Size of test tray
This question may appear of minor significance but can have a cost implication. Two points arise – if it is agreed that say 2-3 litre of material is to be tested and this is then diluted 3 fold this means that up to 6 litre of material is to be tested- assuming a thickness of 20 mm tray(s) with a surface area of 3,000 square cm is required. As can be seen if the sample is tested in either duplicate or triplicate a large amount of test space will required – being either in a laboratory or greenhouse.
Conclusion:
This question is linked to 2) and 6) above.

8) Length of test
No one was sure for how long the test was necessary, e.g. 14, 21 or 28 days. The longer the test took place the greater the strain on laboratory work space with possible cost implications. There is distinction between characterisation and verification testing. Characterisation testing may be more elaborate to give information on material behaviour, while verification or compliance testing will provide a quick answer for quality control of production. The function of the tests is different, but both aspects are needed to be able to make proper decisions.
Conclusion:
Whilst research was being carried out above records should be kept on weed seed emergence and from this data obtain the minimum time necessary to undertake the test.

Conclusions

Weeds can be determined by either physical examination of a prepared sample under a microscope or by allowing the seeds to germinate - the later process was agreed as the best procedure to adopt. Various questions were raised during the discussion and are listed below. It was agreed to undertake preliminary trials to evaluate the proposed method and to try and answer some of the points raised.

- **Should sewage sludge be included?**
- **Effect if any of various diluents**
- **Size of samples – should all the test sample be tested?**
- **Effect and correct electrical conductivity**
- **Should the test sample be subjected to heat or freezing treatments?**
- **Watering regime and moisture content**
- **How deep should the test sample be**
- **Length of time for the test to be undertaken**

Plant Response (Phytotoxicity)

Presented by Andreas Baumgarten

What is meant by "Phytotoxicity"?

In general terms it means that plant growth is not "normal". This change of plant growth can be caused by any number of conditions for example, high soluble salt content, toxins or by residual herbicides. The structure and drainage of the growing media can also cause poor plant growth but these conditions will not be addressed in this paper.

It is an unfortunate fact that the human population produces a large amount of waste which has to be disposed of. Some wastes can have a beneficial effect if used correctly – sewage sludge and manures are two classic examples. But excessive use of either can have disastrous effects on plant growth – it is therefore essential to know how much to apply to the land. These amounts have been developed over many years and the amounts to apply are either regulated as is the case for sewage sludge or in the case of manure it is usually normal farm practice that comes into effect. So why go further? Waste comes in many forms, for example household waste, green waste and industrial wastes. Industrial waste is a concern for all – is the waste buried, recyclable, disposed into water courses, applied to land? At some stage whatever the disposal the waste will be brought into contact with plant life and it is at this time it is necessary to know what effects it will have on that plant life. Whilst in the normal course of events excessive plant growth may not be considered a phytotoxicity problem the addition of minerals into water courses can increase plant growth to such an extent as to be hazardous to fish, amphibians and water flow.

Can the material be applied to land or recycled into a plant sustaining medium? In order to answer these questions laboratory style tests have to be carried out. Field trials are an option but the cost factor and possible environmental aspects have to be considered.

Once the method has been developed it should be possible to advise on best use of waste materials in agricultural and horticultural situations and perhaps landfill situations. The test method should also be able to give some indication as to why in some situations there is poor plant growth e.g. residual herbicide.

Synopsis of the method

The test material is, if necessary, diluted with inert materials in order obtain a final electrical conductivity acceptable for best plant growth. In some instances it may be necessary to add various nutrients again to ensure adequate plant growth conditions. The amended test sample is placed into pots and maintained at optimum temperature and moisture for plant growth. Seeds are planted at spaced intervals in the pot with emergence and plant growth being recorded.

Discussion points

Following the presentation and highlighting the written comments received the meeting agreed that the method needed much more development, the major points being listed below.

1) Phytotoxicity

It was felt that this word was not correct and that the correct title should be “plant response”. It was not known if poor plant responses were due to the physical nature of the test material, chemical composition or the presence of “toxins” which could include residual herbicide activity or any other factor that could inhibit normal plant growth. From past experience germination rate and subsequent plant growth rates could be quite different to standard peat based compost.

Conclusion:

The title description be changed from “Phytotoxicity”
To “Plant Response”

2) Plant emergence and subsequent plant growth

A long discussion ensued over this aspect. It was agreed that there should in fact be two tests, one to record seed emergence and a second to record plant growth characteristics. If plants were to be grown for a specific period of time should that time be taken from sowing or from seedling emergence. For long term growth trials would plant plugs be better than waiting for seedling emergence?

Conclusion

Two sets of test to be developed one for seed emergence and a second to observe longer term plant growth effects. Work is needed to ascertain the benefits, if any, of using plant plugs and if so which plants to use (see below).

3) Material of dilution (this was also covered in the weeds section – see above)

Discussion took place as to what material should be used to dilute the test sample. It was generally agreed that dilution was necessary as most composted wastes and sludge’s in their natural state would not support plant emergence due to high conductivity and the strong possibility that the pore structure would be unsatisfactory. Various diluents were suggested for example soil, peat, perlite and vermiculite but no agreement was reached as to the most appropriate – it may be that more than one diluent is required.

Should the diluent be commercially fertilised peat based compost?

Conclusion:

Research is required into the effects of various diluents and ways of ensuring that the diluents are weed free. A further question was raised, if a sample is diluted should the entire original sample be tested or only a portion. It was agreed that all the original sample should be tested hence a possible large increase in sample size – see 7) below.

A key issue in this context is the relevance of judgment for the final use of the material.

4) Electrical conductivity (EC) threshold (this is also covered in the weeds section)
No agreement was reached as to the "best" EC threshold. In addition to the EC threshold there may be a need for the addition of some nutrients especially over long term growth trials.
Conclusion:
Optimum EC levels to be agreed and any additional fertilizer needs to be determined and how these fertilizers will be added to the test/control samples.

5) Moisture and watering regime (see also weeds section)
This may appear a simple subject but over or under-watering can have a significant impact on the result. As so many different sample types are to be included this area needs investigating – different regimes may be required for different matrices.
Conclusion:
Investigate the watering regimes necessary to give the seeds the best chance of emergence and plants to continue to thrive.

6) Plant pots
For seed emergence flat trays are appropriate but for longer term plant growing trials larger plant pots may be required.
Conclusion:
Trials are necessary to determine optimum plant growing conditions.

7) Length of test
No one was sure for how long the test was necessary, e.g. 14, 28 or even 56 days if herbicides are thought to be present. The longer the test took place the greater the strain on laboratory work space with possible cost implications. However, the proper assessment of risk is of primary importance to decide on this parameter.
Conclusion:
Research is necessary to be certain of the optimum length of testing time especially when herbicides are considered a possible contaminant. Emphasis should be placed on the option to identify quickly if herbicide residues are of relevance (role for very fast growing plants under almost any condition, which when inhibited would point at herbicide or other inhibiting factors).

8) Growth conditions
The test must be carried out under optimum growing conditions; this will require controls of light, temperature and moisture. In view of the diverse light and temperature conditions within the EU this may prove more difficult that originally thought.
Conclusion:
Research across the EU is necessary to be sure the test can be carried out from the Mediterranean to the colder climes of Norway. Growth cabinets may have to be purchased to ensure constant climatic conditions.

9) Control (test plants)

It was amazing how much debate this topic produced. The numbers of plant species that have been used in the past were considered. A short list was drawn up but no final agreement was achieved on which plant species were to be used other than Chinese cabbage.

Conclusion:

Agreement has to be reached on which plant species are best suited for this test. Trials with the various plants are considered the correct procedure. Under standardised conditions e.g. climatic chamber with controlled lighting the use of a generally agreed plant should not be an issue, when in parallel a locally relevant species can be tested.

10) Control (growing media)

In order to compare data a control must be run along side the test sample. Should this control be of a similar nature to the test sample or a simple peat based growing medium? If a peat based medium is used should it be a commercially readily fertilised compost or pure peat and fertilised with the test house?

Conclusion:

Work necessary to determine the optimum conditions.

11) Interpretation of the data

It has to be recognised that the test sample may not produce the same growth characteristics as the control even under ideal growing conditions. One would not expect a potting compost designed for seed emergence to behave in the same way as a grow bag compost therefore there has to be care if data is compared in simple percentage terms. Chlorosis caused by phyto-toxins and leaf distortion caused by residual herbicides will have to be factors recognised by the test house – an area of expertise not always readily available.

Conclusion:

In the development work listed above it may be possible to get data to give testers a means of interpreting the data obtained. Standardation is the key word here. Too much variability in conditions will not lead to comparability of results.

General observations

It is hoped to develop a modular approach to seed germination and longer term plant growth trials. A project team has been set up to try and answer questions raised above.

There are many reasons for additional research, some of which have already been highlighted above are listed below:

- Economics: certificate of fitness for purpose is necessary. If the material is to be used for or connected with plant growth (e.g. landscaping, growing media soil improving) then there can be serious financial consequences if the product causes plant loss or harm to the environment.
- The existing ISO method does not fit in the needs for HORIZONTAL, furthermore only toxic substances are in the scopes of the ISO methods

- Two modules needed – germination and growth
- Appropriate control sample to refer to
- Influence of physical characteristics
- Nutrient status, fertilization during the test
- Choice of test crop
- Proper Interpretation of results
- Saving on peat resources

In view of the similarity of need within ISO and TC 190 it was agreed that ISO and TC190 be informed of the work programme and invited to contribute to the research programme in any form they considered appropriate.

Conclusions

It was agreed that the only way to determine plant response or phytotoxicity was to grow test plants. There was little consensus on what plants to grow, under what conditions and for how long. **Considerable research** will be required before a standard method can be proposed. The main points requiring answers are listed below.

- **Germination and longer term growth tests**
- **Effect if any of various diluents**
- **Size of samples – should all the test sample be tested?**
- **Effect and correct electrical conductivity**
- **Watering regime and moisture content**
- **How deep should the test sample be – trays for seed germination and pots for longer periods of growth**
- **Length of time for the test to be undertaken**
- **Growing conditions**
- **Control plant species**
- **Control growing media**
- **Interpretation**
- **Agreed unable to proceed further until funding for research became available**

Many of the above mentioned parameters are directly related to material pre-treatment and a definition of the exposure conditions to which plants should be subjected. Selecting a condition as close as possible to the final use is of importance. Highly variable conditions as imposed by highly variable properties of the raw materials (e.g. pure domestic refuse compost, sludge etc.) will not lead to a reasonable data interpretation. The materials are not applied in undiluted form, thus this aspect should be taken into account.

Impurities

Presented by Gerrit Wever

Some years ago recycled household waste was applied to a vineyard. As the organic matter biodegraded the vineyard was left looking rather "blue". The cause was non biodegradable polythene bags in which householders had collected their shopping and sent to the domestic refuse recycling plant.

The above is a classic case and one that is repeated so often that it makes the use of recycled ands waste materials into agriculture and horticulture very difficult.
It is not just agriculture and horticulture that requires "safe" materials. Amenity sites such as golf courses and play parks for children also want tot be sure any materials applied to the land are not going to cause injuries and consequential costly litigation.

What is an impurity?
To some extent it will depend on the end use of the material. A waste being applied to a new road side in order to increase organic matter can have a certain amount of stone/brick waste without causing any adverse effects. Add the same material to a golf course and the consequences a grass cutter hitting a stone is highly significant.
As it is not possible to have different methods for each end use, there has to be a universal method to determine the visible "impurities" such as stone, brick, plastics and metals including needles.

It is essential that as much waste as possible be applied back to land and therefore to encourage such use methods must be available to ensure that that material is safe and fit for that use.

Synopsis of the method
The dried sample is sieved and the impurities removed by hand and the mass recorded

Discussion points

Following the presentation and highlighting the written comments received the meeting went on to discuss specific points as listed below.

1) Stones
Were stones an impurity or an integral part of the sample? The consensus view was that the stones even very small stones could be of considerable interest in specified areas especially top dressing for turf where their presence could cause physical damage to grass cutters.
Conclusion:
a) **To include "Stones"** *in the title name "Impurities and stone content.*

b) *To determine the stone content in the same way as the other contaminants and report accordingly.*

2) Scope
The meeting did not consider the method applicable to unprocessed organic wastes*.
Conclusion
That the scope of the method should state that the method was only applicable to "processed organic waste*, sludge and soil.

NOTE (* See above on a need for definitions within the HORIZONTAL framework. There is an urgent need to draw together all the ISO/CEN agreed terms and definitions and only then consider if any new definitions are required.)

3) Particle size
Whilst the method was written for sample materials with a particle size up to and including 40mm there was no clear guidance what to do with particles greater than 40 mm. EN 13040:2000 Soil improvers and growing media – Sample preparation for chemical and physical tests etc. give some guidance on this issue. If < 20% is retained on the maximum sized sieve it is permissible to break the sample a minimum number of times to ensure it passes that sieve. Obviously this would not apply to any physical contaminants that exceed the maximum sized sieve. Is a large particle of the mass of the sample an impurity or an integral part of the sample?
Conclusion.
Research is necessary to resolve these matters.

3) Temperature
The method was written to dry the sample at 105°C. It was pointed out that at this temperature some plastics could/ would melt and deform or undergo some other physical changes. Also aggregation of materials can take place. The question of speed of drying as compared to plastic deformation was debated. It was felt that specific drying conditions would be needed to dry wet organic materials at low temperatures.
Conclusion
In order to determine the optimum drying regime research is necessary with a range of temperatures, sample matrices and thermo sensitive plastics and bio plastics.

4) Light plastics
There is not a relationship between surface area and weight of plastics. There is a need for surface area determination to be included and the method.
Conclusion
A method was to be provided that would then be incorporated into the main method.

5) Destruction of the mass of the sample

There was quite a debate on this issue. Should the sample be pre-treated prior to any sieving? There is no doubt that removal of as much extraneous organic matter as possible before any sieving will make the final test that much easier. Two methods were proposed namely destruction with bleach and a high pressure water wash. The costs and hazards of the bleach method could be a deciding factor. Peroxides, whilst equally hazardous may also be a possibility.

Conclusion

Research was necessary to determine the best procedure. In a small inter-laboratory trial with 5 laboratories using 4 samples agreed to test the different methods.

6) Other impurities.

Are bones impurities? No one was certain on this issue; it was generally felt that if they were clearly visible then that fact should be reported.

Conclusion

A pre-inspection of the sample was deemed advisable to see if any impurities were considered hazardous and these were to be removed prior to any testing. No specific mention to be made of these items, they were to be included in the general report. General impurities over 20 mm were to be reported. The term “general impurities” will need clarification.

Conclusions

The workshop agreed on physical examination of the sample to determine impurities. There was not agreement on how the sample should be pre-treated and also some other minor points as listed below. **It was agreed that a small trial be undertaken where it was felt the majority of these questions would be answered**.

- **A need to have agreed terminology**
- **Particle size of an agreed impurity**
- **Stones – integral or impurity?**
- **Sample preparation - effect of drying samples**
- **Pre treatments to remove bulk of the sample or make visual examination easier**
- **Light plastics – surface area measurement**
- **What should be included under “other impurities”**

Biodegradability (Stability)

Presented by B Cooper

At first thought one may be justified in thinking that this topic only applies to the composting process, but this is far from the truth. Virtually all organic matter biodegrades, it is the rate of biodegradation that is important. Following on from this there are two more aspects a) what is evolved during the biodegradation process and b) what is the intended end use. For landfill it may not have an end use as such but landfill site operators wish to know the rate of biodegradation and at what point the rate of biodegradation is no longer significant i.e. what is the gas production rate and leachate quality in terms of COD and NH4.

Materials undergoing biodegradation produce heat and often toxins. In agricultural use where the materials may be used as a source of organic matter or nutrient then depending on the time of application the actual rate may not be significant, but at other times of application it could be very significant.

Horticultural use is totally different – a rapidly biodegrading material could cause problems if bagged and sold i.e. gas production as well as the effects of heat. Also as has been stated above toxins are usually formed during the biodegradation process that are injurious to plants. There is considerable antipathy to the use of composted waste and any method that can confirm the safety of a product must be to the good of all.

There are very many methods describing "stability" but in general they are confined to a limited range of matrices and conditions. The proposed method can be applied to a wide range of matrices from sludge's to soils and virtually all forms of wastes that undergo a biodegradation process. The described method measures carbon dioxide – a gas produced under aerobic conditions, however with different sensors other gasses could be measured even under anaerobic conditions – a useful addition to the knowledge of landfill site biodegradation.

<u>Synopsis of the method</u>

After moisture adjustment the prepared sample is place in a continuous flow chamber maintained at a constant temperature. Carbon dioxide is removed from the ingressing air. Evolved carbon dioxide is trapped in soda lime and determined by titration.

<u>Discussion points</u>

<u>Stability</u>

Following the introductory talk it was clear to all that the term "Stability" had so many different meanings and in many cases could be misleading. The workshop agreed that term BIODEGRADATION was more meaningful and should be used in place STABILITY.

From the debate it became apparent that there were at least three areas of interest.

a) Current rate of Biodegradation
What is required is knowledge of what is happening to the sample at a given point in time. This information is necessary to give advice as to whether the material is fit for its intended purpose. The rate may be very different for different end uses for example a material intended as a soil improver that will be applied to the soil in a non-growing period (can be more active) compared to material intended as an ingredient of a growing media where minimal activity is required.

More than 1 method may be required for proper characterisation.

b) Potential Biodegradation (carbon pool)
Knowledge of the composition of the carbon pool is a valuable tool in assessing the potential biodegradation of the material. This is of great interest especially where material is destined for landfill. Will there be problems of odour, methane production etc. Knowledge of the carbon pool is also of interest where the material is applied to agricultural land. Will the material significantly add to the organic matter of the soil and what is the possible long term value?
Several methods were suggested, these will have to be investigated and evaluated.

c) Nitrogen (im) mobilisation
This topic is of concern to all where plants will/are being grown in or around biodegrading materials. Depending on the degree of biodegradation nitrogen can be taken from the surrounding area to aid further decomposition or the material may release nitrogen into the surrounding area. This may be a particular problem with high nitrogen source materials such as sludge's kitchen and animal wastes. In some cases leachates from biodegradation processes may be of concern.
Methods are required to answer these questions.

Some key words of debate:

a) Applicability of the method. As can be seen in the Annex many methods exist to determine rate's of biodegradation. Can the proposed HORIZONTAL method give all the answers? Should the method analyse the sample "as is" or can the sample be homogenised without affecting result? What is meant by "actual reactivity" is it the activity of the sample as it is or is it the materials potential to activate under ideal conditions?
b) Fields of application – The current thinking appears to try and give an answer to the question "is it stable". Since this term has no agreed definition a better approach is to ask "where is the material going" and then to decide on the best method(s) of test(s). With this approach it may be that specific methods of test are required in certain circumstances.
c) State clearly what questions can be answered by a specific method/parameter e.g. odour reduction, re-growth of pathogens, biogas production.

This requirement is in an ideal world and it may take several years before this can be answered with some degree of certainty. The laboratory testprovides information on the sample and not the environment from which the sample has come from nor the environment into which the sample will go.

d) Interpretation and reporting data: To what is the rate of degradation referred to (e.g. dry matter, volatile solids). Having obtained a figure what does it mean? As has been pointed out before different end uses will in all probability have different requirements so for example give the result an index number may be only of value to a limited sector.

e) Aspect for growing media: What is the biodegradability within 1-2 years? Is the rate of change acceptable for a certain time of storage?

Next steps

After an in depth discussion of the different aspects a draft table* was created in order to evaluate stepwise:

- → What types of materials are involved
- → What questions need to be answered as related to a following process management and the final use respectively
- → What parameters can be used to answer the concerned question and
- → Which method (methods) would be most suited to give results that can be interpreted in relation to the intended process or use

* the draft table shown below was prepared within the Workshop; a refined table with questionnaire was developed and is appended as an Annex 5.

Draft use related assessment of suitable methods for the identified matrices

A key differentiation has to be made between the uses of a material as such (landfill, further biological process, growing media) or when it is applied on land when processes induced in the soil may also have to
be assessed!

It might be possible to distinguish between:

- o **Biological Stability** → process control; MBT- stabilised residual waste
- o **Use related Value** → use related value in GM, SI / Agriculture, landscaping etc.

MBT – municipal biologically treatment
GM – Growing media

SI Soil improver

Draft table indicating use related parameters of biodegradation in order to answer specific questions

Materials/uses [1)]	**Questions to be answered in relation to use**	**Suggested requirement** [2)]	**Minimum requirements for biodegradation testing** [3)]	**Potential methods**
SOIL; dredged & excavated soil	*C-breakdown*	C-pool Resp.		
MANUFACTURED SOIL incl. other sources than soil	*C-breakdown* *N release [N-(im)mobili-sation];*	C-pool N		
SEWAGE SLUDGE	***All other treatments than composting***			
Sl: Land reclamation	*Prediction: N release [N-(im)mobilisation]; short term C-mineralization in soil*	*N* *C-pool*		
Sl: Agriculture	*Preliminary agricultural interest:* *Prediction: N release [N-(im)mobilisation]; [short term C-mineralization in soil]*	*N* *C-pool*		
GM	*--> only in composted form*	*Resp*		
conditioning/ storage	*?*	*Resp?*		
other Sludge's	***All other treatments than composting***			
Sl: Land reclamation	*Prediction: N release [N-(im)mobilisation]; short term C-mineralization in soil*	*N* *C-pool*		

Conclusions

This topic proved to be the most contentious with no agreement on the methodology to be used. To date there is no clear picture as to what is that is to be determined, i.e. the current rate of biodegradation, the potential for further biodegradation, what if conditions change, which gasses are important, should the method cover all eventualities and sample types etc. Until these points are agreed there is little value in continuing the debate on a method or methods of test. As different questions need to be answered, it is unlikely that one procedure will suffice. It was agreed to circulate a questionnaire in order to try and get answers to some of the points listed below. Future development will depend on the outcome of questionnaire. One issue that needs to be clear, that proprietary methods can not be standardised in CEN. They may be used for in house verification and agreements between parties, but they will not be acceptable in a regulatory framework, unless the methods have been validated against an accepted standard reference method.

Currently, the multiplicity of available tests for stability (biodegradability) does not help to paint a clear route forward. Therefore is is important to start from the questions that need to be answered rather than from the test and what it can be used for.

- **What is it that is to be measured?**
- **What is the rate of biodegradation at the point of sampling?**
- **What are the consequences of this rate of biodegradation?**
- **If the environment changes e.g. moisture, oxygen availability etc. will there be significant changes to the rate of biodegradation?**
- **Effects of biodegradation on other plant species in the surrounding area**
- **Should the sample be analysed "as is" or can it be homogenised without affecting the results?**
- **Short, medium and long term potential biodegradability of the sample**
- **The relevance of the test – e.g. odour reduction, mass reduction, potential end use etc.**
- **Can one method be used to answer all the questions?**
- **How sophisticated should the method be?**
- **Can one method be used in many situations, e.g. land fill, waste, sewage sludge, composting etc.?**
- **Versatility of the method – measure one parameter or several**
- **Interpretation of data obtained – this may vary on end user needs**

Conclusions of the Workshop

The Workshop proved to be a very beneficial meeting place of like minded people. It enabled progress to be made on two aspects namely impurities and weeds seed germination and highlighted the extensive need for further research into the plant response (phytotoxicity) method. The Workshop also brought together interested parties in the methodology of biodegradability and created a forum whereby it is hoped that an agreed procedure can be developed.
Once the questionnaire has been completed by all who have an interest in the topic a compilation of that data will be made. It is not until all the data has been received will it be possible to predict the future, if necessary a further Workshop will be held.

Observations
It should be kept in mind that for all materials considered the end point is the use as a fertilizer, a growing medium or a soil improver following in most cases some dilution with a natural material. This implies that preferably the final product should be the target to determine acceptability rather than the raw material, as translation of effects from raw material to performance in actual application is hard to achieve.
So in case of fertilisers, compost or sludge judgment of the final application may provide a better basis for judgment of use. The advantage of such approach would be that normal soil properties in terms of pH, EC , DOC etc can be used as basis of reference and judgment of acceptability. For testing a reference (sandy) soil can be applied to provide the necessary dilution.

The WS has been very useful, as it has been the first time all aspects have been addressed in a more integral manner than normally practiced in TC meetings. The discussion now started was highly needed.

For two subjects it was concluded that the Phase II work could be pursued. For phytotoxicity and stability pre-normative work is needed to resolve the various questions raised. Proprietary methods cannot be standardised in CEN, this implies that a reference method needs to be established against which the proprietary methods can be calibrated.

In relation to stability the end points relevant for different uses of materials may not be the same. This implies that different points of compliance may need to be defined. In the figure 1 the biodegradation of organic matter is illustrated with different points of compliance dependent on the use of a material.

The emphasis on traded products is no different from testing of construction materials under CE marking as developed now under the Construction Products Directive. In the construction sector alternative materials (formerly wastes) are use in construction applications and rules need to be defined to ensure fit for purpose conditions.

In several cases, it seems a hierarchy in testing may help solve problems between those needing proper information to judge material behavior and those producing products and just in need for a quick method to verify compliance.

It is clear from the discussion that there is a need for a better (more fundamental) understanding of processes and properties of materials.

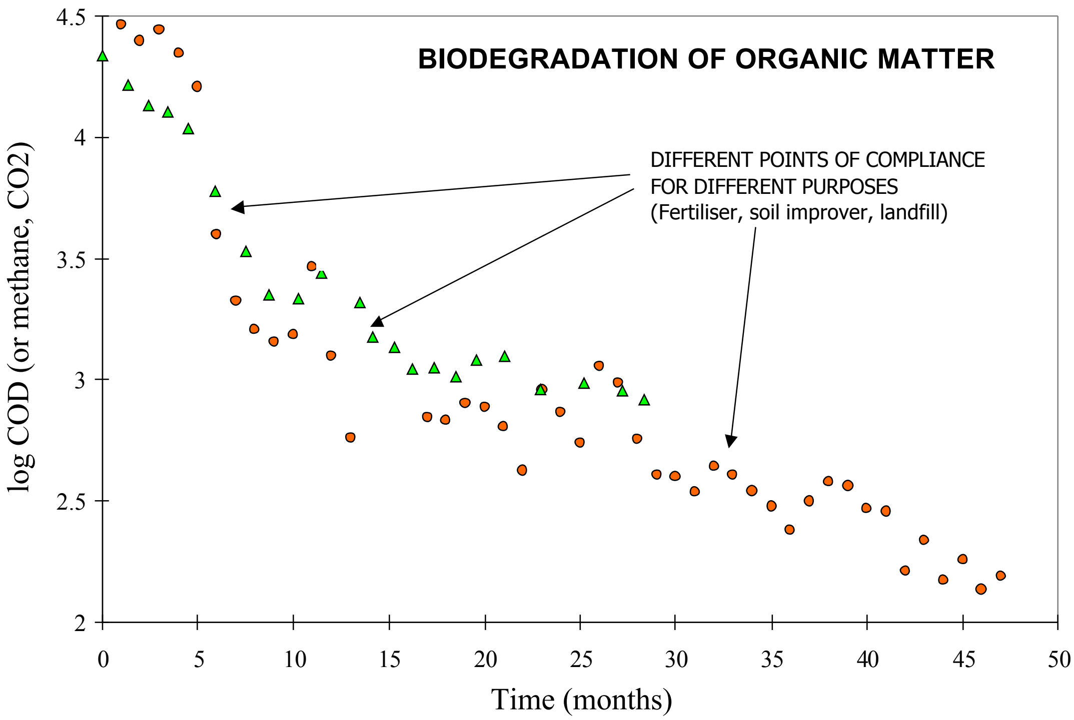


Figure 1. Biodegradation of organic matter with different stages of degradation (fast, moderate and slow - note the log scale on the y-axis) and the different points of compliance that may be relevant for different uses of materials.

Presentations

Plant Compatibility/Response Test - Dr A Baumgarten

Slide 1

Phytotoxicty

Project HORIZONTAL
Meeting Vienna Dec. 2004

Slide 2

Phytotoxicity

Definition:

Negative impact originated from test material on seed germination, development of plant seedling, growth or seed production (Marina Himanen)

Slide 3

Material

Soil

Sludge

Biowaste Compost

Growing Media??

Soil Improvers??

Slide 4

Method

Leachate

- proposed by G. Wever

Direct use

- Emergence
- Growth
- Combination

Slide 5

Points of discussion

Dilution (salt)
Similar to practical use
Soil, growing media: undiluted
Compost: diluted and undiluted
Soil improvers: mixed with soil
pH-adjustment
4,8 – 8??
Nutrient supply

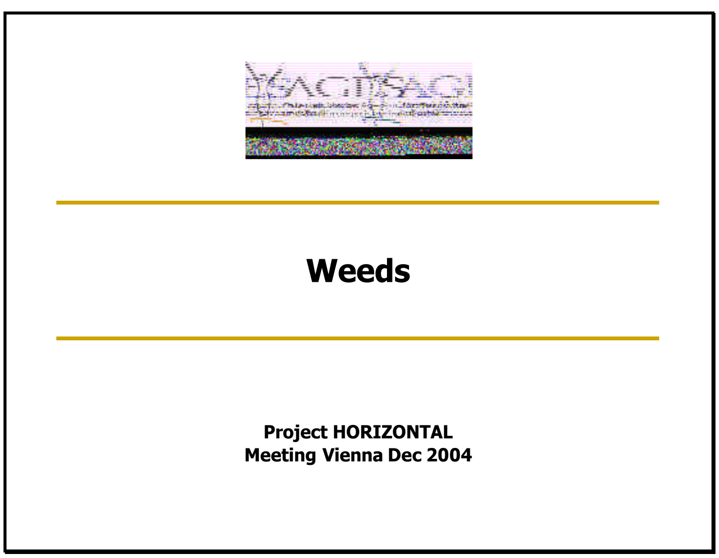
Slide 6 **Points of discussion (2)**

Water holding capacity
Scope of the method – material <50% (see G.Wevers results)
Exact definition?
Reference material?
Test plant
Oat, wild turnip
chinese cabbage
Cress, tomato
Everything but cress
Monocots yes / no
At least 5 test plants……

Slide 7 **Points of discussion (3)**

Description of the method (final user!)
Too complicated
Not precisely enough
Apparatus
Drainage
Measurements
Mass
Germination rate
More?

Slide 8



Slide 9 **Points of discussion**

Amount of material (3 – 20l)
Sieving (< 10mm)
Dilution
Peat
Perlite
Watering
Layer (10 – 50mm)
Duration (15 – 28 d)

Impurities - Gerrit Wever and Ard van Leeuwen

Slide 1

HORIZONTAL Impurities WP9

Gerrit Wever
Ard van Leeuwen

Gerrit.Wever@wur.nl

Slide 2

Introduction

- Impurities: coarse stones, plastic, glass and metal
  - An adverse experience such as a cut hand on a glass shard will lead to customer rejection, adverse publicity and possibly financial liability.
- Objective: Method to indicate amount of impurities.

Slide 3

Methods available

Method	Drying	Treatment	Sieving	Differentiation
BGK	105 °C	-	2, 5 mm	Stones >5mm, other impurities >2 mm
PAS 100	40 °C	-	31.5, 16, 8, 4, 2, 1 mm	Glass, metal, plastic, stones, other
BNSCAO	80 °C	Destruction with bleach and densitometric sorting	40, 25, 12.5, 5, 2 mm	Stones, Glass, Metals, Films and PSE, Other plastics
AT-CompOrd	105 °C	-	20, 2 mm	Plastic > 20 and 2 mm; glass, metal and total impurities > 2 mm

Slide 4

Suitability

Method	Good characterisation	Simplicity	Cost	Experience
BGK	+	++	++	++
PAS 100	++	+	+	-
BNSCAO	++	-	-	+
AT-CompOrd	++	++	+	+

Slide 5

Conclusion on Standard

- Impurities sorted in 3 fractions
- An adapted BGK method is suitable
  - adaptation concerning differentiation of the type of impurity

Slide 6

The Proposed Standard

- dry 105 ^{o}C
- Sieve en sort

	>20	>5	>2 mm
• stones	x		
• glass		x	
• rigid plastic	x		x
• plastic light (flexible or film)	x		x
• metal		x	

Slide 7

Comments & Proposal

- deals only with materials up to 40 mm
  - research how to adapt volumes in analyses.
  - influence method sampling
- Influence temperature plastic impurities
  - aggregation at 105 ^{o}C
  - research
- Determination light plastics
  - by surface determination
  - only foil
- Are stones impurities?
  - large stones are

Slide 8

Sorting difficult

- 'destruction' and densitometric sorting
  - method complex
  - accuracy better
  - without 'bleach', only impurities >5 mm

Slide 9

Slide 10

Slide 11

Differentiation better

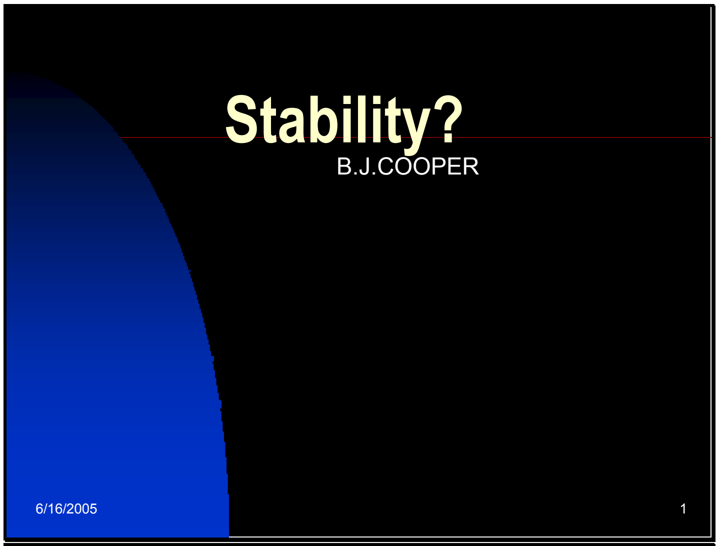
Slide 12

Proposal

- An interlaboratory trial
  - 4 labs
  - different methods → which method most suitable

Stability? - B. Cooper

Slide 1



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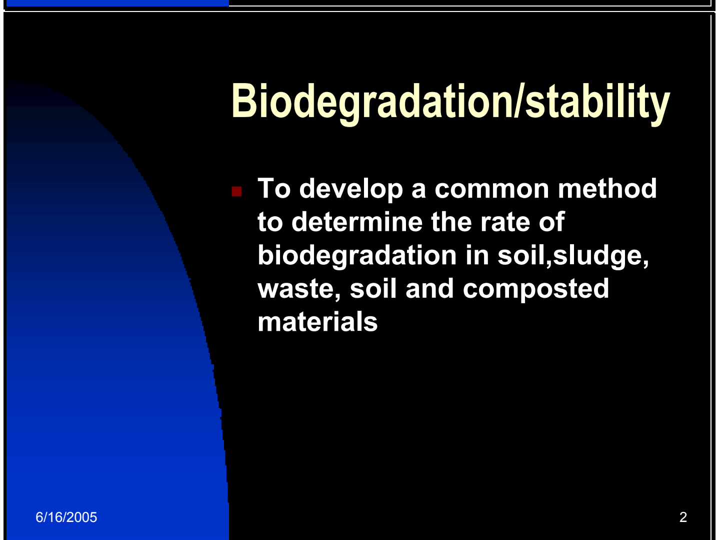

Slide 3

Slide 4

What are the sample of interest?

- Soil
- Sludge
- Landfill
- Composted materials

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Slide 5

Stability - soil

- Physical structure
- Building purposes
- Drainage
- Landslip
- Biodegradation

6/16/2005 5

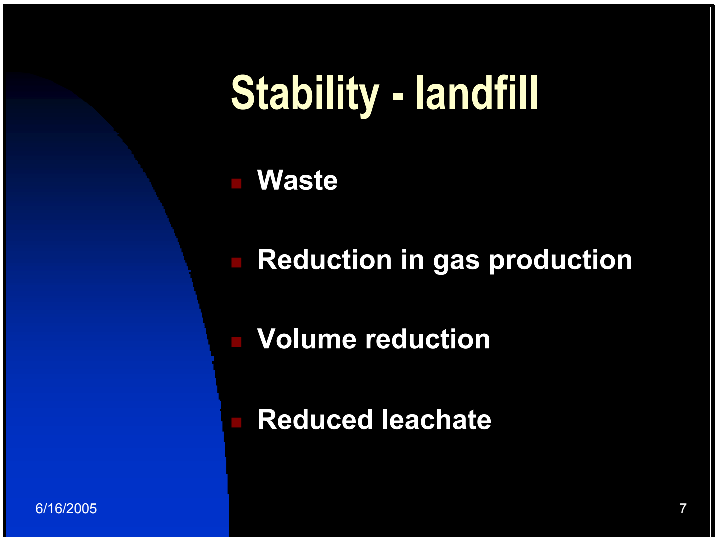
Slide 6

Stability - sludge

- Odour removal
- Addition of lime
- Aerobic treatment

6/16/2005 6

Slide 7



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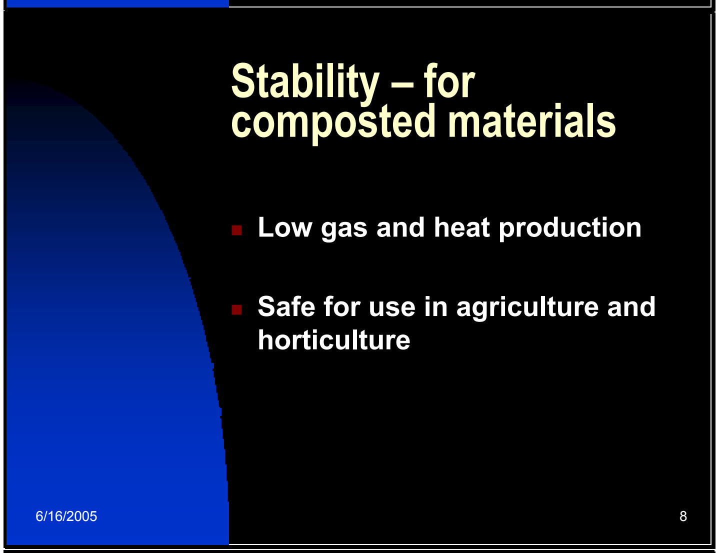

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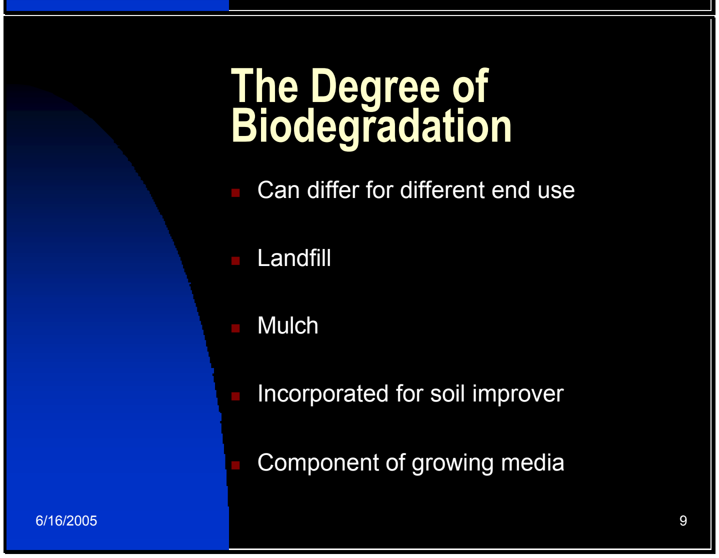

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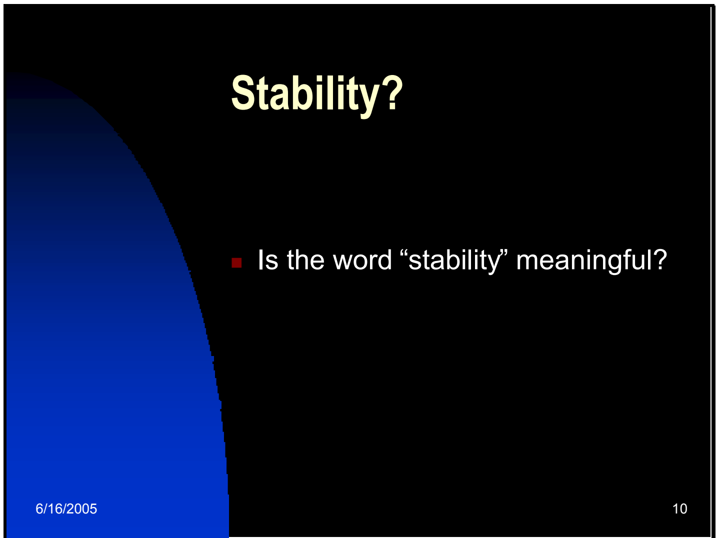

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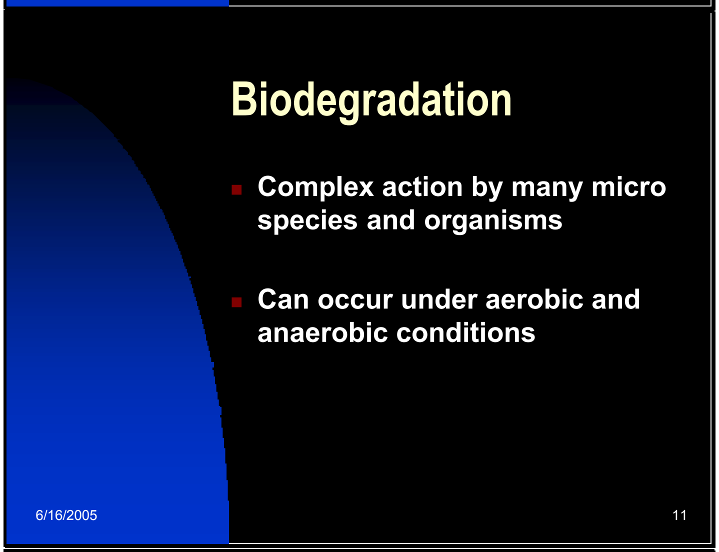

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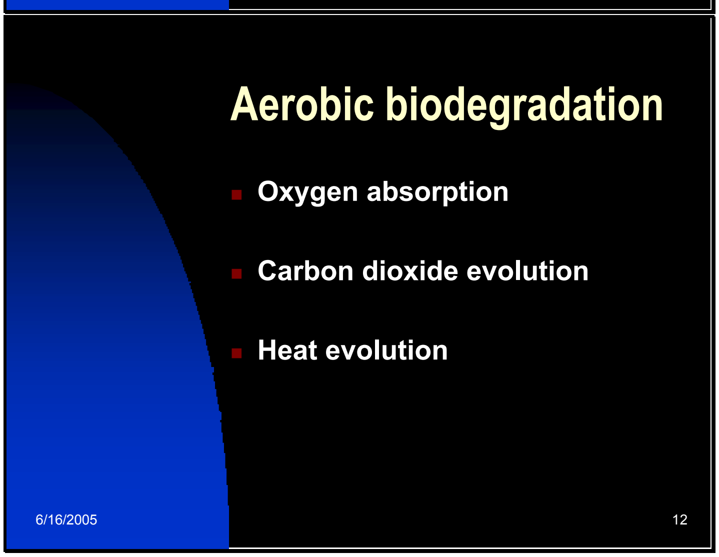

Slide 13

Anaerobic Biodegradation

- Methane production
- Carbon dioxide production
- Heat?

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Slide 14

Microbial conditions for biodegradation

- Moisture
- Nutrients
- Temperature
- Oxygen

6/16/2005 14

Slide 15

Determination of Biodegradation under aerobic and anaerobic conditions

- Common denominator
  - Carbon dioxide
  - Heat?
- Can be measured and reported as a numerical figure

6/16/2005 15

Slide 16

Carbon Dioxide determination

- **Many methods exist**
- **– pass air/oxygen over sample and measure/collect carbon dioxide evolved.**

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Slide 17

BUT

- **If there is no gas/heat production does this mean the biodegradation process has completed?**

NO!

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Slide 18

This Could Mean

- The conditions that favour biodegradation have changed.

- Change in ambient temperature
- Lack of oxygen
- Lack of essential nutrients
- Lack of moisture

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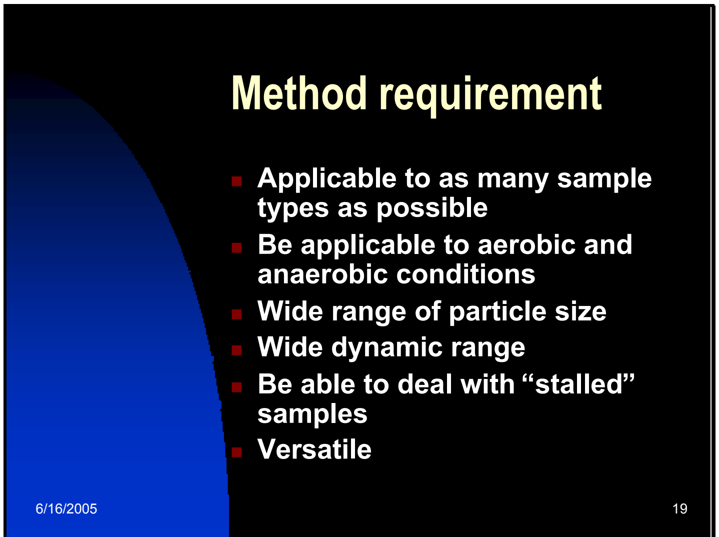
Slide 19



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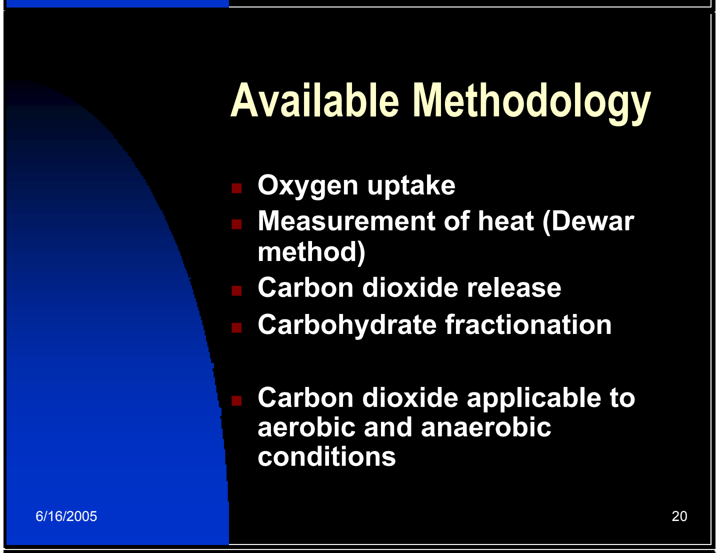

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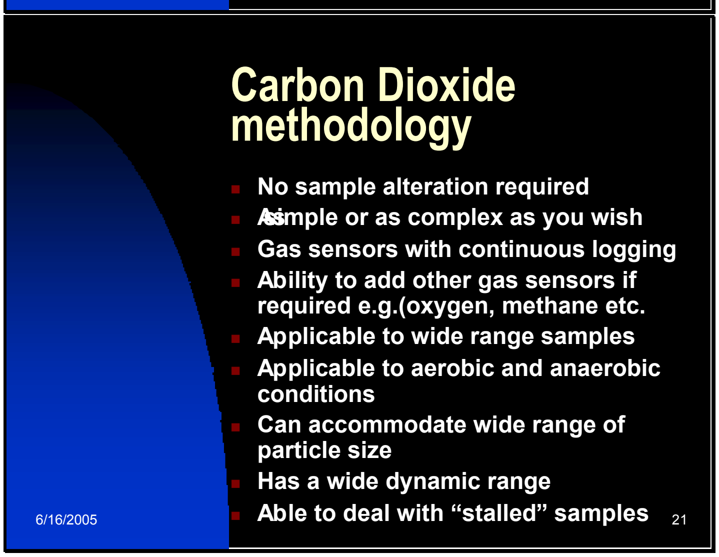

Slide 22

Method development

- **It is necessary to determine:**
- **Optimum moisture**
- **Optimum operating temperature**
- **Optimum nutrients**

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Slide 23

Interpretation of data

- A need to understand the data obtained
- A need to correlate data from other procedures

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Slide 24

The Future

6/16/2005 24

Annex 1 – Letter of invitation

Dear …

Experts' workshop on Horizontal draft standards evaluation regarding Stability, Phytotoxicity, Weeds.

You are invited to apply to attend the above workshop which will take place on 13 to 14 December 2004 at the Austrian Standards, Vienna.

The aims and objectives of the workshop are set out below.

As places are limited it is requested that you apply as soon as possible completing the attached questionnaire.

Yours sincerely

H Van der Sloot HORIZONTAL project leader
F Amlinger
B Cooper Leader Biological parameters (HORIZONTAL)

Annex 2 – Aims and objectives

Experts' workshop on Horizontal standards for Stability, Phytotoxicity, Weeds and Impurities.

In the framework of project HORIZONTAL, which aims at development of horizontal and harmonised European standards in the field of sludge, soil and treated bio waste relevant for EU Directives, desk studies were carried out dealing with sampling, hygienic and biological parameters, methods for inorganic and organic contaminants, leaching and mechanical properties. After the modifications of the desk studies on the Biological parameters "stability", phytotoxicity, weeds and impurities a final conclusion on how to proceed with these topics was not reached. The Steering Committee in its meeting on May 12, 2004 agreed with the proposal to organise a workshop to sort out the questions making use of the expert list established through consultation of NSB's through BT/TF 151. This workshop on Evaluation of Horizontal standards for "stability", phytotoxicity, weeds and impurities is organized by the Austrian Standards Organisation in close cooperation with BT/TF151 and project HORIZONTAL to ensure participation of all relevant CEN TC's.

- **The objectives**
    - Identify what questions need to be answered in relation to the different applications of soil, sludge and bio waste.
    - Distinguish methods intended for understanding the problem (characterisation tools) from quality control and compliance testing.
    - Agree for what purposes and matrices a horizontal standard is desirable and/or feasible.
    - Provide a better understanding of the pros and cons of the suggested methods including practical experience in the use of these methods.
    - .
    - Provide the desk study writers and HORIZONTAL project management with the best advice on how to proceed.
    - Where applicable agree the next phase(s) e.g. method development, validation and inter laboratory trials.
    - in order to increase the success of the standardisation procedure when the prEN's are taken over by BT/TF 151

- **Key questions to be addressed**
    - Discuss the objective of the method of the desk study.
    - Discuss and agree on what the methods are required to determine.
    - Do the proposed desk study methods meet these requirements accepting the fact that further development work may be necessary?

- Consider requirements such as versatility, availability, costs and time constraints of a method. This might result in identification of further work to be done which will need additional funding and organisation.
- Address potential drawbacks, limitations, uncertainties in this relation with respect to interpretation and reproducibility.
- Discuss the necessity to validate methods depending on final use of the product/matrix (e.g. stability/biodegradability of a product for land filling / soil improving / as a growing media constituent; e.g. phytotoxicity of topsoil / sewage sludge / a growing media constituent).

Annex 3 - CEN BT TF 151 Horizontal Expert List for Work Package 4

Work Package	Name	Company	Email
Stability Germinating Phytotoxicity	Arja Vuorinen	Plant Production Inspection Centre (KTTK) PB 83, 01301 VANTAA Finland +358 9 5765 2640	Arja.vuorinen@kttk.fim
Stability Germinating Phytotoxicity Impurities	Paul Waller	Paul Waller Consulting 15 Cuckfield Avenue Ipswich IP3 8 RZ UK +44 (0) 1473 436935	P.waller@ntworld.com
Stability Germinating	Andy Godley	WRC Frankland Road, Blagrove Swindon, SN5 84F UK +44 1793865081	Godley-ar@wrcplc.co.uk
Stability Phytotoxicity	Ward Devliegher	VLACO vzw Kan De Deeckerstraat 37 B-2800 Mechelen Belgium +32 15451 373	Ward.devliegher@vlaco.be
Stability Phytotoxicity	Dr. Kirsten Brandt	University of Newcastle 512 AB School of Agriculture, Food and Rural Development Agriculture Building University of Newcastle New Castle upon Tyne NE1 7RU UK +44 (0) 191 222 5852	Kirsten.brandt@newcasle.ac.uk
Stability Phytotoxicity	Prof. Carlo Leifert	University of Newcastle Tesco Centre for Organic Agriculture Nafferton Farm Stockfield Northumberland NE43 7XD +44 (0) 166 183 0222	c.leifert@ncl.uk
Stability Phytotoxicity	Dr. Martin Wood	University of Reading Whiteknights PO Box 217 Reading RG6 6AH UK +44 (0) 118 987 5123	M.Wood@reading.ac.uk
Stability Phytotoxicity	Dr. David Schellinger	Louisiana State University Agriculture Center LSU AgCenter P.O. Box 25100 Baton Rouge LA 70894-5100 USA +1 225 578 6998	dschellinger@agcenter.lsu.edu
Stability Phytotoxicity	Dr. William Brinton	Woods End Research Laboratory P.O. Box 297 Mt. Vernon ME 04352 USA +1 207 293 2457	Will@woodsend.org
Stability Germinating Phytotoxicity Impurities	Dr. Jacques Fuchs	FiBL Ackerstrasse, CH-5070 Frick +41 62 865 72 72	Jacques.fuchs@fibl.org
Stability Phytotoxicity	Dipl.-Ing. Jürgen Martens	Bauhaus-Universität Weimar, Dept. Of Waste Management, Zi 510	Juergen.martens@bauing.uni-weimar.de

		Coudraystrasse 7 D-99423 Weimar Germany +49 3643 58 46 01	
Germinating Phytotoxicity	Dr. Christian Bruns	Universität Kassel Nordbahnhofstr. 1a 37213 Witzenhausen Germany +49 5542 981543	bruns@wiz.uni-kassel.de
Germinating Phytotoxicity Impurities	Volker Gerdelmann	RWE Umwelt Organik GmbH Nobelstr. 3-5 41189 Mönchengladbach Germany +49 2166 1360 433	Volker.gerdelmann@rwe.com
Stability Germinating Phytotoxicity Impurities	Dirk Kostmann	Deutches Institut für Normung – DIN Burggrafenstr. 6 10787 Berlin Germany +49 30 2601 2026	Dirk.kostmann@din.de
Stability Impurities	Dr. Bertram Kehres	Bundesgütegemeinschaft Kompost e.V. (BGK) Von-der-Wettern-Str. 25 51149 Köln Germany +49 2203 358 370	b.kehres@bgkev.de
Stability	Dr. Stefanie Siebert	Bundesvereinigung Humus und Erdenwirtschaft e.V Im Dohlenbruch 11 44795 Bochum Germany +49 234 438 9447	siebert@vhe.de
Germinating	Frank Sundermann	Reterra-Vertriebs-Service Wsetnfeld 107 48341 Altenberge Germany +49 2505 933 211	Frank.sundermann@rethmann.de
Stability Germinating Phytotoxicity Impurities	Mike Leggett	BSI 389 Chiswick High Road London W4 4AL UK + 44 (0) 20 8996 7107	Mike.Leggett@bsi-global.com
Stability Germinating Phytotoxicity	Laure Metzger	Rittmo 24 Rue du Moulin 68740 Nambsheim France +33 3 89 83 76 80	Laure.metzger@rittmo.com
Phytotoxicity Impurities	Bruno Berken	CAS 7 rue Alexander Fleming 49066 Angers Cedex 02 France +33 2 41 20 19 09	Bruno.berken@cas-asso.com
Phytotoxicity	Philippe Morel	INRA 42 rue Georges Morel BP 57 49071 Beaucouze Cedex France +33 2 41 22 56 48	morel@angers.inra.fr
Impurities	Bernard Morvan	Cemagref 17 Avenue de Cucille CS 64427 35044 Rennes Cedex France +33 2 23 48 21 43	Bernard.morvan@cemagref.fr
Stability Impurities	DI Gerhard Pilz	Linde-KCA-Dresden GmbH / Office Linz A4030 Linz, Lunzerstrasse 64 Germany +43 (0) 732 6585 2431	Gerhard.pilz@linde-kca.com
Stability	Alasdair Neilson	IVL Swedish Environmental Research Institue Ltd. Box 210 60 SE-100 31 Stockholm	Alasdair.neilson@ivl.se

		Sweden +46 8 598 563 00	
Stability Germinating Phytotoxicity Impurities	Ann-Sofie Allard	IVL Swedish Environmental Research Institue Ltd. Box 210 60 SE-100 31 Stockholm Sweden +46 8 598 563 00	Annsofie.allard@ivl.se
Stability	Dr.ir. S.W. Moolenaar	Nutrienten Management Instituut BV P.O. Box 250 NL-6700 AG Wageningen The Netherlands +31 317 46 7700	s.w.moolenaar@nmi-agro.nl
Phytotoxicity	Dr. ing. C. Sonneveld	IGPA P.O. Box 1160 NL-6040 KD Roermond The Netherlands +31 475 35 34 87	Sonneveld37@zonnet.nl
Stability Germinating Phytotoxicity Impurities	J.B.G.M Verhagen	Foundation RHP P.O. Box 98 NL-2670 AB Naaldwijk The Netherlands +31 17 46 20 360	verhagen@rhp.nl
Stability Phytotoxicity	Mr. G. Wever	PPO-Glastuinbouw P.O. Box 8 NL-2670 AA Naaldwijk The Netherlands +31 174 63 67 22	Gerrit.wever@wur.nl
Phytotoxicity	Minna Vikmann	VTT/Biotechnology P.O. Box 1500 Fin-02044 VTT Finland +35 9 456 5172	Minna.vikman@vtt.fi
Stability	Dr. Merja Itävaara	TT/Biotechnology P.O. Box 1500 Fin-02044 VTT Finland +35 9 456 5172	Merja.itavaara@vtt.fi
Stability Phytotoxicity	Dipl.-Ing. Matthias Klauss	Bauhaus-Universität Weimar, Dept. Of Waste Management, Zi 510 Coudraystrasse 7, D-99423 Weimar Germany	Juergen.martens@bauing.uni-weimar.de
Stability	Jean-Yves Baliteau	SADEF Põle d'Aspach Rue de la station 68700 Aspach le Bas France +33 3 89 48 91 67	baliteaujy@sadef.fr
Stability Germinating Phytotoxicity Impurities	Pascal Pandard	Ineris Parc Technologique Alata BP 2 60550 Verneuil en Halatte France +33 3 44 55 67 19	Pascal.pandard@ineris.fr
Stability	Sabine Houot	CREED 291 Avenue Dreyfous Ducas Zone Portuaire 78520 Limay France +33 1 30 98 54 11	shouot@cgea.fr
Stability Phytotoxicity	Antonio Bispo	Ademe 2 Square Lafayette 49004 Angers Cedex 01 France +33 2 41 20 43 07	Antonio.bispo@ademe.fr
Stability	Christian Gancet	Atofina Centre de Recherches	Christian.gancet@atofina.com

		BP 34 64170 LACQ France +33 5 59 93 67 63	
Stability Germinating Phytotoxicity Impurities	Gerrald Goselink	NEN P.O. Box 5059 NL-2600GB Delft The Netherlands +31 15 2 690 254	horizontal@nen.nl
Impurities	Dr. Hans Jörg Bachmann	Agroscope FAL Reckenholz Reckenholzstr. 191 / Postfach CH-8046 Zürich Switzerland +41 1 377 71 50	Hans-joerg.bachmann@fal.admin.ch
Stability Germinating Phytotoxicity	Dr. Sergej Ust'ak	Research Institute of Crop Production Prague, Czech Republic Cernovická 4987 43001 Chomutoc Czech Republic +420 474 629 726	ustak@atlas.cz
Stability	Anne Bøen	Jordforsk – Norwegian Center for soil and environmental research Fredrik A. Dahlsvei 20 N-1432 Ås Norway +47 64 94 81 63	Anne.boen@jordforsk.no
Stability	Jens Ejbye Schmidt	Environment and Resources DTU Building 115 DK-2800 Lyngby Denmark +45 45 25 14 54	jes@er.dtu.dk
Stability	Nina Christensen	Miljø & Ressourcer DTU Bygningstorvet, bygn. 115 DK-2800 Lyngby Denmark +45 45 25 15 97	nic@er.dtu.dk
Phytotoxicity	Guido Persoone	Microbiotests Inc. Venecoweg 19 9810 Nazareth Belgium +32 475 717 719	Guido.persoone@ugent.be
Stability	Dr. Andreas Wecker	Bundesverband der Deutchen Kalkindustrie e.V. Annastr. 67-71 D-50968 Köln Germany +49 221 9347 74 46	wecker@kalk.de
Stability Impurities	Julia Sumna	Water Research Institute Nabr. Ar. Ge. L. Svobodu 5 812 49 Bratislava Slovakia +421 2 593 43 488	sumna@vuvh.sk
Stability	Roald Sørheim	Jordforsk – Norwegian Center for soil and environmental research Fredrik A. Dahlsvei 20 N-1432 Ås Norway +47 6494 81631 8110	Roald.sorheim@jordforsk.no
Stability	Erwin Binner	Universität für Bodenkultur IWGA – Abteilung Abfallwirtschaft Muthgasse 107 1190 Vienna Austria +43 1 31 89 900 315	e.binner@mail.boku.ac.at
Stability Germinating Phytotoxicity Impurities	Florian Amlinger	Kompost-Entwicklung & Beratung Hochbergstrasse 3 2380 Perchtoldsdorf Austria	f.amlinger@kabsi.at

		+43 1 86 56 084	
Germinating Phytotoxicity	Karl Aichberger	Ages GmbH, LWT Linz Wieningerstrasse 8 4021 Linz Austria +43 732 381 261	Karl.aichberger@lwlnz@ages.at
Stability Germinating Phytotoxicity	Wilfried Hartl	Ludwig Bolzmann Institut für biologischen Landbau Rinnböckstrasse 15 1110 Vienna Austria +43 1 79514 97943	Wilfried.hartl@univie.ac.at
Impurities	Urs Hildebrandt	Beratung f. Boden u. Kompost Pühret 5 4722 Peuerbach Austria +43 7276 3618	hildebrandt@nextra.at
Stability	Georg Husz	OEKO-Agrar GmbH Konrad-Duden-Gasse 34 1130 Vienna Austria +43 1803 61 13	office@oekoagrar.co.at
Stability Impurities	Gerhard Pilz	Linde-KCA-Dresden GmbH Lunzerstrasse 64 4030 Linz Austria +43 732 6585 2431	Gerhard.pilz@linde-kca.com
Stability	Franziska Plahl-Wabnegg	MA 48 D. Stadt Wien – Abfallwirtschaft Stadtreinigung und Fuhrpark Percostrasse 2 1220 Vienna Austria +43 2583 521 32	plahl@aon.at
Stability	Michael Loidl	BM für Land- und Forstwirtschaft, Umwelt und Wasserwirtschaft Abt. III/3 Stubenbastei 5 1010 Vienna Austria +43 1 51522 3452	Michael.loidl@bmlfuw.gv.at
Impurities	Christian Demanze	SGS Multilab 7, rue Jean Mermoz ZI ST Guenault Courcouronnes F91031 Evry Cedex France +33 1 69 36 72 83	Christian_demanze@sgs.com

16/07/2004

Annex 4 – Attendees

Appl.	Name	Company	Email	TC/NSB or other Institution	Parameters	Matrices	Remarks
	Austria						
☑	Amlinger, DI Florian	KOMPOST-ENTWICKLUNG & BERATUNG Hochbergstrasse 3 2380 Perchtoldsdorf Austria +43 1 865 60 84	f.amlinger@kabsi.at	CEN/TC 223; WG 1, 2, & 4 BT/TF 151 ON 199 "Biological waste treatment and recycling" (Convenor)	Stability Germinating Phytotoxicity Impurities	compost	
☑	Baumgarten, Dr. Andreas	AGES, Spargelfeldstrasse 191 1226 Vienna Austria +43 (0) 50555 34100	andreas.baumgarten@ages.at	CEN TC 223, WG Analysis	Weeds Phytotoxicity	Compost,soil improver, growing media	Responsible for fertiliser and growing media approval in Austria
☑	Binner, DI Erwin	Universität für Bodenkultur IWGA – Abteilung Abfallwirtschaft Muthgasse 107 1190 Vienna Austria +43 1 31 89 900 315	e.binner@mail.boku.ac.at	CEN BT TF 151 Horizontal	Stability	soil improvers and growing media, landfill, composting process, MBP-wastes	Legislation: Assistance to the Austrian government during formulation of the MBP-guidelines and the Austrian landfill ordinance (drafting of an expert's report about possible parameters describing the reactivity of MBP-Wastes and limit values for these parameters) Analytical Methods: Respiration Activity (Sapromat)Gas Generation by Incubation TestGas Generation by Fermentation TestTOC, LOI, Cellulose, Van Soest, BOD5, BOD20, COD, DOC, NH4-N, NO3-N in EluatesPlant Germination Test (cress test)Humic Acids,Thermogravimetric Analysis Other specific expertise:

Appl.	Name	Company	Email	TC/NSB or other Institution	Parameters	Matrices	Remarks
							Evaluation of Wastes (MBP, sewage-sludges, material from abandoned sites, compost) as to their biological reactivity
☑	Fertsak, DI Sabine	AGES, Institute for Plant Protection Products Evaluation and Authorisation Dept. Efficacy and Phytotoxicity Spargelfeldstrasse 191, A-1226 Vienna Austria +43 50 555 33 444	sabine.fertsak@ages.at	no		Soils, aqueous solutions	Legislation: Preparation of official expert opinion within the authorisation procedure of plant protection products according to the Austrian Plant Protection Act 1997 Analytical Methods: We (former department of herbology) developed a bioassay to give evidence of the existence of substances occurring in soils and aqueous solutions that are harmful (and available) to plants. As indicator plants we chose cress (Lepidium sativum) and rye (Secale cereale).
☑	Pilz, DI Gerhard	Linde-KCA-Dresden GmbH / Office Linz Lunzerstrasse 64, A-4030 Linz, Austria +43 (0) 732 6585 2431 +43 (0) 676 5512 790	Gerhard.pilz@linde-kca.com	Austrian Standard working groups	Stability Impurities	soil improvers and growing media, landfill, composting process,	Practical experience as LINDE Process Engineer for Waste Treatment Plants with the application of analytical methods for biological waste treatment in regard to requirements between contractual conditions (theory) and real conditions (practice).
	Belgium						
☑	Devliegher, Ward	VLACO vzw Kan De Deeckerstraat 37 B-2800 Mechelen Belgium +32 15451 373	Ward.devliegher@vlaco.be		Stability Phytotoxicity	soil improvers and growing media, composting process,	Legislation: Quality assurance at composting plants. Analytical Methods: Compost maturity/stability testing (different methods: O2, CO2, Self-heating, NO3/NH4,

Appl.	Name	Company	Email	TC/NSB or other Institution	Parameters	Matrices	Remarks
							Solvita)Phytotoxicity testing Other specific expertise: Over more than 12 years, Vlaco has been investigating compost samples at several composting plants. During that period, a number of research projects have been carried out in order to try to find the best suited methods for compost maturity/stability and phytotoxicity. This has resulted in a lot of expertise in these issues.
	Czech Republic						
☑	Habart, Jan	Cz Biom Czech association for biomass Drnovska 507 161 01 Praha 6 - Ruzyne Czech Republik +420 (603) 27 36 72	hhabart@seznam.cz		Stability	soil improvers and growing media, composting process,	Legislation: recently preparing general technical standards for composting and application of compost, implementation program for MSW (2003), participation in Waste management plan of Czech republic and several regional waste management plans (2002 – 2004) Analytical Methods: Experimental measurement of biological stability using Dynamic Respiration Index.
☑	Ustak, Dr. Sergej	Research Institute of Crop Production Prague, Czech Republic Cernovická 4987 43001 Chomutoc Czech Republic +420 474 629 726	ustak@atlas.cz		Stability Weeds Phytotoxicity	Soils, soil improvers and growing media , sludges, composting process, Plant analysis for horticulture	trade affiliation analytical methods: head of Research Station of Research Institute of Crop Production and the head of analytical laboratory. We provide analytical support to research activities of our institute and especially division of agroecology. Our department of ecotoxicology

Appl.	Name	Company	Email	TC/NSB or other Institution	Parameters	Matrices	Remarks
							deals with research of biowaste proceedings and use in agriculture, compost and biogas production etc. We conduct analyses of soils, plants, sludge, waste, water, deposits and air pollution. Legislation: only indirect way (preparation of background reports for Ministry of Agriculture, preparation and application of amendments (e.g. for manure, waste and biowaste legislation). Materials: Analytical Methods: Compost stability tests: O2 consumption,CO2 release, Lignin/cellulose test.Phytotoxicity tests: for growing media, cress test, agrobacter test.Chemical analysis: Mehlich – II. and III. extracts of soil; 2 M HNO3 extract of soils; aqua-regia extract of soil, compost and biowaste, mineralisation and determination of total nitrogen in soils, composts, sludge and biowastes, water extract of waste etc., Physical analysis methods for analyses of composts, organic manures etc.. Other specific expertise: Plant, soil and manure nutrient analyses. Field and vegetation growing trials

Appl.	Name	Company	Email	TC/NSB or other Institution	Parameters	Matrices	Remarks
							Methodological management of compost production for 10 large compost plants in the Czech Republic. Laboratory experiments Numerous scientific and expert publications (about 120).
	Croatia						
☑	Havranek, Tea	Ulica grada Vukovara 78, 10000 Zagreb, CROATIA +385 1 6106005,	teah@dznm.hr	DZNM/TO 134 is affiliet member of CEN/TC 223 and CEN/TC 260	Stability	Soils, soil improvers and growing media	Analytical methods for waste product, fertilizer, soil and plant analyses regards on impurities and phytotoxicity. Legislation: Working group for drafting Regulation concerning the performance of analitical methods and interpretation of results. Analytical Methods: ISO and CEN standards
☑	Poljak, Prof.Dr.sc. Milan	University of Zagreb Faculty of Agriculture Department of Plant Nutrition Svetošimunska cesta 25 10000 Zagreb, CROATIA +385 1 2393861, Mob.: +385 (0)91 6692991	mpoljak@agr.hr	Affiliated member of CEN/TC 223	Stability	Soils, soil improvers and growing media, sludges, composting process	trade affiliation: Analytical methods for waste product, fertilizer, soil and plant analyses regards on impurities and phytotoxicity. Legislation: Member of Croatian work group who was prepared the law for Fertilizer and Soil conditioners; Member of work group for preparation of Acts and Ordinance connected on law of Fertilizers and Soil conditioners Analytical Methods:

Appl.	Name	Company	Email	TC/NSB or other Institution	Parameters	Matrices	Remarks
							Analytical methods for impurities in soils, sludge, compost, soil conditioners, fertilizers, growing mediapH, E.C., -ion conductivity meterO.M., ashN- Kjeldahl, P- spectrophotometer, K –flame photometry, total and available form of microelements(Zn, Cu, Fe, Mn) and heavy metals (Cd, Pb)– king water extraction AAS determinationWet sample digestion (MLS-microwave) Other specific expertise: Physiology of plant nutrition – disorders. Recycling of organic waste and use in agriculture. Soil pollution and soil protection. Water and soil remediation.
	Denmark						
☑	Carlsbaek, Morten	Solum Group Vadsbystræde 6, DK-2640 Hedehusene Denmark +45 4399 5020	mc@solum.dk		Phytotoxicity Stability Weeds		
☑	Kjær, Christian	Department of Terrestrial Ecology, Vejlsøvej 25, P. O. Box 314, DK-8600 Silkeborg, Denmark +45 89 20 14 61	ckj@dmu.dk	convenor of ISO/TC 190/SC4/WG 3: Soil quality – Biological methods - Flora		Soils, soil improvers and growing media	specific knowledge of plant testing in general. member of the working group in ISO covering this member of the ad hoc expert group in OECD concerning plant testing guidelines
	Finland						
☑	Vuorinen, Arja	Plant Production Inspection Centre (KTTK) PB 83, 01301 VANTAA	Arja.vuorinen@kttk.fim	TC 223; TC223 Wg 3 and 4	Stability Weeds Phytotoxicity	Soils, soil improvers and growing media, composting	Legislation: working with national legislative work (fertilizers, growing media and soil improvers) co-operating

Appl.	Name	Company	Email	TC/NSB or other Institution	Parameters	Matrices	Remarks
		Finland +358 9 5765 2640				process	with the Ministry of Agriculture and mainly working with the enforcement of the law – including advice, inspection and acceptance of the composting plants and the quality control of the products Analytical Methods: Phytotoxity, weeds, stability Other specific expertise: Soil organic matter, especially soil enzymes in composts (Dr Thesis) Soil and compost analytics in general
☑	Himanen, Marina	University of Jyväskylä, Department of biological and environmental sciences, Survontie 9, FI-40500 Jyväskylä, FINLAND +358 44 076 0268 (mobile) +358 14 260 2335 (office)	marina.himanen@bytl.jyu.fi	Invited expert for the SFS Finnish standard association discussing comments on the project HORIZONTAL	Phytotoxicity	Soil improvers and growing media, sludge, composting process	plant growth test (modified standard ISO 11269-2)Others:Germination index test using water compost extract on cress salad seeds Lepidium sativum
	France						
☑	Berken, Bruno	CAS 7 rue Alexander Fleming 49066 Angers Cedex 02 France +33 2 41 20 19 09	cas@cas-asso.com	CEN TC 223 (WG 3+4)	Phytotoxicity Weeds Impurities	soil improvers and growing media	Legislation: ..Director of the French Federation of Soil Improvers an d Growing Media
X	Bispo, Antonio	Ademe 2 Square Lafayette B.P. 90406 49004 Angers Cedex 01 France +33 2 41 20 43 07	Antonio.bispo@ademe.fr	ISO TC 190/SC7 and SC4 CEN TC 345 Member of the steering committee of HORIZONTAL on the behalf of the French	Stability Phytotoxicity	Soils, soil improvers and growing media, sludges,	Legislation: Technical help to the French Ministry for Environment Analytical: Bioassays with soil organisms and plants Degradation assays Agronomy

Appl.	Name	Company	Email	TC/NSB or other Institution	Parameters	Matrices	Remarks
				Ministry for Envir.			
☑	Houot, Sabine	CREED 291 Avenue Dreyfous Ducas Zone Portuaire 78520 Limay France +33 1 30 98 55 93	shouot@cgea.fr	TC 223 WG 4	Stability	Soils, soil improvers and growing media, composting process,	Legislation: FRENCH Legislation through normalisation (AFNOR working group U 44 A, U 44 B and U 44 E) Analytical Methods: Organic matter characterization,Compost maturityC and N mineralisation Other specific expertise: Effect of compost and sludge application on soil and plant qualities Effect of compost application on soil structure stability Organic pollutant degradation in composts
☑	Metzger, Dr. Laure	Rittmo 24 Rue du Moulin 68740 Nambsheim France +33 3 89 83 76 80	Laure.metzger@rittmo.com	CEN TC 223 (and of the WG 3 of CEN TC 260)	Stability Weeds Phytotoxicity	Soils, soil improvers and growing media, composting process, use of organic products in agriculture	Legislation: taking part to French standardization, chairman of the commission in charge of organic soil improvers characterisation. Analytical Methods: Potential N and C mineralisation, Characterisation of organic mater by biochemical fractioning, Phytotoxicity, Bioaccumulation of pollutants in crops, Weed seeds presence, Cress test, Self heating test, Genotoxicity test (micronuclei Vicia faba), Suppressive effect of composts, Impact on specific soil microbial populations, Impact on soil microbial diversity through

Appl.	Name	Company	Email	TC/NSB or other Institution	Parameters	Matrices	Remarks
							genetic methods… Other specific expertise: Good knowledge of the priorities of stakeholders through regular visits to SMEs involved in organic fertilisation (wastes producers, industrials transforming wastes into soil improvers, fertilisers or growing media, farmers using the products…) Good knowledge of French regulation concerning the modalities for obtaining the authorisation of trading new organic products by assisting professionals in building the requested documents
☑	Morvan, Bernard	Cemagref 17 Avenue de Cucille CS 64427 35044 Rennes Cedex France +33 2 23 48 21 43	Bernard.morvan@cemagref.fr	CEN/TC 292 WG1 Sampling of waste	Impurities	composting process, sampling waste	Analytical Methods: French standard for impurities in composts, Number U44-164, method with bleach. Characterisation of waste on dry matter, French standard project X30-466 Other specific expertise: Composting plants of MSW or Biowaste
☑	Pandard, Pascal	Ineris Parc Technologique Alata BP 2 60550 Verneuil en Halatte France +33 3 44 55 67 19	Pascal.pandard@ineris.fr	CEN/TC 292 (WG 7) ; ISO/TC 190/SC4 (WG 2, WG 3, WG 4) and French mirror committees (T95E, X31E, X30D..)	Stability Weeds Phytotoxicity Impurities	Soils, sludges, wastes, chemicals	Legislation: Notification of new chemical substances ; Risk assessment of existing chemicals Analytical Methods: Phytotoxicity tests: germination, inhibition of root growth, inhibition

Appl.	Name	Company	Email	TC/NSB or other Institution	Parameters	Matrices	Remarks
							of emergence and growth of higher plants (sludges, soils, chemicals, wastes, mulching products)Biodegradation tests: (chemicals) Other specific expertise: Ecotoxicity tests (soil, water, sediments)
	Germany						
☑	Fricke, Klaus Prof. Dr.-Ing.	TU Braunschweig Leichtweiß-Institut für Wasserbau Abteilung Abfallwirtschaft Beethovenstr. 51a D-38106 Braunschweig T:(+49) 0531/391 - 3969 F: (+49) 0531/391 - 4584	klaus.fricke@tu-bs.de		Stability	waste residues composting process compost MBT material	
☑	Kehres, Dr. Bertram	Bundesgütegemeinschaft Kompost e.V. (BGK) Von-der-Wettern-Str. 25 D-51149 Köln Germany +49 2203 358 370	b.kehres@bgkev.de	CEN/TC 223	Stability Impurities	soil improvers and growing media, composting process,	Publisher of the “Method Book for the analysis of compost” Legislation: Not directly, but in the organisations function as a so called “assurance organisation” in the sense of the German biowaste ordinance Analytical methods: Stability, phytotoxicity, impurities, weeds etc. Other specific expertise: Quality assurance systems for compost, digestate, composted

Appl.	Name	Company	Email	TC/NSB or other Institution	Parameters	Matrices	Remarks
							sludge; interlaboratory tests with compost
☑	Marciniszyn, Eleonore	INFU mbH, Geschäftsbereich PlanCoTec Karlsbrunnenstr. 11, D-37249 Neu Eichenberg +49 5542-9319-30	eleonore.marciniszyn@plancotec.de	develop method standards for the revised Ordinance of bio-waste	selfheating test, oxygen consumption, plants tests, bio assays for different plant pathogens and seeds	waste resuidues soil improvers and growing media sludges, composting process compost and potting soil	plant tests, mainly with barley, cress and lettuce phytotoxicity test with cress stability test, like selfheating test and oxygen consumption Development of test method - sum of area indices for impurities (plastic) Direct hygienic process evaluation
☑	Riepert, Frank	Biologische Bundesanstalt für Land- und Forstwirtschaft, Königin-Luise-Str. 19, D-14195 Berlin Tel. +49 (0) 30 8304 2350	f.riepert@bba.de	CEN/TC 292 WG 7, ISO/TC 190/SC4 WG2 (convenor), WG3, WG 4, SC 7/WG 3	Bio-assays applied in soil characterization ,	soils wastes	Legislation: Notification of plant protection products, formerly for a period of 20 years in the chemicals act Chemical testing and waste characterization
☑	Schmielewsly, Gerald	Klasmann-Deilmann GmbH, Moorgutsweg 2, 26683 Sedelsberg-Saterland, Germany ++49 4492 8275	schmilewski@klasmann-deilmann.de	TC 223 WG 3 (Sampling) TC 223 WG 4 (Methods) Since 1992 head of the DIN WG on Soil Improvers and Growing Media since 1992 chairman of the German Mirror Group to TC 223 involved in drafting CEN Rep. 13456. and CEN Report 13455.	Stability Phytotoxicity Weeds	soil improvers and growing media, composting process,	Legislation: Indirect involvement in German legislation as a member of the German industry-WG on legislation for growing media. Analytical Methods: As a German delegate to TC 223 WG 3 and 4 I've been involved in the development of ENs 12579 and 12580, 13037 to 13041, 13650 to 13652, 13654-1 and –2. Other specific expertise: chaiman of the HOPE (Horticultural Peat) WG within the IPS (Int. Peat Soc.)
☑	Scholz, Dr. Katrin	Umweltbundesamt, FG II 4.1,	katrin.scholz@uba.de	TC 223 TC 223/WG4			

Appl.	Name	Company	Email	TC/NSB or other Institution	Parameters	Matrices	Remarks
		Seecktstr. 6-10 D-13581 Berlin +49 30 8903-3561 Fax: 49 30 8903-3203		TC 308 TC 308/WG 1			
☑	Schulz, Dr. Elke	UFZ Centre for Environmental Research Leipzig-Halle Ltd. Department of Soil Sciences, Theodor-Lieser-Str. 4, D-06120 Halle, Germany +49 345 558 5421	elke.schulz@ufz.de	Expert of DIN in connection with CEN TC 223 and HORIZONTAL		Soils	"Hot water extractable carbon and nitrogen"VDLUFA Methodenbuch, Bearbeiter: E. Schulz, Halle, B. Deller, Karlsruhe, * pools and dynamics of soil organic matter (SOM); isolation and characterization of relevant fractions of SOM (chemical and physical methods of soil fractionation)
☑	Siebert, Dr. Stefanie	Bundesvereinigung Humus und Erdenwirtschaft e.V Im Dohlenbruch 11 44795 Bochum Germany +49 234 438 9447	siebert@vhe.de	CEN/TC 223 Soil improvers and growing media	Stability	Soils, soil improvers and growing media, composting process, sugar beet sludge, recultivation of mine soils	trade affiliation: soil scientist. Consultant for the german association for compost quality (Bundesgütegemeinschaft Kompost e.V. (BGK)). Representative of the german association of humus and substrate industry (Bundesvereiningung Humus- und Erdenwirtschaft e.V. (BHE)) legislation: EU: Soil Thematic Strategy, Member of the working group Organic Matter for the European Compost Network (biowaste directive) D: Biowaste directive, Fertilizer directive, Soil directive Analytical Methods:

Appl.	Name	Company	Email	TC/NSB or other Institution	Parameters	Matrices	Remarks
							Characterisation of soil organic matter, microbiological activity and biomass (DMSO reduction, CO2-mineralisation, N-mineralisation) Characterisation of organic nitrogen (GC-MS, TMHA, Hydrolysis of amino acids), Analytical methods of compost (stability, impurities, nutrients) Bio-indication with earthworms, rye grass
	Ireland						
☑	Prasad, Munoo	Bord Na Móna Horticulture Main Street Newbridge, Co. Kildare Irland +353 (45) 439742	munoop@bnm.ie	CEN/TC 223 WG 4 since 1995.Was involved with the present EN methods from the start.	Phytotoxicity Stability Weeds	Soils, soil improvers and growing media, composting process, plant analysis for horticulture	trade affiliation: No,but providing analytical support to the compost industry in Ireland and UK. Analytical Methods: Compost stability tests: O2 consumption,CO2 release,Self heating test,Lignin/cellulose test.Phytotoxicity tests: for growing media,cress test,PAS 100 (UK) tests.Chemical analysis: water extract,CAT method,(have published work on comparison of these methods), soil tests eg Olsen extract,Ammonium acetate extract etc.Physical analysis EN method,other published methods for anaylsis of composts. Other specific expertise: Enzyme methods Dehydrogenese,Fluroscien Diacetate hydrolysis as indicator of microbial activity. Evaluation methods for organic

Appl.	Name	Company	Email	TC/NSB or other Institution	Parameters	Matrices	Remarks
							fertilisers for example using leaching columns. Numerous publications on method of analysis. Plant nutrient analyses including sap testing Growing trials
	Italy						
☑	Adani, Fabrizio	Dipartimento di Produzione Vegetale – Università degli Studi di Milano, 20133 Milano Italy. + 39 02 50316546	fabrizio.adani@unimi.it	CEN/TC 223 and CEN/TC 343	Stability	Soils, soil improvers and growing media, landfill, sludges, composting process,	Legislation: National legislation on biological treatment and OM reduction in landfill Analytical Methods: Biological Stability: Dynamic Respiration Index, static respiration indexesPhytotoxicity: vegetation test with lettuceI
☑	Paradisi, Luca	ARPAV -Veneto Environmental Protection Agency – Osservatorio Regionale per il Compostaggio) Via Baciocchi 9 31033 Castelfranco Veneto (TREVISO) Italy +39 0423 422 345	lparadisi@arpa.veneto.it			soil improvers and growing media, composting process,	Legislation: supporting regional administration to arrange technical rules about composting and MBT plants management; involved in a national working group about reduction of landfilled biodegradable wastes. Analytical Methods: STATIC RESPIRATION INDEX (IPLA, 1998) DYNAMIC RESPIRATION INDEX (ADANI ET AL., 2001) Other specific expertise: The Veneto Region developed since 90 th years a Municipal Solide Waste integrated management. First of all was widely developed the

Appl.	Name	Company	Email	TC/NSB or other Institution	Parameters	Matrices	Remarks
							separated collection of biowaste, which increases the construction of new composting plants (quite 600.000 tons of biowaste was composted in 2003). We have direct contact with all regional plants and we directly control since 1995 the production of compost and stabilised biowaste in the Region. Particularly a correct management of composting process was promoted and consequently we have studied and applied since 2000 respiration analysis to assess compost stability and to control odours emissions produced by plants. Our experience includes laboratory tests (Static and Dynamic Respiration Methods) and composting process control on full scale plants. We carried out in 2000 and 2001 together with Agrarian Institute of S. Michele all'Adige (Trento) and University of Trento (Department of Engineering) an experimental design in order to test the influence of different test factors (as temperature, storage time and modalities, sample size etc.) on the final result of Static Respiration Index and to establish the best conditions to conduct the trial. We also experimentally compare results between Static (IPLA, 1998) and Dynamic Respiration (Adani,

Appl.	Name	Company	Email	TC/NSB or other Institution	Parameters	Matrices	Remarks
							2001) Index and now we are involved in the UNI (Italian Standardization Company) Working Group n. 5 to standardize Dynamic Respiration Index. REFERENCES about stability: Silvestri, Dallago, Guzzo, Paradisi, Andreottola, Giandon, Zorzi. Development of methods for static and dynamic respirometry to assess compost stability. Proceedings Sardinia 2003. Cossettini, Paoli, Franz, Paradisi, Codato. Monitoring of composting process by the determination of dynamic respiration index (DRI) and some chemical-physical parameters at the Vesta plant of Venice, Proceedings ISWA 2004 (in press) Other papers in Italian language.
	Lithuania						
☑	Sarunas, Antanaitis	Savanoziu 287, LT50127, Kaunas, Lithuania +370 8 687 11951	sazunas@lzi.lt	TK 57 Fertilisers		Soils, soil improvers and growing media, peat, peat products, sludges, composting process, carbonate liming materials	Translating legislation
	Norway						
☑	Bøen, Anne	Jordforsk – Norwegian Center for soil and environmental	anne.boen@jordforsk.no	no	Stability	Soils, soil improvers and growing media,	

Appl.	Name	Company	Email	TC/NSB or other Institution	Parameters	Matrices	Remarks
		research Fredrik A. Dahlsvei 20 N-1432 Ås Norway +47 64 94 81 63				composting process,	
	Switzerland						
☑	Fuchs, Dr. Jacques	FiBL Ackerstrasse, CH-5070 Frick +41 62 865 72 30	Jacques.fuchs@fibl.org	no	Stability Weeds Phytotoxicity Impurities	Soils, composting process, compost quality and use	Analytical Methods: Biotests (Phytotoxicity, disease suppression, …) Physical + chemicals tests analyses (water capacity, self heating tests, …) Microbiological activity and diversity (enzyme activity, isolation and count of microorganisms, biolog, …) Chemicals analyses methods for the practise (development, adaptation, teaching and training from compost plants workers, …)… Other specific expertise: Co-Autor from "ASCP Guidelines 2001: Quality criteria for composts and digestates from biodegradable waste management" (published by the Association of Swiss Compost Plants (ASCP) in collaboration with the Swiss Biogas Forum)
	The Netherlands						
☑	Van der Sloot, Dr. Hans	Environmental Risk Assessment Clean Fossil Fuels Energy research Centre of the Netherlands Westerduinweg 3 P.O. Box 1,	vandersloot@ecn.nl	Projekt Horizontal			

Appl.	Name	Company	Email	TC/NSB or other Institution	Parameters	Matrices	Remarks
		1755 ZG PETTEN The Netherlands +31 224 564249					
☑	Verhagen, J.B.G.M	Foundation RHP P.O. Box 98 NL-2670 AB Naaldwijk The Netherlands +31 17 46 20 360	verhagen@rhp.nl	TC223 TC 223/ WG 4	Stability Weeds Phytotoxicity Impurities		
☑	Wever, Mr. Gerrit.	PPO-Glastuinbouw P.O. Box 8 NL-2670 AA Naaldwijk The Netherlands +31 174 63 67 00	Gerrit.wever@wur.nl	TC223 Projekt Horizontal	Stability Phytotoxicity	soil improvers and growing media	Analytical methods: General (physical, biological, chemical)
	UK						
☑	Cooper, Bev	8 Old Coach Road, Bishops Wood Stafford ST19 9AD UK + 44 (0)1785 841 451	shropsgrp@csma-netlink.co.uk				
☑	Frederickson, Jim	Integrated Waste Systems, Systems Department, The Open University, Walton Hall, Milton Keynes, MK7 6AA, England, UK +44 1908 653387	j.frederickson@open.ac.uk			soil improvers and growing media, composting process, MBT material	Analytical Methods: undertakes the usual range of determinations associated with the analysis of soils, sludges, manures and municipal solid waste; particularly interested in the analysis of biodegradable wastes and composts, along with liquid and gaseous emissions from waste and waste treatment processes; operate one of the most sophisticated respirometry facilities in Europe for the determination of Dynamic Respirometric Index (DRI) and AT4 values for composts and fresh wastes; currently working with the Environment Agency and Andy Godley (WRc) on the development

Appl.	Name	Company	Email	TC/NSB or other Institution	Parameters	Matrices	Remarks
							of a respirometric test to determine waste biodegradability. Other specific expertise: elected director of the UK Composting Association for 10 years with particular responsibility for the development and introduction of compost standards; member of the PAS 100 adjudication committee in the UK with Bev Cooper, who suggested that I attend the Vienna meeting; member of the BSI steering committee for the revision of PAS 100.
☑	Godley, Andy	WRC Frankland Road, Blagrove Swindon, Wiltshire, SN5 8YF, UK Tel:+ 44 (0) 1793 865081 Fax:+ 44 (0) 1793 865001	godley_ar@wrcplc.co.uk www.wrcplc.co.uk		Stability Weeds	Landfill, MBT characterisation, composting process, composts	Legislation - Assisting the UK Environment Agency to develop methods for monitoring landfill diversion and biodergradable waste reduction in composting and MBT processes. Analytical methods - Respiration activity by aerobic incubation tests, anaerobic activity by biogas production tests, compost product quality by chemical and biological testing. Specific expertise - microbial growth and organic waste decomposition
X	Papadimitriou,	CalRecovery Europe	e.papadimi@calrecove	Member of British		sludge's, landfill,	trade affiliation:

Appl.	Name	Company	Email	TC/NSB or other Institution	Parameters	Matrices	Remarks
	Efstathios	Ltd, 1 City Square, LS1 2ES Leeds, UK +44-113-3002032	ry-europe.com	Standards Committee PTI/017 mirroring CEN/TC 335 "Solid biofuels" and CEN/TC 343 "Solid recovered fuels"		composting process, Hydrothermal processing	Involved in R&D regarding stability measurement in biodegradable waste treated biologically or hydrothermally Analytical Methods: SOUR- AT4- Thermogradient respirometry- Sealed electrolytic respirometry- A proprietary biological method under investigation Other specific expertise: R&D and implemented work on biological processing systems in waste Management. Recently, provisionally selected as an expert advisor for WRAP's Organics programme in the UK.
☑	Stentiford, Prof Ed	School of Civil Engineering Leeds University Leeds LS2 9JT UK +44 (0) 113 343 2267	e.i.stentiford@leeds.ac.uk		Stability	sludges landfill composting process	Analytical Methods: AT4, Solvita, Germination tests, Solid state respirometry, Liquid state respirometry, Specific Oxygen Uptake Rate (SOUR) developed in our labs in Leeds Other specific expertise: Range of research experience with composts, digestates and organic waste generally stretching back over 20 years
☑	Waller, Paul	Paul Waller Consulting 15 Cuckfield Avenue Ipswich IP3 8 RZ England +44 (0) 1473 436935	P.waller@ntworld.com	CEN/TC 223 (and WG 4)	Stability Weeds Phytotoxicity Impurities		trade affiliation: member of the UK Growing media and Composting Association
	United States						

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☑	Brinton, Dr. William Fisher	Woods End Research Laboratory P.O. Box 297 Mt. Vernon ME 04352 USA +1 207 293 2457	wfbrinton@woodsend.org	no	Stability Phytotoxicity	Soils, soil improvers and growing media, sludges, composting process, plant analysis for horticulture	Analytical: Commercial testing laboratory, CO2 respiration testing, Solvita Maturity test kit design and manufacturer Legislation: advisor the US government; USDA, EPA, DEQ Analytical Methods: Compost stability tests: CO2 evolution, Dewar self -heating, Solvita testsPhytotoxicity tests: Cress, cucumber and red-clover bioassay (herbicide damage test) PAS 100 (UK) tests via Earthcare Ltd.; Disease suppressivity methods for Phythium, Rhizoctonia, Fusarium (Ohio State University methods).Chemical analysis: Certified laboratory by USA Compost Proficiency Program (CAP), MAP USDA-APHIS.Physical analysis TMECC Methods, EN methods for PAS 100, Other specific expertise: Soil microbial respiration; test methods for certified organic fertilisers (USA- OMRI protocol); microbial hygiene of composts, compost tea analysis Several journal articles and publications on compost quality and test methods. Plant growth trials in greenhouses
	Institutions						
☑	Vincent-	ECOS	penelopevs@wanadoo	CEN :	Impurities in	soil improvers	lobbying with the European

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	Sweet, Penelope	9 rue du Saint-Eynard FR- 38600 FONTAINE France Tel: +33 476 535 041	.fr	TC 292 : TC & WGs 2 & 6 TC 308 TC 223 BT/TF 151	compost Simple phytoxocity bioassays for compost	and growing media, sludges, composting process,	Environment Bureau and France Nature Environnement Involved in revising Ecolabel for soil improvers

Annex 5 – Questionnaire

This Questionnaire was devised by Ward Devliegher and Florian Amlinger and is to be circulated to all who attended the workshop.

Methods

Method	What number for "Methods"
ASTM 1996	1
CO2-evolution	2
Dewar	3
DIR	4
GS21/GB21	5
Oxitop liquid	6
Oxitop solid	7
Sapromat	8
SOUR	9
Solvita	10

What "stability" is being measured?

What stability	Number for "What stability"
Current rate of biodegradation	1
Potential biodegradation (carbon pool)	2
N (im)mobilisation	3
Other	4

Materials

Material	What number for "Material"
Soil, dredged & excavated soil	1
Manufactured soil, incl. other sources than soil	2
Sewage slugde	3
Other than sewage sludge	4
Composted organic material	5
Digestate	6
Other soil improvers	7
Other growing media constituents	8
MBT-treated waste	9
Other	10

Questionnaire

	INPUT FIELDS	What to enter?	CHOICES
Choose a method			
Method:		NUMBER	See spreadsheet "Methods"
Possible variation in pre-treatment conditions			
Sieving - homogenisation		TEXT	
Milling - grinding		TEXT	
Liquid suspension		TEXT	
Particle size limitation		TEXT	
Sample weight/volume		TEXT	
Moisture adjustment		TEXT	

Possible variation in treatment conditions

Detection procedure		TEXT
Dynamic or static		TEXT
Nutrient supplement		TEXT
Liquid and/or solid		TEXT
Temperature		TEXT
Equipment		TEXT
Ease of setting up		TEXT
Required laboratory space		TEXT
Sensitivity		TEXT

Applicability		TEXT
Reproducibility		TEXT
Known interferences		TEXT
Time		TEXT

Costs?

Cost of equipment		TEXT
Cost of determination		TEXT

Any other remarks?

Remarks		TEXT

INPUT FIELDS	**What to enter?**	**CHOICES**

First, please choose a material and a "stability area"

Select a material		NUMBER	See "Material" spreadsheet
Select a stability area		NUMBER	See "What stability" spreadsheet
Remarks as to the given material or stability area		TEXT	

Second, please specify all applications that would allow testing for by the same test(s) for the material and "stability area" you indicated

Process control		Y of N
Soil improver and agriculture/horticulture		Y of N
Soil improver in landscaping		Y of N
growing medium constituent		Y of N
Growing medium		Y of N
As soil		Y of N
Landfilling		Y of N
Storage		Y of N
Other		Y of N
If other, please specify		TEXT

Third, please specify the range of possible test conditions that would still allow to answer the above specified "stability" issues

Minimum sample size, indicate standard dimensions e.g. liter or cm³		TEXT
Maximum sample size, indicate standard dimensions e.g. liter or cm³		TEXT
Screening during pre-treatment? Allowed or prohibited, if applicable indicate mesh size		TEXT
Homogenisation during pre-treatment. What method (dry or wet, suspension, etc...)		TEXT
Other issues for pre-treatment		TEXT
Dynamic or static		TEXT
Test in liquid or solid state		TEXT
What about moisture conditions during testing		TEXT
What about temperature during testing		TEXT

Duration of a test, please indicate a minimum, optimum and/or maximum?		TEXT
Addition of nutrients, allowed (y/n), how,..		TEXT

At last, please indicate, for the above indicated conditions, what test methods would be suitable according to your knowledge

ASTM 1996		Y or N
CO2		Y or N
Dewar		Y or N
DIR		Y or N
GS21/GB21		Y or N
Oxitop Liquid		Y or N
Oxitop Solid		Y or N
Sapromat		Y or N
SOUR		Y or N
Solvita		Y or N

Please write below any further remarks

Remarks		TEXT