WORKSHOP PROCEEDINGS

PROBLEMS AROUND SOIL AND WASTE II - HORIZONTAL ASPECTS OF SAMPLING

DG JRC WORKSHOP
ISPRA, 28 FEB - 1 MAR 2005

B. M. GAWLIK AND G. BIDOGLIO (EDS.)

EUROPEAN COMMISSION
DIRECTORATE-GENERAL
Joint Research Centre

2005

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The mission of the IES is to provide scientific and technical support to EU policies for the protection of the environment contributing to sustainable development in Europe.

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Directorate-General Joint Research Centre
Institute for Environment and Sustainability

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Background of the workshop

With its new workshop series “Problems around Soil and Waste”, the European Commission DG JRC’s Institute for Environment and Sustainability is highlighting those technical problems regarding the characterization of soil and waste, which are relevant for the respective EU legislation. In this context, the question was raised whether the development of a commonly underlying approach towards the design of sampling campaigns of soil, soil-related matrices and waste would facilitate the implementation of EU policies. This initiative goes along with a strong support of the JRC for the activities related to horizontal standardization, in particular as performed in the so-called Project HORIZONTAL, dealing among other with the development of an across-matrix framework for the sampling of soil, (treated) biowaste and sludges. Indeed, one important aspect of the Workshop “Horizontal aspects of sampling” was to build a bridge between standardization actions like HORIZONTAL and other national and European initiatives.

In the framework of Project HORIZONTAL, which aims at 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 study on sampling was subject of extensive discussions. Following the Steering Committee of Project HORIZONTAL, which re-groups mainly the National Environmental Protection Authorities, 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 National Standardisation Bodies (NSB's) through CEN/BT/TF 151.

Thus, the main objective of this workshop was to discuss an overarching framework of sampling of any material (soil, sludge, construction materials, waste, etc.) as well as to deepen the understanding of uncertainties related to sampling.

Overview and discussion sessions

Some 35 participants attended the event, which was hosted in facilities of the IES. The workshop's program was organised in a way to leave a possibly large room for discussion among the participants. To this end, a limited number of key notes addressed the issues of sampling and standardisation, theoretical considerations of sampling and case-studies with elements of comparative sampling. Besides, two parallel group sessions were organised to address in three discussion groups the technical, practical and policy aspects of sampling in relationship to EU policies. The summaries of this discussion session can be found at the end of this report.

To launch the work in the discussion groups a number of questions were formulated for each group:

- Discussion group I (Technical approach and questions):
    - What situations occur for sampling of soil, biowaste and sludge?
    - What technical instructions should be provided in standards?
    - How are the parts of the whole testing programme linked?
    - Do we need to differentiate between different parameters?

- Discussion group II (Policy approach and strategic questions)
    - What policy questions are to be answered for soil, biowaste and sludge?
    - Are these the same questions?
    - What is the objective of sampling for these three matrices?
    - What type of sampling strategy is fit for purpose?

- Discussion group III (Practical approach and questions)
    - What practical differences occur when sampling soil, biowaste and sludge?
    - What are still common aspects?
    - What does that imply for horizontal sampling?
    - Does the sampling plan provide sufficient practical instructions?
    - What level of practical instructions is necessary or desired?

Presentations

Standardization of Sampling: The Challenge!

Presented by
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Abstract

The main objective for WP2 of the project HORIZONTAL is to provide a sampling standard for the assessment of treated biowaste and sludge in order to determine if these materials can be applied on soil. Policy context for the application of these materials on soil is the Sewage Sludge Directive.

The challenge for standardization of sampling is that it is a multiple variable equation: there are potentially a large number of objectives, materials to be sampled and sampling situations. It is therefore not possible to define one solution to the 'equation'. As a consequence, standardization should be aimed at the process of solving the equation instead of a solution of the 'equation'. Harmonization in this context means that through standardization a common approach is established between the EU Member States. As a consequence, there is freedom for the Member States to define the quality level for sampling that is fit for purpose in light of the implementation of the Sewage Sludge Directive on a Member State level.

The multiple variable equation can be compared to cooking dinner. For the main course there are several choices to be made; the vegetables, meat or fish, rice or potatoes, side dishes, etc. When making these choices, some combinations might not be desirable as these do not fit your taste. But even with that restriction, a large number of solutions is still available: a large number of different meals can still be prepared.

In CEN/TC 292/WG 1 (Sampling of waste), it was acknowledged that the number of variables for sampling is just to large to define one sampling standard or for that matter a whole series of standards. In addition to that, it was also acknowledged that there will be differences between the Member States in their views on what quality level of sampling is fit for purpose in different situations. As a consequence, there is a considerable policy aspect incorporated in a technical discussion on sampling. This causes major problems when the goal is to provide sampling standards. A solution was found by accepting the so called 'Shop Shelve Concept'. Within this concept sampling is compared to going to the supermarket in order to prepare dinner. There all the ingredients for dinner are available, but a choice is still to be made. Each individual 'shelve' contains a number of different solutions to a specific part of the same sampling

problem (e.g. sampling pattern, sampling equipment). It is now up to the Project Manager to make the choices from each of the individual shelves in order to compose an unambiguous instruction for sampling in a specific situation. Like writing the menu for the dinner, providing an exact description of the dinner that will be served, the Project Manager writes a Sampling Plan that is a clear instruction to the sampler. There might be a necessity to guide the Project Manager through the 'supermarket', for which purpose 'roadmaps' can be defined, specifying the 'shelves' that are to be 'visited'. If desired, these roadmaps can limit the potential items on a shelve in light of the objective for sampling in a specific situation.

The Sampling Plan is the heart of the standardization of sampling. A standard describing the definition of a Sampling Plan ensures that all necessary steps are taken in the process of defining the way to sample a specific material in a specific situation for a specific objective. The steps defined in the Sampling Plan are:

- Identifying the involved parties
- Determining the objective
- Determining the testing level (for example basic characterization, compliance testing and on-site verification)
- Identifying the constituents
- Applying background information (process and site details, material specifications)
- Health and Safety
- Sampling approach (probabilistic or judgemental)
- Sampling technique
- Sub-sampling in the field
- Packaging and transport
- Reporting

It is important to realize that in the process of defining the Sampling Plan, a number of policy choices have to be made. This does not necessarily mean policy on a (inter)national level; it might well be between on the level of individual companies. However, still policy decisions are necessary. The most important ones are:

- the objective
- the population
- the scale
- the desired reliability

These will be discussed in more detail in a second presentation.

Apart from guidance for the process of defining a Sampling Plan, more detailed instructions can (and should) be provided for the items on each of the individual 'shelves'. So in addition to a Framework Standard describing the Sampling Plan, a series of documents is necessary to provide these instructions.

Standardization of sampling: The Challenge!

1

Introduction

- Frank Lamé
- Netherlands Organisation for Applied Scientific Research, Netherlands Institute of Applied Geo-science (TNO-NITG)
- Soil / Soil Quality / Soil Protection
- Sampling (soil, building materials, waste)
- Chairman of CEN/TC 345 Characterization of Soils
- Chairman of ISO/TC 190 Soil Quality
- Convenor of ISO/TC 190/SC 2/WG 8 Soil stockpiles
- Member of CEN/TC 292/WG 1 Sampling of waste

2

Horizontal WP2

- Main objective
  - Assessing the reusability of treated bio-waste and sludge on soil
- That implies
  - Sampling of in-situ soil to assess the soil quality
  - Sampling of treated bio-waste and sludge
- To determine
  - Environmental quality for organic and inorganic components
  - Hygienic quality
- To compare
  - Characteristics of soil with characteristics of treated bio-waste and sludge

3

Multi-variable equation

- Variables
  - Different objectives
  - Different materials
  - Different sampling situations
- Standardization: solving the equation
- Harmonization: a limited number of solutions
- What can be achieved:
  - Defining a step-wise procedure to solve the equation
  - Harmonization of the approach to solve the equation

4

Sampling and cooking

- You have to prepare a dinner
- Main course
  - Vegetables
  - Meat
  - Potatoes / rice
  - Side dishes

- Multiple variable equation!
- Not all solutions will be acceptable
- Still an infinite number of solutions are possible

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The shop shelve concept (1)

- Introduced in CEN/TC 292/WG 1
- Variety of variables for waste even larger
- No clarity about objectives, numerous types of wastes and situations for sampling
- Policy aspects in a technical working group
- No progress
- The shop shelve concept
  - Accept that there are differences
  - Provide technical tools for every potential solution

The shop shelve concept (2)

- Each 'shelve' contains several solutions to the same problem

- Preparing the dinner is making the right choices
- Taking the items that fit your desires

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Roadmap and menu

- Guidance on what to take from the shelves
- A roadmap through the shop
  - Which shelves have to be visited
- Resulting in a menu
  - Presenting the dinner that will be served
- Menu = Sampling Plan
  - Detailed guidance for the sampler

Sampling Plan

- Sampling Plan is the heart of standardization
- Identification of the key elements of sampling
  - Identifying the involved parties
  - Determining the objective
  - Determining the testing level (BC, CT, OSV)
  - Identifying the constituents
  - Applying background information (process and site details, material specifications)
  - Health and Safety
  - Sampling approach (probabilistic or judgemental)
  - Sampling technique
  - Sub-sampling in the field
  - Packaging and transport
  - Reporting

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Defining the Sampling Plan

- Project Manager defines the Sampling Plan
  - Specific instructions to the sampler
- Sampler uses the sampling plan
- In definition process a number of policy choices should be made
  - Project Manager should have feeling with policy (company, local, regional, national, international)
  - Policy maker / involved parties should understand the basic problems of sampling
- Additional standards / TRs provide ingredients
  - The cookery book for sampling
  - Detailed description of individual items on a shelve

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Conclusions

- Full harmonization is neither possible nor desirable
- A common approach is desirable
- A standard on the definition of the Sampling Plan:
  - Provides harmonization of the approach
  - Formalizes the considerations of the project manager
- The Sampling Plan should be accompanied by technical instructions for a variety of:
  - Objectives
  - Materials
  - Situations

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Project HORIZONTAL – Horizontal standardisation of test methods across the fields soil, sludge and biowaste

Presented by
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Abstract

European Directives in the fields of Sludge, Soil and Biowaste require European (CEN) standards to prevent unacceptable release of contaminants, impairment of soil function or unacceptable exposure to pathogens. The Working document on revision of the Sewage Sludge Directive (86/278/EEC; draft April 2000), the Working Document on Bio-waste (draft Feb 2001) and actions on Soil Monitoring called for standards on sampling, and analysis of hygienic and biological parameters, inorganic parameters and organic pollutants. Standards are required, so the Directives can refer to them to ensure proper enforcement of the regulations. In view of the development of transparent guidelines for all parties concerned, confusion resulting from different standards for the same parameter or property in closely related fields like soil, sludge and bio-waste shall be avoided.

Project HORIZONTAL has started on officially on November 1st 2002. The work started with desk studies on 23 topics among which sampling. After completion of the desk studies a wide spread consultation of CEN and ISO bodies was initiated. The comments were addressed and final desk studies are available on www.ecn.nl/horizontal. In the mean time Project HORIZONTAL-ORG and -HYG have been granted by the EU DG Research under the FP 6 programme. The total budget now approaches 6.3 M€.

Objectives of HORIZONTAL

This project aims at development of horizontal and harmonised European standards in the field of sludge, soil, and treated biowaste to facilitate regulation of these major streams in the multiple decisions related to different uses and disposal governed by EU Directives. The revision of the Sewage Sludge Directive (86/278/EEC; draft April 2000) and the Working Document on Biowaste (draft Feb 2001) call for standards on sampling, on hygienic and biological parameters, on methods for inorganic and organic contaminants and for mechanic properties of these materials. Part of the work will focus on co-normative work with an emphasis on horizontal standardisation starting from existing standards developed for the same parameter in the fields of sludge, soil and treated biowaste. Part of the work will focus on pre-normative research required to develop new standards lacking at this point and needed in the next revision of the regulations in these fields.

Description of the work in HORIZONTAL

The work is split up in coherent Work Packages (WP), which each address a main aspect of all relevant standards required in the Sludge, Biowaste and Landfill Directives. This has been done to make this work involving many contributors manageable. The first phase of the work consists of desk studies on all sub topics. After consultation with relevant CEN and ISO bodies and agreement in the Steering Committee, the next phase of the work consisting of experimental work and validation work will be started. This stage is expected to start in October 2003. The consortium taking on the project is very well embedded in the relevant CEN and ISO TC's, WG's and TG's through their membership of such standardisation bodies and thus provide an excellent basis for subsequent implementation of the deliverables.

Desk studies have been prepared for the following topics:

- sampling of sludge, treated biowastes and soils in the landscape
- enumeration of E.coli, Salmonella, Enterococci Clostridium perfringens, and viable helminth ova in sewage sludge and bio-waste and comparable matrices;
- physical impurities in treated biowaste, weed seeds and plant propagules, the stability of treated biowaste;
- determination of AOX, PCB, PAH, Linear AlkylSulfonates (LAS), NonylPhenol (NP) and endocrine disrupters like phthalates and compounds such as Di-ethylhexylphthalate (DEHP) and Dibutylphthalate (DBP)
- pH, dry matter/moisture content , organic matter/loss on ignition, total nitrogen, ammonium nitrogen, total phosphorus; extraction of trace elements and determination of trace elements from acid digested samples;
- flowability, solidity, thixotrophy, stacking behaviour;
- leaching of sludge, treated biowastes and soils

Following the approval of HORIZONTAL-ORG and -HYG and subsequent discussions in the Steering Committee the following desk studies have been added:

- dioxins and furans;
- brominated flame retardants;
- pharmaceuticals;
- soluble P, AAS flame and AAS – cold vapour;
- electrical conductivity and bulk density;
- viruses & bacteriophages;
- plant pathogens;
- process Control & Validation in Hygienic Safe Treatment;
- pre-treatment.

Ultimately almost all of these methods will be presented to CEN/CMC in CEN format and will contain the results of a validation by international inter laboratory performance evaluation tests according to ISO 5725. With the help of CEN/CMC arrangements have been made for the implementation of the project's deliverables into the CEN system.

For this purpose, the BT/TF 151 HORIZONTAL has been installed. This BT/TF will ensure that proper consultation at different stages of the project and standard development is achieved to facilitate a smooth transition to horizontal, harmonised standards. The organisation is given in the presentation.

To ensure proper consultation at every step of the process the following process in the development of horizontal standards has been adopted:

- Desk study to evaluate the feasibility of preparing a horizontal standard from existing standards in the different fields for a specific property leading to a first draft proposal for TC consultation.
- Consultation of CEN and ISO bodies and national Standardisation Bodies (NSB's)
- Experimental work on existing standards to demonstrate potential for a horizontal standard including ruggedness or study of suitability of new horizontal standards for the range of matrices with ruggedness testing
- Updated draft for a second consultation of CEN and ISO TC's
- Validation and preparation of draft horizontal standard with performance characteristics for a third consultation (End of project involvement).
- Transfer of pre-standards to BT/Task Force 151 for processing to EN in the CEN system

Horizontal standardisation is a new approach in standardisation, which traditionally is organized vertically (= each material its own set of standards). The development of horizontal standards covering a wider range of materials in its scope than traditionally the case in CEN standards calls for some special considerations: The most likely form for standards to be developed under project HORIZONTAL will in the form of modular standards to allow linking of standards together to form a framework of documents covering the full gamma of parameters to be assessed. There is an issue relating to the title and scope of the standards.

The main benefit of developing horizontal standards is that it is advantageous to apply one standard for more than one matrix leading to consistent referencing of standards in regulations and avoiding duplication of work on the same subject in different matrices with very similar properties.

Since this is the first major project, in which horizontal standards are developed for different matrixes crossing the boundaries of different Technical Committees, it will also be a learning process as before standards have largely been developed in vertically organized TC's with limited or no cross TC interaction. This process of horizontal standardisation in the field of sludge, treated bio-waste and soil is not limited to these fields. The technical experience gained in this project may benefit the development of horizontal standards in other areas as well (e.g. sediments, waste, fertilizers, construction). In assessing environmental properties of construction materials in support of the Construction Products Directive, a similar process has started.

Project HORIZONTAL
Horizontal standards for EU Directives on sludge, soil and bio-waste

Project team

Hans A. van der Sloot (NL) Project manager

Bernd Gawlik (EU)

Stephen Nortcliff (UK)

Veronique Pierzo (F)

Bev Cooper (UK)

Reimar Leschber (D)

Kirsten Andersen (DK)

Knut Wichmann (D)

Workshop Sampling (JRC, Ispra 28 Feb & Mar 1, 2005)

1

STANDARDS ARE NEEDED FOR

Sewage Sludge Directive 86/278/EEC

Soil Monitoring Directive (Proposal 2004)

Biowaste Directive (Proposal 2004)

Landfill Directive 1999/31/EC

Water Framework Directive (Groundwater Directive in preparation)

DG ENV HAS ISSUED A MANDATE TO CEN FOR THE DEVELOPMENT OF HORIZONTAL STANDARDS IN THE FIELDS OF SLUDGE, BIOWASTE AND SOIL

MAIN OBJECTIVE OF THE WORK

Development of horizontal and harmonised European standards in the fields of sewage sludge, soil, contaminated soil and treated bio-wastes to facilitate regulation of these major streams in the light of the different uses and disposal options that are governed by EU Directives.

DEFINITIONS

- Horizontal standardisation is the development of test methods applicable to different materials (across the fields of different TC's)
- Harmonisation of standards is the development of test methods applicable in different jurisdictions (i.e. across Europe)
- A modular approach implies the development of separate standards for subsequent steps in the chain of actions needed to reach a conclusion (e.g. sampling - pretreatment - dissolution - chemical analysis)

RELATIONSHIP BETWEEN Project *HORIZONTAL* AND CEN

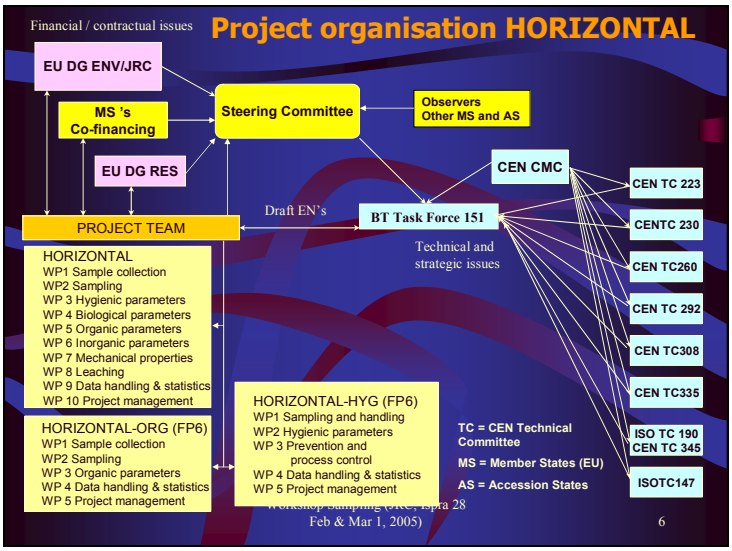
Technical aspects, research and background work on standards ---> HORIZONTAL

Adoption of standards ---> CEN (according to CEN procedures)

CEN has established a BT Task Force 151 to be the interface CEN/*Horizontal*

CEN = EUROPEAN STANDARDISATION ORGANISATION

Project organisation HORIZONTAL



Partnership HORIZONTAL - Experts

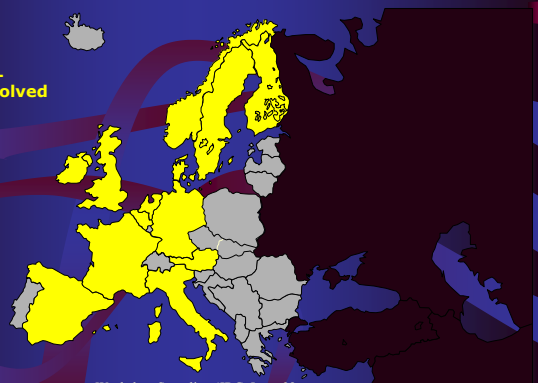
- HORIZONTAL
- HORIZONTAL-ORG
- Not (yet) involved - HYG

For consultation experts have been requested through BT/TF151 from all EU MS

During validation phase participants will be sought in all EU MS

HORIZONTAL Funding MS

- HORIZONTAL
- Not (yet) involved



Funding of Project HORIZONTAL

HORIZONTAL FUNDING MEMBER STATES

Contributor	Country	2002 (€)	2003 (€)	Total amount (€)
DG ENV	EU		100,000	300,000
DG JRC (Lab-work carried out by the JRC)	EU		100,000	300,000
BMLFUW	A- Austria	30,000	15,000	45,000
	B - Belgium Wallonie			20,000
	B - Belgium Vlaanderen			
UBA	D - Germany			150,000
MST	DK -Denmark**		15,000	50,000
	E - Spain		30,000	90,000
	EL - Greece			
ADEME	F - France		33,300	100,000
	FIN - Finland			
APAT	I - Italy		66,700	200,000
	IRL – Ireland			7000
	L – Luxembourg			
VROM	NL – Netherlands	35,000	35,000	96,000
Landbouw	NL – Netherlands			
	P – Portugal			
	S – Sweden			
DEFRA	UK – United Kingdom	60,000	75000	210000
EA	UK – United Kingdom	75,000	75,000	225,000
Scotisch EPA	UK – United Kingdom			
Nordic council of Ministers	Finland		35,000	100,000
	Sweden, Norway			
	Iceland, Denmark			
Total		**200,000**	**580,000**	**1,893,000**

* contribution through Nordic council of Ministers
** contribution to secretatiat BT/TF151

		EU contribution	Total
HORIZONTAL - ORG	**DG RTD**	**1,627,652**	**2,674,949**
HORIZONTAL - HYG	**DG RTD**	**1,648,304**	**1,997,187**
		Total	**6,565,136**

Total 31-12-2004:
6,565,136 Euro

Not yet contracted:
91000 €

EXAMPLES of Horizontal standards for subjects where standards already exist

Subject	Standards produced				
	Soil	Sludge	Treated Biowaste	Waste	Fertilisers
Sampling	ISO/DIS 10381-1 ISO/DIS 10381-4	EN/ISO 5667-13	EN 12579	5 WIs from TC 292 ½/17/18/19	EN 1482 NF U44-100 NF U44-108 NF U44-110 EN 13040 EN 12579
pH	ISO 10390	EN 12176	EN 13037	EN 12506	EN 13037
Dry matter	ISO 11465:1993 ISO/WD 16720	EN 12880 ISO/WD 16720*	EN 13040	WI 292014	NF U44-171 EN 13040
Organic matter TOC	ISO 10694 ISO 14235:1998	EN 12879 EN 13137**	EN 13039	prEN 13137	NF U44-160 NF U44-161 NF U44-171 EN 13039
Total nitrogen (Kjeldahl, Dumas, etc)	ISO 11261 ISO 13878	EN 13342	EN 13654 parts 1 & 2		EN 13654-1 EN 13654-2
Ammonium-nitrogen	ISO 14255 ISO/DIS 14256-1,2	WI 308012	EN 13651 & EN 13652	prEN 13370	
Trace elements, extraction	ISO 11466 ISO 14869-1 ISO 14869-2	EN 13346	EN 13650	prEN 13657	
Determination of trace elements	ISO 11047 ISO/CD 16772 EN ISO 11885 EN 1483 EN ISO 11969			EN 12506	EN 13366 EN 13368-1 EN 13368-2
PAH	ISO 13877 ISO/WD 18287	ISO 13877	ISO 13877		
PCB	ISO/CD 10382	CD 10382 WI 308046	CD 10382	WI292028	

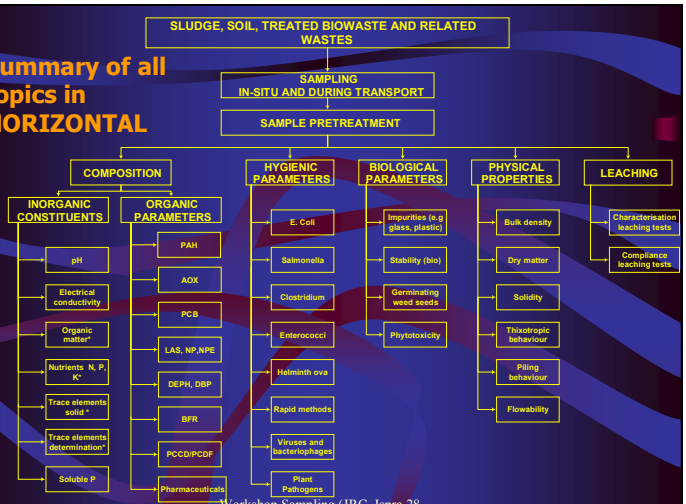
SUBJECTS IN HORIZONTAL

WP No	Topic	WP No	Topic
2	Sampling	5	BFR (FP6)
3	E. Coli & Salmonella	5	Pharmaceuticals (FP6)
3	Enterococci & Clostridium	6	pH
3	Helminth ova	6	Nutrient,N Nutrient,P - 5 methods
3	Rapid methods/Review on pathogens	6	DM, organic matter, TOC
3	Viruses and bacteriophages (FP6)	6	Organic matter, TOC, LOI
3	Plant pathogens (FP6)	6	Bulk density (new item)
4	Stability	6	Electrical conductivity (new item)
4	Viable weeds and propagules	6	Trace elements solids destruction
4	Impurities	6	Trace elements determination ICP
5	AOX	6	Trace elements determination AAS
5	PAH	7	Flowability
5	PCB	7	Solidity, Thixotropy, Piling behaviour
5	LAS, NP, NPE	8	Leaching
5	DEHP and DBP		Pre-treatment (new item)
5	Dioxins and Furans (FP6)		

QUALITY AND INTERRELATIONSHIP OF HORIZONTAL STANDARDS

- Horizontal standards require modifications compared to CEN traditional standards (title, link between modular standards)
- HORIZONTAL standards should be mutually more consistent than traditional standards in terms of definitions, specific aspects like reference to other documents, description of common elements (e.g. performance characteristics, blanks, interference's)
- HORIZONTAL provides an opportunity to create a relationship in the set of standards to be developed that is normally not possible.

Summary of all topics in HORIZONTAL



STEPS IN DEVELOPMENT OF HORIZONTAL STANDARDS

a - Desk study to evaluate the feasibility of preparing a horizontal standard for a specific property leading to a first draft proposal for **TC consultation**.

b1 - Experimental work on existing standards to demonstrate potential for a horizontal standard including ruggedness

b2 - Study of suitability of new horizontal standards for the range of matrices with ruggedness testing

c - Updated draft for **consultation of CEN TC's**

d - Validation and preparation of draft horizontal standard with performance characteristics (End of project involvement)

e - Transfer of pre-standards to CEN/ENV-Tc's group or BT/Task Force 151 for **processing to EN in the CEN system**

BENEFIT OF HORIZONTAL STANDARDISATION FOR MEMBER STATES

Development of horizontal standard from existing standards:

- applying one standard for more than one matrix
- consistent referencing of standards in regulations
- avoiding duplication of work on the same subject in different matrices with very similar properties

BENEFIT OF HORIZONTAL STANDARDISATION FOR MEMBER STATES

- The process of horizontal standardisation is not limited to soil, sludge and biowaste. Similar developments in standards development in support of the Construction Products Directive (CPD).
- The technical experience gained in this project will benefit the development of horizontal standards in other areas as well (e.g. sediments, waste, fertilizers, construction).
- The experience how to handle horizontal standards in the standardization process (across CEN/TC borders) will be a learning process from which future horizontal standardization activities will benefit.

CURRENT STATUS

Final desk study reports available on public web www.ecn.nl/horizontal.

Organic parameters work started under FP6 programme. Hygienic parameters in negotiation.

Preparation for Phase II Ruggedness testing for WP 6 Inorganic parameters started.

Workshop for biological parameters held in December 2004

Workshop on Sampling and Leaching in 2005

Pre-treatment new subject organised by JRC

CONCLUSIONS

- Project HORIZONTAL is reflecting the EU policy approach on environmental issues in matters of standardisation and shows certainly a way forward to reinforce the link between research-standardisation-legislation.

- The project HORIZONTAL is a break with the general approach in standardisation as it stresses exchange between technical Committees rather than the vertically organised nature of standardisation (I.e. by topic).

- Significant reduction in standardisation cost and transparency in regulation can be achieved by working towards a modular approach in which methods or modules in sampling, testing and analysis can be exchanged between TC's.

CONCLUSIONS

- In the process of horizontal standardisation, the similarities need to be stressed not the differences. Exceptions to the rule will always remain.
- Obviously, horizontal standardisation will only be taken forward when technically, scientifically and practically justified.
- The methods developed in the framework of project HORIZONTAL will in general be equally applicable to sediments and other soil like materials.
- Project HORIZONTAL provides an opportunity to create a relationship in the set of standards to be developed that is normally not possible.

INFORMATION

FINALIZED DESK STUDY REPORTS OF PROJECT HORIZONTAL

www.ecn.nl/horizontal

Horizontal aspects of sampling sludges, treated bio-wastes and amended soils

Presented by
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Abstract

The paper briefly introduced the broad themes in the Horizontal programme, the initial work with inorganic constituents, the current focus or organic constituents and the forthcoming work on hygienic parameters. The materials to be addressed are sewage sludges, treated biowastes and the in situ soils to which these materials are added. Sampling is frequently found to be the 'poor relation' in the overall evaluation process and to date much emphasis has been given to ensuring that the variability arising from the analytical procedures and those specific to a laboratory may be estimated and are as small as possible. This emphasis ignores the fact that substantial uncertainty is frequently introduced in to any estimates of parameter values at the sampling stage. It must be recognised that the materials to be sampled will have inherent variability, in addition the task of sampling may introduce sources of variability together with variability arising from storage and transport and pre-treatment. Unless these sources of variability are addressed the overall variability may be large irrespective of the performance in the laboratory. It is imperative that the variability arising at the sampling and pre-treatment stages of the overall evaluation process is recognised and strategies taken to reduce this source of variability. The aim of the Horizontal Programme is to investigate whether it is possible to harmonise sampling (and other procedures) across the three matrices, and perhaps across other associated matrices and develop standards associated with these procedures.

As an initial step currently available Standards or Standards in the final stages of development were reviewed within CEN and ISO. CEN TC 292 'Characterisation of Waste' under its WG1 has developed a Standard and series of linked Technical Reports for wastes. These have been investigated and the possibility of using them for Sludges, treated biowaste and soil evaluated. It is concluded that with some modification the Framework Standard of TC292 could be modified to accommodate sludges and biowastes, with the support of additional Technical Reports. For in situ soil the task may be a little more complicated, but the approach using the TC292 documents would also appear to offer possibilities. The outcome of this process will probably result in the revision of ISO 10381-4 'Guidance on the procedures for investigation of natural, near natural and cultivated sites'. The analysis and evaluation to date suggests this approach will be possible for inorganic constituents and organic constituents, but because the specification of what will be the focus for analysis with respect to Hygienic Parameters is not yet finalised, there will probably be a need to delay progress in this area.

Horizontal aspects of sampling sludges, treated biowastes and amended soils

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Horizontal

To date there have been three broad aspects:-

- Phase 1 – Inorganic Constituents
- ORG – Organic Compounds (current)
- HYG – Hygienic Parameters (recently started)

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Analysis and Sampling

Whilst these three sets of materials may require different procedures to be performed in the laboratory, prior to this they all require materials to be **SAMPLED**

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Variability

Variability will arise at all stages:-

- Inherent variability of the material
- Variability arising from the sampling process
- Variability arising from storage and transport
- Variability arising from pre-treatment
- Variability inherent in the analytical procedures
- Variability arising from the specific laboratory

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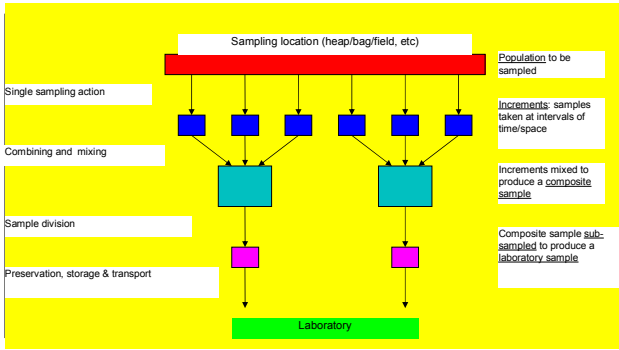

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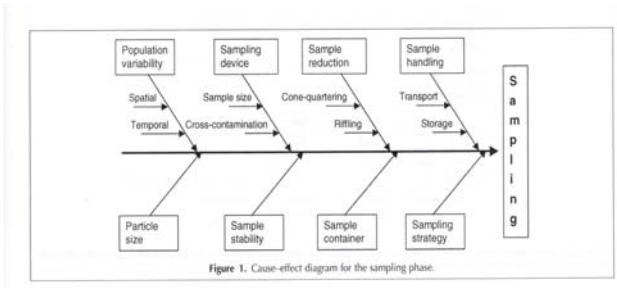

Figure 1. Cause-effect diagram for the sampling phase.

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Variability

Most attention has focused on analytical procedures (considerable body of national and international standards) and the laboratory (national and international accreditation)

BUT

The variability from these sources may be small in comparison to the inherent variability of the materials and that arising from the sampling process.

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HORIZONTAL - Materials

The materials of concern in HORIZONTAL are:-

Sewage sludge – liquid, dewatered, stabilised, etc.

Treated Biowaste – Composts derived from a range of source materials (green waste, paper manufacturing, food processing etc.).

Amended Soils – Soils to which sludge and biowaste may be applied or may have been applied.

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Why HORIZONTAL?

The main focus of HORIZONTAL is to provide standardised procedures at all the stages when dealing with sludges and biowastes.

Member States will use these procedures as minimum requirements when addressing EU Directives.

Additional procedures may be required by Member States.

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HORIZONTAL – The Task

Horizontal will harmonise the approach to the development of standards where possible.

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HORIZONTAL - Sampling

Questions

Are there ISO or CEN Standards which can be applied to the materials under consideration?

Do these materials give rise to the need to develop new standards?

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CEN TC/292

CEN TC/292 Characterisation of Wastes has addressed standard procedures related to sampling in WG1.

Are these standard procedures applicable to the materials considered in HORIZONTAL?

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CEN TC/292 WG1 Documents

Standard - Framework for the preparation and application of a Sampling Plan (Framework Document)

TR1 - Part 1: Information on the selection and application of a basic statistical approach to sampling under various conditions

TR2 - Part 2: Information on techniques for taking a sample

TR3 - Part 3: Information on procedures for sub-sampling in the field

TR4 - Part 4: Information on sample packaging, storage, preservation, transport and delivery

TR5 - Part 5: Information on the process of defining the Sampling Plan

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Is it possible for HORIZONTAL to apply these documents to

- Sludges
- Treated Biowastes
- Amended Soils?

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292 Options - 1

Full incorporation

Full incorporation of the necessary standards for soil (in situ), treated biowaste and sludge into the TC292/WG1 Framework Document and TR's.

This would be truly HORIZONTAL! (where the materials do not meet the environmental standards they are treated as wastes!)

Would probably require major changes to 292 Documents.

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292 Options - 2

Retain and Modify

Retain (and slightly(?) modify) the Framework Standard

Develop TR's specific for sludge and biowaste.

How would soil fit in to this approach?

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292 Options – 3

New Standard and TR's

Produce a new Framework Standard and accompanying TR's specifically with sampling to assess the application of treated biowaste and sludge.

This would be broadly based on the 292 documents.

Horizontal because of communalities.

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Where do we go?

We believe it is probably possible to modify the Framework Standard and produce a set of TR's for sludge and biowaste (Option 2) for Inorganic Constituents and Organic Compounds.

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Hygienic Parameters

Whilst this component of the project is in the early stages, at present, we believe that similar harmonisation is less likely to be achievable.

As a consequence the outcome will not be specific instructions, but guidance on what to consider when sampling hygienic parameters.

Watch this space!!!

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Soils in the Landscape

Considerations when sampling soils in the landscape are significantly different from the sampling of treated sludge and biowastes.

Soil- Can treated biowaste and sludge be applied?

Sludge and biowaste – What is the environmental quality of the material?

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Soils in the Landscape – 2

We believe it will be possible to develop an appropriate TR dealing with soils in the landscape.

This TR might serve as the basis for the renewal of ISO 10381-4 'Guidance on the procedures for investigation of natural, near natural and cultivated sites'

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Statistical requirements versus economic possibilities: the Austrian experience

Presented by Franz Mochty *Lebensministerium, Stubenbastei, A-1010 Wien, Austria* *mailto: Franz.Mochty@lebensministerium.at*	lebensministerium.at
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Abstract

The presentation gives an overview about the successful implementation of the Austrian Compost Ordinance. During a laboratory intercomparison exercise, issues like sampling and achievable performance criteria for the determination of heavy metals were set into relationship to possible data quality.

It could be shown that with a careful planning a minimum number of samples depending on the size of the sampled population are sufficient for regulatory purposes. The rather low number of samples prescribed does not lead to increase of prize of the "product" compost, which would jeopardize its utilisation.

A total of 16 laboratories participated in the testing campaign. Results for cadmium, copper and zinc are presented.

Based on the observations made, it is illustrated how the requested level of confidence into analytical data reflects on the number of samples to be taken and measurements to e carried out.

Statistical Requirements versus Economic Possibilities: the Austrian Experience

Franz Mochty

lebensministerium.at

Important Challenge

Define criteria compatible with the requirements for basic characterisation for landfilling

COUNCIL DECISION of 19 December 2002, establishing criteria and procedures for the acceptance of waste at landfills pursuant to Article 16 of and Annex II to Directive 1999/31/EC

Main decisions by Member States:

- sampling approach
- population, sub populations, scale
- limit values and compliance criteria

Problem:

Different questions to be answered for (re)use/recycling and landfilling

Risk of a landfill

arising from the total load of pollutants of the landfilled waste

Risk of the use of sewage sludge, compost, excavated soil

Depending on the content of pollutants of the single batch used

Instructions on the Sampling Approach

probabilistic sampling ↔ judgemental sampling

general problem for waste characterisation:
waste in general has high variability of pollutant contents

conflict:

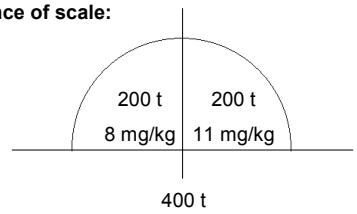
quality of characterisation ↔ available resources

CEN standard gives *flexibility* for use of high quality (statistical = *probabilistic) sampling* ↔ cheaper and simpler *(judgemental) sampling* with higher uncertainties

➔ for unambiguous acceptance criteria Member States have to establish instructions, when which approach has to be followed (otherwise - depending on the chosen approach – the same waste may or may not be acceptable for (re)use/recycling or on a certain landfill)

Defining population, sub populations and scale

importance of scale:



Limit value =

10 mg/kg

scale 400 t: thoroughly testing - one test result: 9,5 mg/kg

→ total amount accepted

scale 200 t: thoroughly testing – two test result:
8 mg/kg for left part and 11 mg/kg for right part of the batch
→ left 200 t accepted, right 200 t not accepted

Austrian decisions for landfilling of waste regularly generated in the same process in a defined quality

According to the EU landfill decision the waste has to be characterised only once - what is "the" waste (the population)?
• one years production is seen as the ***population*** for testing

reason:
as known from every day life and from economy many processes show yearly cycles, EU decision requires to asses the range and variability of characteristic properties,

→ the yearly variability has to be covered by the basic characterisation

scale: daily production

- short, middle and long term variabilities have to be assessed
- number and amount of increments have to be calculated according to CEN (variability related to the limit value and not the mean value!)
- if first test results are below 80% of the limit values in following analysis composite samples may be further combined to pooled samples

limit values and compliance criteria:

criterion I for landfilling:
mean value of test results within one year not higher than the limit value

criterion II for landfilling:
no test result of a single batch with the mass of the scale (e.g. one day's production) may exceed limit values more than a certain level of tolerance (10% to 70% depending on the height of the limit value)

criterion for compost production:
no test result of a single batch (a windrow) may exceed limit values control by the authority: no test result may exceed limit values more than a certain level of tolerance (30% to 50% depending on the parameter)
criterion for production = more stringent than for landfilling
=> no repetition of sampling/testing required if material does not fulfil product criteria and therefore has to be landfilled

Sampling workshop ISPRA 28.February/01.March 2005

Statistical requirements versus economic possibilities: the Austrian experience

lebensministerium.at

Statistical requirements versus economic possibilities

Compost marketing: an area of conflict

- The quality of the product must be guaranteed
- The number of samples to be analysed has to be still affordable for farmers and small enterprises

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Minimum frequency for external quality control for compost products in Austria

Annual amount of compost produced = population	Minimum frequency of external quality control	Minimum scale
50 m^3 to 1000 m^3	Control by quality assurance	
> 1000 m^3 to 2000 m^3	1 control each year	100 m^3
> 2000 m^3 to 4000 m^3	2 controls each year	150 m^3
> 4000 m^3	2 controls each year and additionally 1 for every further 4000 m^3, but at most 12 controls per year	150 m^3

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Conventional sampling for compost products in Austria

Subpopulation [m³]	Number of sampling points = number of composite samples
Greater or equal to 100 m³	5
Greater or equal to 200 m³	6
Greater or equal to 400 m³	7
Greater or equal to 800 m³	8

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Comparison CEN/TC 292 and Austrian Compost Ordinance

Minimum sample size

- **Compost ordinance**: **20 l** per sampling point
- **CEN/TC 292: 10 l** (with the following assumptions)
  - Compost sieved to < 10mm
  - Bulk density (like earth): 0,8kg/l
  - Specific mass of the particles: 1,6 g/cm³
  - Fraction of the particles with a specific characteristic: 1 %
  - Coefficient of variation: 10 %

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Double or multiple analyses near limit value

- **Obligatory if result > 90 % limit value**
- **Material: parallel sample**

Additionally:

- **No single value may exceed the limit value over 30 %**
- **If this is the case the material is classified as waste**

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Raw input waste material

- Organic waste collected by the Vienna public waste collection services (Biowaste containers)
- Structural material from tree and bush cutting
- Total amount: approximately 90.000 tons per year

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Performance of the interlaboratory sampling test

- 16 laboratories took part
- Duration of the test: 4 days
- Each day 4 laboratories took their samples
- Population: a windrow of 6500 m^3
- Scale: 200 m^3 of ripe compost

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Analysis results: Single and limit values

Sample name	Cd	*Cd*	Cu	*Cu*	Zn	*Zn*
Unit ->	mg/kg TM		mg/kg TM		mg/kg TM	
Limit value (B)	3		500		1800	
Limit value (A)	1		150		500	
Limit value (A+)	0,7		70		200	
used sample fraction ->	<45°dried ground	evaluation	<45°dried ground	evaluation	<45°dried ground	evaluation
L V V - 150903 - OP - 1	0,49	*within CI95*	53	*within CI95*	221	*within 2s*
L V V - 150903 - OP - 2	2,3	*	46	*within CI95*	194	*within CI95*
L V V - 150903 - OP - 3	0,43	*within CI95*	47	*within CI95*	191	*within 2s*
L V V - 160903 - OP - 1	0,42	*within CI95*	51	*within CI95*	198	*within CI95*
L V V - 160903 - OP - 2	0,47	*within CI95*	47	*within CI95*	237	*within 3s*
L V V - 160903 - OP - 3	0,44	*within CI95*	46	*within CI95*	199	*within CI95*
L V V - 170903 - OP - 1	0,41	*within CI95*	43	*within CI95*	192	*within CI95*
L V V - 170903 - OP - 2	0,45	*within CI95*	45	*within CI95*	200	*within CI95*
L V V - 170903 - OP - 3	0,46	*within CI95*	52	*within CI95*	187	*within 2s*
L V V - 170903 - OP - 4	0,9	*within 2s*	45	*within CI95*	180	*within 2s*
L V V - 170903 - OP - 5	0,51	*within CI95*	185	*	219	*within 2s*
L V V - 180903 - OP - 1	0,44	*within CI95*	44	*within CI95*	205	*within CI95*
L V V - 180903 - OP - 2	0,45	*within CI95*	46	*within CI95*	196	*within CI95*
L V V - 180903 - OP - 3	0,46	*within CI95*	46	*within CI95*	194	*within CI95*
L V V - 180903 - OP - 4	0,41	*within CI95*	42	*within CI95*	187	*within 2s*
L V V - 180903 - OP - 5	0,47	*within CI95*	50	*within CI95*	195	*within CI95*
Median (all participants)	0,45		46		195	
Mean (all participants))	0,59		56		200	
Standarddeviation (all participants)	0,5		35		15	
% RSD (P=68%)	79		62		7	
Xmin = Mean-CI 95%	0,3		37		192	
Xmax = Mean+CI 95%	0,8		74		208	

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Pooled samples: Comparison day and week

Sample name	Cd	*Cd*	Cu	*Cu*	Zn	*Zn*
Unit ->	mg/kg DM		mg/kg DM		mg/kg DM	
Limit value (B)	3,0		500		1800	
Limit value (A)	1,0		150		500	
Limit value (A+)	0,7		70		200	
used sample fraction ->	<45°dried ground	evaluation	<45°dried ground	evaluation	<45°dried ground	evaluation
pooled sample day 1	0,42	*within CI95*	44	*within CI95*	187	*within 2s*
pooled sample day 2	0,48	*within CI95*	47	*within CI95*	204	*within CI95*
pooled sample day 3	0,48	*within CI95*	47	*within CI95*	203	*within CI95*
pooled sample day 4	0,48	*within CI95*	45	*within CI95*	196	*within CI95*
pooled sample week	0,46	*within CI95*	49	*within CI95*	199	*within CI95*
Median TM 1-4	0,48		46		200	
Mean TM 1-4	0,46		46		198	
Standarddeviation	0,03		1,3		8	
% RSD (P=68%)	6,6		2,9		4,0	
Xmin = Mean-CI 95%	0,42		44		185	
Xmax = Mean+CI 95%	0,51		48,0		210	
Pooled sample "week" in CI95 of individual results?	ok		difference!		ok	

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Sewage Sludge: Effect of long term variability

Confidence Interval	Confidence Level	Number of samples		
		Cd	Cu	Zn
+/- 10 %	80%	116	39	16
+/- 10 %	90%	191	63	26
+/- 10 %	95%	272	90	37
+/- 20 %	80%	30	10	4
+/- 20 %	90%	40	16	6
+/- 20 %	95%	69	23	9

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Final statement

Thank you for your attention!

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Basic aspects of sampling

Presented by
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Abstract

Four aspects in the process of defining a Sampling Plan are essential:

- The objective
- The population
- The scale
- The reliability

For each of these aspects decisions on a policy level are necessary.

Objective

The objective is the underlying motivation for investigating in-situ soil, treated bio-waste and sludge.

The objective for sampling is (almost) always to vague to provide unambiguous guidance to the sampler. A number of more technically defined descriptions is necessary, known as the technical goals. Technical goals provide for example concrete information on the constituents or characteristics to be determined, the size of the sample and the level of testing (e.g. basic characterization, compliance testing or on-site verification).

Deriving a Sampling Plan from the original objective is a stepwise procedure, where at first the technical goals are to be defined and thereafter the unambiguous technical instructions to the sampler.

In order to make these translations, the Project Manager should understand the policy perspective, but it is also important that the policy makers involved in a specific situation understand at least some of the technical problems of sampling. It is neither to WP2 of the project HORIZONTAL or the involved CEN Technical Committees to make these policy decisions. However, they can provide help to the policy makers to make the necessary decisions.

Population

The population is the amount of treated bio-waste or sludge that is to be considered or, for in-situ soil, the size of the field on which the material is to be applied.

The population can be described in different ways. As all particulate materials are heterogeneous, a differentiation in the population might be desirable in order to enhance the representativity of the samples. Differentiations might for example be defined from a quality perspective, a transport perspective or a destination perspective. Especially when the samples are to be taken from a continues production, it is important to define the time period within which the produced material is to be considered as the population. Thus the quantity of material for which the results of sampling are to provide information. A sampling survey throughout that period is than to provide that information on a sufficiently reliable level.

For in-situ soils the population will in most cases be the field on which the treated biowaste or sludge is to be applied. That is when assuming that there will be an equal quantity of such a material applied to the whole field.

Scale

The scale is the amount of material (mass or volume) we want to base our decisions on.

Defining the scale is perhaps the most important aspect of sampling as well as the least well understood.

Imagine that you have to determine the colour of a 1:1 mixture of red and white balls. When you look at these balls from a large distance, you would estimate the colour as being pink. So when the whole population is the sample, the average colour will be pink. As long as the number of balls in the sample is (very) high, the average colour of the sample will stay pink and there will be little or no variation in the average colour. When on the contrary the sample is as small as a few or even one ball, large variations in colour will appear, varying between pure white and pure red. Although this is only a theoretical example, this applies for all particulate materials, including soil, biowaste and sludge. So the mass or volume of the material that is investigated determines the variability.

The amount of material analysed is only a small fraction of the material of the original population. Still, we want that fraction to be a good estimate of the mean characteristic of the original population. That implies that a considerable effort should be made to obtain that representative sample. When the scale is for example the days production of biowaste or sludge, a number of individual increments have to be taken, put together in a composite sample from which an analytical sample is obtained through appropriate sample pre-treatment. The number of increments should be sufficiently high to cover all variation within the defined scale, however, we are not interested to know that variability (the only reason to know that variability might be to optimise the sampling strategy by defining the number of increments that are necessary to get a good estimate of the mean in the composite sample. Little variability within the scale means that a limited number if increments will be sufficient to obtain a good estimate of the mean).

Having defined the scale, for example the one days production, and having defined the population, for example a years production, the number of days that have to be sampled might be estimated or chosen. For each day a defined number of increments is taken, put together in a composite sample from which then an analytical sample is obtained through a process of sample pre-treatment. As each result represents the quality for a days production, the found variability will be equal to the variability between days.

It should be remembered that too often the scale is not defined. As a consequence, the scale will often be equal to the size of the individual samples analysed. As in most situations the variation will increase when the sample size decreases, this will mean that a large degree of variability is encountered. As a consequence there is a high probability of obtaining a non-representative sample and thus a non-representative testing result. Finally, that will imply that there is a large risk of making the wrong decisions, which can have significant financial and environmental consequences.

Reliability

Defining the reliability basically means defining how representative a sample / sampling result should be.

In relation to the reliability a distinction should be made between two basic types of sampling:

- Probabilistic sampling
- Judgemental sampling

The essential characteristic of probabilistic sampling is that every element in the population has an equal change of being part of the sample. This has a number of practical implications, like the size of the sampling equipment, the size of the sample and the sampling strategy (for example random or stratified random sampling). As a result statistics can be used to calculate the reliability of the test results.

Judgemental sampling means that to some extent, the sampling is based on the judgement of the (expert) sampler. Although a valuable approach in a large number of situations, an important disadvantage is that the reliability of the test results for the whole population cannot be quantified. Practical restrains, as well as limitations in available time and funding, might all lead to the conclusion that true probabilistic sampling is unachievable in a specific situation. As a form of judgemental sampling is than the only alternative option, effort should still be put in making the deviation from probabilistic sampling as little as possible. By means of duplicate sampling, the accuracy of sampling can still be estimated even when a judgemental approach is chosen.

Indifferent or the sampling is probabilistic or judgemental, the reliability of the sample(s) will be determined by the degree of variability (and thus the scale!) and the number of samples. As mentioned, in the case of judgemental sampling an additional (but unknown) factor is the representativeness of the obtained increments for the true mean on the defined scale.

Basic aspects of sampling

1

Topics to be discussed

- Objective
- Population
- Scale
- Desired reliability

2

Objective

The underlying motivation for investigating in-situ soil, treated bio-waste and sludge

3

Objective for the application of treated bio-waste and sludge

- Application of treated bio-waste and sludge
  - Is the treated bio-waste or sludge 'X' acceptable?
  - For organic, inorganic and hygienic parameters
  - Composition or leaching should:
    - Comply with limit values?
    - Be less than or equal to local soil quality?
    - Not result in exceeding limit values for soil?
    - Have a beneficial effect on soil quality?

- Do we now know enough to ask a consultant to test the in-situ soil and treated bio-waste or sludge?

4

Sampling Plan is a vehicle

- Defining the sampling plan provides the necessary information
- Standardized Sampling Plan results in a common approach
- Responsibility of policy makers to make decisions on objective
  - Not for WP2 or the CEN/TC responsible for the standard
  - Not for the consultant applying the standard
  - ... But they can provide help with policy decisions

Objective → (translation step) → Technical goals → (translation step) → Technical instructions

Production of the Sampling Plan → Defined Sampling Plan

Translation of the objective

- Objective (almost) never usable from a technical perspective
- Translation into technical goals
  - Constituents to be investigated
  - Level of testing
  - Where, when and how to sample
  - How many samples
  - The size of the samples
  - The number of samples
- Resulting sampling plan provides necessary practical instructions for the sampler

6

Population

The amount of treated bio-waste or sludge that is to be considered

The size of the field on which the material is to be applied

7

Population

8

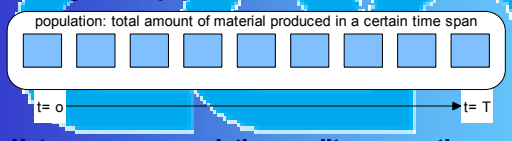
Population

And You?

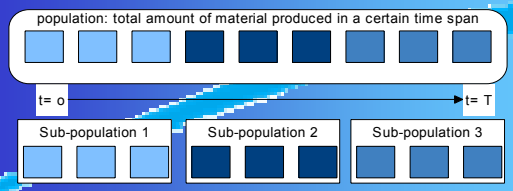
9

Population of bio-waste or sludge

- **Homogeneous population**



- **Heterogeneous population: quality perspective**



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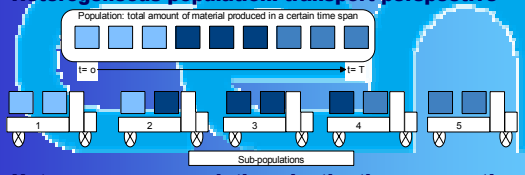
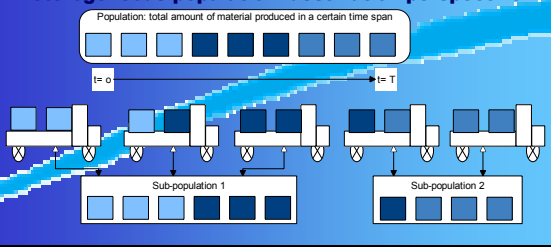
Population of bio-waste or sludge

- **Heterogeneous population: transport perspective**



- **Heterogeneous population: destination perspective**



11

Information about the population

- **Continuous production**
  - **What time period?**
- **One offs**
  - **Total quantity is population**
- **Not necessary to sample the whole population**
  - **Sample survey**
  - **Estimation of the quality that is sufficiently reliable**

12

Population for the in-situ soil

- Where and how do we want to reuse the treated bio-waste or sludge?

13

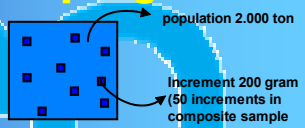
Scale

The amount of material (mass or volume) we want to base our decisions on

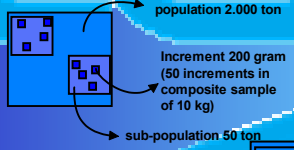
14

Method of sampling

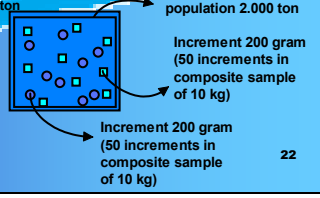
- Scale of composite sample 2.000 tons



- Scale of composite sample 50 tons



- Scale of composite samples 2.000 tons



22

What can go wrong?

- Scale not defined
  - Sample size for laboratory will in practice be the scale
  - Approximately 0,2 – 1 kg (?)
  - Variability will be high
  - Larger scale: less variation
- Result will not represent the mass of material
- Consequence: high risk of wrong decisions
  - Accidental high value: no beneficial reuse
  - Accidental low value: high load of constituent(s) into the environment

23

The central problem is "scale"

- Variability encountered depends on scale
- No need for information on a mass / volume smaller than the scale
- A sample has per definition a certain volume
- A result should be a good representative of the average for the mass / volume it represents
- The scale is a set volume (mass)
- Do not accept the sample size as the scale!

24

Desired reliability

How representative should the result be?

25

Two approaches

- Probabilistic sampling
  - Every part in the population has the same chance
  - Statistics can estimate the reliability
- Judgemental sampling
  - Based on the knowledge of the sampler
  - No quantified reliability
- The choice will depend on the objective
- In practice one has to compromise

26

Determining factors

- Reliability depends on:
  - Variability of the material (and thus scale!)
  - Number of samples

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Conclusions

- Even a clear objective is insufficient to define the sampling
- The Sampling Plan is the vehicle to a systematic approach
- One Europe – one approach
  - But not one sampling method
- In order to define sampling in a specific situation, policy choices must be made
  - Objective, population, scale, reliability

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Essentials of Pierre Gy's sampling theory and practice for particulate materials or The rules of correct sampling

Presented by
André Desaules
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Abstract

Analytical determination is usually a multistep process, which may contain several sample and sample preparation steps. Thus, sampling and the probable error components generated by doing it cannot be neglected.

The purpose of "sampling theory" is to provide guidelines on calculating required sample quantities to realize an objective of accuracy in the estimation of quality parameters determined by the sample. The main sources of sampling theory are development work and publications of Dr. Pierre Gy and more recently by Mr. Francis Pitard. Unfortunately, this advanced theory is not very well known yet by analytical chemist and chemical metrologists although in alignment with principles laid down in the Guide for Expression of Uncertainties in Measurements (GUM) and the respective EURACHEM Guide.

In this presentation a short introduction to Gy's theory is given for the area of soil sampling. According to Gy's sampling theory, one may distinguish the following 7 classes of sampling error in addition to the analytical:

- fundamental sampling error FE;
- integration error IE;
- grouping and segregation error GE;
- increment materialisation error ME
- delimitation error DE
- extraction error EE;
- preparation error PE;

The errors are explained and possible measures for their control/reductions are discussed briefly.

Essentials of Pierre Gy`s sampling theory and practice for particulate materials
or
The rules of correct sampling

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NABO Nationale Bodenbeobachtung Observation nationale des sols Osservazione nazionale dei suoli Swiss Soil Monitoring Network

agroscope FAL RECKENHOLZ Forschung für Landwirtschaft und Natur

Contents

- Introduction – motivation and challenge
- Use and need for a sampling theory
- Sampling errors and sampling rules
- Recommendations for standardisation

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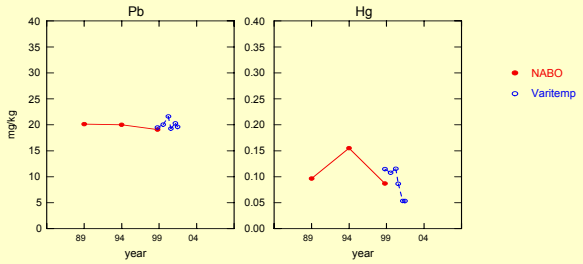
Variograms of soil monitoring results



permanent grassland, sampling depth 0-20cm

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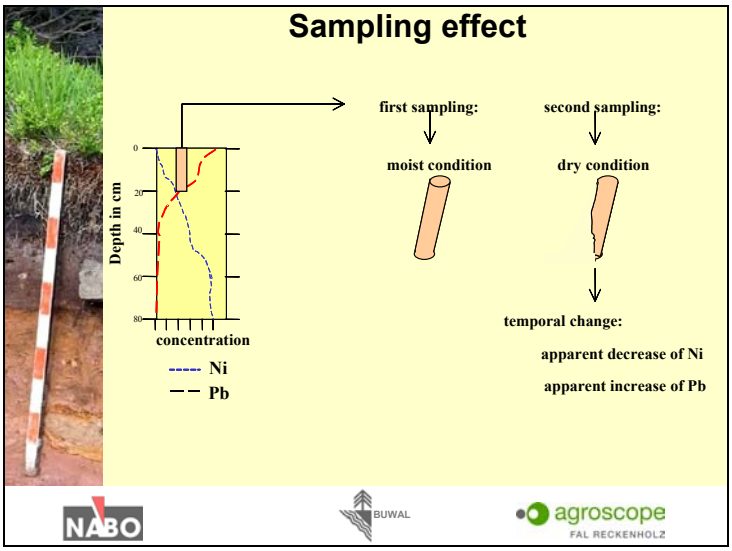
Sampling effect
Depth in cm
0
20
40
60
80
concentration
Ni
Pb
first sampling:
moist condition
second sampling:
dry condition
temporal change:
apparent decrease of Ni
apparent increase of Pb
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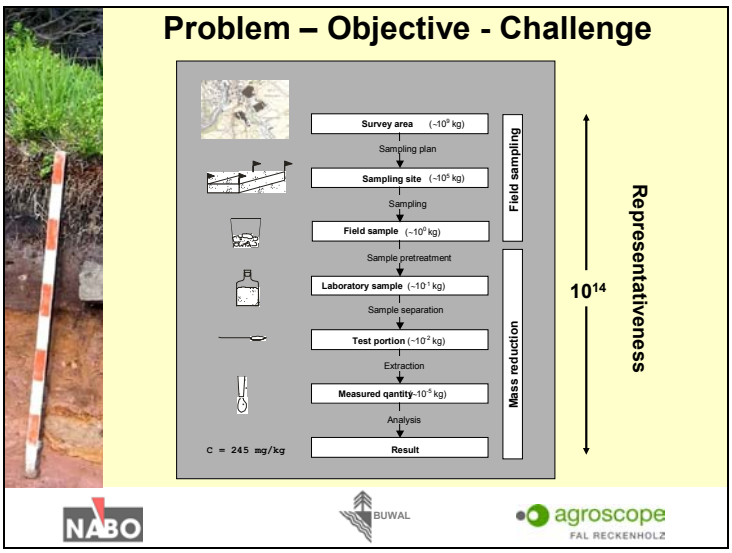
Problem – Objective - Challenge
Survey area (~10⁹ kg)
Sampling plan
Sampling site (~10⁵ kg)
Sampling
Field sample (~10⁰ kg)
Sample pretreatment
Laboratory sample (~10⁻¹ kg)
Sample separation
Test portion (~10⁻² kg)
Extraction
Measured qantity (~10⁻⁵ kg)
Analysis
Result
C = 245 mg/kg
Field sampling
Mass reduction
10¹⁴
Representativeness
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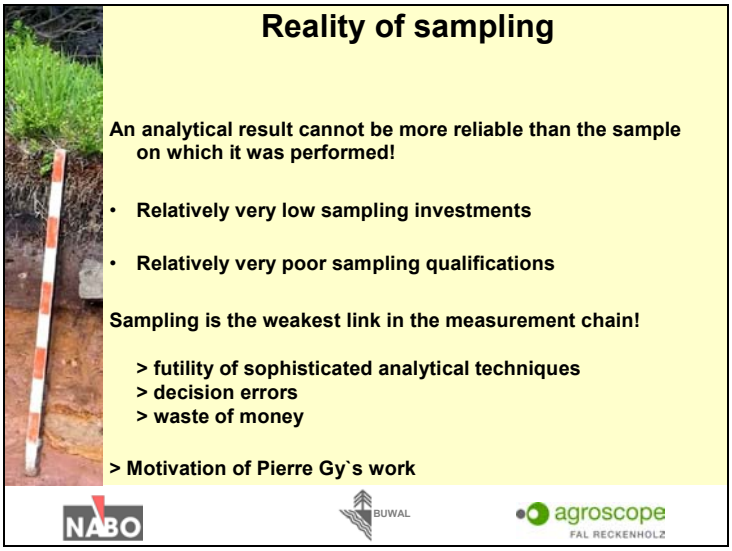
Reality of sampling
An analytical result cannot be more reliable than the sample on which it was performed!
• Relatively very low sampling investments
• Relatively very poor sampling qualifications
Sampling is the weakest link in the measurement chain!
> futility of sophisticated analytical techniques
> decision errors
> waste of money
> Motivation of Pierre Gy`s work
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Use and need for a sampling theory

- **Establishment of sampling as a science**
  Respecting the scientific criteria of objectivity, logical consistency, reproducibility, verification/falsification, ...
- **Benchmark of sampling quality**
  Sampling in theory is either correct or not correct, in practice it is more or less accurate, biased, precise, representative, reliable, ... > The question to answer is how much?
- **Assurance for unbiased standardisation**
  Everybody should sample not just the same but the correct way.

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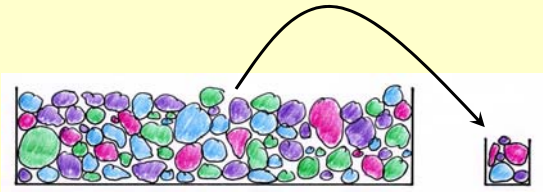
(1) Fundamental sampling error FE



- Constitution heterogeneity CH
- Distribution heterogeneity DH
- DH </= CH

FE only error which is never 0

> comminutition (grinding) *before* (sub)sampling

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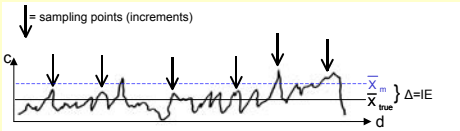
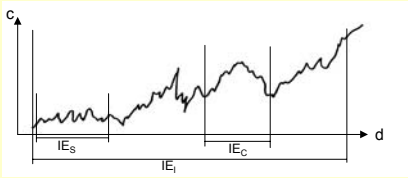
(2) Integration error IE





IE_s short-range
IE_l long-range (trend)
IE_c cyclic

> as many increments as possible
> increasing sampling support (smoothing)
> variographic sampling (preliminary investigation)

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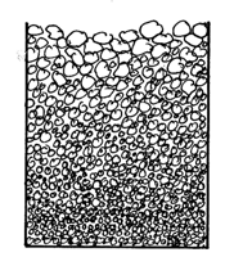
(3) Grouping and segregation error GE



GE = DH
Cause: gravity

> As many probabilistic increments as possible

> Mixing (valuable for very short-terme only)

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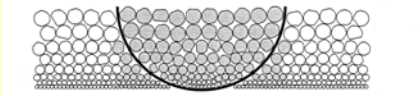
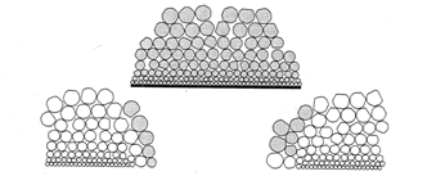
(4) Increment materialisation error ME

ME = DE + EE



(4a) Increment delimitation error DE



(4b) Increment extraction error EE

> best adapted devices (no standardisation)

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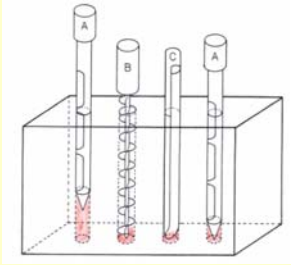
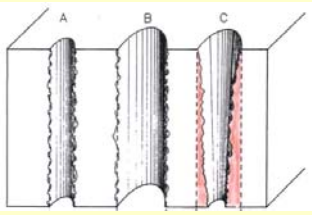
DE by samplers





(Source: Pitard 1993: 236)

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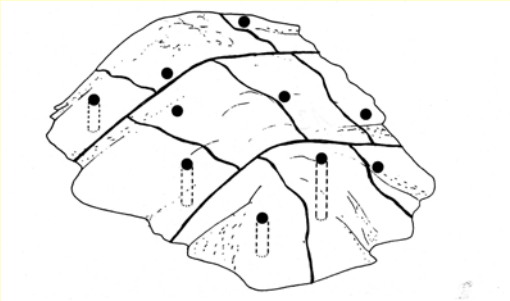
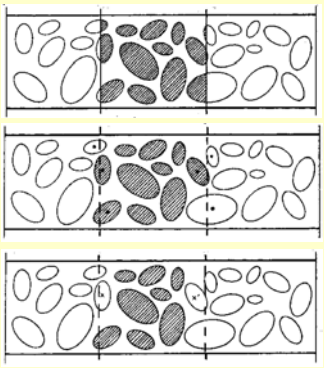
DE by sampling 3-d piles



(Source: Pitard 1993: 237)

Increment delimitation and extraction - ideal vs actual -



Ideal increment delimitation: Model extended increment

Ideal increment extraction: Model fragmental increment

Actual fragmental increment

(Source: Pitard 1993: 208)

(5) Preparation error PE

Concerns all operations which (selectively) alter the sample in a relevant way:

- **Contamination**
- **Dilution**
- **Loss (selective)**
- **Physical alteration**
- **Chemical alteration**

> Qualified manpower

Total sampling error TE

TE = FE + IE + GE + ME (DE + EE) + PE

FE fundamental error
IE integration eror
ME materialisation error
DE delimitation error
EE extraction error
PE preparation error

Overall estimation error OE

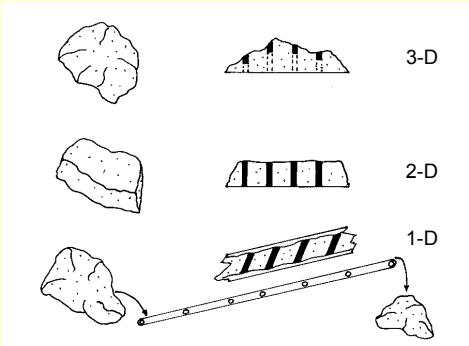
OE = TE + AE

AE analytical error

General sampling rules

- **All materials in the physical world are heterogeneous.**
  - constitution heterogeneity (CH)
  - distribution heterogeneity (DH)
- **Only equi-probable sampling warrants bias-free sampling and the minimum of variance.**
- **Lots/sampling units which cannot be put under the form of stream economically, will never be sampled correctly. Correct sampling of 2- and 3-dimensional lots/sampling units are usually not feasible.**

(1) Sampling error minimising strategy - Dimension reduction



(2) Sampling error minimising strategy

1. All devices and operations are performed that PE is of secondary importance.
2. ME (DE + EE) equal to 0 or as close as possible.
3. Increments of primary and secondary sampling must be as large as possible to approximate GE the closest possible to FE.
4. Sampling distances must be as short that trends (IE_l) are of secondary importance.
5. The sampling protocol considers cyclic effects (IE_c).

(Source: Pitard 1993)

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General recommendations for sampling standardisation

- The standardisation of a sampling strategy is a must.
- The standardisation of sampling devices is possible only if they are correct.
- Implementation of a sampling plan with incorrect sampling devices cannot ensure accurate sampling.
- The standardisaton of a sampling plan is possible only for local conditions, with respect to the amount of heterogeneity carried by a critical pollutant. The pollutant carrying the largest amount of heterogeneity will decide the appropriate sampling plan.

(Source: Pitard 1993: 407)

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Urgent message for the HORIZONTAL-sampling standardisation body

- Sampling uncertainty includes precision *and* bias!
- Biased standardisation is misleading!

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Practionner report - Comparative soil sampling

Presented by
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Agenzia per la protezione dell'ambiente e per i servizi tecnici APAT
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mailto: dezorzi@apat.it

Abstract

A lot of effort has been invested in recent years by various international organizations and bodies in the harmonization and preparation of guidance documents on proper quantification of uncertainty in chemical measurements. All these was/is done with the aim to achieve better international comparability between results produced by testing or calibration laboratories. However, the uncertainty associated with field sampling is normally left out from the uncertainty quantification process and has not been satisfactorily covered yet in any of the existing guidance documents. The SOILSAMP project is to fill this gap in the field of soil analysis.

SOILSAMP, which is funded and co-ordinated by the Italian Environment Protection Agency APAT, has as its main objective to establish quantification of uncertainty components connected to the most widely used methodologies for soil sampling in agricultural, semi-natural, urban and contaminated sites. Thus, SOILSAMP aimed mainly at:

i) analysis, in terms of metal trace elements, and assessment of the uncertainty associated with soil sampling of an agricultural site to be qualified as the reference site for carrying out national and international intercomparison exercises (Reference Sampling);

ii) assessment of the uncertainty associated with soil sampling in different environments (agricultural, seminatural, urban and industrial) by using different devices (Comparative Sampling).

To this end, an agricultural reference site, located in the North-East of Italy has been characterized. A comparative sampling, by using three different sampling devices, has been also performed. Preliminary results on sampling uncertainty are available.

Beside technical findings, one additional result of this project is a compilation of existing and some new terms related to soil sampling and associated uncertainty, which is currently being published as IUPAC recommendations. Although the assessment of uncertainty associated with the soil sampling in agricultural areas represents only a part of the complete project, the results obtained are extensive and very informative. For this reason it was concluded to publish a report on this part as a separate document.

The second part of the project will now start with the assessment of sampling uncertainty in contaminated areas.

Practitioner report – Comparative soil sampling

Dr. Paolo de Zorzi
Servizio di Metrologia Ambientale
APAT (Rome, ITALY)

Problems around Soil and Waste II: Horizontal aspects of Sampling
Joint Research Centre - Ispra (Italy)
March 1, 2005

Background

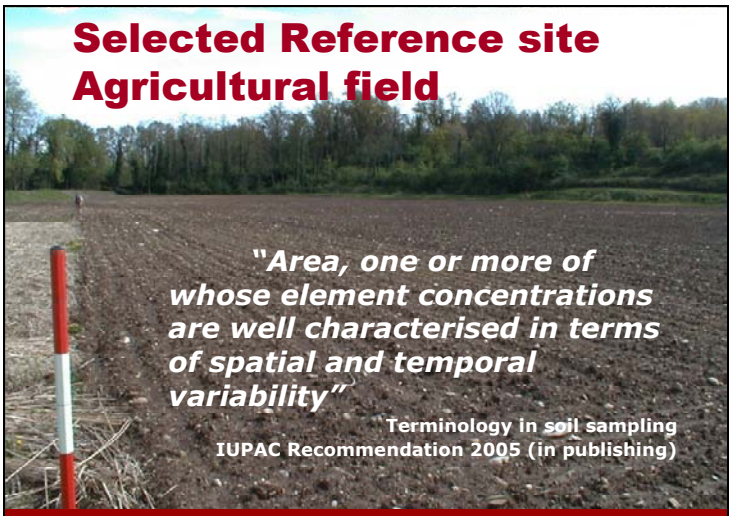
- In the past, it has been pointed out that in soil analysis sampling strongly influences the final analytical data and it contributes to the measurement uncertainty. Some researchers addressed their attention on this issue.

- P. Gy, (France);
- Desaules, A (Switzerland);
- M. Ramsey and M. Thompson, (Great Britain).

SOILSAMP project

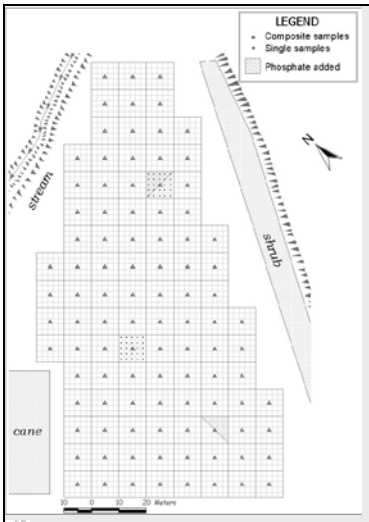
- Establishing protocols for soil sampling in different environments (agricultural, semi-natural, urban and contaminated);
- Assessing uncertainties associated with different soil sampling methods in order to select the "fit-for-purpose" method;
- Qualifying, in term of trace elements (metals) spatial variability, an agricultural reference site for national and international inter-comparison exercises

Selected Reference site Agricultural field



"Area, one or more of whose element concentrations are well characterised in terms of spatial and temporal variability"

Terminology in soil sampling
IUPAC Recommendation 2005 (in publishing)



Reference sampling

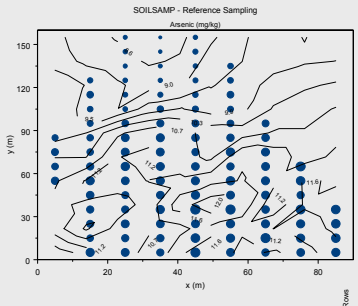
100 composite samples (pooling 25 increments per cell)

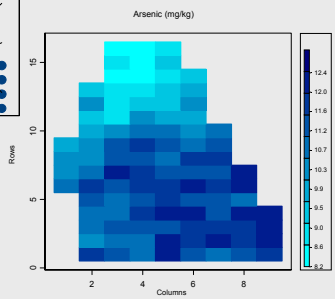
+

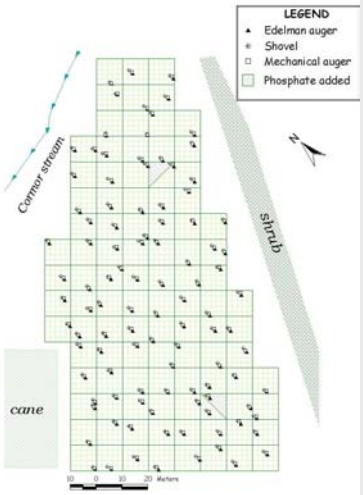
2 cells sampled again collecting 25 single samples each

Adapted from CEEM-Soil Project scheme
Desaules et.al, 2001;
Muntau et al., 2001;
Wagner et al., 2001

Reference sampling – As







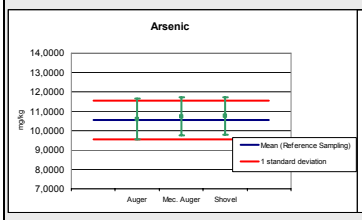
Comparative sampling

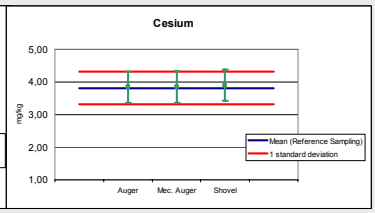
100 single samples (1 per cell) randomly selected

+

5 extra-samples to increase the information on the short range variability

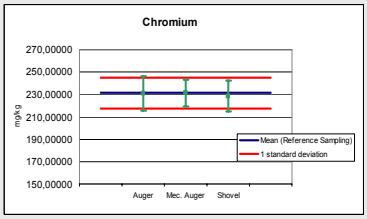
Comparative sampling – INAA (1)



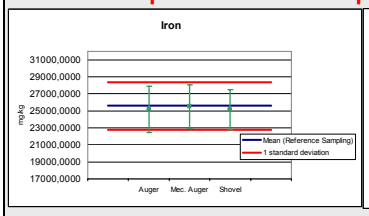


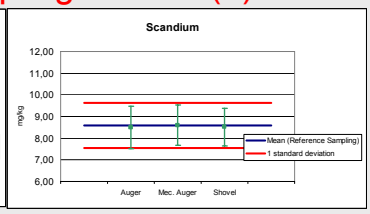
CV-reference sampling
As 9 %
Cr 6 %
Cs 13 %

CV-comparative sampling
As 9-10 %
Cr 6-7 %
Cs 12-13



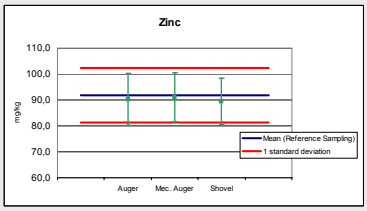
Comparative sampling – INAA (2)





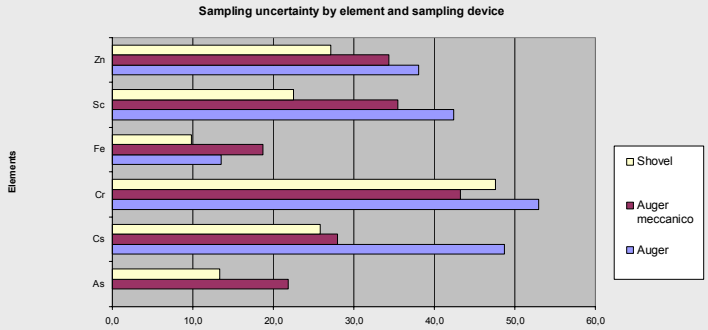
CV-reference sampling
Fe 11 %
Sc 12 %
Zn 11 %

CV-comparative sampling
Fe 10-11 %
Sc 11-12 %
Zn 10-11 %



Sampling Uncertainty

- The uncertainty evaluation is done by a combination of the bottom-up approach and the top-down approach, as reported on the Guide to the Expression of Uncertainty in Measurement (ISO, 1993).
- The proposed method uses classical statistics and the information resulted from geostatistics.



	As	Cs	Cr	Fe	Sc	Zn
Shovel	13,3	25,8	47,6	9,8	22,5	27,1
Auger meccanico	21,9	27,9	43,3	18,7	35,4	34,3
Auger	0,0	48,7	53,0	13,5	42,4	38,1

U (sampl/tot) %

Soil sampling inter-comparison (1)

- National and Regional environmental protection agencies, universities, research institutes,
  - requirements of ISO17025 on sampling
  - monitoring data comparability
- by using different tools for quality control and quality assurance.

Soil sampling inter-comparison (2)

- On October 2004 an inter-comparison exercise (APAT-IC003) has been performed in the reference site located the North-East Italy.
- **Intercomparison Objective:**
  - Determination of the concentration mean value of some elements (metals) within the agricultural area
- **Outcome:**
  - Information on performance of different sampling strategies and techniques normally adopted by laboratories

Soil sampling intercomparison (3)

- Participants: 14 Italian Regional environmental protection agencies

- Their own sampling procedures and techniques as normally applied within routine activities (under stated conditions).
- Sample preparation and measurement (INAA) by a single laboratory

Stated conditions

- Maximum number of samples (15);
  - Simulation on the basis of reference sampling data

- Maximum sampling time;
- Number of sampling teams simultaneously operating in the field;
- Sampling depth.

Soil sampling intercomparison (4)

- The raw analytical data related to each laboratories will be sent to the labs.

- The participants are responsible for the calculation of the concentration mean value of all elements

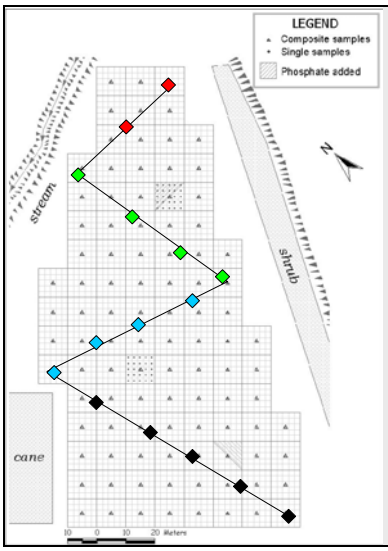
Sampling Strategies

- **Different sampling patterns :**
  - Non systematic
  - Systematic
  - Stratified random
- **Sampling devices:**
  - Hand Auger (Edelmann)
  - Shovel
- **Type of samples:**
  - Composite samples (different number of increments)
  - Single samples

Sampling Patterns

All laboratories adopted different sampling strategies with patterns attributable to 3 main classes:

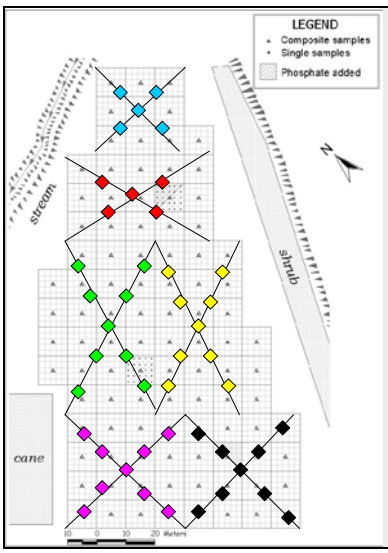
- Non systematic: 4 labs
- Systematic: 5 labs
- Stratified random: 5 labs



Sampling Pattern

Non-Sistematic

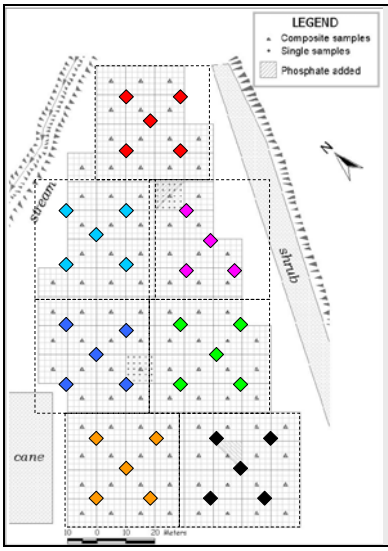
W Shape



Sampling Pattern

Non-Sistematic

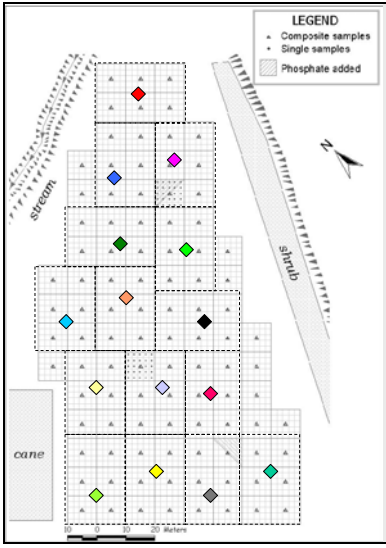
X Shape



Sampling Pattern

Sistematic

Grids 40x40 meters



Sampling Pattern

Stratified Random

Sub-area 30x20 meters

Sampling Techniques

Hand auger
9 labs

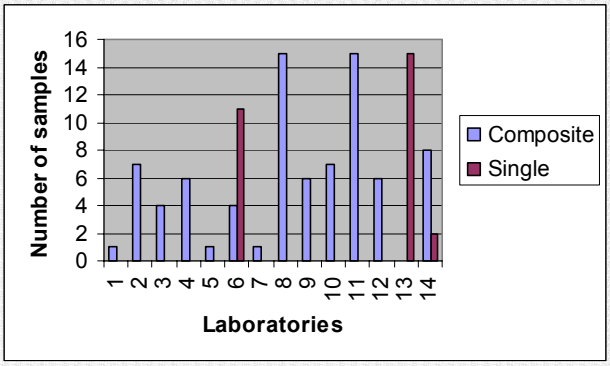
Shovel & spatulas
5 labs

Samples Type (1)

- Composite samples (13 labs)
- different number of increments (3 to 51)

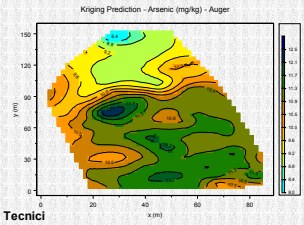
- Single samples (1 lab)
- 15 samples

Number of samples



Results assessment

- Lab Mean values vs. Reference value (As, Fe, Cr, Sc, Zn)
- Sampling strategy *fit-for-purpose;*
- Tentative Z-scores



Mid-term actions

- Draft intercomparison report (August 2005)

- 2nd sampling intercomparison (October 2005)

- **2nd Intercomparison Objective:**
  - Determination of "hot-spots" within a limted area of the reference site

For further information

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00128 Roma

Guidance for soil sampling to certify change of carbon stock in soils of the European Union

Presented by
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Abstract

The entry of the Kyoto Protocol into force opens an opportunity for wide scale implementation of land use, land use change and forestry (LULUCF) projects in European Union (EU). Two supplementary to the Protocol documents: (1) Land Use, Land-Use Change, and Forestry (LULUCF) (IPCC, 2000) and (2) Good Practice Guidance for LULUCF (IPCC, 2003) identify soil organic carbon (SOC) to be an obligatory when implementing Articles 3.3 of (afforestation, reforestation and deforestation since 1990), and Article 3.4 (forest management, cropland management, grazing land management, revegetation). However, these reports provide general modalities on the countrywide SOC account and reporting, which are lack of practical details to work in the field. To facilitate the Protocol implementation the action MOSES (Monitoring the State of European Soils) of the JRC developed guidance for soil field sampling to certify changes of carbon content in mineral soils of EU. The guidance follows general requirements of the International Standard Organization (ISO/FDIS 10381-1:2002(E)). It is particularly relevant to ISO 10381-4 devoted to "Sampling to support legal or regulatory action" that covers the requirements to establish baseline conditions prior to an activity, which might affect the composition or quality of soils. Sampling strategies are consistent with IPCC LULUCF good practice guidance (IPCC, 2003).

In contrary to IPCC (2003) the guidance proposes to certified changes arrived from physically measured carbon stocks prior (baseline occasion) and after the activity is undertaken (second occasion). Changes computed from models cannot be certified as they are subjective and depends on the assumptions behind the models.

The guidance cover cropland, pasture and forest categories. Soils of the latter have different profiles, which is accounted by the sampling strategy. It is suggested to sample only ploughed topsoil in the cropland. The 10 cm layers to the depth of 30 cm are proposed for pastures. The IPC "Forests" (2003) have been modified for the tasks. One sample is suggested for all organic layers. The 0-10 and 10-20 cm samples are proposed for the mineral soil. For all categories semi-random grid distribution of the sample collection and composite samples are suggested. The guidance is going to be tested and submitted to European Commission.

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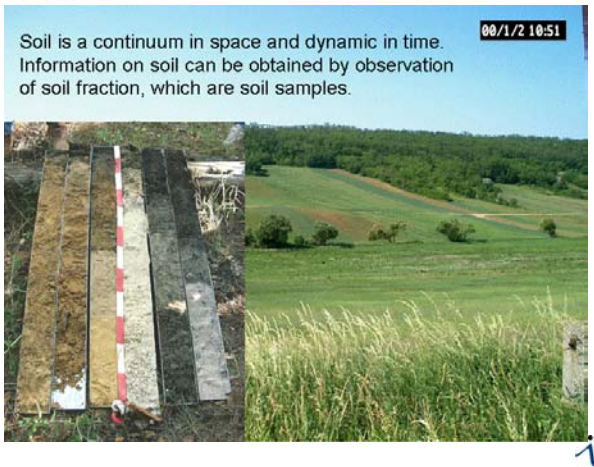
Soil is a continuum in space and dynamic in time.
Information on soil can be obtained by observation of soil fraction, which are soil samples.



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SOIL SAMPLING PROTOCOL TO CERTIFY THE CHANGES OF ORGANIC CARBON STOCK IN MINERAL SOILS OF EUROPEAN UNION

Vladimir Stolbovoy, Luca Montanarella,
Nicola Filippi and Senthil-Kumar Selvaradjou

"Problems around Soil and Waste II – Horizontal aspects of sampling"
European Commission DG JRC, Ispra 28 February – 1 March, 2005

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Path through presentation

- Introduction on the Kyoto soil
- To improve Good Practice Guidance (GPG) on LULUCF
- Sampling Protocol (SP) for the carbon change certification
- Progress and the follow up steps

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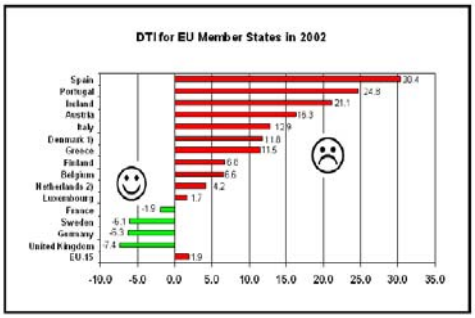
Distance-to-target indicator (DTI) for EU Member States in 2002 (in consideration of the EU burden sharing targets under the Kyoto Protocol). Source: Modified from EEA (2004:Figure 2).



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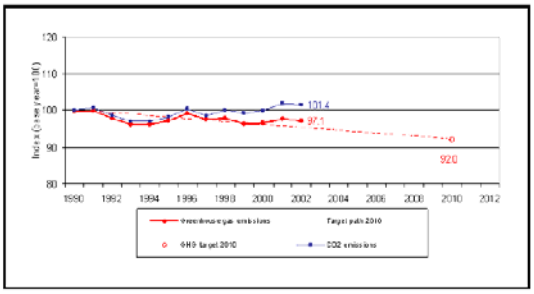
Total EU GHG emissions for 1990–2002 in relation to the Kyoto target for 2008–12. Source: EEA (2004:Figure 1).



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Advantages of using soils in the Kyoto

- Second large C pool and potential to sequester
- Long-term storage $1*10^2$-10^3 (in comparison: litter – 1-10 yr, vegetation $1*10^2$ yr)
- Improving soil quality
- Highly positive environment effect

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Articles 3.3&3.4 of the Kyoto Protocol

3. The net changes in greenhouse gas emissions by sources and removals by sinks resulting from direct human-induced land-use change and forestry activities, limited to afforestation, reforestation and deforestation since 1990, measured as verifiable changes in carbon stocks in each commitment period, shall be used to meet the com ... ources and remo ... er and revie ...

4. Pr ... Protocol, each ... nd Tech ... be made of its ch ... of the Parti ...

Protocol shall, at its first session or as soon as practicable thereafter, decide upon modalities, rules and guidelines as to how, and which, additional human-induced activities related to changes in greenhouse gas emissions by sources and removals by sinks in the agricultural soils and the land-use change and forestry categories shall be adde ... unce ... l Panel on Clim ... in acco ... y in the secon ... ditional huma ... e since 1990.

changes in greenhouse gas emissions by sources and removals by sinks resulting from direct human-induced land-use change and forestry activities, limited to afforestation, reforestation and deforestation since 1990

changes in greenhouse gas emissions by sources and removals by sinks in the **agricultural soils** and the land-use change and forestry

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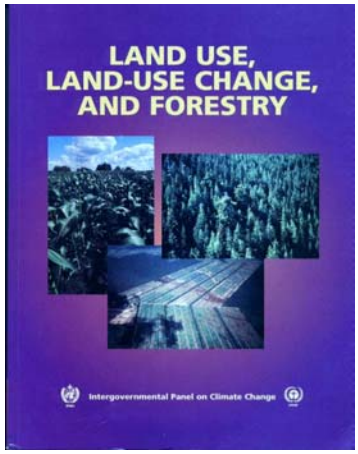

IPCC (2000)

Special Report on Land Use, Land-use Change & Forestry

Concerted attempt to examine the feasibility and implications of implementing the Kyoto Protocol

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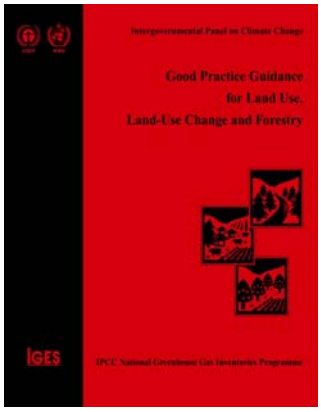

IPCC (2003)

GPG-LULUCF provides methods and good practice guidance for estimating, measuring, monitoring and reporting on carbon stock changes from LULUCF activities.

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To improve Good Practice Guidance for LULUCF

Weakness of the GPG

- Too global orientation on GHG inventory and reporting
- Flexibility of the localization of the soil sampling , loss of pan-European consistency
- One standard sampling depth (0-30 cm) for all soils
- Lack of recommendations on the sampling methods:

Objectives of the SP

- To bring practice in the fields and forests
- Unification of the sampling localization
- Substantialization of the sampling
- Provide with relevant sampling procedure

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Standard and norms

1. ISO/FDIS 10381-1:2002(E)) and particularly relevant to ISO 10381-4 devoted to “Sampling to support legal or regulatory action”
2. Consistent with IPCC LULUCF’s good practical guidance (IPCC, 2003, p.1.6)

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Requirements for the sampling

- Define average C stock (composite sample)
- Certify changes (relative term allowing use of national laboratory methods)
- Simple and operational
- Cost effective
- Statistically sound

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Models and Computation

1. $$SCD_{site} = \sum_{layer=1}^{layer=j} (SOC_{content} * BulkDensity * Depth * (1 - frag))_{layer}$$

2. $$SOC_{refstock} = (\sum_{site=1}^{site=m} SCD / m) * A_{plot}$$

3. $$\Delta SOC_{stock} = SOC_{refstock} - SOC_{curstock} - f_{org} - f_{\lim}$$

Variables are different by origin and techniques, e.g. field and laboratory, boring and trial pits, core cutting cylinder and sampling frame, etc. Result depends on the sampling scheme.

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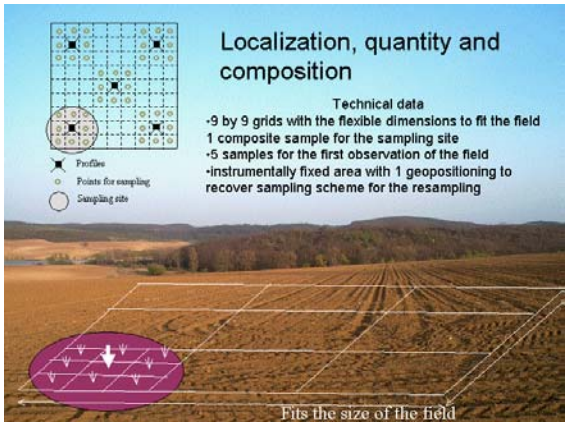

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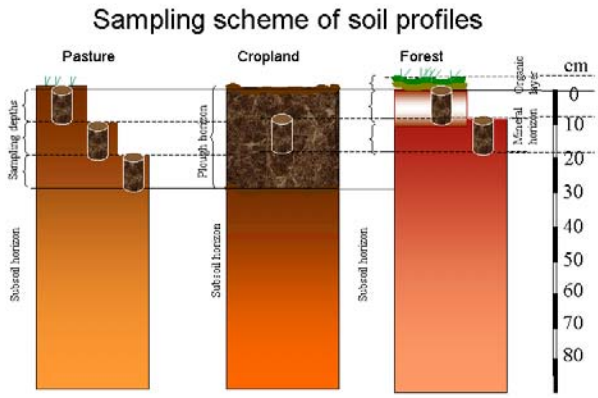

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Progress and the follow up steps

- The draft - TR is to be completed
- Reviewing by stakeholders, e.g. European Soil Bureau Network, Horizontal project, etc.
- Testing on selected areas, ECALP, demonstration project on Forests
- Submission of the TR to European Commission and Executive Board of the UNFCCC in Bonn

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Sampling aspects for Construction Products

Presented by
Rein Eikelboom
Ministry VROM, NL - 2500GX Den Haag, The Netherlands
mailto: rein.eikelboom@minvrom.nl

Abstract

The project Horizontal started with the needs of test methods and evaluation procedures for sludge, biowaste and soil monitoring. However one realized that the same methods are or can be used in other sectors as well. It is preferable that the test methods will be developed in such a way that they can be suitable or easily made suitable for use in other situations.

An evaluation of the Construction Products Directive (CPD) makes clear that there are many cross connections. The CPD aims at harmonization of the European market for construction products. Based on 6 Essential Requirements, relevant parameters for each construction product are selected. For these selected parameters uniform test methods will be selected or developed. Producers of construction products should provide information on the quality of their products, based on these test selected methods. As soon as such test methods are approved as being fit for purpose, it is not acceptable any more that authorities use or demand other information, or information based on other test methods.

The technical specifications for construction products are and will be worked out in CEN-harmonised product standards, since the CPD is a 'New Approach Directive'. The EU-Commission mandated CEN to elaborate these Harmonised product standards as EN's. For more than 100 construction product families or subfamilies such Technical Specifications are in force now. It is expected that finally more than 500 Technical Specifications for product families and sub families will be available. E.g. for aggregates, asphalt, masonry, drinking water products, roofs, heating facilities, etc.

'Essential requirements 3' deals with 'Health, Hygiene and the Environment'.

Until now specifications for 'Dangerous Substances' were exempted from the development of the Harmonised Product Standards. Annex ZA of the Harmonised Product Standards include a clause that refers to the existing national and European legislation for evaluation of 'Dangerous Substances'. 'Dangerous Substances' include all substances for which National or European legislation set criteria or limit values.

In the past two years a special Mandate was prepared on Dangerous Substances. It was prepared in the 'Working group 'Dangerous Substances', falling under the Standing Committee on Construction (SCC). The SCC advises DG-Enterprise on the CPD.

It was concluded that it would be disadvantageous for all parties concerned (construction and environment) if all the relevant CEN Technical Committees would work out their own test methods on dangerous substances. Lots of products, materials or

raw materials can fall under different Technical Specifications, e.g. depending on the manner the product is used.

Different test procedures for the same parameters would lead to a lot of double work. It would also complicate the links to environmental legislation. So it was concluded that one new task force or one new CEN-TC has to be formed that will coordinate the development of test methods on 'Dangerous Substances'. In 2005 a working plan will be worked out and send to DG-Enterprise. As soon as DG-Enterprise accepts the working plan, the work on harmonization of test methods can start. It is foreseen now that the Coordination committee will form 3 subgroups, that will be responsible for 1.Sampling, 2.Effects to Soil and Water, and 3. Indoor Air.These groups will use available methods and knowledge as much as possible. This starting point is important for cooperation within the different sectors of CEN (Construction, Environment and others).

Each of the available Technical Specifications include instructions on sampling. However, these instructions are rather general and often leave much room for interpretation. The Technical Specifications make a distinction between Initial Type Testing and Factory Production Control. This is comparable with the distinction between Characterization testing and Compliance testing as included in the Landfill Directive.

In general it may be concluded that the technical and statistical basis for testing the technical aspects of construction materials or the environmental aspects are the same. However, the specific properties of dangerous substances often call for different test frequencies and different methods of sampling and testing. Especially when the dangerous substances are present in low concentrations with relatively high variations in concentration and leaching properties.

The CPD includes civil engineering work and road construction. So the EN-13242 on Aggregates may include materials extracted from the soil (including extracted dredging sludge) when used in constructions. These materials can be reused as soil with general technical specifications only, or as e.g. sand or clay with specific specifications and specific way of use in embankments, etc. It is not clear yet in detail in which cases excavation, transport and reuse of soil falls under the terms of the Harmonised Standards on Aggregates. But it may be concluded that there are several types of use that gives overlap between general approaches on soil management and soil protection on the one hand and use as construction material on the other hand.

This overlap is an extra reason to support harmonisation of sampling and test methods for soil.

The project Horizontal should be finalized within its own boundaries. The CPD also has its own scope. Its working groups will be organized to concentrate on and serve the activities that fall within this scope.

But due to all kinds of overlap it is important that those involved in different parallel actions are aware of developments in neighboring fields and as much as possible make use of such parallel development.

Project 'HORIZONTAL' - SAMPLING

JRC; Workshop
28 February –1 March 2005

SAMPLING ASPECTS FOR

CONSTRUCTION PRODUCTS

(CONSTRUCTION PRODUCTS DIRECTIVE (CPD))

Rein Eikelboom

CPD- Main goal

Harmonisation on the construction product market

by means of:

Uniform declaration of product quality

CPD – some key points

CPD + EN-Harmonised Product Standards:
main points concerning dangerous substances

- Harmonised test methods in harmonised product standards
- Harmonised presentation of product information
- Test methods + information: Performance oriented (= 'release')
- Testing restricted to 'regulated substances'.
- Level of conformity determined by CPD

Member States / users / architects / etc:
- Specification relevant Parameters and Limit Values

CPD - Dangerous substances.

Essential requirements nr. 3: Hygiene, health and environment:

- the giving-off of toxic gas,
- the presence of dangerous particles or gases in the air.
- the emission of dangerous radiation
- pollution or poisoning of the water or soil,
- faulty elimination of waste water, smoke, solid or liquid wastes,
- the presence of damp in parts of the works or on surfaces within the works.

Which substances:

- Substances mentioned in EU directives and in National notified regulations linked with construction products

Inventory existing legislation: 'EU-database regulated Substances'

- Actually collected: EU + 4-6 MS; →is basis for decisions

EU Environmental Policy and Legislation

EU-Legislation

Water Framework Directive 2000/60/EC,
Groundwater Directive 80/68/EEC, (COM-2003-550)
Soil Strategy.....
Waste Framework Directive, etc.
- o Landfill Directive 99/31/EC,
- o Mining waste Directive
- o Recycling

Biocide Directive 98/8/EC,
Drinking water (98/83/EEC)
Indoor air, WHO-Health and Environment strategy
Env.+Health Action Plans (COM-2004-416)
Substances regulations (... REACH, etc)

Policy and legislation

EU-Legislation

Water Framework Directive 2000/60/EC,
Groundwater Directive 80/68/EEC, (COM(2003)550)
Soil Strategy.....
Waste Framework Directive, etc.
- o Landfill Directive 99/31/EC,
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Env.+Health Action Plans (COM.2004-416)
Substances regulations (... REACH, etc)

Construction Products Directive (CPD)

Policy and legislation

EU-Legislation

- Water Framework Directive 2000/60/EC,
- Groundwater Directive 80/68/EEC, (COM-2003-550)
- Soil Strategy.....
- Waste Framework Directive, etc.
  - o Landfill Directive 99/31/EC,
  - o Mining waste Directive
  - o Recycling
- Biocide Directive 98/8/EC,
- Drinking water (98/83/EEC)
- Indoor air, WHO-Health and Environment strategy
  - Env.+Health Action Plans (COM 2004-416)
- Substances regulations (.. REACH, etc)
- Etc

Construction Products Directive (CPD)

Construction product families

- **Aggregates**
- Cements, Building Limes and Other Hydraulic Binder
- Chimneys, Flues and Specific Products
- Circulation Fixtures
- Concrete, Mortar, Grout and Related Products
- Construction Adhesives
- Curtain Walling
- Doors, Windows and Related Products
- External thermal insulation composite systems/kits with rendering (ETICS)
- Fasteners for structural timber
- Fire stopping, fire sealing and fire protective products
- Fixed Fire-Fighting systems
- Floorings
- etc
- etc

totally about 40 product families; many subfamilies.

Aggregates

- EN 13242:2002 title:

"Aggregates for unbound and hydraulically bound materials for use in civil engineering work and road construction".

Scope

"This European Standard specifies the properties of aggregates obtained by processing natural or manufactured or recycled materials for hydraulically bound and unbound materials for civil engineering work and road construction".

Scope includes: - reused excavated soils
- reused excavated dredging sludge

STRUCTURE OF hEN's

hEN's = harmonised product standards on construction products

→ **Standard** →
- Relevant product parameters
- Selection of test methods
- Presentation form of test results
- (Usualy no limit values; sometimes classes)

→ **Annex ZA** →

CE-mark:
- Which parameters from the standard
- Which level of compliance
- ('Dangerous substances, temporarily excluded)

Sampling in hEN's for construction products; e.g. Aggregates EN 13242:2002

EN 13242: - Sampling method → EN 932-1

EN 13242, Annex C; Factory Production Control:
- Manufacturer should elaborate written procedures
- Procedures should follow principles of this EN
- Minimum test frequencies given for relevant parameters

EN 932-1:
- For technical civil engineering aspects only
- Main principles and demand for elaborating a sampling plan (comparable with general elements in CEN292-WG1)
- No detailed statistical instructions;some remarks only

Testing levels- Landfill Directive

1. **Characterisation and Environmental evaluation**
2. **Compliance Testing**
3. **On Site Verification**

Testing levels- CPD

1. Initial type testing

2b 'Without Further Testing'
for all substances

2a. Factory Production Control

CPD- Testing levels

1. Initial type testing

2b 'Without Further Testing'
for all substances

'Without Further Testing'
for selected substances

2a. Factory Production Control

CPD - Organisation on substances

SCC
-Vote on mandate
-Providing information to WG on national regulations (database)

Expert Group on regulated substances

-Providing information to SCC
-Drafting mandates for horizontal standards

-Evaluating database
-Identification of products CwfT
-Evaluating CEN TR
-Providing information to CEN/TC

Product TC
Product TC
Product TC

CEN horizontal TC
-Work Programme
-Structure for working - liaisons
-Standardisation - validation

>40 TC's

WG sampling

WG indoor air

WG soil - water

>600 Harmonised Product Standards (hEN)

Timetable: CPD and Dangerous Substances (1)

Indicative Timetable (if no delay in each step):

26 October 2004: *Final discussion mandate on Dangerous Substances in Standing Committee on Construction (SCC)*

March2005: *Formal mandate sent to CEN (after finalizing internal EU-Commission procedures.*

During 2005: *Working plan elaboration*
- *17-18 March; Preparatory meeting CSNPE.*
- *Formal start CEN-Construction coordination committees on dangerous substances*
- *Development and completion CEN working plan (within 8 months after formal receiving the Mandate)*
- *indicative start with work on Technical Reports and Standardization.*

End 2005/Beginning 2006: Acceptation working plan by EU
- *Discussion on the CEN-working plan and decisions on the plan by SCC.*
- *Stand still for national standardisation activities, related to the accepted CEN-work items*

VROM 'Horizontal', workshop sampling 28 February 2005 16

Timetable: CPD and Dangerous Substances (2)

General time table; Relevant moments for national legislation, etc.

Beginning 2006: - *Stand still for relevant national standardisation activities.*

From 2006: - *MS can anticipate on selections in the CEN-working plan*

About 2009-2011:
- *First group of new test methods included in national regulations*
- *Producers shall include test results according to new selected test procedures, with CE-marking.*

VROM 'Horizontal', workshop sampling 28 February 2005 17

"Construction and Environment"

CEN CONSTRUCTION SECTOR NETWORK CONFERENCE,
29/30 SEPTEMBER 2003, COIMBRA, PORTUGAL

The CPD and Regulated substances
The Next Step:

Construction meets Environment

VROM 'Horizontal', workshop sampling 28 February 2005 18

Conclusions (1)

- CPD tends to speed up horizontal harmonisation
- CPD determines the time table

- 'Environmental sector' is demanded to deliver adequate test procedures and guidance.

- Sampling procedures in the construction sector for technical aspects include same aspects as the framework, discussed in the JRC-Horizontal workshop (28 Feb -1 March 2005).
- However the sampling procedures should be elaborated further for environmental parameters.

Conclusions (2)

- Project 'HÓRIZONTAL' should be finalized soon within its borders

- CPD offers a challenge to introduce the 'Horizontal message'

  and to introduce experiences and 'Horizontal-standardisation products' into other sectors

Introduction

- Rein Eikelboom
- Ministry Housing, Spatial Planning and the Environment (Netherlands) rein.eikelboom@minvrom.nl

- member CEN-TC292 – Waste
- member Steering group project 'Horizontal'
- member Expert group dangerous substances CPD
- member TAC Landfill Directive- Annex 2 (2000-2003)
- member new horizontal CEN-'taskforce'/'TC' Construction and dangerous substances
- Participant in Project Discharches of the WG2C- Groundwater Directive, 'direct and indirect discharges'

Criteria CPD - Essential Requirements

1. **Mechanical resistance and stability**
2. **Safety in case of fire**
3. **Hygiene, health and the environment**
4. **Safety in use**
5. **Protection against noise**
6. **Energy economy and beat retention**

The CPD only concerns the phase of use of products

Timetable: CPD and Dangerous Substances (2)

Draft mandate mentions that a first group of CEN test standards should be delivered in 2007 and the rest by 2010. Due to extra time needed for development of the manda this timetable should be updated.

The working plan may make a difference in test methods that can be selected and completed rather easily and other methods that need more development time. All tests methods need validation.

A more realistic fastest time table for the first group of test methods may be:

1 year	*finalizing prEN's*
1 year	*validation*
1.5 year	*formal procedures in CEN, incl. voting*
...months	*fitting EN-test methods into EN-Harmonised product standards*
.. months	*acceptance test methods by EU-Commission/DG-Enterprise*
... months	*introduction time; implementation by Member States*

Totally ca. 5 years. Some options for speeding up; some risks for spending more time.

Sampling and accreditation in the framework of EN ISO 17025

Presented by
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Abstract

In the nineties, the standard EN ISO 17025:2000 for the "General requirements for the competence of testing and calibration laboratories" was developed ensure a better quality management considering the needs of laboratories. Chapter 4 of this standard deals with the management requirements, including a section "4.2 Quality System". An informative annex provides correspondence with ISO 9000 standards (1994) (updating pending), whilst Chapter 5 deals with the technical requirements that are the general basis of the competence of the testing and calibration laboratories. These general technical requirements complement the measurement standards for which competence is claimed or accreditation is applied for.

It has to be noted that chapter 5.7 deals specifically with sampling by stating that "*The laboratory shall have a sampling plan and procedures for sampling when it carries out sampling of substances, materials or products for subsequent testing or calibration. ……The sampling process shall address the factors to be controlled to ensure the validity of the tests and calibration results*".

This means that each laboratory performing routine measurements will have its own "recipe" (possibly based on a general guidance standard) unless a sampling standard provides a common tool (a common recipe) of appropriate quality for the sampling scenario under consideration. Consequently, the quality of harmonised sampling relies mainly on the quality of the sampling standards dedicated to specific sampling scenarios and not on the different processes for competence recognition such as accreditation or other third party evaluation.

ISPRA Sampling workshop – Feb. 2005

Sampling and accreditation in the framework of EN ISO 17025

by

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1

Sampling and accreditation in the framework of EN ISO 17025

- In the eighties development in Europe of the European standard EN 45001. Its scope is – de facto - limited to the "analytical" steps of a measurement i.e. the steps carried out within a laboratory
- In the nineties development of the standard EN ISO 17025:2000 for the "*General requirements for the competence of testing and calibration laboratories*"

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2

Sampling and accreditation in the framework of EN ISO 17025

- EN ISO 17025:2000 consist of two parts :
- Chapter 4 deals with the **management requirements**, including a section 4.2 Quality System. An informative annex provides correspondence with ISO 9000 standards (1994) (updating pending)

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3

Sampling and accreditation in the framework of EN ISO 17025

- Chapter 5 deals with the **Technical requirements** that the general basis of the competence of the testing and calibration laboratories
- These general technical requirements complement the measurement standards for which competence is claimed or accreditation is applied for.

STRATENE 4

Sampling and accreditation in the framework of EN ISO 17025

- The chapter 5.7 deals specifically with **sampling** : *The laboratory shall have a sampling plan and procedures for sampling when it carries out sampling of substances, materials or products for subsequent testing or calibration. ……The sampling process shall address the factors to be controlled to ensure the validity of the tests and calibration results*

STRATENE 5

Sampling and accreditation in the framework of EN ISO 17025

- This means that each laboratory performing routine measurements will have its own **"recipe"** (possibly based on a general guidance standard) **unless a sampling standard** provides a common tool (a common recipe) of appropriate quality for the sampling scenario under consideration

STRATENE 6

Sampling and accreditation in the framework o EN ISO 17025

- Consequently, the quality of harmonised sampling relies mainly on the **quality of the sampling standards dedicated to specific sampling scenarios** and not on the different processes for competence recognition such as accreditation or other third party evaluation

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7

Conclusions of the Workshop

Based on the work performed in the various discussion groups as well as in the plenary session and considering the input obtained by the key lectures, a number of conclusions could be elaborated. As underlying leitmotif of all comments there was the common understanding the relevance of sampling of soil, biowaste, sludges, waste and related materials is generally NOT sufficiently considered, if compared to the attention given to the subsequent measurement steps. Often, good sampling is more the result of a series of lucky circumstances rather than of a scientific process. The statement made during the event that "*Sampling is an art; it should become a science"* illustrates this nicely.

Discussion Group I
Technical approach and questions

Chaired by F. Lamé

Conclusions of the first parallel session

Uncertainty

The Standard on sampling should contain instructions on how to determine the uncertainty. In addition to that, it also should be obligatory to determine the uncertainty.

Validation

The necessity to validated EN-standards should have a different interpretation for sampling in comparison to other standards. In light of available time and funding on the one hand, and the large variety of combinations of objectives, materials to be sampled and sampling circumstances, true validation is simply impossible. However, it is considered important to do some benchmarking (performance testing); meaning to apply the standard for a limited number of objectives, materials and situations in order to show that the standard does function as it should.

Necessary instructions for four scenarios

In addition to the standard there should be a series of accompanying documents (for example Technical Reports) that provide instructions for applying sampling in practice. Four scenarios are distinguished based on a first distinction between mobile and immobile materials.

Mobile:	conveyor belt
Intermediate:	trucks / lorries / ships
Immobile:	stockpiles
	in-situ soils

Trucks / lorries / ships and other transport units might be seen as mobile from a macro perspective, but are immobile when looked at the material contained. During loading or unloading the material is mobile, during which period it is best accessible for sampling.

Sampling from mobile materials is relevant to enable probabilistic sampling and shall be applied for basic characterization. For compliance testing, the sampling within the transport unit will be common practice in most situations.

Framework Standard for in-situ soil

As a reaction to the presentation of Stephen Nortcliff, the parallel session sees no basic problems with the implementation of in-situ soil sampling in the Framework Standard describing the production of a Sampling Plan. However, there might be problems with terminology but these can (and should) be solved.

Roadmaps

Given the fact that there will be different objectives for sampling, the session feels that the elements of the standard and accompanying documents that are fit for purpose for a specific objective are to some extent limited. In analogy: not all items on a shop shelve are fit for a specific objective. It is considered essential to specify 'roadmaps' in order to define what methods from the individual 'shop shelves' are acceptable given a specified objective. As such, these roadmaps provide the guidance for sampling on a quality level that is thought to be necessary for a specific objective.

Conclusions of the second parallel session

Five topics for discussion were identified at the start of this session.

The level of prescription

The necessary level of detail provided in the documents that accompany the Framework Standard depends on the person who is applying the Framework Standard. For the sampling expert Project Manager, the level of detail can be limited and as such provide the necessary freedom to apply the standard in such way that is most fit for a specific situation. For the sampler, who in most cases will have only a limited theoretical background, detailed instructions are necessary. As such, the documents as produced by CEN/TC 292/WG 1 provide a good basis as these indeed provide only a common approach for the expert user but contain also detailed instruction for sampling practice.

Accreditation / certification and standardization

The questions raised are if the availability of a sampling standard by itself provides sufficient guarantees that it will be applied in a correct way, or that this should be ensured through certification or accreditation. In a limited number of Member States, some degree of certification for the sampling of soil is established. Accreditation for soil sampling is very limited. The general feeling is that a certain degree of quality control is necessary, although it is not concluded that this should per definition be certification or accreditation. Indeed it was stated that certification or accreditation are by itself no guarantee for quality, but they allow a check on potential errors if there is doubt on obtained results.

Benchmarking

In the first session a discussion on the 'validation' of sampling was discussed, resulting in the conclusion that performance testing for a limited number of scenarios (specific combinations of objective, material and sampling circumstances) is necessary. This was discussed in more detail, resulting in a distinction between the performance test of the standard itself (a) and the sampling personnel (b). For both forms of performance testing it is necessary to have reference sites available throughout Europe.

Communication

Communication on sampling is considered essential as it is though to be a neglected subject despite the fact that major errors in results are related to sampling. However, it is hard to show the advantages of good sampling; clear examples are therefore considered important.

Terminology

A clear definition of terminology in the standard is considered essential in order to ensure that the end-user has the same understanding of the standard as was meant to be by the group of expert that made it. In addition, in (inter)national discussions between experts it is also important to ensure that the same terminology and definitions are used. However, in common speech there will be differences in the definition of terms - or lack of definition of terms - which is a problem that is very hard to overcome. Clarity of terminology in common speech can only be reached in the long term.

General conclusion

A number of clearly articulated desires have been raised during the two technical sessions. These recommendations are very valuable for the further progress of sampling within the project HORIZONTAL and will guide the work within WP2 in the near future.

Discussion Group II
"Policy approach and strategic questions"

Chaired by B. M. Gawlik

Conclusions on the first parallel session

The group identified the following fields of interest in the EU legislative process, that are relevant in relationship to sampling:

- the revision process of the Sewage Sludge Directive;
- the developments aiming at the development of a Soil Framework Directive, which may contain a soil monitoring component;
- activities in relationship to the EU-regulation on Forest Soils (FOREST FOCUS);
- some elements of the Thematic Strategy for soil management;
- The Landfill Directive.

From that legal framework, a series of aspects, problems and concrete questions in relation to sampling were identified. In particular the following four issues were rasised:

Q1. How to develop the necessary instruments, e.g. for sampling issues, in a way that they can be used in a "horizontal" manner and for upcoming and future topics and initiatives?

The group felt that this topic should be developed further as this could also increase the impact of Project Horizontal on the European standardisation scene.

Q2. Is it possible to transfer the experiences gained in the development of an over-arching sampling framework for waste characterisation to similar areas?

The usefulness of the work done in CEN TC 292 was acknowledged and it was discussed how to enlarge the applicability of the respective standardisation document.

Q3. Can pilot-studies (performed or planned) on a series of specific sampling problems in relationship to the policy areas mentioned above, be developed as a tool to establish a common language for sampling issues?

There was a clear wish to better integrate individual, regional or national sampling initiatives for the sake of harmonisation.

Q4. Would a facilitated access to certain environmental standards – at least on EU-level – promote collaboration/integration/implementation of these standards and the underlying policy measures?

This problem was identified as a serious problem in the dissemination of environmental standards.

Conclusions on the second parallel session

Based on the group and plenary discussions of Day 1 of the workshop, the group discussed some strategic options, possible actions and conclusions. Most of the topics addressed mainly the issue of communication between standardisation, research and policy making.

- The group recommends that the results of this workshop should be communicated in an appropriate form to the Steering Committee of Project HORIZONTAL as well as to CEN and its relevant TCs, the respective national mirror committees and to relevant Commission services, in particular at DG ENV.

- In order to better transmit the message of across-matrix, i.e. "horizontal" standardisation, and in particular of horizontal aspects of sampling, it was discussed whether dedicated trainings sessions for legislators, regulators and users of the standards in the lab may be useful. Although the group can only recommend concrete programs and activities in that respect, it was felt that the creation of an expert system on sampling issues, which could facilitate the exchange of experiences, might lead to the establishment of harmonised training programs. On an executing level ("the sampler") the relevance of ISO 17025, which addresses in its current version the issue of "sampling" explicitly, is a strong driving force for training activities. Thus, a series of positive examples were reported from Austria, Germany and the Netherlands.

- To better address those aspects of Project HORIZONTAL that are relevant for landfills, F. Mochty (Austria) proposed to organise a dedicated workshop event, which will also address the special sampling requirements. Details on this proposal will be elaborated at a later stage.

- The group felt that a compilation of various, real-world sampling scenarios covering the matrices soil, biowaste, sludge and waste in four different sampling situations (in-situ field, stockpiles, conveyer belt and transport containers) might be a useful guidance document illustrating the applicability of a framework standard for sampling. In this context the Austrian experience on compost sampling and the French AFNOR campaign on sampling at the output of waste sorting facility were mentioned as two possible candidate scenarios to be included in such a guidance document. A further enquiry among the meeting participants might reveal other suitable experiments.

- Upon proposal by the JRC, it was agreed to use possibly upcoming or planned JRC pilot studies, in particular on forest soils and on contaminated sites, to enhance the aforementioned documents.

- Another issue of discussion was the dissemination of environmental standards with special respect to the situation in the new Member States and the Acceding Countries. The group felt that the access to certain environmental standards should

be facilitated. Unlike industrial standard, the fees to be paid for the purchase of those standards hamper their distribution. The group proposes to trigger a discussion via CEN's Strategic Advisory Board for Environment (SABE), whether alterative methods of standard dissemination are feasible. As a positive example, the German handbook for soil testing was mentioned.

Discussion Group III
"Practical approach and questions"

Chaired by S. Nortcliff

Conclusions on the first parallel session

Practical differences between sludges, biowastes and in situ soils

- The principal difference is that soils in most circumstances do not move. There is however the possibility of soil being moved by natural processes such as erosion or land slipping and by artificial processes such as excavation. Soils naturally exhibit considerable variability at a variety of scales. The processing of sludge and biowaste results in a degree of homogenisation.
- In many respects the task of sampling a soil is different from the tasks related to sampling of sludges and biowastes.
- There is a relatively simple task in specifying the target population of sludges or biowaste. This might be production over one year, a batch over a given time slot, a defined mass or volume.
- Defining the soil population may be more difficult. The normal 'unit' of soil has been specified as a field. Where the field is relatively small this may be appropriate, but with larger fields it may be appropriate to characterise and manage subsets of the field. It was suggested that it might be appropriate to set 10 ha as the maximum size of a soil unit/field. If there is no other basis for subdividing the soil a unit size of 10 ha may be appropriate. As a consequence an area of soil <10 ha may be considered 1 field; 10-20 ha would be a minimum of 2 fields; 20-30 ha, three fields, etc. Finer subdivisions than the basic 10 ha may be possible if there is relevant information available.

How do we identify the depth of soil to be sampled?

- Normally the depth of soil sampled and characterised is the depth affected by the incorporation of the sludge or biowaste. If the incorporation is by ploughing the depth of ploughing would determine the depth of sampling (0-20cm, 0-25 cm, 0-30 cm, etc.). Where material is injected in to the soil this will determine the depth of sampling.

Conclusions on the second parallel session

What is the potential role of pilot studies, benchmark studies?

1. Detailed pilot studies may provide information prior to the design of the details of the overall sampling programme which will guide that programme.
2. An approach involving a degree of detailed sampling at a series of benchmarking sites (chosen on the basis of broad characteristics such as source of feedstock, treatment process involved, geographical location, etc.) which will be supported by a less intensive routine sampling at all sites. Given the diversity

of processes and environmental conditions the selection of benchmark sites may prove very difficult.

What is the objective for the investigations?

1. The choice of parameters to be determined will be decided by the threat to a receptor. If the focus receptor is a human or animal then the focus may be 'plant available', if the focus is on the groundwater as a receptor 'readily leachable' may be the chosen analysis.
2. To what extent does the choice of receptor influence the risk analysis and the sampling framework?

Communication

1. Communication must be addressed at a number of targets who would benefit by using the standards. These will include legislators, regulators, land managers, consultants etc.
2. For many potential users of standards the cost of an individual standard frequently restricts their use. For wider dissemination efforts should be made to increase the ease of access, either through producing compendia of standards available at a reasonable price. Or though simply illustrating the benefits of having standards to all participants.

Soil in situ and removed.

1. The focus in this context is on soil *in situ*. Frequently soil is removed and stored in stockpiles. Consideration needs to be given on the appropriate methods for sampling these stockpiles.

Where the stockpiled soil is contaminated with some contaminants it may show very high ranges of contaminant levels. Sampling must take account of the prior knowledge about the source and distribution of the contaminant in the soil.

Overall conclusions of the workshop

Besides the results obtained in the individual discussion groups, overall agreement on a series of conclusions could be drawn:

1.) The participants agreed that an overarching framework for sampling is possible and useful. The "shop shelves" approach developed for waste (CEN TC 292) could be extrapolated to soil and soil-related matrices, but also to construction materials.

2.) Although it is not possible to "pre-scribe" in all details, how sampling has to be performed in concrete situation, there are a series of common elements from the planning of the sampling to the respective reporting that shall follow common principles. However, any sampling shall start from a proper definition of the objective of the sampling and definition of an appropriate scale of an entity, which has to be described.

3.) The participants acknowledged that the task of sampling of in-situ soil is different from the task of sampling processed materials of sludges and biowaste. This must be considered by any standardization framework for sampling. At the same time, it is acknowledged that for the framework for sampling the consequences are expected to be mainly on the terminology, while major differences are to be dealt with in underlying documents; for example on sampling strategy.

4.) The careful definition of the target population is seen as an essential component for successful and proper sampling. This may be relatively easy in case of waste materials, but may be more complex in case of soil. In this context a careful definition of the objective of the sampling is of utmost importance.

5.) Probably the most important issue of sampling (but least well understood) is the definition of the volume or mass on which decisions are to be based. This volume or mass is known as the scale of sampling. Defining the scale has direct consequences on the variability that is found in test results. Thus the definition of the scale has a major influence on the reliability of testing.

6.) Another critical issue identified was the validation of any standardization document on sampling. The participants agreed that full validation in the classical analytical sense, i.e. testing the applicability for all possible situations, is virtually impossible. In case of sampling, however, benchmarking (comparative sampling exercises) as well as pilot-studies (demonstration or ruggedness testing) are seen as useful tools to demonstrate that a sampling standard is fit-for-purpose. In this context a better integration of a sampling framework into running activities is desirable. The necessity of reference sites for performance tests of the standard itself, but also for the sampling of the personnel was emphasized. A better integration of existing national initiatives was desired.

7.) Sampling is not a stand-alone operation, but must be seen as part of a chain of measurement. In order to maintain the custody of the measurement chain also

with respect to the uncertainty budget (explicit reference was made to the philosophy laid down in the Guide to the expression of uncertainty in measurements), any standard on sampling should contain instructions how to determine respective uncertainty. In any case, a due consideration of the uncertainty resulting from sampling should be mandatory, as this is also relevant for the end-user of the derived data.

8.) The participants agreed that the compilation of illustrating guidance documents on specific scenarios can be useful to provide instructions for applying a sampling standard in practice. Together with the sampling framework standard it was felt that roadmaps are to be developed, in order to define what sampling methods from the individual shop shelves are acceptable given a specific sampling objective.

9.) The workshop highlighted a series of problems related to communication, including the need for a clear terminology. This includes not only the technical level (the sampler), but also the legislator, regulator, land managers, consultants, etc.. It was therefore suggested to incorporate the communication on the products of the project HORIZONTAL within the project and put substantial effort in the communication.

10.) It was felt that for many potential users of standards the cost of an individual standard frequently restricts their use. Efforts should be made to increase the ease of access.

Outlook and perspectives

A part from the conclusions drawn from the 2-day lasting event, the participants are proposing a series of concrete actions and initiatives.

1.) In relationship to Project HORIZONTAL, the group recommends a dissemination of the outcome of the workshop to National Environmental Authorities engaged in the Steering Committee of the Project, CEN and its relevant CEN TCs, the relevant Commission services and mirror committees of National Standardization Bodies.
2.) The representative of the Austrian Government Mr. Mochty, proposed to organise a dedicated workshop event in which those aspects of horizontal standardisation relevant for the issue of landfill sites are discussed.
3.) Upcoming or planned JRC pilot studies, in particular on forest soils and contaminated sites, will be developed in a way that they can be used in support to the development of an overarching sampling framework.
4.) It was suggest that the discussion concerning the accessibility of environmental CEN standards in support to EU legislation should be brought to the attention of CEN.
5.) In relationship the topics discussed during this event, the participants are invited to participate in the upcoming CEN/STAR Trends Analysis Workshop – Chemical and Environmental Sampling – Quality through Accreditation, Certification and Industrial Standards, April 14-15, Brussels, occasion at which also the findings of this workshop will be presented.

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