

Programme of scientific support for standardisation and technical regulations

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FINAL REPORTS SUMMARIES

Programme of scientific support for standardisation and technical regulations

PLAN OF SCIENTIFIC SUPPORT TO AN INTEGRATION OF NOTIONS OF QUALITY AND SECURITY OF THE
PRODUCTION ENVIRONMENTS, PROCESSES AND GOODS IN A CONTEXT OF SUSTAINABLE DEVELOPMENT

FINAL REPORTS SUMMARIES



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This booklet is realised in the framework of the Programme of scientific support to a federal policy concerning the whole of activities relating to standardisation and technical regulations.



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FOREWORD

The "Programme of scientific support to a federal policy concerning the whole of activities relating to standardisation and technical regulations" (1998 - 2003) marked the continuation and fulfilment of the "Programme of scientific support for standardisation" (1993 – 1998). Along with the programme "Protection of worker health", it was part of the "Plan of scientific support to an integration of notions of quality and security of the production environments, processes and goods in a context of sustainable development". It was coordinated and followed-up by the Belgian Science Policy.

The programme has been developed in a context in which the determination of standards is coming to depend increasingly upon decisions at the European level.

The activities being targeted all form part of a vision of sustainable development under which standardisation is not only an instrument of industrial development, but also serves the interests of the individual and society.

The programme was aimed at encouraging Belgian participation in European events relating to standardisation and technical regulations so that Belgium in the future will be able to play a more active role.

Another goal was to further develop Belgian scientific potential and to increase the involvement in this issue of actors who are less involved at present (scientific world, government bodies, users/consumers, etc.).

Moreover, complementarity was being targeted through programmes within the "Scientific Support Plan for a Sustainable Development Policy" that are directly being confronted with this issue.

In order to achieve the stated objectives, a three-folded approach has been followed:

- projects of type A - realisation of pilot studies;
- projects of type B - study and evaluation of the impact on society of all the events relating to standardisation and technical regulations;
- projects of type C - development of actions focusing on promotion/awareness-raising of all the events relating to standardisation and technical regulations.

The research's summaries of this programme are published in this booklet in order to serve as a basis for reflection, as well as a means of communication of the results, to better integrate research into a strategy of standardisation.

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NM/12/01
NM/12/02
NM/33/03

SEISMIC RISK ASSESSMENT AND MITIGATION FOR BELGIUM IN THE FRAME OF EUROCODE 8

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1. CONTEXT

To be allowed to use the Eurocodes, each country has to produce a National Application Document (NAD) in which particular elements are fixed under the authority of national bodies. In 2000, the Belgian regulation concerning the seismic design of structures was not extensively developed: imprecision on the action to apply to the structures, lack of knowledge on the vulnerability of typical Belgian housing with respect to low seismicity context, lack of knowledge on an adapted art of building.

2. OBJECTIVES

The present project, which gathers geologists, seismologists and engineers, aims at defining a common point of view in the Belgian earthquake engineering community.

The main global objective of the project was to define in a short-term period, applicable seismic regulations which are suitable for the seismic hazard and vulnerability in Belgium within the frame of EUROCODE 8.

A second objective was to define a common Belgian position on the various questions arising in EUROCODE 8, in particular a correct seismic action definition (elastic response spectrum), site-specific spectra shapes and practical building regulations adapted to low seismicity regions like Belgium.

To reach these goals, it was necessary:

- to determine the source characteristics of the reference earthquakes to take into account in Belgium for a return period of 475 years;
- to study the site effects in different regions of Belgium and to specify their characteristics for typical geological conditions in Belgium. This is done by in-site experiments and computations from geological, geotechnical and geophysical data;
- to develop and evaluate the capabilities of fast and low cost field measurements to evaluate site effects;
- to define the design response spectra for rock and soil corresponding to the different seismic zones distinguished in the regional seismic hazard map;
- to compare the results with the present proposals for spectra shape modifications and to define a common National point of view for the representatives in the European commissions;

- to analyse by 3D modelling typical Belgian simple building structures under low earthquake action;
- to deduce from these analyses the connection forces between constructional elements (walls, floors, roofs) and the action effects in these elements themselves;
- to design and sketch the connection devices and their layout in the various critical parts of the buildings and to produce design rules for end users concerning these simple structures;
- to disseminate the obtained results at the National level;
- to implement the obtained results in EUROCODE 8 through the natural channel constituted by the participation of one member of the research network in the Project Team of EUROCODE 8.

3. CONCLUSIONS

Concerning the definition of the seismic action to apply to engineering structures, this study is the first ever conducted which is based on the real seismic context of Belgium. It completes the seismic hazard map on the bedrock already realized in the framework of EUROCODE 8 by two fundamental aspects:

- the definition of elastic response spectra for two different reference earthquakes which should allow to realize a choice for the National Document of Application for EUROCODE 8;
- the evidence that regional site effects in the north of the country should be taken into account by a convenient choice of the response spectra. It appears also that the region of the Mons basin should be studied more intensively in the future, because the study suggests that site effects have there disastrous effects on the strong ground motions.

Concerning the practical application of building regulations, two types of results are obtained for the vulnerability study of non-engineered structures in low seismic activity zones as Belgium:

- values of the connection forces between constructional elements (walls, floors, roofs). The values to be considered in the design of the links between the constitutive elements are explained and accompanied by recommendation;

- drawing of connecting details between constitutive parts and their layout in the various critical parts of the buildings.

The interest of the obtained results is that they provide an estimate of the forces to take into account for the seismic design of usual masonry structures like dwellings. Coming from a situation in which no design value existed, these results are a serious step ahead and will for sure be very useful. The results are presented in a technical guide, which does not only give drawings, but also summarises in a simple way the basic seismic design principles to allow the reader to understand and use the results in a wise manner. The further step is to convert this technical guide and all the collected knowledge about seismic behaviour of structures in low seismicity regions into a bi-lingual technical handbook. This handbook would be edited by the Belgian Building Research Institute (CSTC - WTCB) in order to achieve the widest dissemination thanks to the existing channels of this institution, which gather all Belgian constructions companies of all size.

4. CONTRIBUTION OF THE PROJECT IN A CONTEXT OF SUPPORT TO THE PROCESSES OF STANDARDISATION AND TECHNICAL REGULATIONS

The coordinator of the project is also the chairman of the Belgian Committee in charge of discussing and producing Technical Annexes to the EUROCODE 8. As soon as the relevant sections of EUROCODE 8 will become a Euronorm, which should take place in the summer of 2003, the Committee will meet to achieve the Technical Annex. Contacts with similar committees in neighbour countries have also recently taken place.

On the basis of all the results obtained in the project, a prestandard document will be written. It will constitute a new release of the National Document of Application for EUROCODE 8. On another hand, a draft will also be proposed for the parts of EUROCODE 8, which are debated. The writing will be focused on a clear and unequivocal definition of the concepts and the regulations to follow in countries with a low seismic activity, in agreement with the follow-up committee. This will ensure to obtain a document understandable for all the people involved in earthquake engineering and applicable for all the users.

Besides of the strict activity of preparing code documents, a first seminar open to architects, engineers and construction companies took place in February 2003. It will be reconducted at the end of 2003.

5. KEYWORDS

Seismic, earthquake, Belgium, EUROCODE 8, masonry non-engineered structures, low seismicity, site effects.

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EFFECTIVENESS OF INJECTION PRODUCTS AGAINST RISING DAMP

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1. CONTEXT

Humidity is one of the major causes of damage in buildings. More than 30 % of the questions formulated each year by the 60000 members-contractors of the Belgian Building Research Institute (CSTC - WTCB) is dealing with this problem.

Among all humidity problems, capillary rising damp is the most destructive, due to the cumulated effect of water and migrating salts concentrating on the surface of the building materials.

Capillary rising damp is not only a problem in old buildings where a membrane in the bottom of the walls is lacking, but also in more recent constructions, e.g. when this membrane was not incorporated in the planning, in case of erroneous execution or accidental bridging in the anticapillary membranes.

More than twenty years of experience in our laboratories with the different methods against capillary rising damp have proven the effectiveness of injection techniques, this in contradiction with other techniques which proved to be less effective (electro-osmose, atmospheric drying tubes) or which are expensive and difficult to realise (insertion of membranes in existing walls).

The extremely good results obtained with the injection techniques have stimulated enterprises to use gradually these techniques. Nowadays this technique is quite generalised in our country. This could lead to the conclusion that all objectives of the practitioners are obtained. New problems however occur on the European level in the framework of protection of the environment. It can be expected that in the near future popular products, such as siloxanes dissolved in organic solvents, will have to be replaced by solvent-free systems or water-based products.

2. OBJECTIVES

The lack of experience and precise information on the effectiveness of many formulations which are sold nowadays, due to a constant development in the chemical field and the appearance of a new generation of solvent-free or water-based products have to make us careful and have to motivate us to developing a standardised methodology. This has to be representative as well as allowing a simple and fast way to identify the products and to measure their effectiveness.

Starting from this point of view the research was mainly focused on the development and defining of:

- techniques to identify the physico-chemical properties of the most common products;
- a test procedure on standard supports in the laboratory, in order to quantify in standard conditions the potential effectiveness of products;
- a simple control methodology which can be used in situ after an injection treatment.

3. CONCLUSIONS

In the framework of this research, many test campaigns were carried out in order to give an answer to the objectives listed above. They have proven that the subject is very complex, that one has to take into account many parameters and that it is difficult to combine the representativity of a test with the reproducibility of the results.

The necessity to work in the laboratory under well-defined and controlled conditions involves also a limitation in the field of homogeneity and working procedure. In practice masonry, which has to be injected, is very inhomogeneous and the penetration of products is strongly influenced by cracks and voids. There is a clear contradiction between the situation on the work site and the laboratory.

This made it necessary to eliminate, in the present proposition, combined masonry walls and to limit the testing methodology to the different individual materials used in practice. Moreover, it has been proven to be desirable to define an evaluation method in situ and after injection, in order to confirm the recommendations based on laboratory experiments.

Parallel herewith the attention is stressed on the development of the optimal analytical technique, which on the one hand allows a simple identification of the product, on the other hand gives the possibility to differentiate the commercial products.

4. CONTRIBUTION OF THE PROJECT IN A CONTEXT OF SUPPORT TO THE PROCESSES OF STANDARDISATION AND TECHNICAL REGULATIONS

On the national level this project might serve as a basis for each action in the field of standardisation and in the field of technical agreements, regarding injection products against rising damp.

This will be promoted by the active contribution of the Belgian Building Research Institute in standardisation and accreditation in general. Another favourable factor to this aim is the presence of a representative of the Belgian Institute for Standardisation (BIN - IBN) and the Belgian Union for technical agreements in construction (BUtgb - UBAtc) in the steering committee of the research project.

Outside of Belgium one finds a whole series of laboratories seeing themselves confronted with the testing and judgement of injection products and treatments against rising damp. The need for a test procedure therefore exists on an international level.

Next to the actions in connection with standardisation and technical regulations, our laboratory will make use of the developed test procedure in order to deliver comparative test reports in the near future. This will be done on the demand of Belgian producers of injection products, some of which having an extension to a technical agreement in mind.

On the longer term an international collaboration is foreseen to come to a proposal for a test procedure for the EOTA (European Organisation for Technical Approvals) in the framework of the CE marking of products. This path has been followed already for the recently developed test procedure for water repellent surface treatments (convention NO/D2/017).

5. KEYWORDS

Masonry, capillary rising damp, injection, test methods.

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TEST METHODS AND CRITERIA FOR EVALUATING THE MECHANICAL INTEGRITY OF BOOM SPRAYERS

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1. CONTEXT

1.1 Spray boom motions, a major cause of an irregular spray distribution

An exponentially growing world population and constantly increasing food quality requirements made chemical crop protection become one of the most important field operations. Field sprayers, equipped with large spray booms are used worldwide for the application of phytopharmaceutical products to agricultural crops. In the EC there are approximately 400000 field sprayers in operation.

New tendencies towards the use of concentrated spraying agents (small volume spraying techniques), together with the increasing cost of chemicals and pollution pressure on the environment impose more severe technical requirements to spraying-machines in the near future. Spray deposit variations as they occur nowadays are intolerable for these applications for the sake of excessive residues and crop damage. The problem of an unequal distribution of pesticides is mainly situated on three levels:

- variations in the travel speed of the machine and defects in the hydraulic equipment (worn nozzles, technical defect of the pump and valves, leaking hoses, etc.);
- environmental factors as wind influencing the travel distance of the droplets;
- vibrations of the spray boom during field operations, mainly caused by an ineffective suspension or by mechanical defects in the boom construction (worn hinges, boom deformation ...).

During field operation, tractor vibrations, mainly effected by soil unevenness, induce undesired spray boom motions creating local under- and overdoses of spray liquid. Resulting spray boom motions can be divided into two main groups: vertical and horizontal boom movements. Vertical vibrations, as rolling, give rise to local variations in spray deposit between 0 % and 1000 % and horizontal vibrations, as yawing, between 20 % and 600 %, (100 % is ideal) and by this belong to the major causes of an irregular spray deposition.

Vibrations of the spray boom during field operations are mainly caused by an ineffective suspension or by mechanical defects (boom deformations, improperly locked hinges causing backlash in the hinges, worn springs and dampers ...).

1.2 Inspection of field sprayers

The present hydraulic state of all sprayers in use is being inspected on regular basis in several European countries, including Belgium, Germany and the Netherlands, in a mandatory procedure. The mandatory inspection aims at checking hydraulic pressure variations along the boom, liquid distribution, nozzle wear and other defects, influencing the liquid distribution under static conditions. A CEN working group within CEN/TC144/WG3 is harmonising the today's used evaluation criteria throughout Europe.

Although unwanted spray boom vibrations dramatically effect the spray distribution pattern, procedures to evaluate the mechanical integrity or structural condition of booms are not included yet in current sprayer inspections. ***Therefore, to keep spray boom vibrations within tolerable margins, boom constructions should be properly designed and well maintained which can only be guaranteed by inspecting on a regular basis the performance of the suspension and the quality of the hinges and hinge locks, springs and dampers built in the boom structure.***

Unfortunately, still no standards have been formulated to establish the mechanical condition of operational spray boom constructions and new makes by which no procedures have yet been included in current sprayer inspections to evaluate the mechanical condition of spraying-machines.

Consistent research about boom vibrations and related spray distribution patterns has been initiated within the shared cost action AIR3-CT94-1170 "European System for Field Sprayers Inspection at the Farm Level (SPECS)", funded by the EC. In this project, six leading research groups in spraying techniques, coordinated by the K.U.Leuven, Laboratory of Agro-Machinery and -Processing, started developing a systematic procedure for testing the mechanical integrity (i.e. condition) of operational sprayers at the farm level. In a final stage of this research project, two prototype test systems were developed with a view to evaluate the feasibility of integrating a standardised inspection for the mechanical status of sprayers in use and new makes, in current sprayer inspections. However, both procedures still show important insufficiencies which must first be solved before they become applicable in routine tests.

1.3 Insufficiencies of the test procedures of the SPECS project

1.3.1 *Input disturbances*

Soil and road unevenness induces vibrations on a spraying-machine crossing the field or moving on the road during transport. In vibration engineering, these are called systems with base motion since the input disturbances are displacements under the tires. In the SPECS project, the ISO 5008 standard tracks have been used as input excitations. These tracks are however not very reliable as their power spectrum shows the absence of important frequencies in the frequency band of interest (i.e. mainly between 0 Hz and 5 Hz) indicating that not all dominant natural frequencies of the structure between 0 Hz and 5 Hz will be excited equally. Representative input excitations at the suspension of the spray boom have also been derived. It is clear that these excitation signals can only be used when the spray boom is uncoupled from the machine which is unfeasible in practice.

1.3.2 *Experimental modal analysis*

In the first procedure, the tested spraying-machine is excited on a mobile shaker. During the experiment, input excitations and response accelerations on appropriate locations of the machine are registered in the longitudinal and the vertical direction as well. From these input-output signals, experimental models are built which are used to simulate longitudinal and yawing spray boom motions as a response to certain standardised input disturbances. In their term, simulated boom vibrations are used to calculate the corresponding spray distribution pattern from which conclusions concerning mechanical integrity of the tested spraying-machine are drawn. The linear dynamic models of the sprayers are derived by experimental modal analysis (EMA) from measured output accelerations of certain locations on the structure as a response to force input excitations. Consequently, the derived dynamic models can only use forces as input signals. Because spraying-machines are directly excited by soil unevenness which are displacements and not forces, EMA in its current form was not the appropriate method for model building in this application. In addition, an EMA on mechanical structures should be performed by specially trained people and will therefore not be considered in this research proposal.

1.3.3 *Inspection rig with camera*

In the second procedure, the tested spraying machine is driven across a bump and the vertical and horizontal movements of one of the boom tips is registered by camera. However, this methodology could not fully be evaluated and compared to the modal analysis based method due to a lack of time. In addition, before starting

the measurements with the camera, some data like geometrical features of the sprayer and the track had to be used to calibrate the measurements. If this was not done very carefully, the measurements became completely worthless and the measurements had to be repeated. At last, but not at least, it is clear that a bump is not a representative track and the motion of one of the boom tips is not a representative measure for vibrations on other parts of the boom (backlash in the hinges, flexible deformations ...).

1.3.4 Spray liquid simulation models

Within the SPECS project, mathematical models to simulate spray liquid distribution and which are function of the tractor speed and rolling and yawing of the boom, are developed. Experimental validations showed that under certain conditions, these models do not generate reliable output simulations mainly because important parameters which contribute significantly to the final spray deposition pattern as evaporation drift induced by yawing of the boom were introduced in the model.

2. OBJECTIVES

2.1 Overall objective of the research proposal

Research in this field has been initiated in the EC project "European System for Field Sprayer Inspection at the Farm Level" that still show some insufficiencies. The overall objective of the proposal therefore concerns: ***the improvement and extension of the methodology for testing the mechanical integrity of sprayers in use and new makes, developed in the EC research project AIR3-CT94-1170***, such that the methodology becomes applicable in routine tests, can be used to define directives concerning tolerable boom movements, can easily be integrated in current (mandatory or voluntary) sprayer inspections, provides sufficient technology and know how to develop a standardised procedure for the evaluation of the mechanical status of sprayers.

2.2 Sub-objectives of the research proposal

- Development of a mathematical model of a self-propelled sprayer and a trailed sprayer to be used for the derivation of representative tracks and optimization of the optimal position of the sensors.
- Derivation of representative tracks that can be used as excitation sources for the sprayer tests. These tracks will have the same stochastic characteristics as the field unevenness sensed by the sprayer tyres.

- Determination of the type of sensors (accelerometers, optical sensors as camera, laser, infrared, ultrasonic), their number and their position on the sprayer by performing field tests combined with the mathematical models. The sensors will be used to measure the mechanical condition of the tested sprayers.
- Development of reliable spray deposit distribution models to simulate the spray distribution as a function of boom vibrations.
- Establishment of the maximum tolerances for variation in liquid distribution under a spray boom during operation (i.e. under dynamic conditions) based upon extensive field measurements.
- Development of a test rig (based upon a sequence of bumps tests) for rapid testing the mechanical status of sprayers. The inspection procedure will consist of four major parts: excitation of the tested sprayer by driving it across the track, simultaneous registration of boom movements, processing the measurements and simulation of the related spray distribution, formulation of a quality label for the tested machine.

3. CONCLUSIONS

3.1 Multibody model of a trailed and self-propelled sprayer

A multibody model of a trailed sprayer from the company Beyne and the self-propelled sprayer "EUROTRACK" from the company Delvano was built with the general purpose software ADAMS and DADS respectively.

The model of the trailed sprayer consisted of two parts: a detailed model of the boom with suspension and a model of the carrying frame with the tires. Boom roll and hop could be predicted accurately. Predictions of horizontal boom movements were not so reliable. Roll of the frame could be well predicted contrary to yaw of which the model could not provide reliable results.

In the model of the EUROTRACK much attention was paid on a detailed model of the tractor. The model of the boom with suspension was conceived in less detail. Based on measurements of machine vibrations, unknown machine parameters were estimated through an optimisation procedure in OPTIMUS. To this end a mono poster mobile shaker was conceived. Tractor roll, tractor hop and boom roll could be predicted accurately. Prediction of tractor pitch and yaw gave unreliable results.

From the results it may be concluded that multibody models are an interesting tool for predicting the dynamic behaviour of machines. However, the accuracy of the

prediction of the dynamic behaviour of both sprayers depends on the modes considered. Vibrations in the modes roll and hop can be well predicted, vibrations in the modes yaw and pitch are much more difficult to predict. The accuracy of the models could be improved by increasing the number of bodies in the multibody and the introduction of more precise parameter values (masses, centres of mass, moments of inertia for the different bodies, damping and stiffness coefficients of tires and suspensions, better tire models ...). This problem could be (partially) solved by setting up extensive experiments for a precise determination of these parameters.

The model of the self-propelled sprayer was used for deriving excitation tracks in a formal way. The model of the trailed sprayer was used to determine the optimal position and number of sensors for measuring the mechanical integrity of the spray boom and suspension and for evaluating the derived tracks.

3.2 Derivation of representative tracks as excitation source of the tested sprayer

Currently, the ISO 5008 track is available for testing the dynamic behaviour of mobile agricultural machinery. From a stochastic viewpoint this track was not rich enough such that not all the modes of interest on a spraying machine could be excited in a proper way.

Representative tracks were derived according to a unique procedure:

- measurement of vertical (rolling) and horizontal (yawing) boom vibrations of different spraying machines under different field conditions. The newly designed tracks had to be able to reproduce similar (i.e. realistic) boom vibrations;
- traditional derivation of excitation tracks is a tedious and extremely time consuming work. Fortunately, a formalised procedure for deriving representative tracks has been proposed called "service load simulation". The procedure is has been developed in the road vehicle industry and was used for the first time on agricultural machinery in this project. Normally, a four poster electro-hydraulic shaker should be available for reproducing iteratively measured accelerations on the wheel axles. The vertical movement of each hydraulic cylinder under the tyres of the vehicle is a representation of a wheel track. For heavy vehicles, a powerful four poster had to be available. In this project, the real vehicle was replaced by a multibody model with which the measured vertical axle accelerations were reproduced by a virtual four poster placed under the tyres of the model. The vertical motion of each poster represented the wheel tracks. Although the accuracy of the EUROTRACK model was not complete, the axle accelerations could be reproduced very precisely by the introduction of four feedback control

systems, increasing the robustness of the reproduction procedure against model uncertainties. This procedure, based on multibody models is unique;

- based on this information 16 short tracks with the shape of a multisine and a block profile were derived with a power spectrum as close as possible to that of the reproduced tracks. An important conclusion was that a simple block profile could reproduce a spectrum as rich as any other type of track (e.g. multisine) which is an important conclusion from a practical viewpoint (easy to construct ...);
- the two virtual tracks that could reproduce most accurately realistic boom vibrations were selected with the model of the trailed sprayer. Although the selected tracks were much richer than the ISO 5008 track, they were unable to provide satisfactory results (i.e. reproduction of realistic boom vibrations) especially for boom roll. From this it seemed clear that representative tracks may not be derived based on one machine;
- finally the block profile with a constant block height of 5 cm and a total length of 51.2 m with an adaptable distance between the blocks and lengths of the blocks;
- the designed track was finally tested. Measured boom movements of a trailed sprayer while crossing the track were higher than under field conditions, especially between 0.1 and 0.2 Hz. This problem could be solved by smoothen the edges of the blocks and/or by lowering the blocks (e.g. by filling up the space between the blocks).

3.3 Determination of the type of sensors to be used, their number and position on the spraying machine

- *Radar sensor*: rigidly fixed to the sprayer frame or to the tractor (trailed sprayer), measures tractor or sprayer forward speed.
- *Gyroscope*: rigidly fixed to the sprayer frame or a sprayer part rigidly fixed to the frame, measures yaw and roll.
- *Ultrasonic distance sensors*: placed symmetrically on the sprayer boom at a minimal distance of 45 cm from the boom centre, measure the relative displacement of the boom with respect to the vehicle.
- *Five accelerometers*: placed on five different predefined locations on the spray boom, measure the absolute horizontal boom accelerations.
- *Two accelerometers*: placed on two different predefined locations on the spray boom, measure the absolute vertical boom movements.

- *Infrared sensor*: placed on the suspension, measures the distance related to the relative inclination between the boom and the sprayer frame. In addition, a detailed procedure is given for describing the calibration of the infrared sensor.

It is the first time according to the most recent literature that such a detailed procedure for measuring boom movements has been described.

3.4 Development of reliable spray deposit distribution models to simulate the spray distribution as a function of boom vibrations

In a next stage, after registration of horizontal and vertical boom movements of the sprayer under consideration, these movements should be related to a so called dynamic spray deposition pattern. The latter is extremely difficult to obtain directly. Therefore, an indirect method was worked out consisting of four steps:

- registration of the static spray distribution pattern of different nozzles. Based on a 2D-scanner, developed at the University of Uppsala, Sweden, in the framework of the SPECS project, a totally refreshed 2D-scanner was designed. The scanner consists of 24 liquid tubes that are filled with liquid from the nozzle during a predefined number of steps the scanner moves at constant time intervals under the nozzle during the experiment. With this scanner it is possible to measure the static spray distribution of any kind of nozzle at a certain liquid pressure and height of the nozzle by measuring the evolution of the liquid height in the tubes during the experiment. The time needed to register one static spray pattern is between 2 and 4 hours. Since it took quite a lot of time to upgrade the SPECS scanner, only about 20 static spray patterns of different nozzles could be registered yet;
- preparation of the data for developing the dynamic spray distribution pattern. The data should be presented as a data matrix in excel (24 liquid tubes of the scanner x the number of steps the spray scanner has been executing);
- a mathematical relation between the static spray distribution model and the dynamic spray distribution model has been established by F. Lebeau whose model is an improvement of the model of H. Ramon;
- a methodology for the validation of the dynamic spray distribution model was executed. A laboratory set up intended for validation under more controlled conditions, was constructed but calibration and experiments could not be performed yet. The experiment makes use of differences in capacity between two steel plates depending on the amount of demineralised water between the plates. The principle is not new but the precision is increased significantly compared to

the existing set ups owing to the use of smaller steel plates. In addition, a large surface of 5 m x 1.2 m could be measured in one test instead of a small strip. Three field tests were examined. In the first test or mineral tracer test, the sprayer crossed wooden grids covered with special absorbing paper, sprayed with mineral water. By chemical analysis of the papers, on which the tracer was grafted, undesired boom movements during spraying could be quantified. Unfortunately, this is an expensive method that limited the number of experiments. In the second test water sensitive paper strips were fixed on wooden sticks and placed on regular distances in the field. After spraying, the strips were treated by Image Analysis techniques. A full 2D spray distribution pattern was obtained by interpolating the measured data. This method is cheap but gives only qualitative results. In the third method, a pesticide is used and meanwhile boom movements are recorded. Boom movements were induced by crossing wooden obstacles or small ditches with the sprayer. In this research a round up was used and its effect was successfully reproduced by the dynamic spray distribution model.

3.5 Establishment of the maximum tolerances for variation in liquid distribution under a spray boom during operation

Field experiment three was used to establish the relation between boom movements and efficiency of the pesticide. Only round up was used. In more extensive experiments the relation between boom movements and the efficiency of other pesticides should still be investigated. Conclusion from the project is that phytopathologists had to be involved in the project to derive the relation between tolerable boom movements and pesticide efficiency. Final directives and standards about tolerable boom movements is however an international matter in which the project results and developed methodologies can contribute significantly as it is the first project in succession of the SPECS project that provides a well established and systematic procedure for investigating tolerable boom movements.

3.6 Development of a test rig for rapid testing the mechanical status of sprayers

As a final result of this project, a detailed description of a test procedure with necessary equipment, for evaluating the mechanical status of spraying-machines is established. The proposed test procedure is unique in the sense that it has been performed for the first time.

The procedure includes the following steps:

- description and calibration of the sensors (used together of the data acquisition apparatus) and the power source;
- description of the test track with proposed travel speed for excitation of the sprayer;
- placement of the sensors and acquisition equipment on the machine;
- description of the configuration of the boom and suspension during preparation and during the test.

4. CONTRIBUTION OF THE PROJECT IN A CONTEXT OF SUPPORT TO THE PROCESSES OF STANDARDISATION AND TECHNICAL REGULATIONS

- First development of excitation tracks shaped as an easy to construct block profile, for off-road (agricultural) machines in a scientific way based on service road simulation by the aid multibody models of two types of sprayers.
- Extensive measurements of vertical and horizontal boom movements under different field conditions with different sensors.
- Determination of the type and number of sensors used and their position on the machine and boom to register in a reliable way boom movements.
- Refinement of existing laboratory equipment to register the static spray distribution pattern of a nozzle (i.e. the 2D spray scanner) and the dynamic spray distribution pattern, the latter based on capacity measurements.
- Dynamic spray distribution pattern model, developed by Lebeau, using the static spray distribution set up based on capacity measurements, for validating the dynamic spray distribution pattern.
- Evaluation of three different field test for validating the dynamic spray distribution pattern model.
- Establishment of a methodology for the formulation of directives and standards for allowable boom movements derived from maximum acceptable unevenness in the spray deposition pattern.
- Establishment of a methodology for rapid testing the mechanical status of field sprayers.

5. KEYWORDS

Trailed sprayer, self-propelled sprayer, field sprayer, spraying-machine, spray boom, sprayer frame, boom suspension, liquid tank, undesired horizontal (jolting, yawing) and vertical (roll, hop) spray boom movements, Multi body models, electro-hydraulic shaker (four poster, one poster), excitation track (multisine, block profile), 2D-scanner, static and dynamic spray distribution model, capacitor method, mechanical status of field sprayers, data acquisition, power spectrum of a signal, field trials, water sensitive paper, maximal acceptable tolerances in the spray distribution pattern (spray deposition pattern, spray pattern), sensors (accelerometer, ultrasonic sensor, infrared sensor, radar sensor, gyroscope).

NM/G9/09
NM/G3/10
NM/G2/11

**EUROCODE CD-ROM: DEVELOPMENT
OF "USER-ORIENTED" FUNCTIONALITIES
TO PROVIDE AN EASIER APPLICATION
OF THE EUROCODES**

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1. CONTEXT

This project is a consequence of the programme "Eurocodes" of the European Commission, which defines the calculation rules for buildings and civil engineering works, to be used by engineers and architects.

This programme, which was initiated in the 1980's for the Public Procurement Directive [CE (1993)], is intended to replace the national standards by a unified standardisation based on the probabilistic limit state calculation.

In 1989, the programme is associated with the Construction Product Directive [CE (1989)], because it defines the first of the "6 essential requirements" imposed to construction products - stability and mechanical resistance – including some precisions on other essential requirements as the resistance to fire (n° 2) and the security of use (n° 4) [CE (1994)]. The Eurocodes are thus necessary for an unambiguous and transparent CE marking, which is the condition for the free circulation in the European Union.

2. OBJECTIVES

The project is intended to carry out a scientific tool, to facilitate the implementation of the Eurocodes in Belgium, and thereafter their user-friendly use by the designers (engineers and architects) and by other users as the manufacturers of construction products, contractors, university and high school professors, etc.

The need of an adequate scientific tool is caused by the very particular character of the Eurocodes, which is less user-friendly without special tools [CE (2002), Labeeuw (2002), Spehl (2002)].

The Eurocodes are a very wide collection of 60 standards, which starts with the definitions of the actions (imposed loads, traffic and climatic loads) and goes into the typical calculation rules for several materials (concrete, steel, composite, timber, masonry, aluminium and soil), including the resistance to fires and to earthquakes.

These standards are integrated, using the same definition of the security as the bases of design. This requires for a given subject the consulting of the standards "in parallel", e.g. the standard "steel bridges" is made of additions to the standard "steel general", etc.

Because each standard requires a national complementary document (NAD in the prestandard stage ENV, NA in the stage of European standard EN), the use of each standard requires in fact 2 documents.

Outside these European needs, there is also a typical Belgian need: the need of a Dutch translation that "legally" corresponds to the French text, and this is not provided by the CEN, for which the 3 official languages are French, English and German.

The following objectives of user-friendliness were reached:

- consulting of several documents in parallel;
- use of summarized files;
- tools for the search in a document or in all documents;
- standardised terminology;
- easy access to tables, figures and formula's;
- presentation of all tools on a CD-ROM on a sufficiently universal manner, which can be distributed on the customary way by the BIN - IBN Belgian Institute for Standardisation.

3. CONCLUSIONS

The main objectives of the project were reached.

The most visible consequence is that the CD-ROM with the Eurocodes in their prestandard version (ENV + NAD), could be distributed by the customary way of BIN - IBN (about hundred CD's including the provisional version of November 2003).

The great options of the project, as the choice of the medium, the PDF format and the standard tools of Acrobat, are today widely used by the CEN and the National Institutions.

Some aspects of the project needed still to be modified.

At the one hand, some functionalities became unnecessary for the future, when the CEN decided to simplify the structures of the EN-Eurocodes, for example the very special "parallel numbering" of the paragraphs in the part "precast concrete" (suppressed), the need of printing the national additional rules "on-line" within the basic standard (this is no more permitted for the National Annexes NA of the EN), etc.

But the main reason is that the working out of the electronic documents was more complex than predicted, about two times longer, particularly because electronic

documents were not present in the first publications of CEN (before 1994-1995). Moreover, when such electronic documents existed, some automatic tools provided in the project could not be used, because the document look-up was not uniform.

With the acquired experience, it seems possible to work out a CD-ROM with the definitive version of the Eurocodes (EN + NA, to be completed for 2005-2006). This new project could use the wider capabilities of the format PDF 1.4 and of Acrobat version 6.0 (mi-2003), particularly for the JavaScript language.

4. CONTRIBUTION OF THE PROJECT IN A CONTEXT OF SUPPORT TO THE PROCESSES OF STANDARDISATION AND TECHNICAL REGULATIONS

Since its first version of 2001, the CD-ROM was used as a tool for several phases of the standardisation:

- drafting of the national application documents of the ENV-Eurocodes;
- drafting of the remarks sent to the CEN during the survey made before starting the conversion of an ENV-Eurocode into an EN;
- information about some lacks or contradictions in the ENV-Eurocodes (e.g. the lack of rules for the anchorage of steel structures on concrete foundations), with communication of the remarks to the Commission TC250 Eurocodes of CEN;
- medium for the information sessions on Eurocodes, organised with Cobomedia at the SRBII in Brussels and at the KVIV in Antwerp (October 2002 - April 2003) : 80 Cd's sold;
- tool integrated in the "toolbox" for the Dutch translation of the EN-Eurocodes, as organised together from 2003 by BIN - IBN (Belgium) and NEN (Netherlands);
- on sale of the version of November 2003 at BIN - IBN.

5. KEYWORDS

Structure, work, construction, building, civil engineering, bridge, silo, tank, chimney, stability, mechanical resistance, calculation, design, limit state, action, material, concrete, steel, composite, timber, masonry, brick, geotechnics, earthquake, aluminium, fire resistance, Eurocodes, European prestandard, ENV, national application document, NAD, DAN, NTD, European standard, EN, national annex, NA, AN, NB, ANB.

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NM/G3/12
NM/G2/13

LIMIT STATES CRITERIA OF CONSTRUCTIONS ABOUT VIBRATIONS

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1. CONTEXT

A large amount of general standards exist in the field of vibrations.

However, few are specific to vibrations of buildings, and on the other hand, there is no uniformity in this field, neither in measurement methods, nor in criteria (when they exist) about discomfort and safety against eventual damages.

2. OBJECTIVES

The goals of the project are the following:

- (1) to establish recommendations about vibration measurement methods in buildings, for the discomfort of people and the damages to structures. In practice, there is a link between the two; therefore the problem will be considered as a whole;
- (2) to establish vibration criteria in buildings for the two same problems of discomfort and damages, by using i.a. the results of the prenormative Belgian Science Policy project "Effects of vibrations: requirements and assessment methods" (period of 1 April 1996 to 31 March 1999), in order to be proposed for Belgian and European standardisation;
- (3) to establish a draft European standard on criteria for serviceability limit states, including the criteria for discomfort and safety against vibrations, and criteria for admissible deformations actually discussed within the Eurocodes Committee of the Belgian Institute for Standardisation. The goal is to establish a Belgian proposal, to present it to CEN (European Committee for Standardisation) and to participate to its works in order to obtain a European standard.

3. CONCLUSIONS

The research part concerning de measure methods and the buildings vibration criteria (goals 1 and 2), and particularly the survey by questionnaire among the members of the users committee of the research have come to the following conclusions:

- about de comfort criteria, the measure methodology of the German standard DIN 4150, Part 2, and particularly the basic factor KB, including the concept of RMS detection with exponential characteristic, are unanimously recognized;

- however, it is proposed to extend the existing standard in order to characterize the vibrations more completely by a specific characteristic for the source of vibrations, which would be the vibration rate, determined over the effective time of activity of the source;
- it is proposed to introduce additional clauses to improve the identification and the treatment of perturbations in the measurements;
- it is also proposed not to describe completely and a priori the scientific means to be used to identify the sources and the perturbations, but to specify that these means should be described in detail by the expert concerned in each of his measurement reports;
- as far as the safety criteria are concerned, in agreement with the users committee, it is proposed to adopt the German standard DIN 4150, Part 3, and it is recommended, in parallel with the measurements on the building structure, to perform measurements on the foundations to evaluate the potentiality of damages to the structure.

4. CONTRIBUTION OF THE PROJECT IN A CONTEXT OF SUPPORT TO THE PROCESSES OF STANDARDISATION AND TECHNICAL REGULATIONS

On the basis of these conclusions, the research part about the prestandard and the Belgian participation to the European standardisation works within CEN Technical Committee TC250 "Structural Eurocodes" (goal 3) has reached the following results:

- the publication in 2002 of the Belgian standard NBN B 03-003, which makes (in its chapter 8. VIBRATIONS) DIN 4150-2 and DIN 4150-3 applicable in Belgium, which sends back to the Belgian standard NBN B 03-002 for the vibration effects of wind, and specifies critical values of modal vibration frequencies of structures, below which a dynamic calculation is requested, for the effects of synchronized movements of persons;
- the publication in 2004, for public enquiry, of a project of Belgian National Annex to the European standard EN 1990 "Eurocode – Basis of structural design", Annex A1 "Application for buildings", which sends back (in its clause A1.4.2 Serviceability criteria) to the Belgian standard NBN B 03-003 as far as the buildings are concerned, and to the European standard EN 1991-1-4 as far as the vibration effects of wind are concerned.

5. KEYWORDS

Vibrations, buildings, criteria, safety, comfort, serviceability limit states, prenormative research.

NM/G2/14
NM/19/15
NM/G4/16
NM/67/17

"FITNESS FOR USE" EVALUATION OF SMALL (<20 PE) DOMESTIC WASTE WATER TREATMENT PLANTS

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1. CONTEXT

Before 2015, all surface and soil water must be of "good" quality in the European Community. Although this objective was established in a European directive, published in 2000, all Community Members are already working on the problem since several decades, putting their effort however mainly on the treatment of the urban waste water. But the realisation of the 2015-objective requires that also the waste water coming from buildings not connected to a public sewer, due to their spread, is taken into consideration. For Belgium it is estimated that 15 to 25 % of the buildings will never be connected to a public sewer. The discharge of untreated or not correctly treated waste water of this huge amount of buildings represents a considerable source of diffuse environmental pollution. The treatment of this waste water will require the use of small waste water treatment plants. For the construction professionals small waste water treatment means: "using a septic tank". However the regional requirements for the effluent coming from these treatment plants are such that the use of a septic tank is insufficient. Use will have to be made of better performing systems, of which can be assured that the treatment will lead to an effluent in accordance to the legal requirements. This need for quality assurance was already felt in Europe at the beginning of the nineties, in last century. This brought industry to request the European Committee for Standardisation (CEN) to establish a European standard enumerating product requirements and procedures for the verification of the performances of the plants. The CEN working group CEN/TC165/WG41, was charged with this task and brought out a first draft standard in the second half of the late nineties, i.e. the prEN 12566-3 (annexe 1). For evaluating the treatment efficiency, this draft proposed two alternative procedures, lasting for 1 year: the first is a monitoring of the plant on a test facility, the second a monitoring on site.

Immediately a lot of questions were raised from different sides, questioning the validity of the proposed procedures. This questioning was the basis of the research set up by 4 Belgian laboratories: the "Centre Scientifique et Technique de la Construction" (CSTC - WTCB) in Brussels, the "Centre Belge d'Etude et de Documentation de l'Eau" (CEBEDEAU) in Liège, the "Fondation Universitaire Luxembourgeoise" (FUL) in Arlon and the Flemish Institution for Technological Research (VITO) in Mol. This research was financed by the Belgian Science Policy.

2. OBJECTIVES

The objective of the research launched by the 4 laboratories was to validate and improve the procedures proposed in prEN 12566-3, in order to be sure that the plants tested according to this standard would be correctly evaluated.

The approach adopted hereto was to realize the proposed procedures, evaluating critically each step. The programme was as follows:

- task 1: making operational a test rig (CSTC, CEBEDEAU, VITO);
- task 2: evaluating the prEN treatment efficiency procedure for laboratory testing, by measuring the performance of commercial plants on the test rig measuring (CSTC, CEBEDEAU, VITO);
- task 3: evaluating the prEN treatment efficiency procedure for on site testing, by measuring the performance of commercial plants in situ (CSTC, FUL, VITO);
- task 4: evaluating the prEN proposal for assessing the mechanical stability of small plants (CSTC);
- task 5: proposals for improving the prEN 12566-3 (all partners).

3. CONCLUSIONS

The research confirmed that the general scheme for addressing the treatment efficiency was indeed a good basis for this assessment. However important improvements could be identified with respect to the different stress tests that are to be conducted, e.g.:

- between two periods where the plants are submitted to stress loading, there must absolutely be a period with normal loading, allowing the plant to come back to normal working conditions. This being the only possibility to see the effect of the different stresses;
- there is no necessity to have several long periods of steady state working of the plants, it suffices to have only one such a period, for instance at the beginning of the test campaign. This allows certainly shortening the whole test duration;
- it is superfluous to do analyses on punctual samples taken just after certain stress tests (bath discharge);

- the execution of two simple physical tests (measurement of the aeration capacity and establishing the hydraulic response of the plant) allows to avoid the starting of a 1 year campaign on plants which obviously do not have the minimum capabilities.

Concerning the structural stability the recommendation was made to limit the calculation methods to concrete and steel. For the testing it was recommended to adopt only the pit-test for all materials.

4. CONTRIBUTION OF THE PROJECT IN A CONTEXT OF SUPPORT TO THE PROCESSES OF STANDARDISATION AND TECHNICAL REGULATIONS

The active participation of the research partners to the standardisation activities lead directly to the input of the research results into the standard. Two actions were set up hereto:

- FUL, VITO and CSTC participated actively in the meetings of CEN/TC165/WG41, so that improvements could be argued during the discussion of the standard;
- at the level of the Belgian Institute for Standardisation (BIN - IBN) a mirror committee to CEN/TC165/WG41 was created, comprising delegates of industry, administration and the 4 laboratories. Also through the official comments of this group to CEN the research results were injected into the European standard. The meetings of this group allowed industry and administration to take knowledge of the ongoing European standardisation process. It allowed the laboratories also to take knowledge of the needs of industry. This knowledge will certainly influence their future research actions.

The information of the different regional administrations about the problem of small waste water treatment plants was also enhanced by having them in the group guiding the research.

5. KEYWORDS

Waste water, treatment, small waste water treatment plant, treatment efficiency, mechanical stability.

NM/02/18

**RESEARCH ON ELECTROMAGNETIC FIELDS
IN THE INDUSTRY: SOURCES, MEASURING
PROCEDURES AND NORMS**

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1. CONTEXT

In the industry, many sources of electromagnetic fields are present. Although in the literature a potential risk for the workers is mentioned, not much attention has been paid to this problem or a complete lack of information is present.

At the start of this project no law concerning normalisation and technical regulation was in force in Belgium and even internationally. More specific, limits for electromagnetic radiation have been proposed. However, no procedure to control these limits has been standardised. This project will contribute to the standardisation of the acquisition of electromagnetic fields in the industry. On the basis of the acquisition a technical regulation for limits of electromagnetic radiation of equipment in the industry can be developed. The developed procedures could be used to verify the limits.

2. OBJECTIVES

This project aims at the development of a measurement procedure for electromagnetic radiation in the industry. The characterisation will be used to check whether the occupational exposure does not exceed the limits. We have defined different subtasks and purposes to realise this. These purposes are here described.

In order to be able to define measurement procedures, we will first list the electromagnetic sources. Due to the large diversity of electromagnetic sources it is impossible to develop one single measurement procedure for all sources. Therefore we aim to develop a measurement procedure that can be used in the frequency range 110 MHz to 10 GHz and can be used for the most common sources in the industry namely antennas, e.g. telecommunication antennas.

We want to apply this procedure at a typical GSM base station antenna (K736863 antenna). Using this practical case adaptations for the procedure will be proposed.

The next purpose is the determination of the parameters that will influence the measurement procedure.

To determine and measure the different quantities (electromagnetic fields, Specific Absorption Rate or SAR) the characteristics of the measurement probes have to be investigated. Suitable measurement probes have to be selected and a comparison with commercial equipment has to be performed.

Calibration of measurement probes is very important. To perform electromagnetic field measurements, these fields have to be converted into electrical quantities such

as voltage and current. These quantities can be measured using voltage meters and spectrum analysers. Antenna calibration involves the determination of this conversion and the determination of the antenna factor (AF).

We want to perform accurate and correct narrow-band measurements. Therefore a study to increase the accuracy of narrow-band measurements was necessary. When EM-field measurements around a GSM and UMTS base station with the spectrum analyser are performed, the measured power will be overestimated due to overlapping contributions in the measurement frequency points. The larger the resolution bandwidth, the larger the overestimation will be. Our purpose is to be able to immediately determine the field values at a measurement site. Therefore we need a fast and accurate deconvolution algorithm for correcting noise disturbed measurements and eliminating the influence of the resolution filter of the spectrum analyser. Furthermore, because of the presence of noise our algorithm has to be robust.

We want to characterize the influence of the measurement probe on the evaluation of the far and near field of an electromagnetic source. While measuring, the electromagnetic field will be disturbed by the measurement probes themselves. Therefore not the true, free-space field but the disturbed field will be measured. So the measurement probe itself causes disturbance that has to be characterized.

To determine the safety compliance boundaries for occupational exposure of a base station antenna, the electromagnetic fields around the base station antenna must be determined and be compared to the reference levels. Therefore it is important to be able to perform accurate electromagnetic field measurements close to the source. Both electric and magnetic field have to be determined when performing measurements in the near field of the base station. Mostly, antenna radiation measurements are performed in an anechoic chamber. However, this is expensive. We want to perform near-field measurements in an indoor open-site surrounded by absorbers to minimise interference. To obtain accurate results, residual reflections due to the non-anechoic property of the measurement site have to be eliminated with a de-embedding method. Our purpose is to develop a low-cost method delivering accurate results.

To determine the compliance boundaries of a base station not only the electromagnetic fields have to be determined but also SAR assessment is necessary. To determine the SAR a phantom (model of a human) has to be used. Therefore different phantoms will be compared. One type of phantom will be proposed to perform the measurements.

We want a good agreement between measurements and simulations (EM-field and SAR). Then we will have accurate results and a practically usable model of a GSM antenna.

It will be necessary to determine the SAR in a realistic model of a human and to compare the determined SAR values with those obtained in the homogeneous phantoms. We aim then to define a safety factor dependent on the frequency and the used phantom.

It is the objective to compare the safety distances of the EM-fields with the safety distances of the localised and whole-body SAR. We investigate typical GSM base station antenna for different input powers used in Belgium.

Finally, SAR assessment is expensive and very time consuming so it would be interesting to determine the distance from which on electromagnetic field assessment will always deliver the most restrictive compliance boundaries and thus when it is not anymore necessary to determine the SAR to obtain the most restrictive safety distances.

3. CONCLUSIONS

We have listed the electromagnetic sources of RF-radiation in the industry in Belgium in [Joseph et al. (2000)]. Frequencies and input powers of the several sources are reported. The parameters that influence the measurement procedure are investigated in [Joseph et al. (2001a)].

We have developed an accurate and consistent method to determine the antenna factor [Joseph et al. (2001c)], [Joseph et al. (2001d)] and [Joseph et al. (2001e)]. By using the inverse FFT and by using antennas with totally different antenna factors the mean deviation is only 0.15 dB and the maximum deviation is only 0.49 dB for the antenna factor of a conical dipole antenna. Furthermore, this method does not need to be performed in an anechoic chamber to be accurate resulting in a low-cost method. The Austrian Research Center Seibersdorf specified the antenna factor with an uncertainty of ± 1 dB. So our result is lying within this uncertainty interval.

In [Joseph et al. (2002e)] we have developed a robust and accurate deconvolution algorithm for the determination of the maximum power of non-stationary signals located in a wide frequency band with a spectrum analyser. This algorithm fulfils the demands in paragraph B (elimination of resolution filter of the spectrum analyser, be able to determine immediately the field values at a measurement site, fast and automated and robust for noise). We have applied the method to GSM and UMTS

signals and have shown that it still performs excellent in cases where the signal-to-noise ratio goes down to 3.

We have presented the characterisation of the disturbance caused by a probe measuring the electric or magnetic field in [Joseph et al. (2001c)], [Joseph et al. (2003b)], [Joseph et al. (2002b)] and [Joseph et al. (2002c)]. It can be concluded that the disturbance of the measurement probe in the far field of the transmitting antenna is negligible (below 1 %) when a probe with maximal sensitivity is used, but this is not anymore the case in the near field of both the transmitting antenna and the measurement probe. A selection of measurement probes with a disturbance required to be lower than 5 % for near- and far-field exposure measurements around a 900 MHz base station is made. It was concluded that for far- and near-field measurements different probes have to be used. For measurements in the far field of the base station, a $\lambda/2$ dipole offers the highest sensitivity and a disturbance lower than 1 %. For the near-field measurement, an optimal length of $\lambda/4$ was found (7.5 cm at 900 MHz) with a disturbance of lower than 5 % and the highest reachable sensitivity under this condition.

In [Joseph et al. (2001b)], [Joseph et al. (2001b)], we have developed a procedure for laboratory measurements to determine the safety distances of an EM source in the frequency range 110 MHz to 10 GHz. To determine the safety distances of a base station antenna two possible routes can be followed. The electromagnetic fields around the base station antenna can be determined and the field values can be compared to the reference levels. On the other hand, the compliance boundaries can be determined using SAR assessment and the SAR can be compared with the basic restrictions.

We have developed an accurate low-cost method [Joseph et al. (2003d)] for measurements close to a base station antenna. The compliance boundaries for different input powers have been determined. Excellent agreement between measurements and simulations for both the electric and magnetic field has been reported. The maximum and the average of the relative deviation of E^{plane} (i.e. averaging of the field in a plane) are respectively 6.8 % and 2.8 %. The maximum and the average of the relative deviation of E^{vol} (averaging of the field in a volume) are respectively 2.8 % and 2.1 %. These are all very small deviations compared to measurement uncertainties published in the literature.

We have developed in [Joseph et al. (2002a)] and [Joseph et al. (2003a)] a measurement procedure for the localised SAR in a rectangular box phantom. We have compared SAR measurements and simulations close to a K736863 antenna

and good agreement is reported. It has to be mentioned that a spheroid phantom delivers higher SAR values due to its curvature than a rectangular box phantom.

In [Joseph et al. (2003a)] and [Joseph et al. (2003c)] the safety distances for the localised SAR (10 g) and the electric field are compared. For the SAR a safety factor 3 has been taken into account at 947,5 MHz for the rectangular box phantom. From 2.3 cm ($<\lambda/10$) on the electric field averaged in a volume delivers the highest safety distances and from this distance on it is not necessary to determine the localised and whole-body SAR to obtain the most restrictive compliance boundaries.

When the maximum field value or the averaged field value in a plane is chosen, the electric field will always deliver at 10 and 20 W the most restrictive safety distances. At 10 and 20 W the maximal safety distances for the K736863 antenna are respectively 15.7 and 30.4 cm. These distances are much smaller than practically used safety measures in Belgium [GOF (2002)].

We have investigated plane wave excitation using FDTD-simulations for a homogeneous rectangular box phantom, a homogeneous prolate spheroid phantom and a realistic heterogeneous model of a man. We have presented a new safety factor [Joseph et al. (2003e)] for the determination of the SAR in a homogeneous phantom. From our results the arbitrary factor 2 of [CENELEC (2002)] is not a good choice. The safety factor is frequency and phantom dependent and e.g. for the rectangular box phantom at 947.5 MHz equal to 3 instead of 2.

4. CONTRIBUTION OF THE PROJECT IN A CONTEXT OF SUPPORT TO THE PROCESSES OF STANDARDISATION AND TECHNICAL REGULATIONS

This project has contributed to the standardisation organisation CENELEC (European Committee for Electrotechnical Standardisation) technical committee TC106 for the base station standards put-into-service (EN50XXX) and put-into-field (EN50YYY).

This project has also contributed to the workgroup COST281 (www.cost281.org) where input for official organisations such as WHO, ICNIRP, NRPB, CENELEC and the European Commission is given.

Furthermore, the results are passed on to the BIN - IBN (Belgian Institute for Standardisation).

The results of this project are presented on national and international level. The results of this project are scientific publications and the support for standardisation organisations. We have 3 accepted A1-publications: 2 in IEEE Transactions [Joseph

et al. (2002d)], [Joseph et al. (2003b)] and 1 in IEE Electronics Letters [Joseph et al. (2003d)]. These magazines have a large impact.

Furthermore we have 7 accepted conference papers [Joseph et al. (2001c)], [Joseph et al. (2001d)], [Olivier et al. (2001)], [Joseph et al. (2002b)], [Joseph et al. (2002c)], [Martens et al. (2002)], [Joseph et al. (2003c)] and two papers are submitted [Joseph et al. (2001e)], [Joseph et al. (2003e)].

Half yearly reports were distributed and the results were presented for a commission with members: Buyse Dany (Agoria), Nicolas Jacques (MINECO), Niemegeers Philippe (Proximus) en Van Den Bossche Stefan (Mobistar).

Agoria represents in Belgium the technological industry. Because of their membership in other European standardisation organisations like ETSI (European Telecommunication Standardisation Institute), this project can further be introduced for standardisation. Because of the presence of Mr Nicolas of the "Ministry of Economic Affairs, Metrological Services" the results of this project can also be distributed.

5. KEYWORDS

Electromagnetic field, measurement, occupational exposure, measurement probe, antenna, dipole, GSM, UMTS, RF source, calibration, network analyser, spectrum analyser, resolution filter, probe disturbance, near field, far field, anechoic chamber, de-embedding, Specific Absorption Rate, SAR, safety distance, compliance boundary, phantom, safety factor.

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NM/67/21
NMG5/22

GLOW DISCHARGE OPTICAL EMISSION SPECTROMETRY FOR THE ANALYSIS OF METALLIC COATINGS ON STEEL - GAMeS

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1. CONTEXT

A method for the determination of thickness and composition of zinc-based coatings on steel was developed in the framework of a standardisation project financed by the Belgian Science Policy. The method is based on radiofrequency glow discharge optical emission spectrometry (RF GD-OES) and uses commercially available instrumentation, software and reference materials.

2. OBJECTIVES

The objectives of the project GAMeS were:

- to develop and apply an experimental method, based on RF GD-OES, to determine the composition and thickness of zinc-based coatings on steel;
- to recognize and describe critical factors in the analysis that could prevent both DC and RF GD-OES from becoming a routine tool in the steel industry for the envisaged application;
- to link up Belgium with the rest of the world as far as GD is concerned.

The research work covered the following aspects: selection of test samples, selection of analytes and their concentration ranges, selection of suitable spectral lines for the different analytes, optimization of analysis parameters, selection and procurement of suitable calibration samples, measurement of densities and sputtering rates of calibration samples, limited interlaboratory exercise on relative sputtering rates, setting up of calibration curves, measurement of compositional depth profiles, determining thickness and composition, interlaboratory comparison on thickness and composition.

3. CONCLUSIONS

Analysis results obtained on industrial galvanized and galvanized test samples with the experimental procedure used are satisfactory and in good agreement with the generally accepted values from ICP-spectrometry.

The calibration curves can still be improved by applying a DC bias voltage correction. The interlaboratory comparisons show that:

- relative sputtering rates are not necessarily universal values that can be tabulated and exchanged among users;

- there is a need for better agreements on how to derive sputtering rates from profilometer data;
- the scatter on thickness and composition is too large;
- GD-OES has not reached the level of a sufficiently accurate routine tool for the analysis of zinc-based coatings.

4. CONTRIBUTION OF THE PROJECT IN A CONTEXT OF SUPPORT TO THE PROCESSES OF STANDARDISATION AND TECHNICAL REGULATIONS

- An experimental procedure complementary to the ISO-standard under preparation, which can assist the implementation of this standard. The procedure will be distributed through the final report of the project and through a VITO-report based on this report.
- Experience with the application of RF GD-OES for determining thickness and composition of zinc-based coatings on steel. Expertise and instrumentation of CERTECH and VITO are available to third parties, for contract work.
- Awareness of the need for a procedure for measuring crater depths with a profilometer. Even the best standard for GD does not make any sense when crater depths and hence values for the relative sputtering rates cannot be measured correctly. Our results were presented at a meeting of Jobin-Yvon GD users, in the presence of an international expert and member of the ISO/TC 201.
- Awareness of the fact that a relative sputtering rate of a calibration sample can vary significantly and that these variations are not only due to errors in measuring the crater depth. The data were discussed with an international expert in the field and with a Belgian industrial GD user. The results were also presented at a meeting of Jobin-Yvon GD users. More work will be done to substantiate and publish the findings briefly discussed in this report.
- Awareness of the fact that many European labs are interested to apply or are already applying GD-OES to zinc-based coatings on steel, but that problems exist on the level of calibration, as well as on the level of integration of the compositional profiles. The results of our interlaboratory comparison will be reported to all participants and discussed with active members of the ISO/TC 201.

5. KEYWORDS

GD-OES, glow discharge, spectrometry, standardisation, coating, zinc, steel.

NM/12/23
NM/03/24
NM/01/25

NORMS AND GUIDELINES FOR THE PRACTICAL ESTIMATION OF UNCERTAINTY IN ANALYTICAL MEASUREMENTS

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1. CONTEXT

In routine analysis, it is essential to dispose of reliable analytical methods. The goal of many analytical methods is to gain information so that important decisions can be taken, for instance, about compliance with governmental regulations. It is generally accepted among analysts that a correct interpretation of measurement results requires a reliable estimation of their uncertainty. Uncertainty is a basic performance characteristic of measurement results that is fundamental in order to assure comparability among results and allow end users to rely on them.

2. OBJECTIVES

The aim of the project has been to develop norms and guidelines for the practical estimation of uncertainty in analytical measurements obtained from methods applied in the chemical, pharmaceutical and related industries. It mainly concerns liquid chromatographic (LC) and capillary electrophoretic (CE) methods for the analysis of bulk pharmaceutical compounds, for the bioanalysis of drugs in the frame of pharmacokinetic studies and for the enantiomeric purity testing of chiral drugs.

In order to achieve the objectives of the project, the network has used the following strategy:

- first, the existing situation and in particular the two approaches used to determine the uncertainty on a measurement has been examined, namely the ISO approach commonly known as "bottom-up" and the analytical method committee approach commonly known as "top-down";
- second, some fields of application have been investigated and a few technical problems such as sampling, quality control, limits of detection and quantitation, have been studied in order to define general guidelines;
- third, the general guidelines including a "menu-driven" approach and finalised standard procedures are being developed. These procedures should be practical and cost-efficient;
- finally, the network will try to obtain acceptance of the proposed guidelines.

3. CONCLUSIONS

In this project, the collection of the material and the existing situations as well as the study of particular themes was evaluated in the first part. The bottom-up approach

(also called error-budget approach) for uncertainty evaluation was examined and consisted in four steps: specification of the measurand, identification of uncertainty sources, quantification of the uncertainty components for each potential source of uncertainty identified in step 2 and calculation of the combined uncertainty. The uncertainty evaluation based on precision assessment was also examined considering intralaboratory as well as interlaboratory studies. The second part concerned the practical estimation of uncertainty of an individual analytical result obtained from an interlaboratory study. For this purpose, some novel liquid chromatographic (LC) and capillary electrophoretic (CE) methods for the analysis of drugs were developed, validated and applied. Three interlaboratory studies were performed. Two were successfully completed while another one is nearly finished. The developed LC and CE methods were included in the different protocols elaborated for these studies.

The first interlaboratory study dealing with the analysis of a phenoxymethylpenicillin (Pen V) sample consisted of a Karl-Fischer semi-micro determination of water and a liquid chromatography test for the determination of 4-hydroxyphenoxymethylpenicillin and other related impurities. The two methods were based on the European Pharmacopoeia monograph. The first interlaboratory study consisted also of a potentiometric acid-base titration to assay the content of Pen V. The study showed how different uncertainty estimates of analytical measurements can be determined and how the results of an interlaboratory study can be used to estimate the uncertainty on future results by a single lab analysing similar samples.

The second interlaboratory study was performed in order to validate a new LC method for the analysis of erythromycin. The reproducibility of this method was examined in an interlaboratory study. All labs obtained adequate selectivity allowing the content determination of erythromycin A and all identified related substances. The analysis of variance (ANOVA), performed on these results, demonstrated the good reproducibility of the method. The method is suitable to replace the existing official method of the European Pharmacopoeia. The results of the validation can also be used by any lab that would like to make an uncertainty statement for this method.

Another interlaboratory study related to timolol maleate was proposed. It involved the determination of R-timolol and other related substances by liquid chromatography in the normal phase mode. A LC method for the determination of R-timolol, described in the 4th edition of the European Pharmacopoeia, was adapted, validated and tested for the robustness. The results of the robustness testing were used to assess uncertainty.

As for CE methods, two interlaboratory studies were proposed. The first concerns the analysis of metacycline and the second the enantiomeric purity testing of ketoprofen. For the first CE study, serious problems of method transfer using different equipments were observed. These results did not allow a statistical analysis. On the other hand, another interlaboratory study based on the CE method developed for ketoprofen was proposed. Considering the results obtained for the first CE study, it was found necessary to perform robustness testing for the CE method on ketoprofen after having validated this method.

4. CONTRIBUTION OF THE PROJECT IN A CONTEXT OF SUPPORT TO THE PROCESSES OF STANDARDISATION AND TECHNICAL REGULATIONS

At the end of this project, the expected results were to develop a general strategy including a "menu-driven" approach and to establish standard procedures. These procedures should be practical and cost-efficient. Therefore, a set of draft guidelines have been prepared. The network of the project will try to obtain their acceptance in order to valorise the expected results.

The network will try also to obtain the acceptance of the draft guidelines in the ISO group and its application in the European Pharmacopoeia commission.

The network will try to initiate a new commission of the "Société Française des Sciences Techniques" (SFSTP) on "Harmonization of quantitative analytical procedures".

Finally, the last activity concerned the definition and assessment of a set of minimal guidelines for the determination of uncertainty in an analytical laboratory and its assessment in analytical reports.

International collaborations with pharmaceutical and chemical industries as well as University laboratories were made.

5. KEYWORDS

Uncertainty assessment, liquid chromatography methods, capillary electrophoretic methods, interlaboratory studies, validation, robustness, guidelines.

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NM/10/27
NM/50/28

NORMALISATION OF THE CERTIFICATION, DISTRIBUTION AND USE OF MICROBIAL REFERENCE MATERIAL

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1. CONTEXT

Microbiological reference strains are imposed for the validation of methods described in national and international norms and standardised methods (NBN, ISO, EN, NF, Pharmacopoeia ...) in fields related to microbiology. Most of these strains are available in the Belgian collections of the BCCM consortium (Belgian Coordinated Collections of Micro-organisms). Belgian laboratories and industrial companies concerned need to have access to this reference material in a user-friendly form and with proven properties.

2. OBJECTIVES

BCCM/IHEM (biomedical fungi and yeasts), BCCM/LMG (bacteria) and BCCM/MUCL (agro-industrial fungi and yeasts) wished to raise its profile and to meet the needs of the Belgian laboratories and industrial companies concerned.

Norms necessitating the use of micro-organisms were defined. The search of these standards was focused on the areas related to the specialisation of our 3 collections: health (disinfectants, antiseptics, drugs), foodstuffs (food and water analysis) and materials (wood, plastics, paints, textile, paper).

The performances of the strains imposed in the norms were tested following the test method described in the norms, and compared with those of alternative strains. Potential strains were tested when the norm didn't specify the strains.

The possibility was assessed to distribute the strains under a user-friendly form as ready-to-use working stock.

3. CONCLUSIONS

BCCM/IHEM selected 3 European and 1 French norms related to disinfectants and antiseptics necessitating 2 fungal and 4 yeast strains. The performances of these strains were studied and compared to those of 4 other strains (2 fungi and 2 yeasts) of species particularly important in hospitals. Species listed in the norms were found rather suitable for the defined objective. Only one of the alternative yeast species could be more judicious than those cited in the norms. Two of the strains studied and 4 bacterial strains tested by BCCM/LMG are listed in two methods from the European Pharmacopoeia; performance tests of those strains gave conform results.

BCCM/LMG tested 37 bacterial strains chosen for the validation of 48 standardised methods and norms in the food sector that didn't specify any strain(s). Ninety six

percent of the performance tests realised (detection, enumeration, confirmation), i.e. 358 out of 373, gave a result conform to the corresponding method. Consequently, 33 of the strains studied will be available to the clients with a certificate mentioning the realised performance tests.

BCCM/MUCL selected 20 fungal strains involved in wood degradation to check their performances according to 4 European standards concerning wood preservation products. Wood test specimens were exposed to the strains for determining the mass loss allowing to evaluate the virulence of the strains and to validate the assays. Only one strain out of the 4 mentioned in standards, and 9 out of the 16 alternative strains have shown a sufficient virulence.

Furthermore, each of the 3 collections selected representative strains to assess the preservation on cryobeads at -20°C , in order to meet the need of clients to receive strains under a user-friendly form as a ready-to-use working stock. The viability of 18 strains (2 from BCCM/IHEM, 7 from BCCM/LMG and 9 from BCCM/MUCL) was followed during a period of 14 to 18 months. In most cases, this preservation method was satisfactory. Twelve clients from BCCM/LMG and BCCM/MUCL agreed to test strains on cryobeads with regard to viability and performance and to give their opinion in a detailed questionnaire. This form of supply was highly appreciated. Following this project, 26 out of the BCCM/LMG reference strains can be distributed to the clients under this form.

A catalogue available for the users of these reference micro-organisms has been established specifying all the norms studied and the corresponding strains tested (imposed or proposed).

4. CONTRIBUTION OF THE PROJECT IN A CONTEXT OF SUPPORT TO THE PROCESSES OF STANDARDISATION AND TECHNICAL REGULATIONS

After carrying out the performance tests on strains and studying of the norms we expressed some remarks about the normative texts in the different fields considered and suggestions to improve them. These remarks and suggestions were sent to the Belgian Institute for Standardisation and Beltest.

5. KEYWORDS

Antiseptic, bacteria, bioassay strain, control strain, disinfectant, food, fungi, micro-organisms, norm, pharmacopoeia, reference strain, standard, test strain, wood, yeast.

NM/01/32
NM/03/33
NM/10/34
NM/02/35

**METHOD NORMALISATION, VALIDATION
PROTOCOLS AND QUALITY CONTROL
FOR BIOMONITORING TESTS FOR
MUTAGENS/CARCINOGENS**

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1. CONTEXT

We know from animal studies that a large number of mutagens and carcinogens can be found in the workplace, the living environment, food and drinking water. Epidemiological methods up till now have only been able to prove conclusively the carcinogenic properties for humans of a limited number of these, including cigarette smoking, certain occupational exposures, drugs and ionising radiation.

The use of suitable biological markers can contribute in several important ways to the advancement of cancer epidemiology and cancer prevention. Possible benefits are the availability of better exposure data in epidemiological studies, the use of biomarkers for early effects instead of clinical disease as end-points and a more solid basis for extrapolation from experimental animals to humans.

The development of better biomarkers will also greatly contribute to a better risk surveillance and risk control. As such they may become valuable tools in occupational and community medicine for monitoring exposures to mutagens/carcinogens and for screening for pre-clinical effects. Studies on the basis of these biomarkers should also prove useful for regulatory bodies in the implementation of adequate control measures.

2. OBJECTIVES

In this context the concrete objectives of this study were to develop and validate a number of biomonitoring methods. They belong to different categories of biomarkers, namely biomarkers for internal dose, for biologically effective dose and for early biological effects. More specifically, these methods are:

- development and validation of a method to assess the urinary excretion of inorganic arsenic metabolites in man;
- the alkaline comet or single cell gel electrophoresis assay for the detection of DNA breaks, alkali labile sites, open repair sites and DNA-protein cross-links on a single cell level. This test measures primarily exposure and, secondarily, early biological effects;
- the determination of N-terminal valine adducts to haemoglobin by means of a modified Edman degradation technique for epoxide forming mutagens. This test also measures exposure and the earliest biological effect;

- the micronucleus test a tool for the determination of damage to the chromosomes caused by ionising radiation or chemicals. This test also measures biological effects.

3. RESULTS AND CONCLUSIONS

3.1 Inorganic arsenic metabolites

The determination in urine of inorganic arsenic (iAs), which is a human carcinogen, and its relevant metabolites (MMA: monomethylarsonic and DMA: dimethylarsinic acids) allows to characterise an exposure to this element. Before using such a biomonitoring method, analytical difficulties must be resolved particularly with regard to the existence of two valence states (iAsIII and iAsV) and organic species, some of which derive from biotransformations after absorption (MMA and DMA) and are to be considered in the assessment of exposure, and others from the ingestion of arsenicals present in seafood (AsB: arsenobetaine and AsC: arsenocholine), generally atoxic and to be disregarded for the interpretation.

A technique for the biomonitoring of exposure to iAs is developed: high pressure liquid chromatography on ion exchanger is selected to guarantee arsenic species discrimination; a prior hydride generation step makes it possible to avoid interferences from seafood arsenicals and an atomic fluorescence detector provides sensitivity and specificity at a low cost. A fully automatic technique is developed by coupling the three operations. In addition, conditions are defined to allow the on-line mineralization of AsB and AsC when their determination is wanted.

Starting from 50 µl of urine (which can be stored at 4°C for several weeks without loss), concentrations of the 4 species iAsIII, iAsV, MMA and DMA as low as 1 µg As/L can be measured; CV of replicate determinations amounts to 10 % at the 2.5 µg As/L level and remains below 5 % for concentrations equal or above 10 µg As/L.

Analytical performances of the automatic technique developed are similar to those of the previously used manual method based on atomic absorption. An excellent proficiency in the determination of the urinary As excretion is demonstrated by the results obtained in the course of interlaboratory comparison programs organized by German and Canadian institutes.

DMA measurements in standard materials (tuna fish extract and urine) lead to results in the tolerance range but are in one case below and in the other above the target value, pointing to the need for certified standard solutions of both MMA and DMA.

The usefulness of urinary As measurements is demonstrated in cases of acute (attempted suicide) and chronic (Spa water treatment of asthmatic boys) exposures to the element.

3.2 Styrene adducts

Many carcinogenic compounds cause mutations by chemically binding to DNA. The results of such binding processes are called adducts. Adducts may cause mutations because at the binding site copying errors may arise when DNA replication takes place during cell division.

The study of adducts is a valuable new tool in cancer risk assessment. Adducts may offer information on the mechanisms of mutation, the level of exposure of individuals to carcinogens and the degree of cancer risk. However, the direct study of DNA adducts in humans is difficult for a number of reasons. Therefore, indirect methods are sought that can serve the same purposes. For this reason adducts to proteins are frequently used as surrogate for DNA, because they are formed by the same chemical processes that lead to DNA adduct formation.

The study of adducts requires the development of extremely sensitive analytical techniques. The normalisation program offers a framework for research on method development and validation. The concrete aim was to develop and validate a method for the determination of adducts to the blood protein haemoglobin. As model compound styrene was chosen. This substance is important for human health because of its widespread use in the plastics industry. It is also a putative mutagen because of its metabolism into styrene-7, 8-oxide, a known mutagen and carcinogen.

The method developed consists of a sample preparation step allowing the specific isolation of adducts to the amino acid at the end of the haemoglobin chain (N-terminal valine), followed by a gas chromatographic and mass spectroscopic analysis. In the development stage rigorous procedures had to be devised to eliminate interference by other compounds both from within the sample and from external sources. The method was validated with respect of the required limit of detection; the linearity and fit of the calibration curve, the precision and accuracy (versus a certified commercial adduct standard). It was also shown in a group of workers exposed to low levels of styrene that the method is able to discern between adduct levels at the limit of detection and the background noise in a non-exposed reference group.

3.3 Comet assay and micronucleus test

The main goal of the Laboratory for Cell Genetics was the validation of the micronucleus test and the Comet assay for the evaluation of DNA damage after exposure to mutagens. Practically, the laboratory's activities concentrated on the implementation of an internal standard in the Comet assay, the use of more specific reporter cells in both the Comet assay and the micronucleus test, the use of the Comet assay in a Global Repair Phenotype assay, the use of the micronucleus test in biomonitoring studies and some final discussions necessary for the validation and the international acceptance of the in vitro micronucleus test.

Implementation of an internal standard in the Comet assay

The electrophoresis step in the Comet assay is the most critical step of the method and is very sensitive to experimental variation. This can be minimized by the systematic use of an internal standard in every electrophoresis run. Our laboratory introduced and validated untreated and ethylmethane sulphonate treated K562 cells as an internal standard in the Comet assay.

Use of more specific reporter cells in both the Comet assay and the micronucleus test

In human biomonitoring studies the cells most commonly used are peripheral blood lymphocytes in the ex vivo/in vitro cytokinesis blocked micronucleus test (CBMN test) or in the regular in vivo micronucleus test, for the simple reason that peripheral blood lymphocytes are easy to obtain and to cultivate. Very often, these peripheral blood lymphocytes are actually not the target cells of certain chemicals, nor the cells being exposed to them directly. Nasal or buccal mucosal cells or lung epithelial cells in sputum for instance are the cells exposed directly when exposure through inhalation is considered (relevant for instance in the case of exposure to chemicals like chromium, cobalt and styrene). For this reason the laboratory tried to use these cells in both the Comet Assay and Micronucleus test.

Use of the Comet assay in a Global Repair Phenotype assay

Since more than 100 enzymes are involved in DNA repair along at least 5 different pathways, it is quite difficult to predict the repair phenotype from a selected number of DNA repair genotypes. By in vitro challenging with the involved mutagen, one can evaluate the in vivo repair phenotype.

The alkaline version of the Comet assay can be used for this in vitro evaluation of individual repair capacity e.g. for ionizing radiation or styrene (as was done in the laboratory), following the DNA damage with time (15', 30', 60', 12 h and 24 h).

Use of the micronucleus test in biomonitoring studies

Plenty of literature has been published on the cytokinesis blocked micronucleus test, but before strongly recommending this method it was essential to evaluate both its negative and positive features. Fenech and co-workers summarized these. Nevertheless, until now, nobody took the presence of micronuclei in mononucleated cells into account, although it can be very complementary to the information embodied in binucleated cells. Later, Kirsch-Volders and Fenech suggested the integration of the frequency of micronuclei in mononucleated cells in the CBMN test in biomonitoring studies. This contribution will improve the assessment of accumulated mutations.

Towards validation and international acceptance of the in vitro micronucleus test

Micheline Kirsch-Volders was chairman of two International Workshops on Genotoxicity Testing (IWGT) (the 1999 IWGT in Washington and the 2002 IWGT in Plymouth). In these workshops the major topics of the test were discussed, the main goal being the recommendation of a protocol for a reliable in vitro micronucleus test for the detection of both clastogens and aneugens. The 1999 workgroup focused their discussion on the first step (the detection of micronuclei), and the 2002 workgroup had data available to prepare final conclusions on the main aspects of the in vitro micronucleus test protocol.

3.4 Micronucleus Test

The determination of the micronucleus frequency in peripheral blood lymphocytes after in vitro mitogen stimulation is a valuable assay to assess the chromosomal damage in individuals exposed to ionising radiation or mutagenic chemicals. As different protocols for the test and a variety of scoring criteria are used throughout the world, normalisation and validation are necessary. The test is used as exposure biomarker in case of accidental, occupational, environmental and medical exposures. To give the test a legal dimension for regulatory bodies a quality assurance programme for accreditation of laboratories applying the micronucleus test was worked out.

In the framework of present project a standard protocol or modus operandi for the test was elaborated. The effect of different variables (culture time, fixation and staining methods) on the sensitivity and quality of the slides to be scored was investigated. A consistent set of scoring criteria was worked out in collaboration with the Human MicroNucleus working group, which aims the normalisation of the test at a world scale.

As a first step in the validation programme the reproducibility of the test was assessed by a study of the intralaboratory variation in replicate cultures. Furthermore, the inter- and intra-individual variation of the test over nine months after an in vitro exposure of blood samples was studied. The intrinsic variability of the test amounts to 5 % while the intra- and inter-individual variabilities are 9 %.

The sensitivity of the micronucleus assay after a mutagenic exposure of an individual is determined to a large extent by the variability in the spontaneous micronucleus frequency within a non-exposed population. A study of the micronucleus frequency distribution in a control population showed that age and gender are important confounding factors while the effect of smoking habit was statistically not significant.

Procedures were worked out for quality assurance and quality control of the micronucleus assay as exposure biomarker for mutagens. Also important elements in the validation file for the accreditation of laboratories performing the micronucleus assay were worked out: confidentiality of personal information, laboratory safety requirements, calibration curve, scoring procedure, reporting of results. These quality assurance and control programmes must assure the quality of the laboratory's output over extended periods of time. The elaboration of these procedures concurred with the draft of a document of the International Standardisation Organisation "Standard criteria for service laboratories performing biological dosimetry by cytogenetics - Quality assurance and control, evaluation of performance".

4. CONTRIBUTION OF THE PROJECT IN A CONTEXT OF SUPPORT TO THE PROCESSES OF STANDARDISATION AND TECHNICAL REGULATIONS

4.1 Results directly connected with the process of normalisation

- The validation results of test methods that may contribute to the development of normalised testing protocols.
- The project allowed working out criteria for accreditation of laboratories performing cytogenetic analysis of blood samples for assessment of chromosomal damage after exposure to mutagenic chemicals and ionising radiation.

4.2 Contacts with national and international institutions for normalisation

The following organisations were represented in the follow-up committee of the project:

- Beltest;

- Ministry of Labour;
- The Belgian Institute for Standardisation.

Members of the project are participating in the following normalisation activities:

- at CEN: membership of Technical Committee 137 working on "Measurement of Dermal Exposure – Requirements and Test Methods" (KUL);
- membership of Technical Committee 85 at the International Standardisation Organisation working on "Reference radiations" and "Physical and biological dosimetry" (RUG);
- chairperson in the workshops on the in vitro micronucleus test at the IWGT held in Washington (1999) and Plymouth (2002). The proposed protocol will be integrated by OECD (VUB);
- coordination of the HUMN-project (HUMAN MicroNucleus project) (VUB);
- evaluation for WHO-IPCS (World Health Organization – International Programme on Chemical Safety) of nitro-PAHs (VUB).

4.3 Presentation of the results to institutes for normalisation

The results of the project with respect to the micronucleus assay are partially included in the draft document ISO/TC 85/SC 2 n 551 on "Standard criteria for service laboratories performing biological dosimetry by cytogenetics - Quality assurance and control, evaluation of performance", now distributed for voting to the national members of the Technical Committee 85 of the ISO.

5. KEYWORDS

Mutagens, carcinogens, biomarkers, mutagenicity testing/DNA damage, in vitro/in vivo, biomonitoring, inorganic arsenic, urinary metabolites determination, haemoglobin adducts, Comet assay, micronucleus test, quality control.

NM/A3/37
NM/10/36

THE CONSUMER SAFETY

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1. CONTEXT

There is a great need for means to give consumers as well as professionals information about the existing regulations on the consumer safety. In the framework of this study, we look into the various guidelines that set forward the rules for the safety of a certain product and the way in which these guidelines are translated into national law for the following subjects: toys, personal protective equipments, machines and low voltage, medical devices, construction products, lifts and general product safety. In order to attune these information means to the needs of the target group in the best possible way, the consumer behaviour must be taken into account. For that purpose the consumers have been consulted.

2. OBJECTIVES

The project has 4 objectives:

- a qualitative analysis of the information needs in the field of safety protection;
- the preparation of texts for brochures (1 per guideline) destined to the consumers and dealing with safety matters, based on a study of the regulations (guidelines, laws and standards);
- the development of a database with all the names of organisations that are active in the safety protection;
- the preparation of technical files (1 per guideline) for the Federal Public Service Economy, S.M.E., Self-employed and Energy meant to inform "small manufacturers, exporters and distributors" who wish to design and make, export or distribute products that meet the regulation requirements.

A supervising committee directed the whole project. Its task consisted of watching over the coherence between all the different actions and over the good course of the project.

The project is split up in 3 phases.

Phase 1: A qualitative analysis of the consumers' information needs

The needs for effective communication means were analysed in this phase.

The first part consisted of a survey among institutions and organisations. The consumers' needs were evaluated on the basis of questions and complaints about

safety matters, that were addressed to the Federal Public Service Economy, S.M.E., Self-employed and Energy and to other organisations.

The second part was a qualitative survey among a small group of consumers. Individual as well as group surveys were conducted in order to get a view of the consumers' behaviour, expectations, knowledge and experiences in the field of safety.

Phase 2: Judicial and practical aspects of the product safety for consumers, manufacturers and public authorities

This study's aim is to make a detailed analysis of the guidelines, Belgian regulations and Royal Decrees bearing on the various subjects we selected for this study. This analysis must allow us to make a comparison between the different regulations and the general law on the consumer safety.

Phase 3: The working-out of communication means

Different sorts of communication means have been worked out.

- ***Inventory of organisations and institutions:*** organisations, institutions and services that are active in the field of safety and prevention have been stored in an Access database. This database has been permanently updated. More explicit information about the organisations in question will be gathered through the distribution of a questionnaire.
- ***Texts for brochures destined to the consumer:*** these texts take into account e.g. the questions asked by the consumers, the information that is required to recognise a safe product and the necessary documents that have to accompany a product.
- ***Recapitulating texts for the professionals:*** these texts explain the regulations. Particular attention is given to the sections that are of interest to the professionals, e.g. the safety requirements, the procedures that have to be respected, etc. The texts are based on the results of phase 2. They are completed with information about accidents.

The "Centre du Droit de la Consommation" was charged with the execution of phase 2. This study consists of a describing and an evaluating approach of the various guidelines and regulations.

The "Centre de recherche et d'information des organisations de consommateurs" (CRIOC - OIVO) is charged with the realisation of phases 1 and 3, i.e. the working-out of communication means based on the consumers' information needs.

3. CONCLUSIONS

The project was a positive experience thanks to the interaction between the various actors, i.e. the public authorities, the professionals and the consumers. It led to a further development of the CRIOC's expertise.

At the consumer's level:

- the survey showed that the consumer has a need for information about the safety of products;
- the information must be clear and transparent, and it must be given in an appealing manner. Brochures seem to be about the best suitable means to get the message through to the consumer;
- the consumer is looking for advice on good purchases and is particularly interested in information about how to purchase safe products;
- the consumer does not give enough attention to the product manual and thinks the labelling is too difficult. Manuals are often considered to be too complicated and illegible. Pictograms and labels get more attention, although their meaning is often insufficiently known because of the massive number and variety of labels and pictograms. Safe products must come with a clear, understandable and brief labelling;
- the project's final results, including the brochures, received a positive evaluation from the middlemen as well as from the consumers themselves.

From the professionals' and the public authorities' point of view:

- professionals, like manufacturers and semi-professionals, also have a need for information. The complexity of the safety regulations makes it necessary for this target group to have simplified communication on the regulations and safety aspects for the various product groups;
- the Federal Public Service Economy uses this project's final results, such as the technical files, for website material.

4. CONTRIBUTION OF THE PROJECT IN A CONTEXT OF SUPPORT TO THE PROCESSES OF STANDARDISATION AND TECHNICAL REGULATIONS

This project led to various sorts of results and by-products:

- a database containing all the institutions and organisations that deal with safety matters;
- texts for 7 different brochures: toys (published already), personal protection equipment (1 brochure on do-it-yourself and 1 brochure on sports) (published already), machines and low voltage, medical devices (lenses), general product safety (risk analysis), lifts and construction products;
- technical files (1 file per guideline) for the Federal Public Service Economy and the professionals;
- judicial studies: 1 per guideline;
- valorisation of the results of the project: information on the website of the CRIOC and links to websites of the consumer organisations.

The indirect valorisation of this project resulted from the interaction between the registration systems (such as EHLASS) and the prevention. The consumer organisations, journalists, animators specialised in prevention, the library, etc. are not only interested in data about accidents, but are actually also potential users of the results of the project, e.g. the analysis of consumer behaviour and the regulations, as the basis for prevention measures.

The valorisation of the project was made through the individual contacts that the CRIOC has with institutions such as the Belgian Institute for Standardisation and ANEC, among others.

5. KEYWORDS

Accidents, accident registration, Belgian legislation, brochure, communication means, construction elements, consumers, consumers behaviour, consumers' right, database, EHLASS, European directives, garage gate, labelling, lenses, lifts, low voltage, machines, medical devices, personal protective equipment, prevention, prevention campaign, product information, product safety, professionals, risk analyse, safety, toys.

**ASSESSMENT OF THE ADEQUACY
OF FIRE BEHAVIOUR TESTS
FOR CABLES**

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1. CONTEXT

It is now acknowledged that electric cables (and optical fibre cables) must be considered within the scope of the Construction Product Directive (89/106/EC). Consequently, a Euroclass system appropriate for cables is required. The system built for common building products is based upon the Single Burning Item (SBI) as main test (decision 2000/147/EC). Whether such a test is valid for linear products remains questionable.

Two competing proposals have been introduced in relation to cables:

- Europacable (European Confederation of Cables Manufacturers) has suggested a system built upon the EN 50266-2 (equivalent to IEC 60332-3) test, with improvements as developed in the FIPEC (Fire Performance of Electric Cables – New test methods and measurement techniques) project. Two different scenarios were proposed, in order to permit the discrimination of cables with high fire performance (e.g. as required for installation in some hidden voids);
- CFRA (Cable Fire Research Association) preferred the SBI, adapted to enable testing of cables. They consider such a test to be more pertinent for the evaluation of "plenum" cables (the CFRA proposal suggested at some stage to use SBI only for communication cables).

While each test method has been assessed individually in specific research programmes (the former in FIPEC, the latter in PIT (Partners in Technology – Study of cable Insulation Fires in Hidden Voids) and PII (Partners in Innovation, Harmonisation of Reaction to Fire Tests for an "Exotic Product" - Communication Cable), no extensive comparison of both tests was available.

2. OBJECTIVES

Our laboratory has just completed an extensive study (Assessment of the Adequacy of Fire Behaviour Tests for Cables, Belgian Science Policy project, 2000-2003), the objectives of which were, amongst others, to compare those 2 test methods, for a sample of cables including high performance ones (plenum cables: LC – Low Combustible, FEP – Fluorinated Ethylene Propylene).

The methods were compared in terms of:

- ability to measure the essential parameters: Flame Spread (FS), Total Heat Release (THR), FIGRA, Total Smoke Production (TSP);

- discrimination (i.e. ability to discriminate cables, whatever their level of fire performance);

Smoke measurements: two families of tests were

performed and compared, dynamic (Full Scale & SBI)

and static (3Meter Cube)

We have also investigated whether the tests could correlate with each other, by means of:

- ranking order correlations;
- linear correlations between parameters obtained at the 3 tests.

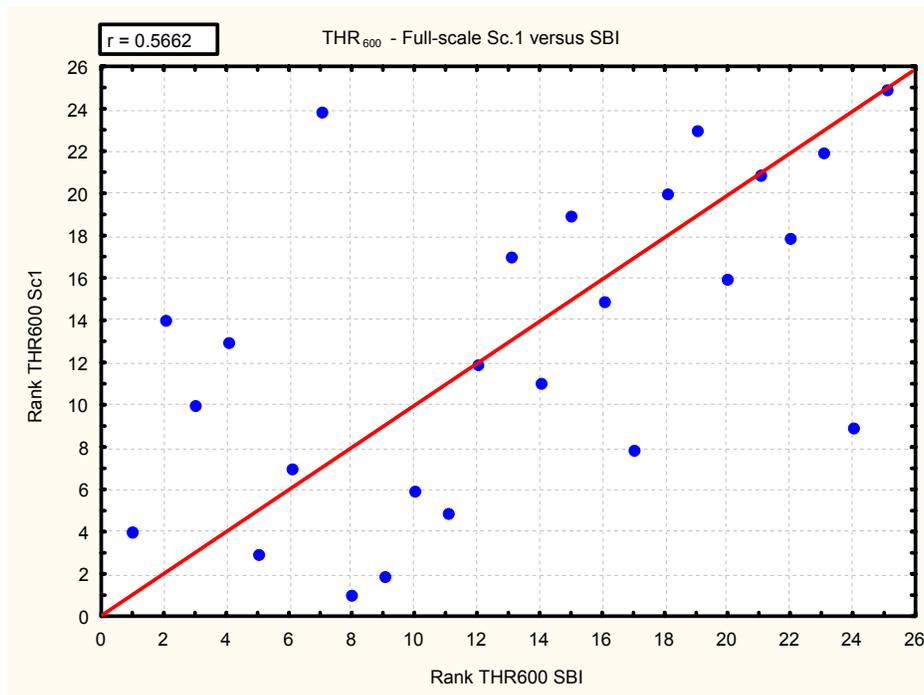
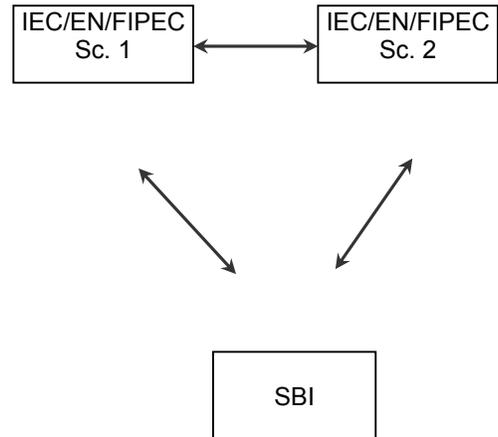


Figure 1: Example of correlation: Spearmann correlation between SBI and Europacable Sc. 1 tests for THR600

While each method has been found to be applicable for most selected cables, significant differences have been highlighted, both in terms of ability to measure the main parameters and to discriminate and/or rank the cables. This could have been expected since tests conditions are not comparable: ventilation, environment, mounting of the cables (it has been demonstrated previously that the mounting

procedure is the parameter with the most influence on the test results), type of burner (premixed against diffusion flame) ...

3. CONCLUSIONS

Proved large-scale calorimetry tests are now available for cables. Based on scientifically sound measurement techniques, they offer enough sensitivity to allow a robust classification of the different types of cables available in the market place, where their construction and used materials can vary greatly.

About smoke measurements, dynamic tests offer some improvements with regard to 3Meter Cube test. None of the method permits a reliable discrimination of low smoke cables.

For most parameters, no robust correlation has been found between the methods, except between the full scale scenario 2 and the SBI. Weighting the parameters (e.g. THR per unit length of cable) might improve the correlation.

4. CONTRIBUTION OF THE PROJECT IN A CONTEXT OF SUPPORT TO THE PROCESSES OF STANDARDISATION AND TECHNICAL REGULATIONS

A few critical findings have been pointed out, that are essential with regard to the development of future Euroclasses for cables:

- SBI does not enable to rank the cables in term of FS;
- for other parameters (THR600s, HRR peak, FIGRA, TSP), both methods can be adequate;
- using FIGRA for classification may lead to nonsensical results, i.e. top performance cables can be relegated in lower classes;
- with the 2 "Europacable" scenarios, difficulties in maintaining the hierarchy between classes can be encountered.

5. KEYWORDS

Full scale test, SBI, heat release, FIGRA, flame spread, EUROCLASSES, cables fire testing, smoke measurements, correlations, cable classification.

NM/67/41
NM/G2/42

REFERENCE MATERIALS FOR ADEQUATE POROSITY MEASUREMENTS

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1. CONTEXT

Results of measurements of porosity, pore volume, pore size and pore size distribution, are always strongly dependent on the method and on the apparatus used to perform the measurements. Therefore, it is not only sensible to compare the measurements of different techniques on the same material, but to compare them also with measurements obtained on well-defined reference materials.

MIP (Mercury Intrusion Porometry) is a fast, cheap and reproducible method to study porous materials. Moreover, MIP measurements cover a large pore size range from 5 nm to 0.3 mm. Originally the objective of this Belgian Science Policy project was to develop MIP reference materials for this whole range of pore sizes. In view of the work already done by BAM, we have focused our efforts to pore sizes starting from 5 μm .

In a first part of the project the MIP results on the obtained reference materials are compared with other pore size analyzing techniques, and especially IA (Image Analysis). Indeed, with the arrival of strong hardware and computer processing of images, IA becomes an important additional tool for the study of pores. It gives especially the possibility to quantify the morphological aspects of the pores. MIP does not consider these morphological aspects in a pore size measurement, because all the data are interpreted by a model based on cylindrical pores.

Therefore, it is the main objective of this project to be able to correct the pore size distribution obtained by MIP measurements for their known "bottle neck" behaviour, by IA. In this way, better exploitable measurement data by MIP can be obtained.

This objective was extensively worked out in part two, especially for materials with maximum pore size of 5 μm and 50 μm , in view of the considerations of the steering committee.

2. OBJECTIVES

The aim of the project was to develop:

- porous reference materials for MIP measurements;
- a method to correct MIP measurements for their "bottle neck" behaviour;
- to apply the method to practical problems.

In the first year, porous materials were produced in a broad pore size range with different manufacturing techniques and analyzed with different techniques.

In the second year, the study was concentrated on materials with pore sizes between 5 and 100 μm . These materials were extensively characterized with MIP and IA measurements. A method was worked out to correct MIP measurements with a model based on Image Analysis of SEM pictures of the microstructure. The obtained method could successfully be demonstrated on real brick materials.

3. CONCLUSIONS

- Manufacturing routes for porous references for the whole range of pore sizes were worked out.

For the materials used in the pore size range of 3 to 15 nm, we produced flakes by a sol gel method. A Reaction Bonded Al_2O_3 manufacturing route could be used to produce strong materials with pore sizes between 0.15 μm and 10 μm .

The pore size range of 10 to 100 μm can be covered by a system where large agglomerates are mixed with 5 to 10 wt% of fine powder and synthesized by pressing and sintering. Finally, materials with pore sizes bigger than 100 μm can be produced by ceramic foam techniques.

MIP measurements can only be done for pore sizes between 6 nm and 0.3 mm. This was a first limitation. Sol gel and ceramic foam techniques are therefore excluded. Later on after a year, we decided to concentrate on pore sizes between 5 and 100 μm , because there are no reference materials of BAM in that pore-size range.

- The different materials originally produced were tested with different analytical techniques and compared to MIP measurements.
- MIP measurements were performed with two apparatus to optimize the materials, their structure, their shape and volume and the way of measurement.
- Very reproducible materials could be produced.
- The same materials were also extensively study by Image Analysis and a method was worked out to correct MIP measurements with a model based on Image Analysis measurements. Figure 2 demonstrates the method.
- The obtained techniques and their interpretation were demonstrated on materials with pore sizes between 5 and 100 μm and on a few real brick materials with a well known pore structure.
- An onset was made to study the water transport behaviour in brick materials.

- A paper, describing the first part of the project, was already published [J. Luyten et al. (2002)].

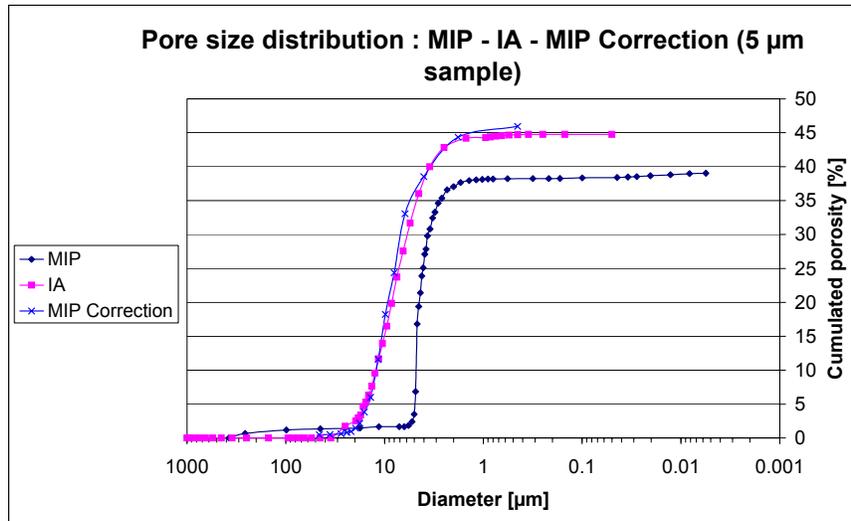


Figure 2: The comparison of pore size distribution, for the VITO 5 µm porous reference material, between MIP, IA and MIP Correction is given above. A good correlation is found between IA and MIP Correction (based on SEM Images)

4. CONTRIBUTION OF THE PROJECT IN A CONTEXT OF SUPPORT TO THE PROCESSES OF STANDARDISATION AND TECHNICAL REGULATIONS

- A procedure was developed to manufacture porous reference materials in the range of 5 µm to 150 µm. Such materials were not existing yet.
- A method was developed to correct MIP measurements for their "bottle neck" behaviour based on image analyze and on the porous reference measurements. This method was demonstrated on real brick materials. Also this will be a new tool for standardisation and improved the measurements.
- Due to the fact that prof. K. Meyer of BAM was in the users committee there was an exchange of documentation, results, specimens and rapports with the well known normalisation group of BAM.

5. KEYWORDS

Mercury intrusion porosimetry (MIP), Image Analysis (IA), porous reference materials, corrected MIP measurements.

6. REFERENCE

[J. Luyten et al. (2002)]: J. Luyten, A. Buekenhoudt, F. de Barquin and J. Elsen, "Reference Materials for adequate porosity measurements", Key Engineering Materials, vol. 206 - 213 (2002), p. 681.

**THE PHYSICAL CHARACTERISTICS
OF FERTILIZER PARTICLES:
MEASURE AND INFLUENCE**

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1. CONTEXT

Among available fertilizers, the bulk blends consist in a physical mix of different raw fertilizers. This production method allows to obtain a quite cheap compound fertilizers. However, we regularly observe segregation of the components in function of their differences.

This segregation is marked during the flows during storage and transport and also during spreading on the field. The segregation during the flows will lead to the fertilizer marketing of variable formulation and thus will involve problems of respect for the contents indicated by the manufacturer. The second segregation during spreading will cause a heterogeneity of fertilizers on the crops, which will involve a reducing of the output and a higher cost. Ultimately, this process results in a harmful effect on the environment.

Many recommendations of quality for the bulk blend exist but they remain vague and imprecise. Moreover the properties, on which they are based, don't always have a standardised method of measurement and thus complicate any comparison.

2. OBJECTIVES

The goal of this work is double, at once a better knowledge of the physical properties of the fertilizers and on the other hand a quantification of the maximum difference between these properties in order to avoid segregation. It means the development of measurement methods of physical properties of the fertilizers and the analysis of the blends behaviour following various solicitations.

3. CONCLUSIONS

The main measurements concern the dimension, the density and the shape of the particles. It is in particular for the last property that we used the techniques of Image Analysis. The techniques of Image Analysis are applicable to the fertilizer particles and make it possible to quantify parameters of shape. Correlations were found between the shape parameters calculated on the basis of Image Analysis and the value of the angle of repose and the increment of density following compressing. The method of measurement of flow rate was standardised and an appendix was added to standard EN1235 (sieving test of fertilizers). This appendix defines the procedure of interpretation of the data issued from the sieving test. Tests were carried out on the measure of the hardness of the particles, on the shock resistance, on the

generation of dust (friability) but the variable results obtained did not allow to define a method of measurement which can be the subject of a standard.

Correlations were found between the physical properties of which in particular flow rate with the density and the size of the particles. A link exists between the angle of repose and granulometric spread. Tests were also carried out with different dimension group of a set of current fertilizers. These tests make it possible to better test the influence of a parameter on another. Thus flow rate (l/min) and the angle of repose are related to the diameter of the particles. A relation makes it possible to calculate flow rate on the basis of value of the density, the diameter of the particles and a shape parameter (angle of repose or roundness).

The principle of the experimentation is to realize a set of bulk blend of two components and to follow their behaviour and especially the tendency to segregate. For each mix, two fertilizers quite similar, excepted for one particular parameter are selected. Then, with these products, we are able to simulate the different situations: transport, flowing and finally spreading. For the tests of flows, simple laboratory tests were carry out in order to simulate the real situations.

The tests of segregation during flow consist of the realization of a heap on a plate, of the filling and the emptying of a container.

For the heap on the plate, samples are taken at various places (centre, border). One observes primarily an accumulation of the fine particles in the centre of the heap in particular for the bulk blend having a content of fines (particles smaller than 1 mm) higher than 1 %.

The test of filling the container leads to similar results but the granulometric variations are more important. One observes thus that the large particles move further than fines and concentrate at the border of the container.

Lastly, the emptying of the contents of the container by the trap door still accentuates the granulometric differences between the samples of the beginning and the ending of emptying. Variations of more than 0,5 mm in median diameter were marked. These fertilizers require a different adjustment for spreading and moreover the chemical composition varies between the first and the last samples.

Physical properties have a great influence on the segregation tendency. It appears that the difference of dimension between the particles must be limited in order to reduce this phenomena during the flow. The granulometric spread of the fertilizer must be limited to a value of 1 mm. Above this value, fertilizer will be subjected to a

demixing of the components during flowing. The finest particles accumulate under flow and largest roll further.

In the same way the content of fines, i.e. of the particles of less than 1 mm must be null, these fine particles are indeed very sensitive to the percolation and thus accumulate quickly in the bottom of the heaps under vibrations.

For spreading, difference of dimension of the particles is of little importance but the shape and the mass of particles cannot differ too much. Thus a variation of angle of repose from 4 to 5 ° and a variation of density of 200 kg/m³ appear to be the limits above which the segregation during spreading will be marked. On the other hand, these two physical properties appear not to have any influence on the segregation during the flows.

The use of a Hele-Shaw cell makes it possible to quickly simulate in laboratory the process of segregation during the flows. The opening of the vertical wall against which the heap rests makes it possible to recover two samples whose granulometry can be compared. The results show a good representation of the phenomenon of segregation such as it proceeds during the filling or the emptying of a container.

4. CONTRIBUTION OF THE PROJECT IN A CONTEXT OF SUPPORT TO THE PROCESSES OF STANDARDISATION AND TECHNICAL REGULATIONS

During the project, the Department got involved in the working group for the measurement of the physical properties of fertilizers (CEN/TC260/WG2). Among the subjects, the method of measurement of flow rate is currently standardised (INTO 13299: 2000) as well as appendix ZA to the standard on the method of measurement of the granulometry, which relates to the interpretation of these measurements (EN 1235 - 1995 / prA1: 2002 informative Annex ZA). Two reports were also drawn up, one concerning a study on the homogeneity (CR 13960: 2000-08 study on homogeneity) and one on the determination of the dust content (CR 14061: 2000-12 determination of dust content).

Regular contacts were thus established between the participants in the working group of standardisation, these people representing either the research centers, or the fertilizer producers.

A meeting of the working group (TC260) took place in Gembloux and the work about the problems of segregation was presented to the participants.

The "Laboratoire d'analyse des propriétés physiques des particule d'engrais" has developed and is in the process of ISO 17025 accreditation in order to provide in the near future accredited measurements.

The measures suggested are done in accordance with the standards defined in CEN committee.

Lastly, although it is not come to anything yet, the measurement of the shape by the techniques of Image Analysis seems promising. That allowed a close cooperation with the laboratory MICA of the University of Liege, as well as the company Occhio, both specialized in the Image Analysis techniques.

5. KEYWORDS

Bulk blend, segregation, granulometry, shape.

INTERNATIONAL STANDARD FOR
ARCHIVAL DESCRIPTION
"PALLAS"

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1. CONTEXT

In the past ten years, national, federal and European scientific policies have focused on the need to develop and improve the exchange of information between institutions and researchers (fundamental and applied research), in the scientific, technical and cultural fields. Knowledge and technology transfers between universities, semi-public bodies and the private sector are a key element of development (as shown by the European Action Plan 2002 and the 5th Framework Programme for Research and Technological Development, which focuses among others on "Creating a user-friendly information society (IST)" (see <http://www.cordis.lu/ist>). Those are core elements in the development of the "European research space". However, two key conditions have to be met to ensure an efficient transfer of information, namely the ability to deal with, understand and process the information that has been collected, and the availability of common information production tools. Technical preservation and archival methods have been a key priority, including digitising policies and electronic documents preservation, used for example to build collections of documents and make them accessible from a distance. In this context, two key factors have often been neglected:

- we lack tools to produce common catalogues (including databases and online catalogues, both for the description of items and the collection of data);
- we need to produce instruments and use them to compare "samples" (still to be processed) and collected results, on the basis of common sets of records. In this field, standardisation is a crucial element.

2. OBJECTIVES

The objective of the programme entitled "Implementation of the International Standard for Archival Description (G) - Pallas" is to implement unified archival description standards, in order to:

- ensure that descriptions will be compatible, relevant and explicit;
- facilitate the retrieval and exchange of archive (and library) records;
- allow the integration into a unified information system of descriptions whose origins are different. The main target groups are the State scientific institutions and other Belgian scientific institutions.

Rather than producing documents in order to publicise existing standards already being pushed forward either by the institutions that either originally developed them

(International Archives Council) or by those that promote them (national archives institutions), the project promoters have decided to focus their efforts on the further development of a software invented by CEGES - SOMA, a Federal Scientific Institute.

The objectives are threefold:

- ensure the effective use of description standards (hence go beyond theoretical advising) and allow users to practically apply and use recent theories;
- produce a tool (software) that meets the conditions presented above. This software had to be up to the highest scientific expectations and integrate the latest discoveries (including the adoption of the XML language for mark-up), in order to meet both data exchange and retrieval requirements. Another objective was to define the technical setup required to ensure the smooth and cost-effective operation of the tool (operating system, hardware, middleware, etc.);
- work on the "access policy" for public scientific and cultural institutions, while continuing the system's development.

3. CONCLUSIONS

Version 2.0 of the Pallas system is now available and meets the objectives presented above.

In particular, from a scientific viewpoint:

- in order to meet specific description requirements and allow the exchange of data with other management systems and institutions, Pallas integrates several widely used international standards;
- the programming of Pallas has been completely reviewed, in order to meet current software requirements (XML + XSL, Web Application, JavaScripting, etc.);
- a first network of users has been set up and a campaign to disseminate the software has been launched.

Those two initiatives have made it possible to achieve the following:

- the structure of the software has been reviewed in order to make it more user-friendly, after a series of tests and through joint research programs (DISSCO – Belgian Science Policy project, with IRM, VUB, CEGES, ULB, MRAH and TACSI – ULB, VUB, CEGES);

- co-operation agreements have been signed with other public institutions (City of Brussels, Belgian French community, Brussels region, etc.);
- a plan to develop the programme has been designed, taking into consideration converging wishes expressed both by designers and users (audio-visual module, module dealing with collections management).

4. CONTRIBUTION OF THE PROJECT IN A CONTEXT OF SUPPORT TO THE PROCESSES OF STANDARDISATION AND TECHNICAL REGULATIONS

In order to meet specific description requirements and allow the exchange of data with other management systems and institutions, Pallas integrates several widely used international standards, namely the MARC AMC standards for the database structure, ISBD for non archival-related descriptions, ISAD(G) for archive material, APPM for the unified presentation of descriptions, and EAD for the presentation and exchange of archive data.

5. KEYWORDS

IST, documents, archival, cataloguing, ISAD(G), MARC AMC, ISAAR, APPM, EAD, XML.

**ENERGY EFFICIENCY THROUGH TECHNICAL
STANDARDS: A EUROPEAN APPROACH TO
REDUCE MARKET FRAGMENTATION
AND EFFICIENCY BARRIERS**

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1. CONTEXT

In the past, technical standards have been analysed to reduce their potential role as market barrier for consumer and producer goods. The unified European market can not function properly with this type of market barriers and therefore a process of harmonisation and normalisation of technical standards coincided with the ongoing enlargement and economic deepening of the European Union.

Since the Kyoto Protocol, energy efficiency through technical standards became one of the many option to realise the greenhouse gas emissions reduction target.

2. OBJECTIVES

In this research project, we wanted to analyse how energy efficiency standards are currently integrated into climate policy and what role technical standards can play in the future development of European climate policy. Technical efficiency standards are currently developed by European and national regulators with a rather slow record of progress. A more dynamic view emerges with technical standards that are the subject of voluntary agreements between industry and regulators. In most voluntary agreements that relate to climate policy, the target is a relative reduction of energy use or emissions per unit produced. As with "conventional" technical standards, these voluntary initiatives do not lead to absolute reductions of energy use or emissions. For the latter part of the analysis, we had to focus on the major developments in European environmental policy, such as the Integrated Pollution and Prevention Control (IPPC) Directive and the Integrated Product Policy (IPP) green paper. Both initiatives are no pure climate policy initiatives but they will play an important role in the further elaboration of climate policy in the EU.

3. CONCLUSIONS

The IPPC Directive will lead to a permit system for EU industry that is based on using Best Available Technologies (BAT). Firms that do not use BAT, risk to lose their operational permits. From 2008 on, this directive will fundamentally alter the use of technical regulation for industrial processes. Another consequence relates to future voluntary agreements; they will be transformed into agreements to use BAT.

In addition to the IPPC Directive, the IPP green paper will bring a policy perspective based on life cycle analysis (LCA). The environmental impact during production as well as during consumption will be considered. Products for which the LCA-assessment turns out to be too negative will be banned from the market. The full

implementation of IPP will reduce the relevance of technical standards for consumer goods (like refrigerators ...). The main conclusion from the above analysis is that the new climate policy instruments did not at all replace classical command and control regulation. The new instruments like voluntary agreements are based on technical standards and promising new developments of EU environmental policy indicate the future importance of technical regulation in EU environmental and climate policy.

4. CONTRIBUTION OF THE PROJECT IN A CONTEXT OF SUPPORT TO THE PROCESSES OF STANDARDISATION AND TECHNICAL REGULATIONS

The goal of this research project was to support policymaking so no technical products have been developed. The policy recommendations mainly deal with the role of technical regulation in broader policy frameworks to improve energy efficiency. The researchers to this project do not participate in working groups of normalisation organisations.

5. KEYWORDS

Energy efficiency, technical standards, product regulation, economic instruments, IPPC.

**PROMOTION OF STANDARDISATION
AND CERTIFICATION OF BUILDING
PRODUCTS IN AGRICULTURE**

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1. CONTEXT

Agriculture and horticulture are sectors in which constructions have several important functions to fulfil, either for housing people or animals, or for storage and conservation of raw materials and products. The building materials of which concrete is the most important, are very often used for among other things sheds, slurry cellars, floors in animal houses and glasshouses, etc.

Specifically for the agricultural sector, it is important that both the constructional and the agricultural requirements are satisfied. In practice, errors are often made through lack of information and guidance in the field of the application of existing standards, through lack of certification or certified products and guidelines and lack of supervision.

Increasingly, manufacturers and contractors active in the agricultural sector experience the lack of Belgian standardisation and certification and lacking supervision as problems that weaken their competitiveness on foreign markets. The farmer would benefit also if he/she could be assured, through certification, that the offered building materials comply with the requirements outlined in a standard or certificate. Certification and standardisation demand an interdisciplinary consultation and until now such an approach is seldom made in Belgium.

Within this two-year project, "AgriCONSTRUCT" tried to play a pioneering role in the design and the promotion of agricultural concrete products in Belgium. Problems related to standardisation and certification will become the subject of a discussion between farmers and their organisations, agricultural research, the agricultural extension services, the concrete industry, the agricultural concrete industry and BIN - IBN (here represented by Probeton).

There is a great demand from the concrete industry for support and advice with the application and maintenance of the BENOR quality label. This is, in first instance, clearly observed in the sector of manufacturers of concrete slats since concrete slats were the first concrete products for agricultural use that were standardised.

On the other hand, there are many questions from the agricultural and horticultural sector on the realisation of new concrete constructions or the maintenance and repair of concrete constructions on the farm. AgriCONSTRUCT is ideally suited to perform such a service i.e. giving advice and information to the sector and can, as such, be seen as a turning point between the industry and the customer.

2. OBJECTIVES

The main goals of this project are the promotion of standards and certificates, and the initiation and coordination of several working groups on building products for the agricultural branch. The objectives are: practical directives for building particular agricultural constructions, normative documents, BENOR-labels for concrete products and aTg-labels for agricultural building systems.

These standards and certificates are promoted in the agricultural sector through some concrete actions:

- the realisation of an inventory of the application of standards and certified building products in agriculture and horticulture;
- sensitisation of manufacturers and construction companies in the agricultural sector to apply normative documents and standards and to use certified products;
- publication of the quarterly information magazine "AgriCONSTRUCT" for agriculture and horticulture. This magazine discusses besides concrete also other construction materials;
- maintenance and extension of the electronic network on the Internet;
- several promotional activities such as the organisation of courses and workshops and participation in agricultural and horticultural fairs.

3. CONCLUSIONS

Both on national and European level normalisation in the agricultural sector is in its infancy. The Belgian Technical Prescriptions for slatted floors (PTV 203) and wall panels (PTV 212) are important steps forward in the direction of normalisation and certification in the agricultural sector.

The BENOR-label for slatted floors has gained increasing acceptance among manufacturers and consumers (farmers) and stands for quality and guarantee.

Besides the introduction of the BENOR-label for slatted floors among manufacturers and farmers the standard slat has also been introduced among manufacturers, contractors of animal houses, advisers and farmers.

The standard slat for pigs and cattle is designed according to the geometric prescriptions of PTV 203.

4. CONTRIBUTION OF THE PROJECT IN A CONTEXT OF SUPPORT TO THE PROCESSES OF STANDARDISATION AND TECHNICAL REGULATIONS

With the Belgian Science Policy projects "Promotion of Normalisation and Certification of Concrete Products in the Agricultural Sector" (NO/43/025) from 1 July 1998 until 30 June 2000 and "Promotion of Normalisation and Certification of Building Products in the Agricultural Sector" (NM/43/20) from 1 July 2000 until 30 June 2002 the first steps were set in Belgium towards normalisation and certification of construction materials for use in agriculture.

The projects soon led to two Belgian technical prescriptions: PTV 203 (slatted floors not subjected to traffic loads) and PTV 212 (wall panels), used for certification.

The need for normalisation in the agricultural sector was hereby demonstrated together with the need for more research on national and European level in connection with these and other normative documents.

The Department CLO-DVL participates in the standardisation commission, the activities of which are situated in the field of agricultural construction, techniques and environment.

There has been cooperation in the drawing up of European standards for concrete slatted floors (CEN/TC229/WG2/TG2) (J. Daelemans acted as President of the European Working Group) and for other issues such as drainpipes (CEN/TC155/WG18), and the hydraulic properties of geotextiles and associated products (CEN/TC189/WG4).

Dr. Ir. B. Sonck and Ing. K. Bousserly belong to the following international societies and working groups:

- Working Group TK 2.4: Slatted floor elements and Working Group TK: Wall panels of PROBETON;
- EOTA WG 02.05/01 - Belgian Mirror Group, ETA-Guidelines for cold storage room kits;
- the Organising Committee of the IVth International Symposium on Concrete for a Sustainable Agriculture. Agro-, Aqua- and Community Applications, in Gent, 21 - 24 April 2002).

CLO-DVL (B. Sonck, K. Bousserly) has many international contacts e.g. through CIGR (Commission Internationale du Génie Rural). The General Secretariat (1989 - 1998) of CIGR was held by Prof. Dr. Ir. J. Daelemans, formerly also Head of the

Department of Mechanisation, Labour, Buildings, Animal Welfare and Environmental Protection (CLO-DVL). Staff of the Department also participated in many congresses, symposiums, workshops and Working Groups on international level.

As a result of the attention paid to normalisation and certification of construction materials within the agricultural sector there is a growing demand for advice on the correct use of construction materials. The advisory service "AgriCONSTRUCT" provides information on the use of concrete, metal, cement, wood, etc.

This information, together with the promotion for normalisation and certification of construction materials is disseminated by means of workshops, courses, the quarterly magazine "AgriCONSTRUCT", the website (www.clo.fgov.be/agriconstruct) and through participation in several agricultural and horticultural fairs (Agriwest Ieper, Agribex 2002, the "Werktuigendagen", etc.).

5. KEYWORDS

Concrete, construction materials, normalisation, standards, certification, agricultural sector, agriculture, promotion.

NM/B2/29
NM/G6/30
NM/A4/31

NORMACH: A PROGRAMME FOR PROMOTION AND AWARENESS OF STANDARDS AS TO SAFETY OF MACHINERY

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1. CONTEXT

A previous study funded by the Belgian Science Policy has revealed that mechanical engineers and machine operators have little knowledge of technical directives and there is a great need for information on machine safety standards.

2. OBJECTIVES

To address this problem, an information platform was set up as part of the project with the aims of:

- providing suitable training and information (task 1);
- developing an interactive telematics system to provide users with information and create a forum for the exchange of knowledge between users, experts, the authorities and BIN - IBN (Belgian Institute for Standardisation) (task 2).

3. CONCLUSIONS

The first task (training and dissemination of information) started out from the needs pinpointed in the previous Belgian Science Policy study.

The non-technical project partner (the Eastern Flanders Development Agency GOM Oost-Vlaanderen) developed a network to enable the project to organise seminars across the country. Regional development agencies, Chambers of Commerce and Industry, SPI+ and various EICs were all involved in this.

During the programme, 54 workshops were held all over the country. These workshops were run by both WTCM - CRIF (Centre for Scientific & Technical Research in Metal Manufacturing) and TCHN - CTIB (Belgian Institute for Wood Technology) and most were arranged locally, for each province, to ensure that maximum attention could be paid to the problems facing small and medium-sized enterprises (SMEs). The workshops proved highly successful.

New series of seminars should now be organised and many more seminars offered so that greater headway can be made in increasing people's familiarity with technical regulations. The industry is specifically requesting that more technical and detailed subjects should be tackled. Standards should be the tools used for this. Moreover, they should be collated and made freely available in book form or on a CD-ROM.

The second task (maintaining and expanding a telematics system) comprised two sub-tasks.

The first sub-task involved major expansion of the project website with the URL <http://normach.wtcm.be>.

This website was promoted and had more than 2500 hits in the course of the project. Companies are continuing to consult the website, so the objective of "disseminating information on technical rules and regulations over the Internet" can be hailed as a great success. However, more information could be added to the website.

In a second sub-task, a discussion forum on technical rules and regulations was set up.

The website developed in this project needs to be maintained and further expanded. In addition, both it and other resources on technical rules and regulations need to be promoted more effectively.

One solution for meeting these needs would entail the authorities responsible for technical rules and regulations awarding subsidies.

4. CONTRIBUTION OF THE PROJECT IN A CONTEXT OF SUPPORT TO THE PROCESSES OF STANDARDISATION AND TECHNICAL REGULATIONS

The workshops held in connection with the first task helped to ensure better application of the standards on the ground than had previously been the case. These workshops were a great success: in total, 1854 registrations were received and several seminars were attended by more than 100 participants. The development of a telematics system on machine safety for this project was also publicised while this task was being performed, which also included answering telephone enquiries on problems to do with standardisation.

The second task allowed the industry to be kept up to date on developments with regard to technical rules and regulations and standardisation via the website.

The website provides the following information:

- the texts of laws on technical rules and regulations (applying both in Europe and in Belgium and proposed legislative amendments);
- useful guides and documents on the rules and regulations in question;
- lists of standards updated several times a year;
- interesting links.

Information is also provided on the following directives:

- *Directives on marketing machines, equipment, appliances and protective equipment*
 1. Machinery Directive (Directive 98/37/EC and amendments)
 2. Pressure Vessels Directive (Directive 87/404/EEC and amendments)
 3. Pressure Equipment Directive (Directive 97/23/EC)
 4. Lift Directive (Directive 95/16/EC)
 5. Directive on equipment for use in potentially explosive atmospheres (Directive 94/9/EC)
 6. Personal Protective Equipment Directive (Directive 89/686/EEC and amendments).

- *Directives on workers' health and safety*
 1. Work Equipment Directive (Directive 89/655/EEC and amendments).

In a second sub-task, a discussion forum on technical rules and regulations was set up. This forum can be accessed via the project website or the URL <http://forum.wtcm.be>. Whilst only two topics are covered at present (the new "Machinery Directive" and standards on the "Machinery Directive"), the discussion forum will be extended to cover new subjects.

5. KEYWORDS

Machine safety standards, technical directives, information.

**RESPONSIBLE MANAGEMENT THROUGH
ENVIRONMENTAL INDICATORS MASTERING
"GERMAINE"**

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1. CONTEXT

The upheaval in the economy attributable to information technology and market globalisation is changing management methods. Inter-company initiatives and gestures are becoming more and more standardised. The use of marketing tools such as EMAS or ISO 14001 is also challenging new sectors such as services, small and micro-businesses and public sector institutions. The federal environmental charter requires from public administrations to work out their **environmental management control panel** and action plan. It is necessary to develop simpler, more appropriate management tools in order to be ready for this development.

Introducing regular systematic environmental management that integrates environmental protection and sustainability into day-to-day operations of a very small company is possible; "light" management tools like Ecomapping proof this hypothesis.

Ecomapping is an easy, creative process of "scanning" environmentally relevant topics and practice directly in the physical reality of the shop-floor. It requires basically only observation, judgment, communication, patience and very little documentation. It helps in target setting and monitoring progress made in environmental performance as well as in the training and the raising awareness of both employer, managers and workers.

Ecomapping has been developed by Heinz Werner ENGEL in 1998. From the very beginning, the Ecomapping tool was intended to be shareware and therefore freely distributed by INEM (International Network for Environmental Management) worldwide. Conceived as a do-it-yourself-tool it is used in Europe and over the world now by a variety of actors.

2. OBJECTIVES

The GERMAINE applied research project helps to experiment two easy, simple tools to develop environmental management in companies and public services: Ecomapping and environmental management control panel.

The environmental management control panel project allows participating companies to benefit from environmental consultancy services to set up environmental management control panels.

The project should permit:

- the development of generic environmental indicators;

- the development of sectoral indicators;
- benchmarking, i.e. the comparison indicators;
- the most suitable experimentation with environmental information.

Throughout the project, information exchanges will be possible through workshops and a website. The technical group will establish links with analogue activities at an European level.

The project is targeting businesses in the service sector, including very small businesses and public-sector institutions:

- institutional catering;
- plastic injection moulding SMEs;
- mechanical workshops;
- cultural establishments;
- federal administrations.

The ***Ecomapping*** Brochure, presenting the other light tool for environmental management, has been downloaded more than 20000 times from the INEM server. There is a growing number of successful uptakes of Ecomapping worldwide. The need for a step by step training for trainers on Ecomapping was expressed by a lot of organizations worldwide.

Therefore, the overall aim of the Ecomapping project was to exchange information among the different users and build training capacity by:

- compiling and publishing 12 international case studies;
- elaborating a training manual for trainers;
- communication through a website.

3. CONCLUSIONS

The environmental management control panel project contributes to working out and follow-up environmental management control panels in about twenty federal

administrations, a cultural institution, an institutional catering, a mechanical workshop, a plastic injection moulding SME. These companies and administrations will keep their environmental management tools going out after this project.

The different experiments generated on general and specific brochures on environmental management control panel:

- Environmental management control panel;
- Sustainable management control panel;
- Environmental management control panel for cultural institution;
- Environmental management control panel for institutional catering;
- Environmental management control panel for public administration;
- Environmental management control panel for local authority administration.

A website (www.abece.be/germaine) presents the project and the brochures (downloadable in French, Dutch and English).

The Ecomapping project delivers:

- 16 international case studies;
- a training for trainers manual;
- a website (www.ecomapping.org);
- a international network;
- an expression of interest to participate to the VIth framework programme of the European Union;
- a research and development project called STIMMS submitted in the framework of the mixed actions call of the Belgian Science Policy.

Others indirect results of the Ecomapping project:

- elaboration of the electronic smart Ecomaps concept in Iceland with IceTec, Landmat and Environice to create a virtual assistant within LA 21 programs and develop other forward looking applications for Internet based EMS tools is under way (<http://www.landmat.is>; <http://www.icetec.is>);

- the Canadian Web based initiative Iso14001registry launched in March 2002 will be a central part in the concept of recognition in supply chain management and concepts like green productivity. The Registry makes the link between the ISO world and the Ecomappers (<http://www.14000registry.com>);
- the German NGO and management consulting Baum has developed an interactive CD software tool to introduce EMS in SMEs called Baumis;
- projects are to build a Web based tool and integrate Ecomapping as entry level. Cooperation strategies will be mapped with Iceland and ABECE (<http://www.baum-ag.de/index2.asp>);
- Ecomapping is integrated in the EMAS toolkit which is available on the INEM. A new version is under way (<http://www.inem.org>);
- the French NGO Ecolindus of Jean Francois Vallés puts TV interviews on line with news and smart sustainable business ideas. The site of Ecolindus has an intro to Ecomapping (<http://ecolindus.free.fr>);
- Ecomapping Guidebook for industrial estates in collaboration with OREE was developed and experimented in August 2002. Feasibility of an electronic component will be studied (<http://www.oree.org>).

4. CONTRIBUTION OF THE PROJECT IN A CONTEXT OF SUPPORT TO THE PROCESSES OF STANDARDISATION AND TECHNICAL REGULATIONS

- Two of the organizations participating in the environmental management control panel project have been certified ISO 14001 (the mechanical workshop Rectilux and the institutional catering of the "Theatre de la Monnaie").
- A presentation of the environmental management control panel project in Stockholm, in a INEM (International Network for Environmental Management) conference on ISO 14031 (June 2000).
- A presentation of environmental management control panel in Washington to the GRI (Global Reporting Initiatives) in November 2000 (<http://www.gri.org>).
- A presentation of environmental management control panel to the working group ISO/TC 207/ISO 14031 (July 2001) in Kuala Lumpur, Thailand.
- A presentation of Ecomapping in the European EMAS governmental and competent body meeting (January 2002) proposed Ecomapping as to be adequate as documentation and internal audit support in the EMAS regulation or

ISO 14001 implementation. Ecomapping is now on the EMAS Helpdesk server (http://europa.eu.int/comm/environment/emas/documents/kit_en.htm).

- A presentation of Ecomapping at the UNEP "Aid and Trade" Conference (June 2000) in New-York City (<http://aidandtrade.com/iat>).

5. KEYWORDS

Environmental management, EMAS, ISO 14001, environmental management control panel, Ecomapping, environmental performance indicators, public sector, services companies, small and medium sized enterprises.

**HYGIENE IN DAIRY PRODUCTION:
FARMERS AWARENESS AND
USEFUL METHODOLOGY
FOR RISKS EVALUATION**

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1. CONTEXT

In compliance with the European directive, the Belgian legislation compels to the application of self-controls measures based on the HACCP principles (Hazard Analysis Critical Control Point), in milk collecting, standardisation, treating and processing centers (A.R. of 7 march 1994). On the other hand, raw milk producers are only submitted to an analytical result obligation (somatic cells, germs ...). Moreover, these results characterize the "quality" of their milk. When results are beyond certain limits, there only exists few ways to find the origin of the contamination.

The special dispensation given by Belgian to milk manufacturer farmers stopped in the end of the year 2000 with the extension of products responsibility to farmers (directive 1999/34/CE). At the same time, the "Unité de Technologie des Industries agroalimentaires" underscored that use of HACCP only to manufacturing was not enough to keep special risks due to raw milk farmer products under control. In this context, this study has begun with the application of the HACCP methodology to milk production for "cow-to-consumer" manufacturer farmers.

2. OBJECTIVES

2.1 Farmers awareness

The aim is to grow awareness of raw milk producers by informing them of the legislation evolution and of their new role in front of manufacturers and consumers. This awareness program underlines advantages they may take out of applying the HACCP method and the hygiene principles in raw milk production.

During this first step, it is important to show that HACCP and QFL (Qualité Filière Lait) are two complementary preventive methods that allow to control problems in relation with milk quality. The QFL consists in specifications concerning animal health, animal welfare, breeding practices, hygiene and environment. It was put in place by the Belgian Confederation of milk industry (CBL) in collaboration with the fourth Belgians professional associations (UPA - UDEF, AAB, Boerenbond and ABS). The application of these specifications is a general method applied in milk farms delivering to dairy industry and where the milk undergoes a thermal treatment. HACCP is a more flexible method that can be adapted to every kind of manufacture, even the smallest ones. It allows to answer to more specific needs and to special categories of producers questions. Its disadvantage comes from a too heavy administrative burden for isolated farmer.

2.2 Practical methodology

The application of HACCP with experimental dairy producers allows to define which practical problems might be met. This field knowledge added to a summary of the different works done on the origins of contaminations in farms permits to point real risks that might occur in different kinds of farm.

The aim is then to define a simplified methodology adapted to the work done in farms that will ensure the required quality for milk products. To reduce as much as possible the administrative burden, the existing documents related to quality approach (AA milk, QFL, bio ...) that might already exist in the farms are used.

We offer a technical support to help farmers to get familiar with this method that should help them to analyze easily, by themselves, each problem that might be met in their work.

3. CONCLUSIONS

The main specific risks of farm manufactured food, the most favourable practices to keep risks under control and the project defined methodology are gathered in a guide for the use of self-control in dairy farms. In this guide, basic information illustrated with different practice examples helps milk producers to apply easily and, by themselves, a self-control system adapted to their farm (see below).

The study underscored that it was easier to apply the HACCP methodology in farms where a quality system was already used. A minimal technical help to farmers is necessary to enforce legal exigencies (training course and checking of the system efficiency). The most convincing arguments found to motivate "cow-to-consumer" farmers are used in the training session before distribution of the guide.

4. CONTRIBUTION OF THE PROJECT IN A CONTEXT OF SUPPORT TO THE PROCESSES OF STANDARDISATION AND TECHNICAL REGULATIONS

4.1 Writing of the guide

The supervision of a pilot group of 12 farmers allowed to define the advantages and disadvantages of the completed HACCP run in the agricultural field. This practical experience allowed to develop a simplified methodology suited to the work in dairy concern, published as a "Practical Guide for the setting of self-control". This guide brings the minimal necessary knowledge for the setting of a self-control system in accordance with the Codex Alimentarius prescriptions. It is easily adaptable to the

particular structure of each concern. It must thus allow the farmers-transformers of the dairy sector to put themselves in conformity with the legislation.

The introduction repeats the legal obligations, the concepts of the HACCP method and an example corresponding to the transformation of milk into milk straight from the cow. The guide is composed of 3 parts of equal importance, cleaning and disinfection, raw materials and technical parameters.

These 3 parts are structured on the following manner:

- for each identified danger, its origin is defined and a set of preventive measures commonly used are suggested as a form to tick off. This form can be completed with preventive measures better suited to the type of concern;
- the critical points common to all the farmers are explained, the critical points specific to some concerns have to be searched with the help of the simplified tree of decision;
- a heading explains how to control danger. This point is illustrated with different practical examples met during the supervision of the setting of the HACCP method in the pilot concerns.

To end, different sheets for the capture of self-control data are suggested. In this way, the farmers are able to set up a self-control system based on the HACCP principles and suited to their concern.

Thanks to the financial support of the Belgian Science Policy, 1000 practical guides of this type for the setting of the self-control could be published and distributed to all the Walloon farmers-transformers. The agricultural sector has thus a practical document which allows to take in the new statutory requirements and demonstrates the feasibility of the setting of self-controls in a small agricultural structure.

4.2 Training sessions

It appeared quickly that the guide could really not be effective without a preliminary training session as regards food security. It has the double objective to give a sufficient basic training to allow farmers to set up the self-control and to use arguments liable to motivate them in this step.

This training repeats some notions of food microbiology, presents the HACCP method and explains how to fill in the guide. To this is added a reminder concerning the legal obligations and a few examples of manufacturing defects solved thanks to the implementation of good hygiene practices.

It's then essential to be able to check if these notions have been understood and correctly implemented. A visit to the farmers having attended the training session and filled in the guide allows also to realize some analysis difficult to practise in dairy concern such as surface takings to check the effectiveness of the cleaning and disinfection plan.

4.3 Consequences of the project

The beginning of this project coincided with the extension of the product responsibility to the agricultural sector, which aroused a great interest from the different bodies of the dairy sector (including the regulators of the Ministry of Middle Classes and Agriculture level, DG5) and the farmers. The consequences of the project are:

- setting of a didactic method whose structure can serve as basis for the other sectors;
- underscoring of an important need of supervision of the producers-transformers;
- writing of a guide allowing to provide a training for the farmers and making easier the work of different associations liable to help them in the setting of self-control.

As far as the Walloons are concerned, the spreading was made easier thanks to the existence of help projects for the setting of self-control for craftsmen and farmers. These projects are financed by the Walloon Area and the European Funds of Positioning and Agricultural Guarantee (PDR and CEQ project). To date, more than 70 farmers-transformers got a technical assistance for the setting of the methodology described in the guide.

5. KEYWORDS

Milk, HACCP, quality, farmers, guide.

