

Harmonization of indoor material labelling systems in the EU—a critical review of existing labelling systems

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ABSTRACT

Under the aspect of consumer protection different kinds of labelling systems for material emissions have been developed in many European countries and by industrial organizations. Despite a common market there is no harmonized system for material emission available in Europe. In the second half of 2001, the European Collaborative Action on *Urban Air, Indoor Environment & Human Exposure* established a working group to bring forward the harmonization of the indoor material labelling schemes at European level. This paper presents the results of the first task accomplished by the WG, which is the critical review of existing indoor material labelling systems in the EU. This was achieved by comparing the existing labelling systems on the basis of the following criteria: the legal status, the product relation, the basic requirements, the additional testing needed besides emission, the limit values, the test of functionality and quality, the requirements concerning the test laboratories, the test specimen preparation, the availability of a detailed analytical procedure, the utilization of round robin tests, the regular testing of already labelled materials and finally the costs and the market relevance.

INDEX TERMS

Indoor air quality; Building materials; Labelling systems

INTRODUCTION

Indoor Air Quality (IAQ) and emissions from building materials has been over the last decades one of the major challenges for scientists, industry and consumers. Different kinds of labelling systems for material emissions have been developed in some European countries and by industrial organizations. These labelling systems are partly voluntary and only few are regulatory. Internationally, the best known are the Finnish, Danish and German systems. Up to now, there is no existing label covering all indoor relevant products. One reason for the diversity of the labelling schemes is the different approaches to the topic. Due to a lack of harmonized standards for sampling, emission measurement and analytical procedures, various industrial groups on one side as well as scientists on the other side created their own labelling systems in the last decade. Starting from a very specialized club of indoor scientists by the late 1980s, the topic of setting standards for the emission of organic compounds from various

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products was taken over by industrial organization as well as by research and commercial laboratories.

For most of the industrial organizations starting with emission measurement in the late 1980s or the early 1990s the environmental aspect of the product was the most important factor. Showing that the products have been produced in an environmental friendly way without any harmful substances and being also tested on their relevance to indoor air quality was the basis for the industrial labels. One example for this approach was the industrial label GUT (Gemeinschaft umweltfreundlicher Teppichboden), which appeared in the market in 1990 and was focussed on carpets. Within the 1990s a variety of other labelling systems appeared, being more or less based either on the initiative of industrial organizations in co-operation with scientists or proposals coming directly from scientists, like the ECA 18 scheme (ECA, 1997). Due to the fact that besides progress in standardization of emission measurements, the overall standard EN 13419 Parts 1–3 (CEN ENV, 1999) is still in the status of a pre-standard and not validated yet, and furthermore the analytical part 4 of this standard (ISO 16000-6) (ISO, 2002) is also not in the state of an existing standard, there is still variation within the different labelling schemes. Due to the opening of scientific debates by certain European projects (VOCEM, VOCBASE) some of the labels have changed their criteria to allow for more comparison and harmonization (Cochet *et al.*, 1998; De Bortoli *et al.*, 1999; Jensen and Wolkoff, 1996).

One other important factor influencing the knowledge about the indoor relevance of products is the big differences in the European countries. The far most present systems have been developed in Scandinavia and in Germany. In Scandinavia this development is part of a national and industrial strategy, mainly initiated by the time spent indoors and the harsh climate during the winter season. On the other hand, the ecological movement in Germany and the German speaking countries has also been focussing under aspect of consumer safety on indoor relevant products. Other countries like France or the Mediterranean countries do not have any existing labelling system at all.

Besides the variation in test procedures and limit values within the different labelling systems, the voluntary labels have achieved an important improvement of products and have also promoted new product groups like the EC1 adhesives.

But in spite of European harmonization, many of these labelling systems are still focussed on a national market. Despite a common market, there is no harmonized system for material emissions available in Europe and moreover under the scope of consumer protection a new kind of barrier to trade has been created, promoting the national industry.

Due to this variation in labelling schemes one important aspect of classification is the legal status of the different labelling schemes. Though nearly all of the indoor labelling schemes are voluntary, some of them have an extraordinary market relevance and acceptance. The best known German systems are the industrial based emission standards for adhesives (GEV) and carpets (GUT). These systems have set up the state of the art for the relevant product group and are often the basic requirements for architects and consumers. Due to their private status, these product labels do not have any legal relevance in terms of basic requirements.

At the same time, the German blue Angel system, which in fact is also voluntary, but promoted by the German Umweltbundesamt, has set up product standards for different product groups. Only few product criteria concern the indoor environment, mainly those on dispersion paints and wooden products, like RAL UZ 38 for furniture. This standard has been developed by the 'Bundesanstalt für Materialprüfung (BAM)' in Berlin as a chamber test method with respect to the relevant emissions from wood and wood based materials.

Another well established labelling system is the Finnish 'Emission Classification of Building Materials'. The Finnish Society for Indoor Air Quality (FISIAQ) published the Classification of Indoor Climate, Construction and Finishing Materials in 1995. The work was

done in close co-operation with experts from research institutes and branch associations of technology, building engineering and architecture on the initiative of and with support from the Ministry of the Environment. The classification has been practically carried on by the Building Information Institute, which has tight and fluent contacts with the construction branch. This has helped the classification to get in few years a quite large successful use.

Also in 1995 the Danish 'Indoor Climate Labelling' was presented to a wider public at the Healthy Building Conference at Milan. The ICL scheme was prompted by a request in late 1992 from The Minister of Housing and Building in Denmark. The primary objective was to develop a system to label building products according to their impact on the indoor air quality of emitted VOCs and later other pollutants, e.g. release of mineral fibres. The ultimate objective of developing the original Danish indoor climate labelling system was to improve and secure a better indoor air climate in buildings on the basis of a previously developed Danish Standard for emission testing and evaluation.

There has been also a European wide, mainly scientific based activity, concerning the labelling system. The European Collaborative Action (ECA) on 'Indoor Air Quality and its impact on man' through its Report No. 18 published an approach for product characterization and labelling of flooring materials.

As a successor of this ECA testing, the German Umweltbundesamt published together with the Deutsche Institut für Bautechnik (DiBt) the AgBB scheme in 2001. This scheme based on the former ECA Report No. 18, has not only a scientific basis, but also tries to define criteria in close co-operation with the concerned industrial groups. This activity was planned to cover the hygienic demands of the European building construction directive EU 89/106/EEC, the so called CPD-directive.

Within the scope of this state of the art review, this paper will cover only the above mentioned industrial and national labels as well as the situation within standardization. It will not cover every single label available on the European market; it will instead work out the differences, and the common features that will define the harmonization needs at the end.

METHODS

Classification of European Labelling Systems

Concerning the classification of indoor material emission labelling systems various aspects have to be considered. These will be the entry points of a matrix, in which the differences of the labelling systems will be explained. But before the questionnaire on the different labelling systems will be worked out, the common standardized basis according to the CEN and ISO standards regarding the emission aspects have to be looked at.

Current Situation in Standardization Work

The relevant standard concerning the emission behaviour of materials is the ENV 13419, Parts 1–3. In Part 1 of this standard the testing procedures in a small test chamber is prescribed in details, regarding all the factors influencing the physical parameters of the chamber climate. This incorporates chamber material, the air quality, as well as temperature, humidity and also the airflow rate over the sample. This standard also includes the time of sampling, 72 h and 28 days, as mandatory without considering different materials. In part 2 of this standard the same requirements are written down for the use of so called test cells, for example the FLEC cell. Part 3 of this standard prescribes the sample preparation for different types of materials. This part 3 has been revised and will be sent out for formal voting by the end of January 2003. In this part 3 the materials are classified as solid and liquid products, prescribing in details the sample preparation for different materials. Due to the difficulties of producing combined materials within a certain range of variation in the VOC measurement, in this standard only one method for sample preparation is mentioned.

Although this standard is going to be a EN standard by the end of next year, this standard will not have any validation of the test methods prescribed. The same is valid for part 4, the analytical procedure. This part has been worked out in an ISO subgroup and is published in a preliminary version as ISO/DIS 16000-6. In this part the analytical procedure for the determination of single VOC, the calculation of the TVOC and how proceed with components out of the range is prescribed. Instead of the classification used for volatile compounds in indoor air as mentioned by the WHO, in Table 1 a different approach is used.

Table 1 Classification of organic compounds according to WHO (1998)

Classification	Abbr.	Range of boiling points (°C)
Very volatile organic compounds	VVOC	<0 until 50–100
Volatile organic compounds	VOC	50–100 until 250–260
Semi-volatile organic compounds	SVOC	250–260 until 380–500
Organic compounds associated with particulate matter or particulate organic matter	POM	>380

This new approach is a combination of physical data and analytical logic. Besides using a range of boiling points, VOCs are considered to be the components between hexane (C₆) and hexadecane (C₁₆) measured on an unpolar gas-chromatographic column. Components below C₆ are considered to be very volatile components (VVOC), substances appearing in the chromatogram above C₁₆ are considered as semivolatile components (SVOC). For the calculation of TVOC (total volatile organic compounds) all components between hexane (C₆) and hexadecane (C₁₆) as toluene equivalent are considered.

Besides that 'chamber standard' also a standard for the formaldehyde emission from wooden products (ENV 717-1) (CEN ENV, 1998) exists. There is also a special standard for adhesive testing (ENV13999 parts 1–4) (CEN prEN, 2001) concerning chamber operation, VOC/TVOC determination, aldehydes and isocyanates measurement.

However, with respect to the harmonization needs, the current situation regarding the harmonized standard is still insufficient.

Besides this insufficient situation on the standardization level, there is another discussion still going on in the scientific debate. This debate about TVOC and VOC is one of the hardest and most controversial discussion going on in the scientific world. With respect to all arguments to both sides, this debate is clearly not understood by industry as well as by consumers. But away from the pure scientific controversy, every labelling system has included parts of both ways of thinking, like the GUT has limit values for single parameters as well as the TVOC-value. There are trends for more detailed analysis, but these trends are up to now only scientific discussions and not transformed into a testing procedure or a standard yet.

Questionnaire on the Emission Labelling Systems

Regarding all the different aspects of the labelling systems, certain aspects have at least to be considered. These aspects are:

- *Legal status*: Are the labels voluntary industrial labels, are they promoted by a government organization or are these labels basic requirements?
- *Product relation*: Are the labels focussed on specific product groups, like adhesives, wooden material or carpets or is this label applicable to different product groups?
- *Analytical procedures*: Are there basic requirements, like a ban of certain dangerous substances, a contaminant testing? How is the emission performed, only as a short term or

long term test or in combination of both? Are there any sensory evaluations of the material? Is there besides the emission test a test on functionality?

- *Quality assurance*: Are the labels and the test laboratories accredited and are detailed prescriptions for test specimen preparation and sampling available? Is there an existing prescription of the analytical procedures, including quantification and expression of results? Have any round robin tests been performed on the materials and the analytical procedures and are these data open to public?
- *Costs*: Is there an open price list or are the prices for certificates connected to a certain membership fee?

There has been a lot of data and discussion material about the labelling systems (concerning both, general descriptions and testing procedures) published in different workshops and papers in recent years. This will not be presented again here, but the basis of this review will be the matrix based on the aforementioned questionnaire.

As mentioned in the Introduction, this paper will not cover any single label having set up a limit value on the emissions of certain compounds from different products. In many cases the criteria and test methods are not clear, the available data are insufficient and the market share is at a minimum level. This paper will cover the available data of the following labelling systems: the Indoor Climate Label (ICL-Denmark), the Emission classification of Building Materials (Finland), the Emissioncode system by GEV for adhesives and related material (Germany and Europe), the GUT for carpets (Germany and Europe), the RAL-UZ 38 for wood and wood based material like furniture (Germany); it will be also discussed the scientific system described in ECA Report No.18 and its successor, that is the AgBB-scheme in Germany.

RESULTS AND DISCUSSION

Matrix of the Different Labelling Schemes

The questionnaire above and the data available from the different labels is the basis for the matrix to compare the different labels. Although the ECA report No. 18 is mentioned in the text, this testing protocol is not considered to be relevant for the matrix according to the lack of market relevance.

The results of the state of the art review of the different labelling systems are summarized as follows:

- Besides all achieved harmonization, there is an enormous potential for validation within the basic standards of all emission measurements. As long as these standards especially ENV 13419 Part 1–4 are not validated, the basis for harmonizing the emission labelling is weak.
- Furthermore all standards dealing with emission of volatiles from building products are only focussing on the analytical procedures. Problems arising from the material to be tested and possible sampling procedures are in many cases handled only insufficiently.
- The ongoing debate about TVOC or VOC is not transferable from the scientific world to a wider public or industrial interest groups.
- The private standards have set the state of the art for some product groups. Their way of testing is sometimes not comparable to pure scientific perceptions, but these labels have in fact achieved an improvement of products for a better Indoor Air Quality.
- Some of the labelling systems are promoting national products and industry like the setting of criteria or the acceptance of certain test laboratories.

- Private labels and their analytical partners are forced to have an existing quality assurance system, setting the minimum requirements to the co-operating labs. These labs have to be at least accredited according to EN 45001 or the succeeding standard ISO 17025. This assures a high standard in quality control, validation of test methods, the availability of reference materials and the participation on round robin tests.
- Harmonized emission labelling systems of the future should incorporate more knowledge about the products to be tested, a pragmatic, scientifically based testing procedure and precise analytical procedures that have been validated by round robin tests.

CONCLUSIONS

Considering the current situation concerning existing labelling systems, an enormous effort has to be made, to combine the pragmatic and the scientific approaches towards the emission measurement concepts to achieve a better Indoor Air Quality.

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Table 2 Comparison of the different indoor material emission labelling schemes

Criteria	ICL	M1	GEV	GUT	RAL UZ 38	AgBB
Legal status	Part of Danish building requirements	Private, promoted by the Building requirements	Private	Private	Private, but promoted by the Umweltbundesamt	Transition phase, essential requirement for building products
Product relation	Different product groups	Different product groups	Adhesives and related products	Carpets	Wood and wood based materials	Building products with relevance to Indoor Air
Basic requirements	Yes, CMT substances	Yes, CMT substances	Yes, CMT substances	Yes, CMT substances	Yes, CMT substances	Yes, CMT substances
Additional testing besides emission	Sensory evaluation	Sensory evaluation	No	Sensory evaluation	Formaldehyde	Sensory evaluation (in preparation)
Emission testing	Long term testing, depending on the VOCs of interest	28 days, (TVOC), formaldehyde, ammonia	24 h CMT substances 10 days TVOC	Contaminant testing 24 h TVOC and compounds of interest	24 h CMT substances 28 days (formaldehyde, TVOC, SVOC)	72 hours (TVOC, CMT) 28 days (TVOC; SVOC and CMT)
Limit values	Depending on the VOCs of interest	Yes, according to classification	Yes, according to classification	Yes	Yes	Yes, according to classification
Test of functionality and quality	–	–	–	–	–	–
Requirements to test laboratories	Not specified	Not specified	EN 45001 or ISO 17025	EN 45001 or ISO 17025	Not specified	ISO 17025
Test specimen preparation	Specified, not open to public	Open to public	Open to public	Not specified	Not specified	In preparation
Detailed analytical procedure available	No, just short description	Yes, for details see www.rts.fi/emission_classification_of_building_materials.pdf	Yes, including quantification and calibration procedures (www.emicode.com)	No, just short description	No, just short description	In preparation
Round robin tests	Yes, published	No, not published	Yes, open to public	Yes, data not published	Yes, data open to public	–
Costs	Unknown	Open to public	Unknown	Unknown	Unknown	Unknown
Regular tests of already labelled material	Unknown	Unknown	Yes, market controls	Yes, market controls and yearly control of certified products	Unknown	–
Market relevance	Denmark, Norway	Finland, Scandinavia	Germany	Germany, Benelux, Switzerland, Austria	Germany	Germany