Emission classifications and labels

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Presented at CERTECH conference "Emissions and odours from materials",
Brussels, September 2004

ABSTRACT

A number of emission classification systems changed the test method and/or the classification values, like DIBT, EMICODE, and GuT. New classifications were born, e.g. Natureplus. Harmonisation of the testing protocols showed some progress. But there is also a trend to define limits for SVOC and for single substances. Not all of these parameters can be monitored with sufficient reliability. Identification of complex mixtures is done in a very different manner from lab to lab. This applies especially to terpenes and hydrocarbon mixtures. The GEV round robin test 2003 showed that some laboratories still are facing severe problems with identification and proper quantification.

1. INTRODUCTION

The emission of volatile organic chemicals from products and materials into indoor air is meeting growing attention in several countries. In many countries there are one or several national quality labels available for identifying low emission products. Some countries are about to establish legal requirements for maximum emission levels for construction products and furniture.

In general these classification systems require emission testing in stainless steel or glass test chambers flushed with clean air at 23 °C and 50 % relative humidity. Test duration is between one day and 28 days. Emissions are monitored by discontinuous sampling of chamber air at the outlet, followed by chemical analyses of volatile organic compounds (VOC) and volatile aldehydes. Some labels require additional analyses and/or odour testing.

The author gave an overview of existing labels at CERTECH conference on emissions and odours in 2003. An updated version of that presentation is available for free download from www.eurofins.com/construction_products. The conclusion was that some common tracks could be seen but differences in testing methodology still are hindering harmonisation between many labels.

This presentation will point on new developments and on problems with application of emissions testing to construction products.

2. NEW LABELS AND NEW TRENDS

In the last years some emission classifications were developed newly, and some labels changed their criteria and their testing methods.

In Japan there were set requirements for formaldehyde emissions for 17 groups of construction products. The reference testing method is defined in the Testing Standard JIS A 1901 and describes a chamber test at 28 °C - this deviates from European and US test standards that require a test temperature at 23 °C. For some products the Japanese authorities may accept a faster and cheaper test where a test specimen is placed in a desiccator and transfer of formaldehyde via the enclosed air into water is monitored.

The application procedure is very cumbersome both for exporters and for laboratories wanting to be accepted for doing these tests. It is expected that in 2005 or 2006 these regulations will also cover furniture, and also include limitations for VOCs. There will be a symposium right after this conference covering details of these items.

There are activities in Korea but information available in English is very limited. It looks they will require VOC emission testing in a test chamber at 25 °C - though this test will not be compatible neither with Europe and USA nor with Japan.

The European Commission started an initiative to establish health and environment related requirements in the member states of the European Union by asking CEN to develop horizontal standards. Due to controversial debate between the involved parties this did not yet result in detailed activities but it is expected that this project will start soon.

European industry takes more and more notice of the voluntary requirements on emissions on construction products in the United States, like the Californian program for healthy schools (CHPS) and the Greenguard label. You will hear more about that from a presenter later in the programme of this conference.

There is an initiative in Germany for having all approved construction products tested within the framework of the hygienic requirements of the Construction Products Directive (EEC/89/109). The so-called AgBB concept requires testing after 3 and 28 days in a test chamber and sets limit values for total volatile and total semi-volatile organic compounds (TVOC and TSVOC), plus limit values of air concentrations for individual substances, derived from no-effect level considerations.

Originally this classification referred to the results of the former European Collaborative Action (ECA) research project "Indoor Air and its Impact on Man" as described in the report: Evaluation of VOC Emissions from Building Products – Solid Flooring Materials[1]. The German authorities task force AgBB then revised that list, changed some values and added other ones using toxicological expertise, and they just published the 3rd edition of the so-called NIK list[2] in summer 2004.

After long discussion and some changes of testing details, the AgBB evaluation concept is now set into force for all those non inflammable floor coverings and related products that need to be registered at the German institute for construction technique DIBT. An expansion to other products is intended.

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[1] Report No. 18, EUR 17334 EN, European Commission, Joint Research Centre, Environment Institute

[2] e.g. in www.umweltbundesamt.de/uba-info-daten-e/daten-e/voc.htm

In Europe, the industry specific German labels for carpets (GuT) and for adhesives (EMICODE) changed their testing method such that the determination of VOC is better in conformity with the relevant international standard ISO 16000-6. This improves potential use of one test for application for several classification systems.

The voluntary Natureplus label covers only ecological construction products made mainly of sustainable or mineral materials. This label expanded its number of product specific requirements significantly (www.naturplus.org).

3. HARMONISATION OR DIFFERENTIATION ?

If a company wants to apply for several quality labels with emissions related requirements then it will need to order several emissions tests that are very similar to each other. This does not make any other sense than to generate additional tasks for the involved laboratories. The cumulative costs may even hinder a company from applying for all these labels.

The complexity of the different national and trade specific requirements is still higher when you compare the quantitative classification criteria (the limit values). But this would not be a severe problem if the test methods were harmonised to such an extent that one test may be used for different labels just by calculating the results in different ways, according to the specific requirements.

One example is that you may transfer the concentration in the test chamber (as used for e.g. GuT, EMICODE, Blue Angel) into the emission rate (also called emission factor, used by e.g. Finnish M1, Austrian UZ 42, Hong Kong GL-008-002) by multiplication with the area specific airflow rate.

Harmonisation should be relatively easy for these parameters:

- VOC, TVOC, SVOC determination:
  The existing international standard ISO 16000-6 (present version: FDIS of 2003) could serve as basis for harmonising, as is the intention of ISO and CEN. Today, a growing number of classification systems refer to this standard, but many systems still are "cooking their own pie".

- Aldehydes determination:
  The existing international standard ISO 16000-3 (present version of 2001) could serve as basis for harmonising, as is also the intention of ISO and CEN. Today, most of the reviewed classifications refer either to this standard or to a very similar method.

- Test chamber parameters:
  The existing European standards ENV 13419 parts 1, 2 and 3 (present version of 2003), soon also available as ISO 16000-9, -10 and -11 could serve as basis for harmonising, as is the intention of ISO and CEN. Today, most of the reviewed classifications refer to these standards - but some are deviating in detail, e.g. regarding how to make the test specimen. Testing temperature is 23 °C in all classifications except Japan and Korea. Relative humidity deviates from 50 % only for Blue Angel RAL UZ 38 and Austrian UZ 07 (45 %).

- Testing times:
  Most common is testing after 3 days for short-term emissions and carcinogenic substances, and after 28 days for long-term emissions. Earlier testing times may be applied if the emissions do not change significantly any more after that early testing date. In the USA and in Asia it is more common to require the emission decay profile for estimating steady-state emissions from 3 or 6 measurements within 4 or 5 days or longer.

- Carcinogenic compounds:
  It would facilitate testing at least within Europe if always the European legal classification (see Annex I of European directive EEC/67/548 and amendments[1]) of carcinogenic chemicals were used, instead of different national lists.

- LCI Values:
  Instead of using the 10 years old LCI[2] list as published by the ECA research project (see above) an updated list would be more helpful[3], especially if agreed upon at least between the involved European countries.

- Odour:
  There is still some controversy about how meaningful the different tests and ratings can be. Therefore harmonisation looks difficult for odour testing.

If we want to reduce the necessary number of tests and the costs then it is essential that these voluntary labels consider adapting the international standards and trying to harmonise. The next presentation will be on a research project dealing with this issue.

The Eurofins testing laboratory applied successfully for approval for a number of the mentioned labels and now offers tests that are harmonised as far as possible. The more similar the involved methods are, the more costs can be saved, when compared to conducting one test each for all involved emission labels.

4. LOW LIMIT VALUES AND ANALYTICAL QUALITY

A number of emission classifications sets limits for single substances, or for sum parameters, in the range between 1 and 100 µg/m³. Examples are the LCI list as used in France (CSTB, the old "ECA" list of LCI values), in Germany (DIBT and Blue Angel, using updated LCI values, the NIK list), the Natureplus (using a modified NIK list), and the Californian CHPS system (using a list of Chronic Respiratory Exposure Levels, the CREL).

Some sum parameters are also set on a pretty low level, such as the total semi-volatile compounds TSVOC (40 - 100 µg/m³ with DIBT and Blue Angel), and the substances without assigned LCI value (between 10 and 100 µg/m³).

Such low limits require a reliable and sensitive monitoring technique. There is some concern that the analyses applied do not fulfil these requirements in all cases. There are several problems involved.

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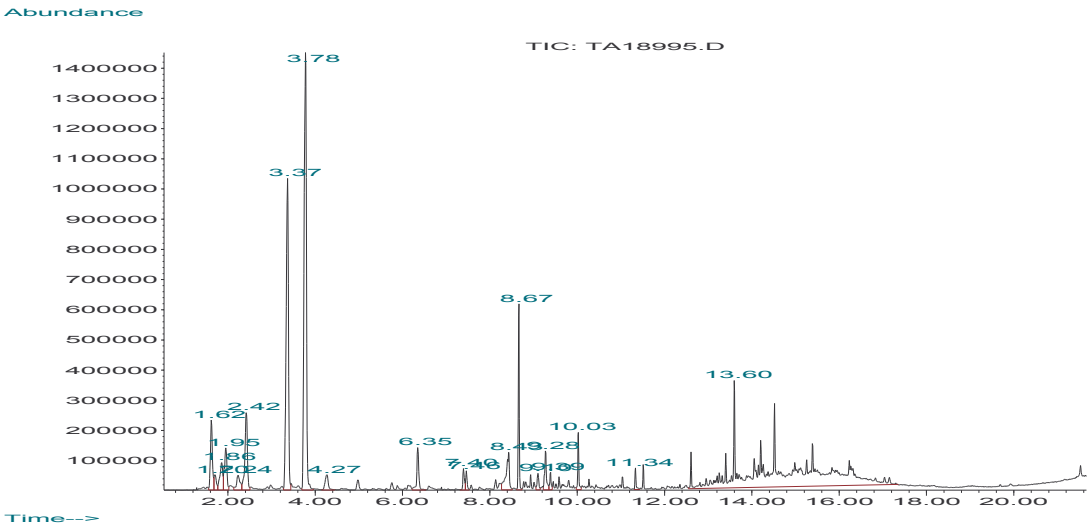
[1] Search 28th_ATP.pdf at http://ecb.jrc.it/classification-labelling - Documents

[2] Report No. 18, EUR 17334 EN, European Commission, Joint Research Centre, Environment Institute

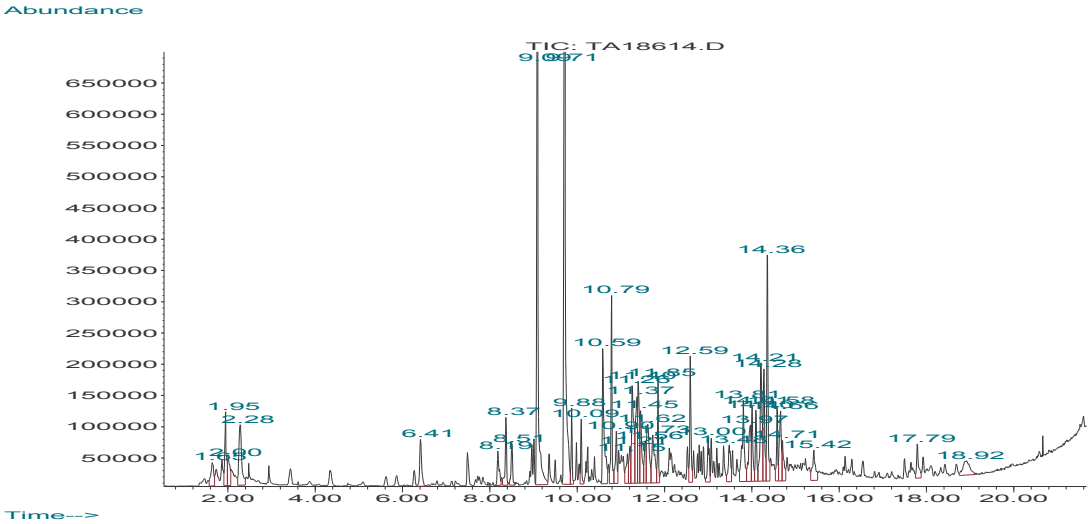
[3] e.g. in www.umweltbundesamt.de/uba-info-daten-e/daten-e/voc.htm

The most important problem is the correct identification of individual substances involved. This is true especially when low concentrations are measured and the identification at the mass spectrometer is difficult - and in the case of complex mixtures of hydrocarbons or terpenes, with bad quality mass spectra due to overlap of peaks from two neighboured substances in the chromatogram. In these cases, even experienced scientists may deliver very different assessments of which signal means what chemical substance. This influences the quantification (the use of an appropriate calibration standard) and the formation of the sum parameters like TVOC of sum of substances without assigned LCI value.

The following picture shows an example gas chromatogram, with a non-separable mixture of hydrocarbons in the retention time range between 13 and 17 minutes.



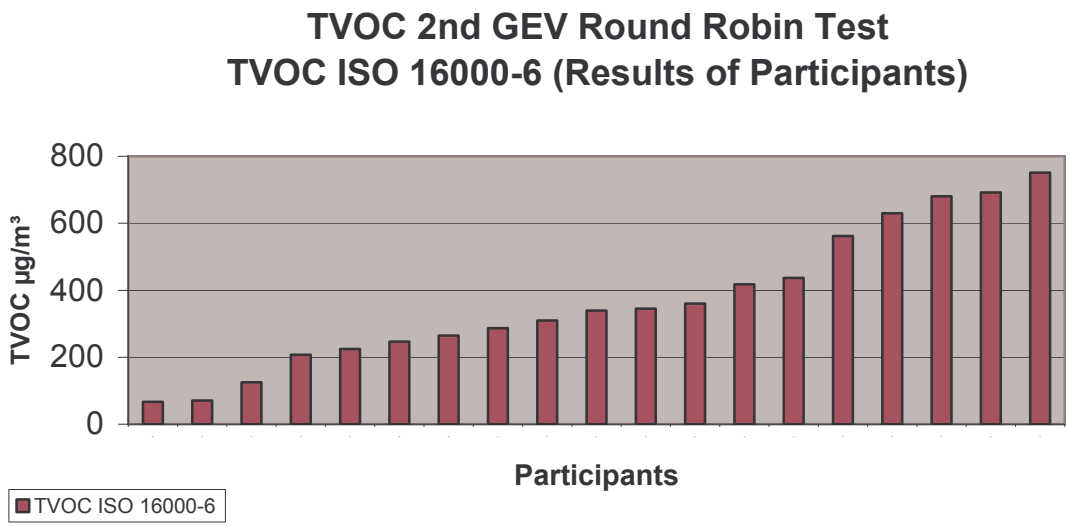
Still worse is the situation if you meet both identifiable and non-identifiable substances at the same retention times, as given between 11 and 17 minutes in the next example gas chromatogram.



Another problem is that the standard technique applied (ISO 16000-6) is not best choice for some compounds analysed. Acetic acid or acetone are too volatile for the sorbent Tenax TA, and some semi-volatile compounds (e.g. the phthalates) may show poor recovery from the sorbent tube during analysis. Both factors lead to lower test results than should be true - but different laboratories have a different degree of control on these parameters. This again contributes to a high variation of the test results.

There have been a number of inter-laboratory proficiency tests where several participants had to test the emissions of the same material. Almost all of these tests showed that the reported results of different laboratories showed a variation of ± 40-50 % around the mean value (expressed as the relative standard deviation).

This means that a result of 70 µg/m³ TSVOC may also be 35 or 105 µg/m³ - and thus below or above the limit values, just depending on which laboratory conducted the test. As an example, the results of the 2nd EMICODE round robin test are shown below where 20 laboratories tested the same adhesive (only 19 of those reported the TVOC). The TVOC results ranged from 75 to 750 µg/m³.



This level of variation is far from satisfactory, but today this is the state-of-the-art. Selection of a laboratory that is accredited according to ISO 17025 or similar standards is a pre-requisite but not sufficient for relying on the test results. Industry is well advised to require reports on participation in round-robin tests and to evaluate the individual results before trusting in the quality of a testing laboratory.

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