Hochschule Rosenheim
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Short report
Emissions from building components

Topic	Investigating the emissions from windows and external doors for evaluating the behaviour of building components with respect to hygiene, environmental protection and health
Short title	Emissions from building components
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1 Motivation and objective of the project

One of the Essential Requirements of the European Construction Products Directive [1] concerns the protection of the health of users of buildings and, amongst others, deals with the potential release of hazardous substances from building products into the indoor air during the period of utilisation. In particular, emissions of volatile organic compounds (VOC) are being discussed in the process (see Figure 1).

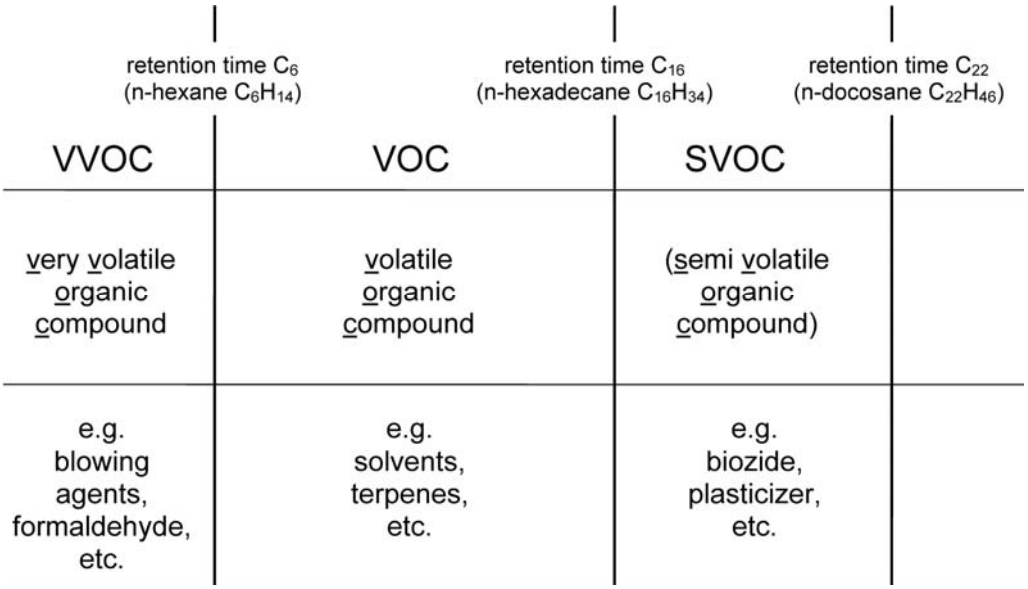

Figure 1 Volatile organic compounds

In the product standards for windows and external doors, EN 14351-1 [2], these requirements have been complied with, although no product-related European harmonized procedures and assessments have been developed so far. There is growing uncertainty arising in the industry since, currently, a variety of product identification systems is finding its way into the market, different national regulations are being implemented, and manufacturers are and manufacturers are requested to declare the corresponding characteristics of their manufactured products. In general, all parties concerned are largely unaware of the emission sources and potential sources of emission in the respective products or the VOC emissions that are caused by them.

Against this backdrop, **ift** Rosenheim, together with the University of Applied Sciences Rosenheim, has executed a research project where the hitherto unknown emission behaviour of such windows has been investigated. In the process, insight was hoped to be gained regarding the contribution of the building products analysed to possible pollution scenarios of the indoor air. However, the aim of the knowledge gained was also to develop practical recommendations on dealing with the subject, and approaches for practical and feasible verification with respect to product evaluations in future taking health-related aspects into account.

The Technical Committee CEN/TC 351 is working on the compilation of horizontal standard papers (cross-product technical specifications) for the implementation of the specific requirements from the Construction Products Directive related to hygiene, health and environmental conservation. Amongst others, what is specified includes pollution scenarios in interior rooms, with which loading factors (i.e. the surface area contributions of different building products to the room volume) are defined. Next to e. g. floors, ceiling elements, and wall coatings, windows are considered as possible sources of emission as well (see Figure 2).

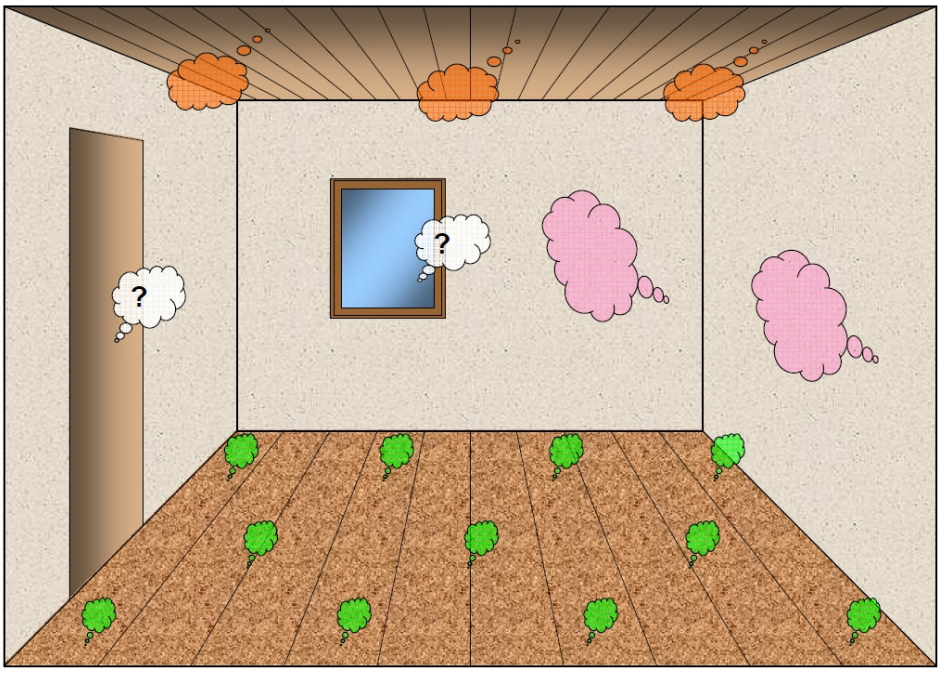

Figure 2 Schematic illustration of the reference room with the building products under discussion

In part, the respective building products differ significantly from one another with respect to manufacturing, design and material composition. For this reason, a product-specific procedure is necessary to consider the specific characteristics of the varying building products in practice.

The objective of the project, thus, was to work on the subject "VOC Emissions" in relation to product designation and testing within the scope of the product standards for windows and external doors, EN 14351-1. For this purpose, the aim was to examine the emission behaviour of the related construction products and/or the components contained therein, and to compile suggestions for the implementation of the future handling of this subject in the field of the product standards, in accordance with the specifications of CEN/TC 351 [3].

2 Procedure

The approach method discussed by the technical committee CEN/TC 351 TG2 (document N 044) includes a test of the emissions from windows of complete window elements. Within the research project, an alternative approach was pursued in addition to this procedure. This approach envisages that examinations and assessments based on the building materials used and/or the components contained shall be made possible. This way, it should be ensured that results can be reproduced and that there is practical consideration on the subject within the product standards, EN 14351-1, for windows and external doors. Tests have been carried out on entire window elements in parallel to those conducted on the individual constituents.

To facilitate a representative selection out of a large number of components, variants and specific characteristics, individual screening tests have been carried out for each product group. Based on these comparative short-time tests, samples were selected for the analysis in the emission test chamber according to the ISO 16000 range of standards [4][5][6]. The samples of these chamber tests have been evaluated with the help of the AgBB system (*Ausschuss zur gesundheitlichen Bewertung von Bauprodukten*, Committee for Health-related Evaluation of Building Products) [7]. When testing individual constituents in the testing chamber, the individual installation conditions prevailing in practice were taken into consideration.

Also, the resulting ratio of the emitting surface to the room volume has been considered for all individual components. The reference room, as defined by CEN/TC 351 WG2 [3] as well as the reference values of a sample window as specified in the product standards for windows and external doors, EN 14351-1 form the basis for the so called loading factors.

From the point in time and the procedure of the sampling, considerable impact can be expected on measured values obtained subsequently. Therefore, within the research project, an approach for the sampling was pursued which takes product specific features into consideration and which is supposed to lead to reproducible results. Standard specifications request that samples are withdrawn as early as possible within the production phase. The project approach complies with these specifications; however it differentiates between the sampling of entire windows and the sampling of individual components. The components were sampled as early as possible (the earliest possible point in time that the product can be placed on the market) at the suppliers'

premises where components fit for use were readily available. The sampling of entire window elements was also carried out as early as possible at the end of the manufacturing process at the premises of the window manufacturer.

The project approach was intended to traceably record the time periods in the product life cycle before the time of sampling. Additionally, the time period that elapses between the manufacturing and the products' effect on the interior air of a room has been considered. This was achieved with an air-conditioned and product-specific ripening storage with the help of which the reproducible conditions of the storage were made possible.

The schematic production sequence of windows is illustrated in Figure 3. Also displayed are the points in time for sampling and the other points in time of the product life cycle which have been considered.

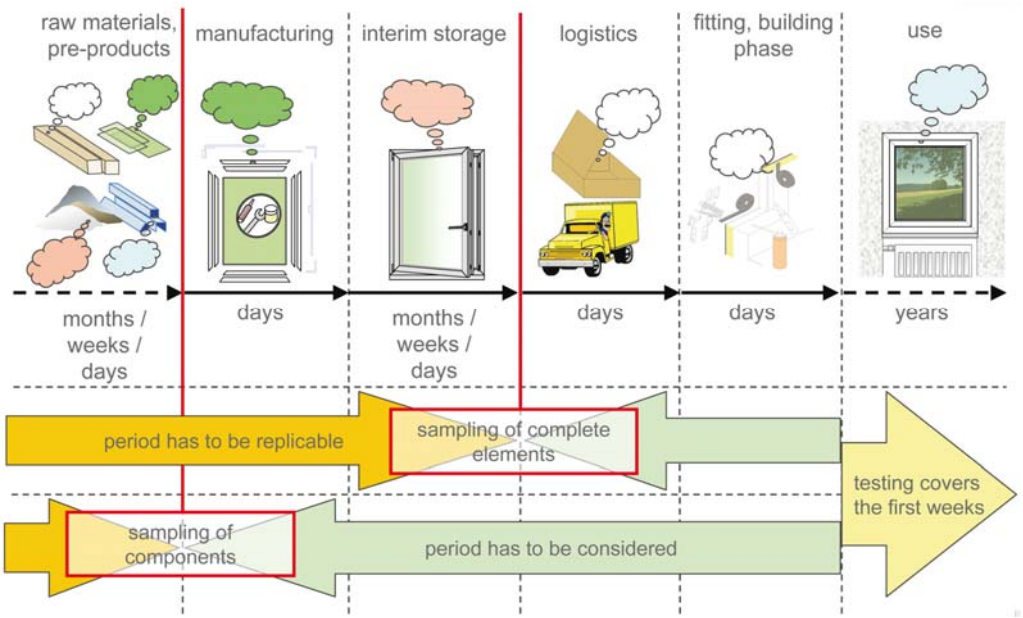

Figure 3 Schematic production sequence of a window

For each product group or component, the point in time and the type of sampling as well as the dimension and/or the quantity of the sampling was determined. Local sampling was ensured and recorded by the responsible persons of each manufacturer in accordance with the exact specifications of the research centres.

To conserve the "fresh condition" at the time of manufacture, the samples for an emission measurement were sealed in special packages made out of aluminium composite material and thus protected from contamination or physical impact such as heat, light and humidity [8]..

3 Summary and outlook

Comprehensive measurements have been carried out and suggestions for the implementation of the procedure have been compiled to gain a representative overview of the emission behaviour of windows. In the process, a series of tests have been carried out on common materials and components. In parallel, tests were also conducted on complete windows.

All window elements tested as well as all components considerably complied with the decision criteria of the AgBB system. Plastic and metallic windows, as well as their associated components, produce little to almost no VOC emissions. Although wooden windows and their components yield comparatively somewhat higher values of VOC emission, they also notedly complied with the AgBB decision criteria. The detailed results and measurement values, together with the comprehensive description of the samples and the sampling, can be found in the final report.

A large impact on later measurement values depends on the product specific selection and sampling. Random sampling and/or unclear points in time for the sampling result in measurement values without meaning, reproducibility and comparability, even despite the insignificant emissions of windows and their associated components.

If European emission classes for building components become available, approval of windows as products "without testing" and/or "without further testing" (wt/wft) or at least facultative classification into one of the preconceived emission classes is recommended based on the results of this research project. In this case, an analysis would only be necessary for specific requirements regarding the emission behaviour or to achieve an emission class that is more stringent or demanding than the preconceived one.

An analysis of the VOC emissions of the critical components of windows in micro chambers can be implemented if the correspondingly adjusted load factors, the positioning of the component within the entire design as well as the corresponding conditions for the manufacture are taken into consideration. This procedure represents a simplification of the process and increases the prospect of reproducible and comprehensible measurement values, especially for further developments, comparative tests or the exchange of specific components.

To ensure reproducible measurement values for the analysis of the VOC emissions of complete window elements, the point in time when components were produced and how the sequence of manufacture took place must be traceable during the sampling. An investigation of the VOC emissions of entire window elements is possible in a large chamber only; the specific deliberations and procedures of the project work should be considered. Based on the complexity of the window as a product, procedures that are applied with other building products cannot be easily implemented.

At EU level, the introduction of emission classes for building elements is intended. The completed investigations show that only a few components of a window are potential sources of emission. For this reason, it would be advantageous if the classification of windows into emission classes could be based on the measurements of the components. Using a "computational procedure", the measurement values of individual components could then possibly lead to the emissions of the entire window. However, more detailed and specific scientific investigations would have to form the basis of such a procedure.

4 Acknowledgement

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Verband Fenster + Fassade, Frankfurt am Main

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[2] EN 14351-1
Fenster und Türen - Produktnorm, Leistungseigenschaften - Teil 1: Fenster und Außentüren ohne Eigenschaften bezüglich Feuerschutz und/oder Rauchdichtheit;
Berlin, Beuth Verlag GmbH

[3] CEN/TC 351/WG2
"Construction products – Assessment of release of dangerous substances"
Document N 129; 2010-02-12

[4] ISO 16000-6
Innenraumluftverunreinigungen - Teil 6: Bestimmung von VOC in der Innenraumluft und in Prüfkammern, Probenahme auf TENAX TA®, thermische Desorption und Gaschromatographie mit MS/FID;
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[5] EN ISO 16000-9
Innenraumluftverunreinigungen – Teil 9: Bestimmung der Emission von flüchtigen organischen Verbindungen aus Bauprodukten und Einrichtungsgegenständen - Emissionsprüfkammer-Verfahren;
Berlin, Beuth Verlag GmbH

[6] EN ISO 16000-11
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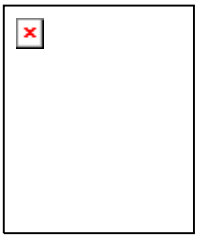

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