

SUSTAINABILITY IN INTERIOR FINISHING WORK – SUPPORT FOR ARCHITECTS IN THE PLANNING FOR REDUCED POLLUTANTS INDOORS

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ABSTRACT

Modern building envelopes are getting thicker and thicker: this reduces the natural ventilation and pollutants remain longer inside the building. Certain building labels and public building owners increasingly demand formal measurements of TVOC in interior rooms after construction in order to verify that the values lie beneath permissible levels. Many modern architects do not have the know-how to plan for reduced pollutants indoors.

It is known that the emissions of the above-mentioned chemical substances vary considerably even in the same product groups. It is also rather difficult for planners to gain access to the emission data of building materials. It is recommended that planners should formulate in the bidding invitation that only products with recognized labels based on corresponding tests would be accepted.

Sustainable construction should not be reduced to energy consumption whilst the building is in service. Sustainable construction is also concerned with the society, the economy and the environment. An important criterion is the quality of the room air: if it should be polluted by the emissions from building materials, there can be negative effects on other aspects. If for example building components with high emissions should be replaced, this has an effect on the cost effectiveness and the balance of grey energy.

1. Introduction

1.1 Problem description

The current state of the art requires a good insulation and an airtight building envelope, which correspondingly gets thicker and thicker. Thus the natural ventilation is reduced and pollutants remain longer in the rooms. In buildings which were built 20 years ago, the frequency of the air replacement is about 10 h^{-1} , which means the air volume in the building is replaced ten times per hour. In modern buildings, the value is about 0.5 h^{-1} .¹ The reporting of pollutant cases in the media has helped to sensitize the general public about the need for reduced pollutants indoors.

Architects can influence the quality of the room air with a careful selection of the building materials as well as with the checking of the construction work. It is difficult to get well structured and comprehensive information about the quality of air indoors. Standardized information is hardly available in Switzerland. Different building labels and building products list tolerable concentrations of pollutants in the air indoors. The Swiss quality label for energy-efficient and health-compatible buildings, MINERGIE-ECO, and certain Swiss cities when they are putting up public buildings, have recently started to demand that the quality of the indoor air should be measured after construction work with regard to the amounts of total volatile organic compounds (TVOC) and formaldehyde.

1.2 Aims

This project work is concerned with the development of tips for planners with regard to a reduced pollutant content indoors, with a special emphasis on the reduction of emissions from building materials. First, the emission behaviour of different building materials and material groups will be analysed with studies of existing measured values. As a next step, different labels for buildings on the one hand, and for building materials on the other, will be compared. Finally, the information will be structured to the different influencing factors for good air indoors.

2. Emissions of building materials and product labels

Even within the same product group, the emissions values exhibit a wide scattering. The selected material should therefore be listed together with its emission value. This is something which is currently seldom done during the planning stage, because it is often very difficult to obtain the emission values for building materials. The few available data have often been obtained under different conditions, so the values cannot be readily compared. Planners simply do not have the time to search for the emission values of the different materials. The following materials are known to have low emissions of formaldehyde und TVOC and they can therefore be recommended without hesitation:

- Gypsum and gypsum materials
- Mineral building materials or glass
- Silicate paints and silicate plastering
- Natural wood (be careful with woods containing much turpentine)

In order to avoid the use of products with a totally unknown emissions profile, products with a label are preferable when dealing with these product groups:

- Paints and plastering with non-silicate base
- Varnishes
- Sealing materials
- Flooring materials

¹ Bachmann P., *Mit Sicherheit gesund Bauen*, Vieweg+Teubner Verlag 2012

- Flooring layers
- Wood-based materials (label or at least compensation of formaldehyde concentration)

Almost all material exhibit falling emission rates with time, hence the invitation for bids should be made as early as possible. The construction companies should be required to purchase and prepare the materials as early as possible. In the bidding documents, the use of products with low pollutant emissions and also possibly with labels, should be prescribed.

Liquid building materials such as paints and varnishes have a very high emission after the application, but the emissions quickly diminish with time. Chemical substances are more volatile at higher temperatures. Thus the building time-table should be planned carefully with regard to the timing of the measurements after work completion, the turning on of the heating, and the date for the last painting work. This is also valid for the fitting of freshly painted or varnished components like doors or windows.

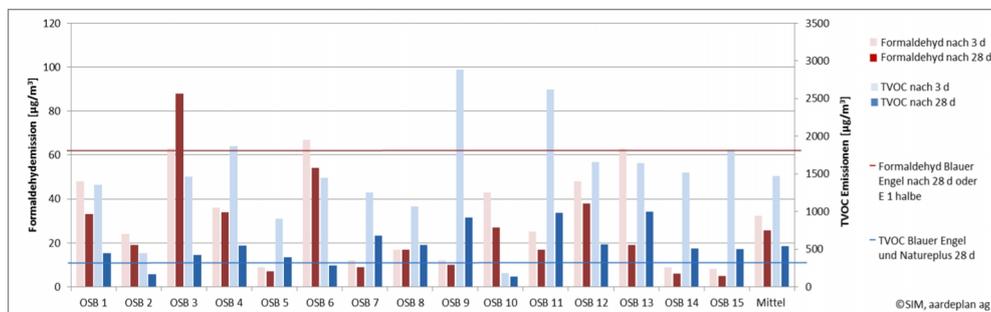


Fig. 1: Formaldehyde and TVOC emissions from 15 different OSB boards^{2,3}. The material concentration shown would establish itself in an indoor room with an OSB-board surface of 1m² per each 1m³ air space, if the air exchange rate is 1 h⁻¹. For comparison purposes, the figure also shows the limiting values for well-known labels. It is evident that the concentration of the formaldehyde is generally at a low level. This piece of good news is an indication of good research and product development.

When a lot of wood-based products are used indoors, not only the formaldehyde concentration, but also that of TVOC-emissions should be taken into account. The use of boards with labels could be a good approach because the scattering is relatively small. In the case of liquid building materials, the emission differences of the various products can vary by factors of tens.

² Horn W., *Umwelt- und Gesundheitsanforderungen an Bauprodukte*, Umweltbundesamt Deutschland, 2007

³ Wilke O., *Emissionsverhalten aus Holz und Holzwerkstoffen*, Umweltbundesamt Deutschland 2012

3. Sustainable construction

Many standards list some simple guidelines for the assessment of the air quality indoors with the least possible emissions of pollutants. However, for an overall assessment, the standards are still at a low level. It is important that sustainability in buildings should not be limited to the service energy required. In the standard SIA 112/1 „Sustainable construction – buildings“, indoor pollutants are an important theme. Apart from the emissions, the choice of materials should also take into account the availability, the environmental cost and the possibilities for later removal. These different criteria may each favour a different material. Benchmarking can help to define the criteria which are the most important for the case at hand. The emissions of building materials can negatively influence the different criteria of sustainability as defined in the standard SIA 112/1. The examples below illustrate:

- Strong emissions of the building materials can lead to the inhabitants frequently opening the windows, which can have a negative influence on the service energy of the building.
- If building components with strong emissions need to be replaced, the costs involved will reduce the economy of the building. Furthermore, the grey energy balance will be increased.
- The emissions of pollutants may cause the inhabitants to ask for a repetition of the measurements, which means additional costs.
- The feeling of well-being indoors is disrupted.

4. Building label and agreed aim

In comparison to the three big quality labels BREEAM⁴, LEED⁵ und DGNB⁶, the Swiss label MINERGY-ECO gives more helpful hints for the indoor climate and discusses in more detail the influencing factors. Apart from the mechanical ventilation and the air tightness, the requirements which influence the quality of the indoor air, are defined by the Chapter ECO and not by MINERGY.

It is important that the planers should decide early, during the preliminary and design project phases, about the building label they wish to attain. The targeted quality of the room air should be definitely decided upon at this time and communicated to the different project collaborators. The choice of building materials should take into account the targeted, reduced room air pollutant. Depending upon the selected building label, some materials which are unfavourable with regard to the indoor climate will be prohibited outright.

5. Outlook

Some pioneering Swiss towns have already started to prescribe measurements of formaldehyde and TVOC after the completion of their buildings. It is quite certain that more public and private building owner will also begin to appreciate an improved indoor climate, thus the issue will become ever more important in the near future. In France, all building products have to be tested for their emission of different chemicals. On 1st July 2013, the „Construction Products Directive“ was turned into European law. Because this is a part of the 1st Bilateral Agreement, Switzerland must adapt its law on building products.

Planners will have to acknowledge that the matter of reduced pollutants in the air indoors is an important aspect of the construction process.

⁴ Building Research Establishment's Environmental Assessment Method, Great Britain

⁵ Leadership in Energy & Environmental Design von U.S Green Building Council, U.S.A

⁶ Deutsche Gesellschaft für Nachhaltiges Bauen, Deutschland