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Eco-friendly and low emitting building products for sustainable and green buildings certified by LEED, BREEAM & DGNB

Dr. Michael H. Rieß
DGNB- / BREEAM-in use Auditor
BIU Büro für integrierten Umweltschutz

Profile

- DGNB-Auditor, BREEAM in-use auditor
- DGNB-founding member, DGNB technical commitee, head of expert group on construction materials and hazardous substances
- Systemexpert of BREEAM.DE

Services

- Auditing of Building Certification
- Harmful building materials, deconstruction planning, environmental sound construction side, green building materials, indoor air quality, environmental data sheets
- More than 40 DGNB- & LEED-reference projects

Outline

- Common principles of BREEAM, LEED & DGNB
- Low-VOC-construction materials– what for?
- BREEAM Hea 02 – VOC emission levels of products & buildings
- LEED Low emission products and indoor air quality assessment
- DGNB – Low VOC products (ENV1.2) and indoor air quality (SOC1.2)
- Conclusions
- Recommendations

Common Principles of the most recent versions

- **Defined criteria for the planning, building and documentation of sustainable constructions, life-cycle costs, advanced comfort and efficient installations (energy, waste, recycling, …)**

- **Credits or ratings for the proofed fulfillment of advanced standards**

- **Adaption of the criteria to the type of building (e. g. office, school, industrial, domestic…)**

- **Healthy indoor air quality as an prerequisite or for additional credits based on**

  - indoor air quality testing
  - usage of low-VOC-materials

- **Certificate – issued by NSO (National Scheme Operator)**

Low-VOC-materials

- **show reduced emission levels of volatile organic compounds (VOC) usually with boiling points in the range of 50…100 up to 240…260 °C**

- **not necessarily are also green**

  (e. g. PU-Foam-Adhesive, EC1+, Difluroethan blowing gas (GWP = 124), <10% Dimethylether)

- **are relevant for the building of healthy rooms with low VOC- or low Formaldehyde-burden**

- **are – if solvent free - environmentally benefical with respect to Photochemical Ozone Creation Potential (POCP)**

BREEAM Hea 02 (2014)

Aim of BREEAM Hea 02 (2014)

- To recognise and encourage a healthy internal environment through the specification and installation of appropriate ventilation, equipment and finishes

Assessment criteria

- Minimising sources of air pollution (4 credits)

  1. Indoor air quality plan (= how to minimize indoor air pollution)
  2. Ventilation regime in order to e. g. minimze CO2-levels
  3. VOC emission levels (products)
  4. VOC emission levels (in the building post construction)

  Adaptability - potential for natural ventilation (1 credit)

VOC emission levels (products) - 1 credit / 1,5% of the total score)

for

- **Decorative paints and varnishes**
- **Wood panels with organic or cementitous binders**
- **Timber structures (e. g. glue laminated)**
- **Wood flooring (e. g. parquet)**
- **Resilient textile & laminated floor coverings (e. g. vinyl, cork, rubber ...)**
- **Suspended ceiling tiles**
- **Flooring adhesives**
- **Wall coverings**

Required product performance:

- **Compliance to Decopaint Directive 2004/42/EU**

  for paints and varnishes

- **Compliance to Formaldehyde E1-class**

  for wood panels
  timber structures
  wood flooring
  resilient textile and laminated floor coverings (e. g. carpet ...)
  suspended ceiling tiles

Required product performance:

- **No carcinogens and no sensitizers as defined in Annex of EN 13999-1 are emitted in a ventilated test chamber after 1 day (EN 13999 parts 2, 3, and 4):**

  Determination of carcinogenic and sensitizing
  - **VOCs**
  - **volatile aldehydes & diisocyanates**

for flooring adhesives

Required product performance:

- **Low emissions of formaldehyde and of vinyl chloride monomer, complying with standards EN 233, EN 234, EN 259, EN 266**

  Migration of heavy metals and other toxic substances complies with above mentioned standards

  for wall coverings

VOC emission levels in the building post construction

(1 credit / 1,5% of the total score)

- **Measured in the building post construction but preoccupancy**
- **Standards are linked to the UK-Building Regulation requirements**
- **Testing is not obligate**
- **Formaldehyde ≤ 100µg/m^3 averaged over 30 min. (WHO guidelines)**
- **TVOC concentration level <300µg/m^3 over 8 hours**
- **If the levels are not met, the project team confirms the measures that have, or will be taken, to reduce the levels to within the limits**

Low-VOC in BREEAM New Construction

- Low-VOC-products only have to comply to the legal standards
- Indoor-air-limits for Formaldehyde and TVOC in the building are quite strict
- Indoor-air-testing is an option to get a credit rather then obligate
- If the limit values are not met, project team can agree on measures like ventilation in accordance to the IAQ-plan .... ; additional indoor air testing for success control of these measures are not necessary.

USGBC

LEED BD+C: New Construction | v4 - LEED v4

Low-emitting materials

Possible 3 points

Language | Guide | Resources | Interpretations | Forum | All credits | Previous | Next

LEED BD+C: New Construction | v4 - LEED v4

Indoor air quality assessment

Possible 2 points

Language | Guide | Resources | Interpretations | Forum | All credits | Previous | Next

Intent of credit (v4) - 3 Credit-Points

- To reduce concentrations of chemical contaminants that can damage air quality, human health, productivity, and the environment.

Assessment criteria

- Different materials must meet different requirements for compliancy to these credits
- If some products in a category do not meet the criteria, project teams may use the budget calculation method (here not addressed)

Extended scope effective from v4 for interior materials

- Compliance of interior finishes may be demonstrated in assemblies with multiple layers in combination, or in each system individually
- Included consideration of furniture emissions
- New referenced standards to address international projects and new product requirements
- Ceilings and insulations are now included in the requirements
- Emissions requirements for on-site, wet-applied, full- spread products measured via chamber tests in air are now included.
- VOC content limits for on-site, wet-applied products are still required

VOC in can or emission limits for

- Interior paints and coatings applied on site
- Interior adhesives and sealants applied on site (including flooring adhesive)
- Flooring
- Composite wood
- Ceilings, walls, thermal and acoustic insulation
- Furniture (included in calculations if part of scope of work)

Required product performance:

- **VOC-limit of SCAQMD rule 1113, effective June 3, 2011 or (outside NA) compliant to national regulations (e. g. 2004/42/EU)**

  for paints and coatings wet-applied on site

- **VOC-limit of SCAQMD rule 1168, effective July 1, 2005 or (outside NA) compliant to national regulations (e. g. AgBB)**

  for adhesives and sealants wet-applied on site

- **Formaldehyde emissions not to exceed 0,05ppm as tested following either EN-717-1:2004, ISO 16000-3: 2010 ....**

  for wood-based panels (= $E_{0,5}$)

Required product performance:

- **Emission testing under** California Department of Public Health (CDPH) Standard Method v1.1–2010, default scenario is the private office scenario, state the range of total VOCs after 14 days (336 hours):

  ≤ 0.5 mg/m^3
  $> 0.5 \leq 5.0$ mg/m^3
  ≥ 5.0 mg/m^3

  or (outside NA) emission levels are compliant to national regulation (e. g. AgBB, French VOC)

  for flooring
  composite wood
  ceilings, walls, thermal, and acustic insulation
  furniture, if part of the scope of work

Intent of credit (v4) – Possible 2 Credit-Points

- **To establish better quality indoor air in the building after construction and during occupancy**

Assessment criteria

- **Building flush-out (1 Point) before or during occupancy**

  Before: Supplying a total air volume of 4267m^3 of outdoor air per square meter of gross floor area while maintaining an internal temperature between 15 to 27°C and relative humidity ≤60%

- **Air testing (2 Points) after construction ends and before occupancy using protocols consistent to specific EPA-, ASTM- or ISO-Standards**

VOC- & Formaldehyde emission levels in the building (2 credits)

- Measured in the building post construction but preoccupancy
- Testing is not obligate
- Formaldehyde ≤ 33µg/m³ (ASTM or ISO)
  TVOC concentration level <500µg/m³ (ASTM or ISO)
- Maximum levels also for PM10, PM2,5, Ozone & CO
- Target concentrations for individual VOCs linked to EPDH v1.1

but	Phenol 200µg/m³	> RW1 (20µg/m³)	Risk for health hazard
	Naphthalene 9µg/m³	> RW2 (3µg/m³)	Clean up efforts

RW: German Indoor Guide Values

Low-VOC in LEED New Construction

- **Low-VOC-products only have to comply to the legal standards exept wood-based panels ($E_{0,5}$-quality)**
- **Indoor-air-limits for Formaldehyde and TVOC in the building are quite strict**
- **Indoor-air-testing is an option to get a credit rather then obligate**
- **Individual VOC-target limits are not ambitious; some are above the German guide values RW1 or even RW2**

DGNB

DGNB CRITERION ENV1.2

LOCAL ENVIRONMENTAL IMPACT

DGNB CRITERION SOC1.2

INDOOR AIR QUALITY

OBJECTIVES AND RELEVANCE

Certain materials, products and methods are hazardous to soil, air, ground, and surface water as well as the health of humans, flora, and fauna. The use of materials, products, and methods which endanger the soil, air, ground, and surface water due to their chemical composition or physical characteristics must be reduced or avoided, or these must be substituted in order to reduce risks to humans and to the local environment to a minimum. This applies particularly to those materials, products, and methods which cause short, medium and/or long-term damage to risks to soil, air, ground, and surface water as well as the health of humans, flora, and fauna. This includes a consideration of their entire life cycle including manufacture and processing on the building site, use in the building, and their end-of-life including demolition, recycling, and disposal.

Low-VOC-materials are adressed with respect to human health (= indoor air quality) as well as with respect to environmental protection (POCP)

(= Photochemical Ozone Creation Potential (POCP)

Principles

- **Requirements for 45 product categories (mixtures and articles) applied of site (only few) and on site - up to 3,4% of total scoring**

- **Criteria have been developed in cooperation with industrial federations of building product manufacturers**

- **Four quality classes of product requirements**

1. Legal standard	e. g. Decopaint-Directive (2004/42/EU)
2. Actual technical state	e. g. solvent reduced laquere
3. Advanced standard	e. g. water-based laquer
4. High end	e. g. RAL-UZ14a (or equiv.), dispersion laquer

- **VOC-content limits or emission standards (e. g. EMICODE, GUT)**

Required product performance (only quality classes 3&4, for interiors)

- **VOC, SVOC and biocides in can**

  for paints and coatings, impregnations (e. g. natural stone)
  anti corrosive coatings (for the product or the coating system)
  bitumen pre-coat
  parquet oil

- **EMICODE EC1 / EC1-R or EC1+ / EC1-R+ or RAL-UZ**

  for adhesives
  sealers
  levellings and adhesives for floorings and wall finishes

- **GUT-Label or RAL-UZ (28d TVOC 1/10 of AgBB)**

  for textile & resilient floorings

OBJECTIVES

The aim of the criterion is to ensure a quality of indoor air quality which does not adversely affect users' health and well-being. To this end, it is particularly important to establish hygiene, to reduce the concentration of harmful substances, and to prevent unpleasant smells.

TVOC concentrations exceeding 3.000 µg/m³, formaldehyde concentrations exceeding 120 µg/m³, or the transgression of Guide value 2 (defined by the German Umweltbundesamt Ad-hoc Working Group for Indoor Air Guide Values) endanger hygiene of rooms in dwellings, offices or teaching rooms used by the same persons for several hours. For this reason, buildings with these high pollution levels are excluded from certification.

Assessment criteria

- **Air exchange rate: Realised ventilation rate - naturally or mechanically according to EN15251**

- **Indoor air testing latest four weeks after construction ends, without furniture and fixtures, before occupancy using protocols consistent to ISO-16000 series**

  - defined number of rooms
  - representative rooms
  - each type of outfit
  - all tested rooms have to meet the requirements

  - usually 3 to 6 rooms have to be measured

Evaluation criteria

INDOOR AIR CONCENTRATIONS FOR ALL TESTED ROOMS

TVOC [µG/M³]	FORMALDEHYDE [µG/M³]	CLP
> 3000	> 120	0
≤ 3000	≤ 120	10
≤ 1000	≤ 60	25
≤ 500	≤ 60	50

= Knock-out scoring

Low-VOC in DGNB New Construction (maximum score 5%)

- **Low-VOC-products for higher DGNB-ratings have to comply to the most advanced VOC- or emission-standards**
- **Indoor-air-limits for Formaldehyde and TVOC in the building are strict**
- **Indoor-air-testing is obligate and compliance to minimum levels have to be demonstrated (knock-out-criteria)**
- **Individual VOC-target limits are much below the German guide values RW1 or even RW2**
- **Low-VOC-product standard and indoor-air limits are balanced**

Low-VOC in BREEAM, LEED & DGNB - conclusions

- **BREEAM and LEED already offer credits for the use of legally complient products (except $E_{0,5}$ wood based panels); DGNB is asking for the most advanced product standards**
- **BREEAM- and LEED-indoor-air testing is voluntary; for DGNB compliance to minimum indoor-air-quality standards is an prerequisite (knock-out criteria!)**

Recommendations

- **Legal compliance testing for products is a chance to check and proof compliance to advanced standards**
- **Use the emission test results for product quality assurance and development**
- **Airtight facades, short construction phases and the increase in the use of building chemicals will facilitate the need for low emission materials**
- **Make available enivironmental product data sheets for material vetting**

Thank you for your attention!

✉ Anna-Wegener-Weg 37, 28357 Bremen ☏ 0421 2768200 www.riess-biu.de