Our
Seal of Approval
promotes a healthy
living environment

Tested and recommended
IBR
Institut für Baubiologie Rosenheim GmbH ®
Product tested for
VOC · biocides · heavy metals
and radioactivity

Seal of Approval Guidelines

IBR

Institut für **Baubiologie**
Rosenheim GmbH

Münchener Str. 18, D-83022 Rosenheim, Phone: +49 (0)8031 / 3675-0

Fax: +49 (0)8031 / 3675-30 info@baubiologie-ibr.de, **www.baubiologie-ibr.de**

Preliminary remarks:

It is the objective of the Institut für Baubiologie Rosenheim GmbH (in this document called IBR) to identify non-polluting building products for healthy living for the consumer by awarding the seal of approval "TESTED AND RECOMMENDED BY THE IBR". The seal of approval was created by the IBR in 1982 to enable consumers with an awareness for health and ecological matters to protect themselves against health hazards caused by building materials and furniture in their residential environment. The seal of approval is awarded to products which ensure healthy living with respect to building biology and at the same time protect the environment.

The aim of awarding the seal of approval to as many products as possible is to enable an increasing number of consumers and end users to make criteria related to building biology a critical part of their decision when purchasing products for building and furnishing their homes.

When awarding the seal of approval, we only use scientific and technical analysis methods which are based on normative regulations as well as the current state-of-the-art of laboratory analytics so that they can be understood both by third-party experts and by end consumers.

For the date of the current version of the seal of approval guidelines, please refer to the 'Conclusion' section.

We will update the seal of approval guidelines as required, but at least once a year. Updates may be caused by changes in standards, requirements with respect to laboratory technology or technological innovations. We reserve the right to update our seal of approval guidelines without prior notice. Only the latest version is applicable. When we publish an updated version of the seal of approval guidelines, all former versions become obsolete. The current version can be viewed on our website under

www.baubiologie-ibr.de/Prüfsiegelrichtlinien

We award the seal of approval based on the version of the seal of approval guidelines which the applicant and later user of the mark receives when placing the order. Along with the extension of the validity period of the seal of approval every two years, the version current at the time of follow-up testing becomes applicable.

Any names of companies, products or brands mentioned in our expert reports are protected by copyright. The fact that we mention them is neither to be construed as a valuation nor as a recommendation. We established these seal of approval guidelines according to the best of our knowledge and ability. If you find any errors, please let us know. Any contributions and suggestions for improvement will also be appreciated.

The information in this document comes from sources copyrighted by the IBR or whose copyright has been obtained by the IBR when commissioning the tests. If you believe your copyrights have been infringed, please notify us accordingly. We will immediately correct the relevant information accordingly in order to protect your intellectual property.

If you have questions related to the seal of approval guidelines explained in this document, do not hesitate to contact us.

This document consist of 24 pages.

Table of Contents

1. How is the IBR financed?

We think it is very important to show transparently how the IBR seal of approval is financed so that we can substantiate the seal's neutrality towards the public.

IBR services are neither financed by advertising nor by interest groups.

The IBR places orders for product tests with external service providers in its own name and on its own account.

We commission the required studies and tests from economically independent laboratories with whom we have been collaborating for a long time. In this way, we can avoid to feature customer-biased results.

We archive all results and make them accessible to the ordering party.

Thus, it can be said that results are always obtained from a qualified, independent third party. Only the interpretation of the study results resides with the IBR.

The IBR obtains its financial means from the surplus resulting from payments received for the basic and follow-up studies as well as the fees for the promotional use of the IBR seal.

1.1 Basic study

Before accepting the request to award the seal of approval to a product, we inform the applicant of the costs of the basic study (basic costs). These include all costs related to the study itself and the creation of expert reports and certificates both in digital form and on paper. This amount will cover all internal and external costs incurred by the IBR in the context of awarding the seal of approval. We will not charge any consulting services, meetings or cost estimates of any kind to the applicant.

Payment of 50 % of the agreed basic costs is due when we receive the order to perform the basic study required for awarding the seal of approval. Payment of the remaining 50 % of the basic costs is due after all work has been completed and the seal of approval has been awarded. We award the seal of approval by sending the expert report files and certificates in PDF format to the client.

1.2 Follow-up study

We periodically perform a follow-up study every two years in order to verify whether the client is still entitled to use the seal of approval. For this, the IBR charges 35 – 40 % of the basic costs to the user of the mark, depending on the expenditure.

1.3 Licence fees for promotional use

For the promotional use of the seal of approval, the user of the mark pays an annual fee of 25 % of the basic costs. This fee includes the following IBR services:

- answering any questions asked by end users free of charge
- protection of the seal of approval against any misuse by unauthorised third parties
- extension and development of the test procedures
- presentation of the seal of approval in the public

2. Scope

The assessment and test regulations apply to all products the applicant produces in his or her company according to these regulations or has them produced by other companies on his or her behalf.

3. Test and monitoring conditions

The test and monitoring conditions strictly apply to all building materials, working materials and supplies used for construction and furnishing homes as well as all components, installations and furniture produced from them.

We reserve the right to change, complement or extend these conditions as required by the technological progress.

Employees of the IBR or persons charged by the IBR may at any time, even without prior notice, visit the applicant's production site.

Product samples are taken either in a procedure under official supervision or by the IBR.

When samples are taken under official supervision, an employee e.g. of the local authorities certifies by the official seal of his or her office that the samples have been taken neutrally and in an unbiased manner from the ongoing production.

As an alternative, it is of course possible to have the samples taken by an officially appointed calibrator, but in most cases this causes unnecessary costs. The appendix of these guidelines contains a form to be used for sampling under official supervision.

In the interest of consumers, follow-up testing of the products must be performed in due time before the seal of approval expires. The applicant will have to reapply for these tests.

4. Data privacy

In the interest of consumers, users and manufacturers, the IBR commissions tests of building biology products from laboratories.

The IBR archives the results of these studies and makes them available to the ordering party for reference.

We undertake to answer questions asked by consumers about products we awarded the seal of approval to in a neutral manner.

We will neither make the current expert report nor any test results contained therein available to the consumers. This information will only be disclosed to others after explicit written permission by the user of the mark. These directives will remain valid until revoked.

The IBR undertakes not to disclose any information of which it has knowledge and which the user of the mark declares as confidential, to third parties.

5. Test criteria

This section describes the various test procedures which are applied for carrying out a basic and/or follow-up study. The procedures depend on the products and their material-related properties.

Tests for radioactivity, hazardous organic substances and heavy metals are carried out anyway, no matter whether this appears to be necessary for the individual product or not.

To carry out tests for volatile organic substances, we either use static headspace technology or the test chamber method.

The method to be applied depends on the material properties of the product.

For products consisting mainly of organic substances such as wood materials or plastic coatings which, due to the materials used, contain volatile compounds, the test chamber method is used.

In case of mainly inorganic products, such as mineral materials, we use static headspace technology to detect any volatile components they might contain.

In the detection of heavy metals, we test for their content in the original substance and, on the other hand, determine the heavy metal content that might be elutable. This is required in order to identify any problems which might arise later with the disposal of this product.

A test for fine dusts only makes sense if we reasonably suspect the emission of fine dust. This can be the case for fibre-reinforced or fibre-composite materials such as mineral insulating felts, fibre cement panels, etc., or if a possible fine dust hazard can be deduced from the material structure.

Systematic testing for formaldehyde will only be carried out on materials where this substance separates inherently, e.g. in case of wood-based materials glued with urea-formaldehyde resin glue, such as chipboards, engineered parquets or laminate flooring. Each material, however, is also tested for aldehydes within the scope of the VOC testing procedure. Only for the products mentioned above, formaldehyde emissions are quantified over a longer period of time.

All other tests are carried out as required or if requested by the applicant.

It is at the IBR's discretion to decide for each individual case whether such a test is required or not.

The following subsections describe how each of the testing procedures is performed.

5.1 Radioactivity

In the discussion about the risks of nuclear energy, the public's interest focuses almost exclusively on the population's radiation exposure caused by nuclear plants. Due to this fact, the problem of radiation exposure inside buildings is being neglected. In many cases, there are uncertainties about the level of radiation to which the population is exposed and about the contributions of the individual natural and man-made sources of radiation. The main part of the natural radiation exposure comes from ambient radiation and the absorption of natural radioactive substances by the body. It must also be considered that the radioactive gas radon may be emitted from building materials into the ambient air. Breathing it in over a long period of time may expose the lungs to radioactive radiation. Human beings absorb this gas and its decay products together with the inhaled air. While most radon particles are exhaled again, its radioactive decay products can be deposited in the lungs. The German Strahlenschutzverordnung (radiation protection ordinance) from 2001 lowered the admissible additional radiation exposure of the population from 1.5 mSv per year to 1 mSv per year. In 1999, the Radiation Protection 112 document issued by the European Commission proposed an Activity Concentration Index (ACI) for building materials. The ACI value for building materials is calculated using a total formula which is based on a dose criterion of 1 mSv per year. Therefore, using the ACI for the evaluation is more stringent than using the previously applied Leningrad formula which is based on a dose criterion of 1.5 mSv per year. The following formula is used to determine the ACI value:

$$ACI = A\ (K\text{-}40) / 3000 + A\ (Ra\text{-}226) / 300 + A\ (Th\text{-}232) / 200 < 1$$

where A(K-40) is the activity of potassium-40, A(Ra-226) the activity of radium-226 and A(Th-232) the activity of thorium-232, all given in Bq/kg. Adding the 3 measured values A(K-40), A(Ra-226) and A(Th-232) will yield the total ACI.

The following table lists the measured activities of the individual nuclides:

Nuclide	Activity [Bq/kg]	Statistical error [%]
Lead 212		
Lead 214		
Potassium 40		
Iodine 131		
Caesium 134		
Caesium 137		

Test result example: For the tested product, an ACI value of 0.00 was determined.
Artificial radioactivity from Chernobyl or from the above-ground atomic bomb tests carried out in the 1960s could not be identified in the examined sample.

Limit or reference values	Requirement
Activity Concentration Index (ACI) for building materials stipulated by the European Commission	ACI ≤ 1.00
Reference value stipulated by the Institut für Baubiologie Rosenheim GmbH	ACI ≤ 0.75
Reference value stipulated by the Munich Environmental Institute (Umweltinstitut München)	ACI ≤ 0.50

Evaluation example: The tested product complies with the official reference value of ACI ≤ 1 as well as with the test requirement ACI ≤ 0.75 stipulated by the Institut für Baubiologie as well as with the stringent reference value of ACI ≤ 0.5 stipulated by the Munich Environmental Institute.

5.2 Biocides, PCB, Pyrethroids, Phtalates

With an increasing presence of chemical substances at our workplaces and in everyday life, the ambient air quality in indoor environment has deteriorated continually. For workplaces, TLV values (threshold limit values) reflecting the concentration of harmful substances have been defined. For habitable rooms, however, where people spend much more time, no legally stipulated maximum quantities or limit values for harmful substances in the indoor air have been defined yet, apart from very few exceptions. The quality of the air in homes and other habitable rooms is essentially influenced by the type of the building materials and furniture and by the types of household chemicals used.

5.2.1 Biocides

Test method: Addition of internal standards (alpha-HCH, 2,4,6-tribromophenole, PCB 209) to validate the test procedure. Extraction using n-hexane/acetone and a carbonate solution. Acetylation of the phenols. Fractionation of extracts using silica gel for each specific category of substances. Analysis using capillary gas chromatography and flame ionisation/electron capture detectors (GC/FID/ECD) or mass spectrometry (GC/MS). Calibration and assay using external standards.

Substance	Measured value [mg/kg]	Limit of detection [mg/kg]
Pentachlorophenol PCP		0.1
2,3,4,5-tetrachlorophenol		0.1
2,3,5,6-tetrachlorophenol		0.1
beta-HCH		0.1
gamma-HCH (lindane)		0.1
Dichlofluanid		0.3
Tolylfluanid		0.3
Chlorthalonil		0.1
alpha-Endosulfan		0.2
beta-Endosulfan		0.2
Endosulfan-sulfate		0.3
Furmecyclox		2.0
Hexachlorobenzene		0.05
Methylparathion		0.3
Ethylparathion		0.3
Chlorpyrifos		0.2
Heptachlor		0.1
Aldrin		0.1
cis-heptachlor epoxide		0.1
trans-heptachlor epoxide		0.1
cis-chlordane		0.1
trans-chlordane		0.1
Endrin		0.05
Dieldrin		0.05
Bromophos		0.2
Mirex		0.5
Malathion		0.3
Hexachlorophene		0.1
o,p-DDT		0.1
o,p‘-DDT		0.1
o,p-DDD		0.1
p,p‘-DDD		0.1
o,p-DDE		0.1
p,p‘-DDE		0.1
Eulan		1.0

5.2.2 Polychlorinated biphenyls

Test method: Addition of internal standards (PCB 209) to validate the test procedure. Extraction using n-hexane. Fractionation of extracts using silica gel for each specific category of substances. Concentration. Analysis using capillary gas chromatography and electron capture detectors (GC/ECD). Calibration and assay using external standards. Determination according to the German PCB-Abfallverordnung (ordinance on the ban of PCB) from 2002.

Substance	Measured value [mg/kg]	Limit of detection [mg/kg]
Polychlorinated biphenyls (PCB) no.: 28		0.05
Polychlorinated biphenyls (PCB) no.: 52		0.05
Polychlorinated biphenyls (PCB) no.: 101		0.05
Polychlorinated biphenyls (PCB) no.: 138		0.05
Polychlorinated biphenyls (PCB) no.: 153		0.05
Polychlorinated biphenyls (PCB) no.: 180		0.05
Polychlorinated biphenyls (PCB) – total:		0.5
Polychlorinated terphenyls (PCT) – total:		0.5
Polychlorinated diphenylmethanes PCDM – total:		0.5
Polybrominated diphenylmethanes PBDM – total		0.5

5.2.3 Pyrethroides

Substance	Measured value [mg/kg]	Limit of detection [mg/kg]
Resmethrin		0.5
Deltamethrin		0.5
Tetramethrin		0.5
Cypermethrin		0.5
Cyfluthrin		0.5
cis-trans-Permethrin		0.5
Allethrin		0.5
Phenothrin		0.5
Cyhalothrin		0.5

5.2.4 Phtalates

Substance	Measured value [mg/kg]	Limit of detection [mg/kg]
Phthalic acid anhydride		5
Dimethyl phthalate		5
Diethyl phthalate		5
Bis-2-methylpropyl phthalate DiBP		5
Dibutyl phthalate DBP		5
Benzyl butyl phthalate BBP		5
Dioctyl phthalate DOB		5
Diethylhexyl phthalate DEHP		5
Diisononyl phthalate DNOP		5
Didecyl phthalate		5
Diundecyl phthalate		5

Note: Due to their frequency of occurrence, concentrations of phthalic acid esters below 20 mg/kg are assumed to be unspecific secondary contaminations.

Evaluation example: For none of the tested substances, a measurable concentration was detected. All measured values are below the specific limit of detection set for each analysis. The tested substances are not expected to have a harmful effect.

5.3 Solvents and odiferous substances (VOC)

5.3.1 Determination by VOC emission chamber measurements

With an increasing presence of chemical substances at our workplaces and in everyday life, the ambient air quality in indoor environment has deteriorated continually. For workplaces, TLV values (threshold limit values) reflecting the concentration of harmful substances have been defined. For habitable rooms, however, where people spend much more time, there are, apart from very few exceptions, no legally stipulated maximum quantities or limit values for harmful substances in the indoor air. It is the declared objective of the new federal building codes in Germany and the European Construction Products Directive to protect the health of building users. The corresponding board which is responsible for finding and establishing VOC limit values is called ECA (European Collaborative Action). As early as in 1997, this board recommended the use of the so-called LCI (Lowest Concentration of Interest) as an evaluation scheme, i.e. concentrations that are just of interest from a toxicological point of view. With the exception of pesticides, volatile organic substances were classified according to the WHO definitions with respect to their boiling ranges or the volatility resulting from it. The following tested substances are in the boiling range from 50 to 260 °C.

Description	Boiling range
1. Very Volatile Organic Compound (VVOC)	< 0 to 50...100 °C
2. Volatile Organic Compound (VOC)	50...100 to 240...260 °C
3. Semi Volatile Organic Compound (SVOC)	240...260 to 380...400 °C
4. Organic compound associated with particulate matter or particulate organic matter (POM)	380 °C

Test method: For the tests, VOC emission chamber measurements are performed. The air exchange rate is adapted to the surface area of the test sample. The following test parameters are used:

Chamber volume	Chamber loading ratio	Air exchange rate	Air velocity	Air temperature	Relative humidity

After three days, the volatile organic compounds (VOCs) and semi-volatile organic compounds (SVOCs) are concentrated using activated carbon adsorption. After desorption with carbon disulphide, the VOCs are separated by gas chromatography and then identified by mass spectrometry. Each substance is quantified by mass spectrometry either directly or by using an external toluene standard.

5.3.1.1 Alkanes

Substance	Measured value [µg/m³]	Limit of detection [µg/m³]
Methyl-cyclopentane		1
Cyclohexane		1
Heptane		1
Methylcyclohexane		1
Octane		1
Nonane		1
Decane		1
Undecane		1
Dodecane		1
Tridecane		1
Tetradecane		1
Pentadecane		1
Hexadecane		1
2,2,4,4,6,8,8-heptamethylnonane		1

5.3.1.2 Aromatics

Substance	Measured value [µg/m³]	Limit of detection [µg/m³]
Benzene		1
Toluene		1
Ethylbenzene		1
m+p-xylene		1
o-xylene		1
n-propylbenzene		1
Styrene		1
2-ethyltoluene		1
3-ethyltoluene		1
4-ethyltoluene		1
1,3,5-trimethylbenzene		1
1,2,4-trimethylbenzene		1
1,2,3-trimethylbenzene		1
n-butylbenzene		1
1,2 / 1,3-diethylbenzene		1
1,4-diethylbenzene		1
1,2,4,5-tetramethylbenzene		1
1,2,3,5-tetramethylbenzene		1
Hexylbenzene		1
Octylbenzene		1

5.3.1.3 Alkenes

Substance	Measured value [µg/m³]	Limit of detection [µg/m³]
2-methylpropene trimer		1
4-phenylcyclohexene		1
4-vinylcyclohexene		1

5.3.1.4 Chlorinated hydrocarbons

Substance	Measured value [µg/m³]	Limit of detection [µg/m³]
1,1,1-trichloroethane		1
Carbon tetrachloride		1
Trichloroethene		1
Tetrachloroethene		1
1,4-dichlorobenzene		1
1-chloronaphthaline		1

5.3.1.5 Terpenes

Substance	Measured value [µg/m³]	Limit of detection [µg/m³]
Dihydro-myrcenol		1
Linalool		1
beta-Citronellol		1
Linalyl acetate		1
Geraniol		1
Hydroxicitronellal		1
Geranyl acetate		1
alpha-ionone		1
alpha-pinene		1
beta-pinene		1
delta-3-carene		1
Limonene		1
1,8-cineole		1
alpha-terpinene		1
gamma-terpinene		1
alpha-terpineol		1
Menthol		1
Isophorone		1
DL-Camphor		1
Verbenone		1
Bornyl acetate		1
endo-borneol		1
Longifolene		1
Eugenol		1
Iso-eugenol		1

5.3.1.6 Monovalent alcohols

Substance	Measured value [µg/m³]	Limit of detection [µg/m³]
Methanol		1
Ethanol		1
1-propanol		1
2-propanol		1
Tertiary butanol		1
1-butanol		1
2-pentanol		1
2-methyl-1-butanol		1
1-pentanol		1
1-hexanol		1
1-heptanol		1
1-octanol		1
2-propyl-1-pentanol		1
2-ethyl-1-hexanol		1
1-nonanol		1
2-nonanol		1
1-Octen-3-ol		1
Decanol		1
Texanol		1
Cinnamic alcohol		1

5.3.1.7 Polyvalent alcohols and their ethers

Substance	Measured value [µg/m³]	Limit of detection [µg/m³]
Ethylene glycol monomethyl ether (EGMM)		1
Ethylene glycol monoethyl ether (EGME)		1
Ethylene glycol monoisopropyl ether (EGMiP)		1
Ethylene glycol monobutyl ether (EGMB)		1
Ethylene glycol monophenyl ether (EGMP)		1
Ethylene glycol diphenyl ether (EGDP)		1
1,2-propylene glycol (1,2 PG)		1
1,2-propylene glycol ethylhexyl (PGEH)		1
1,2-propylene glycol monomethyl ether (PGMM)		1
1,2-propylene glycol monobutyl ether (PGMB)		1
1,2-propylene glycol mono-t-butyl ether (PGMtB)		1
Diethylene glycol monomethyl ether (DEGMM)		1
Diethylene glycol monoethyl ether (DEGME)		1
Diethylene glycol monobutyl ether (DEGMB)		1
Dipropylene glycol monomethyl ether (DPGMM)		1
Triethylene glycol monobutyl ether (TEGMB)		1
Tripropylene glycol monobutyl ether (TPGMB)		1
Tripropylene glycol monoallyl ether (TPGMA)		1

5.3.1.8 Esters of polyvalent alcohols and their ethers

Substance	Measured value [µg/m³]	Limit of detection [µg/m³]
Propylene glycol monomethyl ether acetate (PGMMA)		1
Ethylene glycol monoethyl ether acetate (EGMEA)		1

5.3.1.9 Esters of carboxylic acids

Substance	Measured value [µg/m³]	Limit of detection [µg/m³]
Ethyl acetate		1
Isopropyl acetate		1
n-butyl acetate		1
i-butyl acetate		1
Methyl methacrylate		1
Butyl acrylate		1
Butyl propionate		1
Dimethyl adipate		1
Dimethyl pimelat		1
Dimethyl caprylate		1
Diisobutyl adipate		1
Dibutyl maleinate		1
Dimethyl phthalate		1
Diethyl phthalate		1
Dibutyl phthalate		1
TXIB		1
TxmIB		1
Methyl benzoate		1

5.3.1.10 Ketons

Substance	Measured value [µg/m³]	Limit of detection [µg/m³]
Acetophenone		1
Cyclohexanone		1
3,3,5-trimethyl cyclohexanone		1
Methyl ethyl ketone (2-butanone)		1
Methyl isobutyl ketone (MIBK)		1
2-hexanone (MBK)		1
2-heptanone		1
3-octanone		1
n-methyl-2-pyrrolidone		1
Benzophenone		1

5.3.1.11 Aldehydes

Substance	Measured value [µg/m³]	Limit of detection [µg/m³]
Formaldehyde (methanal)		1
Ethanal		1
Propanal		1
Butanal		1
Pentanal		1
Hexanal		1
Heptanal		1
Octanal		1
Nonanal		1
Decanal		1
Furfural		1
trans-cinnamic aldehyde		1
alpha-hexyl-cinnamic aldehyde		1
Vanillin		1
Benzaldehyde		1

5.3.1.12 Carboxylic acids

Substance	Measured value [µg/m³]	Limit of detection [µg/m³]
Hexanoic acid		1
Heptanoic acid		1
Octanoic acid		1
Nonanoic acid		1
Decanoic acid		1
Undecanoic acid		1
Dodecanoic acid		1

Evaluation example: For none of the tested substances, a measurable concentration was detected. All measured values are below the specific limit of detection set for each analysis. The tested substances are not expected to have a harmful effect.

5.3.2 VOC determination using headspace technology

Test method: The material samples are prepared using headspace technology at 90 °C as well as liquid extraction by means of acetone. Derivative preparation of carboxylic acids. Analysis using capillary gas chromatography, flame ionisation and electron capture detectors (GC/FID/ECD) or mass spectrometry (GC/MS). Calibration and assay using external standards.

The substance groups are prepared as described above. Compared to the emission chamber method, this method uses a different measuring procedure. In addition, the measured concentrations are indicated in a different way. The following limits of detection apply to the tested substance groups:

		Limit of detection mg/kg
Substance groups	Alkanes	1
	Aromatics	1
	Alkenes	1
	Chlorinated hydrocarbons	1
	Terpenes	1
	Monovalent alcohols	1
	Polyvalent alcohols and their ethers	1
	Esters of polyvalent alcohols and their ethers	1
	Esters of carboxylic acids	1
	Ketons	1
	Aldehydes	1
	Carboxylic acids	0.5

The advantages of this method are an increased accuracy of the measuring results and a shorter test duration. Thus, it is possible to examine a higher number of samples in a short period of time. This, in turn, increases the relevance of the overall result. What is more, this method allows to find out whether volatile substances are present in the material at all. If not, this result enables us to principally exclude any hazards caused by volatile organic substances.

The drawback of this method is that, for products which cure chemically, e.g. lacquer, wood oil, coatings, adhesive mortar, etc., it is not possible to detect intermediate products that are only formed in the curing process. In these cases, the first method is preferred.

A further advantage of the emission chamber method is that the emission behaviour of the products can be investigated under realistic conditions of use. The fact alone that volatile components are present does not necessarily lead to a conclusion of how the product will behave with respect to emissions.

Hence, it is not possible to say that one of the two methods is better, more accurate or more significant than the other. We rather need to decide in each individual case which type of testing makes more sense. In some cases, a combination of both test methods may be appropriate.

5.4 Heavy metals

Metals are basically subdivided into light metals and heavy metals. Contrary to common opinion that only heavy metals have a toxic potential, and light metals do not, the following should be noted: Not all heavy metals are toxic and not all light metals are non-toxic. About 14 of the 80 most common metals are essential to human beings and mammals. With a probability bordering on certainty, sodium, potassium, calcium and magnesium as well as the heavy metals iron, zinc, copper, manganese, nickel, chromium, vanadium, molybdenum and cobalt are to be considered as essential.

It is true that an insufficient supply of essential metals results in deficiency symptoms, but an excessive intake of them can cause poisoning symptoms. Nevertheless, intoxication with essential metals is less probable since the human organism has developed control mechanisms which ensure that, up to a certain degree, excessive quantities can be execreted. If, however, that degree is exceeded, a toxic potential develops. The most notorious toxic and environmentally harmful heavy metals are lead, cadmium and mercury. Identifying the metals can shed a light on the base products used as well as on health risks and possible environmental hazards.

Test method: Quantitative determination according to DIN EN ISO 17294-2 using ICP-MS

Principle of analysis: Determination of 62 elements with ICP-MS, using rhodium and rhenium as internal standards;

calibration of the ICP-MS apparatus using multi-element standards (simple linear).

The ICP-MS (inductively-coupled plasma mass-spectrometry) analysis method allows to detect a large number of elements in a short time and, due to its capability to detect elements reliably, it is one of the most common methods of trace element analytics.

ICP-MS is based on the ionisation of the material to be analysed in a plasma at approx. 5000 °C. To create the plasma, a high-frequency current is induced into ionised argon. The resulting ions are transferred to the vacuum system of the mass spectrometer. Then, the beam of ions is divided in the mass spectrometer to yield ions with different masses.

Each element has at least one isotope with a mass that is unique and does not occur with any other natural isotope. Thus, its mass is a characteristic property of each element.

Digestion of the samples: After the vessel has been cleaned, 10 ml of nitric acid and 2 ml of hydrofluoric acid are added. The exact weight of the sample taken is recorded in the weighing protocol. These protocols are added to the process records and archived along with them. According to the work instructions for microwave digestion, the vessel is loaded into the system. Then, the total digestion process is carried out.

After the vessels have cooled down, they are opened carefully under the exhaust. The digestion vessel is filled with 38 ml water and, after mixing the content, part of the solution may be put aside as a blank value. The rest is discarded. Then, the vessel is flushed three times with ultra-pure water. After each use, the vessel must be cleaned again.

5.4.1 Determination in the original substance

As a reference value, we use the limit values according to LAGA (working group of the German Länder on waste issues) in mg/kg: The assignment values Z 0 to Z 2 are the upper limits for each incorporation class when ground material is used for earthworks, road building, landscaping and landfill work (e.g. cap layers), for the filling of building pits and for land reclamation. In this context, the 'solid matter for soil' assignment values are applicable.

Z 0: Unrestricted incorporation

Z 1.1: Restricted incorporation of waste material for construction purposes in open sites

Z 1.2: Restricted incorporation of waste material for construction purposes in open sites in areas with favourable hydrogeological conditions

Z 2: Restricted incorporation of waste material for construction purposes with defined technical safety measures

Metals (element symbol)	Measured value [mg/kg]	Limit of detection	Limit value Z 0	Limit value Z 1.1	Limit value Z 1.2	Limit value Z 2	Limit value IBR
Arsenic (As)		1	20	30	50	150	-
Cadmium (Cd)		0.2	0.6	1	3	10	-
Cobalt (Co)		1	-	-	-	-	20
Chromium (Cr)		1	50	100	200	600	-
Copper (Cu)		2	40	100	200	600	-
Iron (Fe)		20	-	-	-	-	-
Mercury (Hg)		0.1	0.3	1	3	10	-
Manganese (Mn)		2				-	-
Nickel (Ni)		2	40	100	200	600	-
Lead (Pb)		1	100	200	300	1000	-
Antimony (Sb)		1	-	-	-	-	20
Tin (Sn)		2	-	-	-	-	50
Zinc (Zn)		5	120	300	500	1500	-

5.4.2 Determination in the eluate

By determining the content in the eluate according to DIN 38414 S 4, a potential hazard to waters caused by metals should be excluded when the material is landfilled after its useful product life. Here, the LAGA values in mg/l are used as stated above. In this context, the 'eluate for soil' assignment values are applicable. In addition, the standards specified in the TVO (German Drinking Water Regulation, as of January 1st, 2008) are used as reference values. Principle of analysis: The sample material is eluted with water under defined conditions and the undissolved parts are separated by filtration. The concentrations of the components to be identified are determined from the filtrate using the methodology of water analytics.

Metals (element symbol)	Measured value [mg/l]	Limit of detection	Limit value Z 0	Limit value Z 1.1	Limit value Z 1.2	Limit value Z 2	Limit value TVO	Limit value IBR
Arsenic (As)		0.005	10	10	40	60	0.01	-
Cadmium (Cd)		0.001	2	2	5	10	0.005	-
Cobalt (Co)		0.005	-	-	-	-	-	2
Chromium (Cr)		0.005	15	30	75	150	0.05	-
Copper (Cu)		0.005	50	50	150	300	2	-
Iron (Fe)		0.1	-	-	-	-	0.2	-
Mercury (Hg)		0.001	0.2	0.2	1	2	0.001	-
Manganese (Mn)		0.005	-	-	-	-	0.05	-
Nickel (Ni)		0.005	40	50	150	200	0.02	-
Lead (Pb)		0.001	20	40	100	200	0.01	-
Antimony (Sb)		0.001	-	-	-	-	0.005	-
Tin (Sn)		0.005	-	-	-	-	-	50
Zinc (Zn)		0.005	100	100	300	600	-	10

Evaluation example: All measured values are below the permissible limit values. The tested substances are not expected to have a harmful effect.

5.5 Formaldehyde

Formaldehyde (HCHO) is used as a binder component in wood materials or mineral fibre insulations, in flooring or carpet glues, in products for sealing parquets, but also as a pot preservative for paints and lacquers and in detergents and cleaning agents.

Formaldehyde belongs to the aldehydes substance group. In its free form, formaldehyde is a colourless gas with a pungent smell that can be noticed even in very low concentrations. It dissolves easily in water or alcohol and is then called formalin. In nature, formaldehyde is an intermediate product formed in the normal metabolism of mammal cells. In addition, it is present in the atmosphere as a result of photooxidation.

Under certain circumstances, formaldehyde is released from products as a gas and may have harmful effects on health.

Most formaldehydes, however, are formed in the production of plastics, such as urea-formaldehyde resins or amino-resins where formaldehyde is required for crosslinking. The formaldehyde contained in those products can be released as an aerosol over a long period of time.

First symptoms of an exposure to formaldehyde are irritations of the eyes and the mucosa. In addition, breathing difficulties, headache and sickness may occur. Long-term exposure to formaldehyde may cause allergic reactions or promote allergic reactions against other substances.

Formaldehyde is reasonably suspected to have carcinogenic potential.

For the assessment of formaldehyde emissions, we use the official reference values of the German Bundesgesundheitsamt (German Federal Health Agency) or of the WHO:

Limit or reference values	Requirement
WHO ("concentration of no or little concern")	60 µg/m³ (0.05 ppm)
WHO reference value	96 µg/m³ (0.08 ppm)
German Federal Health Agency (intervention level)	120 µg/m³ (0.1 ppm)
Reference value stipulated by the Institut für Baubiologie Rosenheim GmbH	60 µg/m³ (0.05 ppm)

Testing is carried out based on DIN EN 717-1 (determination of formaldehyde release by the test chamber method). The concentration is measured in time intervals as specified below:

Time interval in hrs	HCHO concentration in ppm
24	
48	
96	
120	

Evaluation example: The tested product complies with the official reference value stipulated by the German Bundesgesundheitsamt (Federal Health Agency) (0.1 ppm) and with the more rigorous value stipulated by the WHO and the IBR (0.05 ppm). There are no hazards due to formaldehyde.

5.6 Fine dusts

Dusts are solid substances which are dispersed in gases. They are created by mechanical processes or by resuspension. Together with smokes and mists, dusts belong to the aerosols. In order to evaluate the potential health hazards of dusts, it is necessary to consider not only the specific harmful effects of each pollutant, its concentration and the exposure time, but also the particle size. This is the major difference between dusts and gases or vapours. The intake into the body is mainly via respiration. Transport and accumulation of dust in the respiratory tract are mainly determined by the behaviour of the particles in flowing gases. The smaller a dust particle is, the deeper it might enter the airways and cause health problems there. Dusts may among other things cause:

- allergic disorders of the mucosa
- obstruction of the upper airways
- cancer of the airways

At workplaces, exposure limit values for dust have been established a long time ago. It is true that, in general, the development of dust at workplaces is much higher than in private areas, but people usually spend more time in their homes than at their workplaces. For this reason, it is necessary to find out if a product used in living areas might emit fine dusts.

How are fine dusts defined?

The largest inhalable parts are deposited in the nasopharyngeal space; smaller particles with a size below 25 µm can get into the tracheobronchial tree where they are deposited. The finest particles with a size below 10 µm can even reach the alveolar space (pulmonary alveoli) and be deposited there. For fibrous particles with the density of minerals, this is even possible if the geometric fibre diameter is below 3 µm and the fibre length is up to 100 µm. These values form the basis for measuring and evaluating dust concentrations in a consistent manner.

Fine dusts are alveolar dusts, i.e. dusts that are able to penetrate into the alveoli. They include the respirable fraction passing a separator system which has the same effect as the theoretical separating function of a sediment separator capable of separating 50 % of the particles with an aerodynamic diameter of 5 µm (Johannesburg Convention 1959).

The following table shows the aerodynamic diameters and penetration ratios of such a separator for dust particles with a density of 1000 kg/m³:

Diameter [µm]	Penetration ratio [%]
1.5	95
3.5	75
5.0	50
7.1	0

Fibrous particles with a length of up to approx. 100 µm can penetrate into the alveolar space. However, this is only possible if the geometric fibre diameter is below 3 µm and the fibre density corresponds to that of minerals. This alveolar part of the total dust content is relevant to the assessment with respect to building biology. A product containing dust, which visually seems to be very dusty, must not necessarily contain alveolar fine dust as defined above. The tested material contained larger dust particles as well as alveolar dust of the dimensions specified above to which the TLV value (threshold limit values) and the OEL value (occupational exposure limit) apply. The quantities detected were near the lower limit value for statistical relevance, i.e. below 0.5 mg/m³.

A fine dust concentration upper limit value of 6.0 mg/m³ is assumed to be of statistical relevance.

This value applies to a general impairment of the respiratory system due to the general effects of dusts. Even if the measured value is below this relevant limit value, health hazards can only be excluded if definitely no mutagenic, carcinogenic, fibrogenic, toxic or allergenic effects of the dust are to be expected. These requirements have only been met so far by fine dusts of aluminium and its oxides, graphite (quartz content < 1 %), iron oxides, magnesium oxide and titanium oxide. In all other cases, substance-specific TLV, OEL or TRC (technical reference concentration) values have to be taken into account besides the general dust limit value.

Test procedure: The fine dusts content is determined according to DIN 53482 P 8, reference being made to DIN 53811.

For the test, the sample is introduced into a test tube and a sieve plate is used for separation. The dust particles contained in the sample remain on the screen surface. The quantity is determined by weighing in the half-micron range with a precision of 0.1 mg. For the determination whether the dust particles are slim enough to penetrate into the alveoli, a reflected light microscope with a magnification of 500 is used. Measurements are carried out under a Leitz large field metal microscope (industrial microscope SM-LUX HL with DF-IC vertical illuminator) using a Leitz Latimet telemicroscope. The accuracy of measurement is 1/100 µm.

Evaluation example: The tested air volumes were converted to one m³. The fine dust content was clearly below the admissible limit value of 6 mg/m³ air volume.

Any fine dust pollution of the indoor air or of the environment due to the use of the tested product is not to be expected. The dust as well as the fine dust traces did not show a fibre shape required for the particles to reach the alveoli.

No asbestos fibres were detected in the material, in particular neither chrysotile (white asbestos), nor crocidolite (blue asbestos) nor amosite (brown asbestos). For these, the TRGS 519 (technical rules for dangerous substances) would be applicable in Germany.

5.7 Additional testing

If requested by the applicant, the tests stated above can be complemented by additional testing. Whether it makes sense to carry out such additional tests or not cannot be stated generally in this brief overview. In each case, this has to be determined individually for the product in question. The following list contains examples for such tests:

- Biological compatibility (Ames test)
- Assay of non-allergenic surfaces
- Assay of specific dusts, e.g. free quartz
- Proof of mould growth inhibition on surfaces
- Electrostatic behaviour
- Determination of the steam diffusion resistance
- Determination of the heat storage capacity
- Evaluation of environmental behaviour
- Establishing energy balances

If you require further specific tests, please do not hesitate to contact us for an enquiry without obligation. We will immediately send you a binding quotation if we think that it is possible to perform an economically reasonable laboratory analysis for the requested test profile.

5.8 Further evaluation aspects

Beyond the aspects resulting from laboratory analyses, other criteria contribute to the evaluation. These include the following:

- Has the company been certified according to DIN EN ISO 9001:20xx in order to maintain consistent product quality?
- Are there monitoring contracts with other institutions?
- Is the production subject to continuous internal and external monitoring?
- Do complete and current safety data sheets exist?
- Are there any issues with respect to safe disposal?
- Does the company prepared to communicate any probable risks associated with processing or using the product?
- Are there hazardous substances that need to be reported?
- Are there potential dangers for the employees arising from the manufacturing process?
- Is a complete declaration of the component materials available?

6. Evaluation system

The measured values specified in the documentation correspond to limit values that can be determined with reasonable laboratory and economical expenditure.

The limits of detection for each substance are target values for us which have to be observed. With these quantities, there is a sufficiently high probability that health hazards due to these substances can be excluded.

If measured values dramatically exceed the limits of detection, we will perform a comparative evaluation:

a) DIN, ISO, EN, TRGS and other sets of regulations have first priority in the evaluation.
b) Secondly, we will use relevant sets of regulations such as LCI values, AggB (Committee for Health-related Evaluation of Building Products) evaluation scheme or LAGA (working group of the German Länder on waste issues).
c) In the third place, we will use reference values defined by relevant institutions, such as UIM München, Bremer Umweltinstitut, DIBt or values empirically established over many years by our specialised laboratories.
d) In case there are no values from a) through c), we will define our own internal standards. We will select them according to the "safety first" principle using information provided by our specialised laboratories.

Evaluation criteria

When we test for radioactivity according to the ACI standard and the measured value exceeds the official reference value of the European Commission, the seal will never be awarded.

For the evaluation of individual biocide types and quantities, our laboratory chemists will use GSBL (Joint Substance Data Pool of the German Federal Government and the German Federal States), IGS (hazardous substances information system), GefStoffV (dangerous chemicals ordinance), ChemVerbotsV (chemicals ban ordinance), TRGS (technical rules for dangerous substances), AGW (occupational exposure limits), DGUV (German Social Accident Insurance) data and others. Our evaluation is always based on the so-called LCIs (Lowest Concentrations of Interest), i.e. concentrations that are just of interest from a toxicological point of view.

If toxic substances such as halogenated hydrocarbons or substances with carcinogenic and/or mutagenic potential are detected, the seal will never be awarded.

Volatile organic compounds (VOCs) will be evaluated as indicated above.

When evaluating heavy metals, we use the LAGA reference values as criteria.

If a substance is classified as Z 3 to Z 5 according to LAGA, the seal cannot be awarded.

The stipulations of the current TVO (German Drinking Water Regulation) are only used as an additional evaluation level.

When testing for fine dusts according to DIN 53482 P 8, reference being made to DIN 53811, the seal will not be awarded if more than 6 mg/m³ of fine dusts are found in the breathable air. If a material contains asbestos fibres to which the TRGS 519 (technical rules for dangerous substances) would be applicable in Germany, the seal cannot be awarded either.

Additional tests as mentioned in section 5.7 are, to a limited extent, taken into account for the overall evaluation.

The above mentioned test procedures have to be completed for each product. Even if only a single criterion is not met, the seal of approval will not be awarded, independently of the results obtained in the other tests.

7. Conclusion

These seal of approval guidelines do not claim to be complete with respect to our professional activities. All information is given to the best of our knowledge and ability. We exclude all liability for any claim arising from incomplete or incorrect information on test characteristics.

Due to our internal CIP strategy (continuous improvement process), we constantly strive to improve, complete and extend our processes.

We reserve the right to change these seal of approval guidelines in case of mistakes or errors made by third parties.

The fact that the seal of approval has been awarded does not relieve the manufacturer from the obligation to ensure internal or external monitoring of their products by an accredited institution.

For promotional purposes, the manufacturer may use the seal of approval only with the products for which it has been awarded. The manufacturer is obliged not to try to mislead consumers as to for which products the Seal of Approval has been awarded and for which not. This also applies to the term “TESTED AND APPROVED BY THE IBR”.

The mark of the “IBR” institute may only be used as a constituent part of the Seal of Approval. In case of misuse, the institute may prohibit the use of the seal of approval without notice.

The logo of the seal of approval as shown below is protected by copyright.

All rights are owned by the IBR.

Rosenheim, August 7, 2010

Reimut Hentschel, Managing Director

Johann Freimuth

8.

IBR Institut für **Baubiologie** GmbH, D-83022 Rosenheim, Münchener Str. 18

Phone: +49 (0)8031 / 3675-0 Fax: +49 (0)8031 / 3675-30 Managing Director: Reimut Hentschel
info@baubiologie-ibr.de, **www.baubiologie-ibr.de**
Commercial Register: HRB Traunstein 5362 VAT ID: DE 131182830

Record form for sampling under official supervision

This form comprises 1 page for recording the sampling under official supervision with the purpose to award the seal of approval "GEPRÜFT UND EMPFOHLEN VOM IBR". Please note that a separate form is required for each product. When samples are taken under official supervision, an employee e.g. of the local authorities certifies by the official seal of his or her office that the samples have been taken neutrally and in an unbiased manner from the ongoing production. As an alternative, it is of course possible to have the samples taken by an officially appointed calibrator.

On this day of .... , a representative of the

municipal administration / community / authority of ....

or ....

took a sample of the product ....

....

at the company ....

....

....

Please print clearly

The sample was taken at random without any biasing and it was dispatched while the sampler was present.

....

City Date

We hereby certify that the above information is correct:

....

Sampler Ordering party