INSTITUT FÜR BAUBIOLOGIE ROSENHEIM GMBH

Expert Report
No. 3010 - 411

with reference to the seal of approval

"Tested and Recommended by the IBR"

For the test item

Heat-Retaining Fireplaces

Applicant:	Tulikivi Oyj FIN – 83900 Juuka Phone: +358 (0) 403 063 100 www.tulikivi.de
Samples:	Taken under official supervision on February 17, 2010 on the ordering party's premises and confirmed by the official stamp of the local authorities of Juuka. The sampling protocols were available to us in their original version.
Executing tester:	Staff members of the aforementioned body
Term of validity:	July 2012

It is the objective of the IBR to identify non-polluting building products for healthy living for the consumer by awarding the seal of approval "TESTED AND APPROVED BY THE IBR".

The seal of approval was created by the Institut für Baubiologie Rosenheim GmbH 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.

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 should be understood both by third-party experts and by end consumers.

The aim of awarding the seal of approval "TESTED AND RECOMMENDED BY THE IBR" 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.

The tests listed in our expert reports are not supposed to supersede the requirements in terms of building physics, supervision, legal regulations, or safety. They are merely a complementary set of tests related to health, physiology, building biology, and ecology aspects which have been neglected.

The seal of approval "TESTED AND APPROVED BY THE IBR" is based on a holistic perspective. Besides its focus on the tests that determine the potential physiological impact of the products on human beings and/or the environment, the expert report associated with granting the seal also honours any product whose production, processing, use, and ecological recycling have no or only a limited, tolerable adverse effect on the environment.

The emission of harmful substances, e.g. with a carcinogenic and/or mutagenic potential, is always to be considered as a criterion for exclusion.

The seal of approval will under no circumstances be awarded to such products.

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.

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1. Product description

We were charged by the company to examine their products for harmlessness with respect to building biology.

The products submitted for testing include the various components of heat-retaining fireplaces made of Finnish soapstone (geological name: steatite).

Steatite consists of 40 to 50% talc and magnesite each, and of 5 to 10% chlorite.

The technical properties of this natural stone are clearly better than those of industrially produced chamotte and therefore it is well-suited as a fireplace construction material.

The functional principle of these soapstone fireplaces is based on the masonry stove construction. It uses a brick-lined firebox and a flue system. The flue system works according to the counterflow principle. Thus, the energy generated in the combustion process is used efficiently.

In terms of materials, the construction of such a fireplace essentially consists of the following components:

- The actual soapstone slab material
- Water glass as a binding agent (glassy potassium and sodium silicates solidified from the melt flow)
- Mineral wool for thermal insulation
- Stove gaskets for sealing moveable parts

The following test results apply to all components mentioned above. According to our seal of approval guidelines, the seal of approval is only awarded for products where all components meet the requirements.

The need to use personal protective equipment when processing the material within the scope of the standards stipulated by the employer's liability insurance associations is pointed out explicitly.

A variety of aids is provided to persons charged with processing these materials. For instance, comprehensive product information and processing regulations can be viewed on the manufacturer's Internet site or can be found in the product-specific printed documentation.

The production is subject to continuous internal and external monitoring.

Any further examinations exclusively refer to the materials mentioned above and the products manufactured therefrom.

The local application of additives or coating which might be necessary is not part of the examination.

The safety data sheets were available for reference.

There are no issues with respect to safe disposal.

There are no hazardous components to be disclosed.

Furthermore, a complete declaration of the component materials was available.

For more detailed specifications, please contact the manufacturer.

In the next part of the expert report, the products are examined for harmlessness with respect to building biology. The results disclosed below are valid for all products mentioned above, if not explicitly stated otherwise.

2. Test Results

2.1 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	< 0.5	- -
Lead 214	< 0.5	- -
Potassium 40	< 4.5	- -
Iodine 131	< 0.2	- -
Caesium 134	< 0.3	- -
Caesium 137	< 0.3	- -

Test result: 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: The tested product complies with the official reference value of ACI ≤ 1 and 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.

2.2 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.

2.2.1 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.

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

2.2.2 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**	**0.05**
Polychlorinated biphenyls (PCB) no.: 52	**< 0.05**	**0.05**
Polychlorinated biphenyls (PCB) no.: 101	**< 0.05**	**0.05**
Polychlorinated biphenyls (PCB) no.: 138	**< 0.05**	**0.05**
Polychlorinated biphenyls (PCB) no.: 153	**< 0.05**	**0.05**
Polychlorinated biphenyls (PCB) no.: 180	**< 0.05**	**0.05**
Polychlorinated biphenyls (PCB) – total:	**< 0.5**	**0.5**
Polychlorinated terphenyls (PCT) – total:	**< 0.5**	**0.5**
Polychlorinated diphenylmethanes PCDM – total:	**< 0.5**	**0.5**
Polybrominated diphenylmethanes PBDM – total	**< 0.5**	**0.5**

2.2.3 Pyrethroides

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

2.2.4 Phtalates

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

2.3 Solvents and odiferous substances (VOC)

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: The material samples were 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.

2.3.1.1 Alkanes

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

2.3.1.2 Aromatics

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

2.3.1.3 Alkenes

Substance	Measured value [mg/kg]	Limit of detection [mg/kg]
2-methylpropene trimer	**< 1**	**1**
4-phenylcyclohexene	**< 1**	**1**
4-vinylcyclohexene	**< 1**	**1**

2.3.1.4 Chlorinated hydrocarbons

Substance	Measured value [mg/kg]	Limit of detection [mg/kg]
1,1,1-trichloroethane	**< 1**	**1**
Carbon tetrachloride	**< 1**	**1**
Trichloroethene	**< 1**	**1**
Tetrachloroethene	**< 1**	**1**
1,4-dichlorobenzene	**< 1**	**1**
1-chloronaphthaline	**< 1**	**1**

2.3.1.5 Terpenes

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

2.3.1.6 Monovalent alcohols

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

2.3.1.7 Polyvalent alcohols and their ethers

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

2.3.1.8 Esters of polyvalent alcohols and their ethers

Substance	Measured value [mg/kg]	Limit of detection [mg/kg]
Propylene glycol monomethyl ether acetate (PGMMA)	**< 1**	**1**
Ethylene glycol monoethyl ether acetate (EGMEA)	**< 1**	**1**

2.3.1.9 Esters of carboxylic acids

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

2.3.1.10 Ketons

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

2.3.1.11 Aldehydes

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

2.3.1.12 Carboxylic acids

Substance	Measured value [mg/kg]	Limit of detection [mg/kg]
Hexanoic acid	**< 0.5**	**0.5**
Heptanoic acid	**< 0.5**	**0.5**
Octanoic acid	**< 0.5**	**0.5**
Nonanoic acid	**< 0.5**	**0.5**
Decanoic acid	**< 0.5**	**0.5**
Undecanoic acid	**< 0.5**	**0.5**
Dodecanoic acid	**< 0.5**	**0.5**

Evaluation: 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.

2.4 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.

2.4.1 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	1	20	30	50	150	-
Cadmium (Cd)	< 0.2	0.2	0.6	1	3	10	-
Cobalt (Co)	520	1	-	-	-	-	20
Chromium (Cr)	330	1	50	100	200	600	-
Copper (Cu)	540	2	40	100	200	600	-
Iron (Fe)	180000	20	-	-	-	-	-
Mercury (Hg)	< 0.1	0.1	0.3	1	3	10	-
Manganese (Mn)	1100	2				-	-
Nickel (Ni)	9200	2	40	100	200	600	-
Lead (Pb)	20	1	100	200	300	1000	-
Antimony (Sb)	< 1	1	-	-	-	-	20
Tin (Sn)	< 2	2	-	-	-	-	50
Zinc (Zn)	10	5	120	300	500	1500	-

2.4.2 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	0.005	10	10	40	60	0.01	-
Cadmium (Cd)	< 0.001	0.001	2	2	5	10	0.005	-
Cobalt (Co)	< 0.005	0.005	-	-	-	-	-	2
Chromium (Cr)	< 0.005	0.005	15	30	75	150	0.05	-
Copper (Cu)	< 0.005	0.005	50	50	150	300	2	-
Iron (Fe)	3	0.1	-	-	-	-	0.2	-
Mercury (Hg)	< 0.001	0.001	0.2	0.2	1	2	0.001	-
Manganese (Mn)	< 0.005	0.005	-	-	-	-	0.05	-
Nickel (Ni)	0.11	0.005	40	50	150	200	0.02	-
Lead (Pb)	< 0,001	0,001	20	40	100	200	0.01	-
Antimony (Sb)	< 0.001	0.001	-	-	-	-	0.005	-
Tin (Sn)	< 0.005	0.005	-	-	-	-	-	50
Zinc (Zn)	< 0.005	0.005	100	100	300	600	-	10

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

2.5 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 was 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 was 1/100 µm.

Evaluation: 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.

3. Notice on awarding and using the seal of approval

In order to ensure neutrality and impartiality, all tests were carried out by independent third parties. We commission the required studies and tests from economically independent laboratories with whom we have been maintaining long-standing business relationships. All test results contained in this expert report have been taken from the external test reports. They are archived and can be viewed by the ordering party at any time.

The logo of the seal of approval as shown below is protected by copyright. All rights are owned by the IBR.

This seal of approval must always be used in conjunction with the entire product name. The manufacturer may only use the seal of approval in advertising for the specific products for which it was 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 "IBR" mark may only be used as a constituent part of the seal of approval.

It is possible to apply for an extension before the period of validity expires. Continued use of the seal of approval depends on the results from the subsequent tests performed by the IBR. Subsequent testing will always be performed according to the seal of approval guidelines valid at the time of testing.

The manufacturers are obliged to inform the IBR in due time of any modification of the product that might have any impact on the product relevant to building biology.

In case of misuse, the institute may prohibit the use of the seal of approval without notice. Employees of the IBR or persons charged by the IBR may at any time, even without prior notice, visit the applicant's production site.

Rosenheim, 05th July 2010

Reimut Hentschel, Managing Director

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