Institut für Baubiologie Rosenheim GmbH

Summary Report No. 3001-100

for the award of the Seal of Approval
"Tested and recommended by the IBR"

for the test object

FERMACELL gypsum fibreboard

Client:	Xella Trockenbau-Systeme Dammstrasse 25 47119 Duisburg Tel.: 0203 / 5 01 90 – 11 Fax: 0203 / 5 01 90 – 50 Internet: http//www.xella.com
Test sample:	Sampling carried out under the formal supervision of the Braunschweig Materials Testing Institute
Test personnel:	Employees of the agency commissioned to carry out the tests
Term of validity:	Until April 2006

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1. The company and the product

1.1 The company

Xella Trockenbau-Systeme GmbH, a company owned by Xella Baustoffe GmbH of Duisburg, manufactures and sells construction materials for the dry-lining industry. The company employs over 500 people, including more than 130 in other European countries outside Germany. The products are made in six manufacturing plants and marketed through the company's own sales offices, of which there are currently 17 throughout Europe. The main product groups are the FERMACELL gypsum fibreboard programme for interior dry-lining, the cement-based FERMACELL HD building board for exterior facades, the DICON TU fire-resistant building board and the MULITPOR mineral insulation blocks.

FERMACELL gypsum fibreboards and ancillary products are marketed throughout Europe. The company's sales organisation has six sales offices in Germany and another eight in other European countries: Denmark, France, the United Kingdom, Austria, Poland, the Czech Republic, the Netherlands and Switzerland. The product is manufactured at three factories in Germany, two in Lower Saxony and a third in Baden-Württemberg. There is also a fourth manufacturing facility in the Netherlands.

1.2 The product

Fermacell dry-lining board is a gypsum fibreboard made from a homogeneous mixture of gypsum and paper fibres. In the manufacturing process plaster of paris is mixed with paper fibres produced from the dry shredding of waste paper. These constituents are laid onto a moving conveyor belt and water is added. The wet quilt is then compressed under high pressure to form a continuous slab, which is fed via a conveyor belt to a drying oven. When the slab is fully cured, the two faces are sanded smooth and the continuous slab is cut to the required panel size.

Constituents: approx. 82% plaster (as a dihydrate, $CaSO_4 \times 2H_2O$), approx. 18% recycled paper fibres

The Safety Data Sheets relating to the product were made available to the test personnel. A full declaration of the product constituents was also supplied.

More detailed technical specifications may be obtained directly from the manufacturer.

The remainder of this Report is concerned with an investigation of the biological safety of this material.

2. Tests and test results

2.1 Radioactivity

The sample was evaluated in accordance with the Leningrad formula: (K-40)/4810 + c(Ra-226)/370 + c(Th-232)/259 = f, where c(K-40) is the activity of Kalium-40, c(Ra-226) is the activity of Radium-226 and c(Th-232) is the activity of Thorium-232 (all in Bq/kg). The value f is obtained by inserting the three measured values c(K-40), c(Ra-226) and c(Th-232) in the above equation.

Test results: A value of 0.04 was obtained for the product.

Threshold or guideline values	**Value**
Official guideline value of the Scientific Committee at the Federal Ministry of Science	f = 1
Guideline value of the IBR	f = 0.75
Guideline value of the Munich Environmental Institute	f = 0.5

Evaluation: The radioactivity of the tested product is within the government guideline of f < 1, the threshold value of f < 0.75 stipulated by the IBR, and the strict standard of f < 0.5 adopted by the Munich Environmental Institute.

2.2 Biocides, PCB, DDT, metabolites, pyrethroids

Analytical method: The sample is extracted with a solvent mixture based on the “Blaudruck F 2” method (heavy-volatile hydrogenated hydrocarbons). Any pentachlorophenol present is derived with acetane hydride. The extract is prepared with Florisil and concentrated by insufflation with nitrogen. After immersion in n-hexane/acetone the sample is analysed by gas chromatography (GC/ECD).

Biocides	**Measured value** (mg/kg)
Pentachlorophenol	<0,05
Naled, Dibrom	<0,05
a,b-HCH	<0,05
g – HCH (Lindane)	<0,05
N-dichlorofluor-methylthio-N	<0,05
Tolylfluanid	<0,05
Chlorthalonil	<0,05
a - endosulfan	<0,05
b - endosulfan	<0,05
Endosulfan Sulphate	<0,05
Dichlophos (DDVP)	<0,05
2,3,4,5-Tetrachlorophenol	<0,05
2,3,5,6-Tetrachlorophenol	<0,05
Furmecyclox	<0,05
Hexachlorobenzol (HCB)	<0,05
Methyl parathion	<0,05
Ethyl parathion	<0,05
Heptachlor	<0,05
Aldrin	<0,05
Chlorpyriphos	<0,05
Isodrin	<0,05
cis-heptachlorepoxide	<0,05
trans-heptachlorepoxide	<0,05
cis-chlordane	<0,05
trans-chlordane	<0,05
Endrin	<0,05
Dieldrin	<0,05
Bromophos	<0,05
Hexabrombenzene	<0,05
Mirex	<0,05
cis - Permethrin	<0,05
trans - Permethrin	<0,05
Malathion	<0,05
Bromacil	<0,05
Hexachlorophen	<0,05
Octachlornaphtalin	<0,05

Polychlorinated biphenyls (PCBs)	**Measured value** (mg/kg)
No.: 28	<0,05
No.: 52	<0,05
No.: 77	<0,05

No.: 101	<0,05
No.: 126	<0,05
No.: 138	<0,05
No.: 153	<0,05
No.: 169	<0,05
No.: 180	<0,05

DDT and metabolites	**Measured value** (mg/kg)
o,p - DDT	<0,05
o,p´ - DDT	<0,05
o,p - DDD	<0,05
p,p´- DDD	<0,05
o,p - DDE	<0,05
o,p´ - DDE	<0,05
p,p´- DDM	<0,2
p,p´- DDA	<0,5

Pyrethroids	**Measured value** (mg/kg)
Alphametrin	<0,05
Deltamethrin	<0,05
Tetramethrin	<0,05
Cypermethrin	<0,08
Cyfluthrin	<0,08

Evaluation: All the harmful substances tested for are present in concentrations that are below the detection threshold. This product is not expected to pose a health hazard.

2.3 Solvents and aromatics (VOCs)

With the increasing use of chemicals in the workplace and in our daily life in general, the indoor air quality has steadily deteriorated. The so-called MAK values (= maximum workplace concentration) were introduced in order to monitor safety in the workplace. In the domestic sphere, however, where we spend far more time, there are – with very few exceptions – no statutory limits or threshold values laid down for airborne harmful substances. It is the declared aim of the new German state Building Codes and the EC Construction Products Directive to safeguard the health of building users. The scientific network set up to determine and define VOC threshold values is known as the ECA (European Collaborative Action). In 1997 this body recommended the use of so-called LCI values (= lowest concentration of interest) as the criterion for hazard assessment – meaning concentrations of substances that are just high enough to merit toxicological interest. As an organization dedicated to the protection of the environment we were thus being presented for the first time with an official list of materials which are relevant to the whole solvents debate. In October 2000 the “Committee for Health-related Evaluation of Building Products” published a paper addressing the issue of LCI values and underlining the need for more research on which

to base any health-related evaluation of emissions from volatile organic compounds (VOCs) in building products. Because of the current situation, no further investigative methods have been developed, as they normally would be, from the measurement procedure described in this document. Our own test method is therefore to be understood as only an approximation.

Test method
The preparation of the material samples is carried out by dynamic headspace sampling. The samples are conditioned at 50ºC in a materials testing oven. Sampling is performed by pumping air through a sealed vessel containing activated charcoal tubes supplied by Messrs. Dräger. The adsorbed substances are then eluted with carbon disulphide (CS_2) and analysed using gas chromatography (GC/FID or MS/SIM or full scan mode).

Analyses carried out for the following substances produced negative results.

2.3.1 Aromatic hydrocarbons (detection threshold 0.005 mg/kg)

Toluene	1-Propylbenzene	1.2.4.5-Tetramethylbenzene	4-Phenylcyclohexane
Benzene	1.3.5-Trimethylbenzol (Mesitylen)	n-Buthylbenzene	Styrol
p-Xylol	1.2.4-Trimethylbenzol	1.3-Diisoproyl-benzene	Ethynylbenzene
m-Xylol	1.2.3-Trimethylbenzol	1.4-Diisoproyl-benzene	p-Methylstyrol
o-Xylol	2-Etyltoluol	2-Phenyloctane	o-Methylstyrol
Isopropylbenzene (Cumol)	1-Methyl-2-propyl-benzene	5-Phenyldecan	m-Methylstyrol
n-Propylbenzene	1-Methyl-3-propylbenzene	5- Phenylundecan	Naphthalene

2.3.2. Saturated aliphatic hydrocarbons (detection threshold 0.005 mg/kg)

Isopentan	2-Methyloctane	n-Undecan	n-Hexadecan
n-Pentan	3-Methyloctane	Isododecan	n-Heptadecan
3-Methylpentan	n-Nonane	2.2.4.6.6-Pentamethylheptane	n-Octadecan
n-Hexane	3.5-Dimethyloctan	n-Dodecan	n-Eicosane C 20
2-Methylhexane	2-Methylnonane	4.5-Diethylnonane	2.6.10.14-Tetramethylhexadecan
3-Methylhexane	n-decan	n-Tridecan	Pristane
n-Heptane	2.4.6-Trimethyloctane	n-Tetradecan	
n-Octane	4-Methyldecan	n-Pentadecan	

2.3.3. Unsaturated aliphatic hydrocarbons (detection threshold 0.005 mg/kg)

Cyclohexane	cis-1-Methyl 4 methylethylcyclohexane	Methylcyclohexane	Trans-1-Methyl 4 methylethylcyclohexane	1.4-Dimethyl-cyclohexane

2.3.4. Terpene (detection threshold 0.010 mg/kg)

D-3-Carene	b-Pinen	Trans-Caryophyllene
Camphen	Limonene	Cis-, trans- citral
a-Pinen	Longifolene	Turpentine oil

2.3.5. Aliphatic alcohols (detection threshold 0.010 mg/kg)

1-Propanol	1-Butanol	2-Ethyl-1-Hexanol
Isopropanol	1-Pentanol	1-Octanol

2-Methyl-2-Propanol	1-Hexanol	2.2.4-Trimetyl-1.3-Pentandiol, monoisobutyrate (Texanol)
2-Methyl-1-Propanol	Cyclohexanol	

2.3.6. Aromatic alcohols (detection threshold 0.005 mg/kg)

Phenol	BHT (2.6-di-tert-butyl-4-methylphenol)

2.3.7. Glycols and glycol ethers (detection threshold 0.010 mg/kg)

Propylenglycol	Dimethoxyethan	Diethylenglycol-n-monobuthyl-ether 2-(2-butoxyethoxy)-ethanol
2-Methoxyethanol	2-Ethoxyethanol (ethylglycol)	
Dimethoxymethan	2-Butoxyethanol (buthylglycol)	

2.3.8. Aldehydes (detection threshold 0.010 mg/kg)

Formaldehyde	Hexanal	Decanal	trans 2-Nonenal
Acetaldehyde	Heptanal	2-Butenal (crotonaldehyde)	cis Decenal
Propanal	2-Ethyl-Hexanal	2-Pentenal	2-Undecenal
Butanal	Octanal	cis 2-Heptenal	Furfural
Pentanal	Nonanal	trans-Heptenal	

2.3.9. Ketones (detection threshold 0.010 mg/kg)

Acetone	3-Methyl 2 Butanon	Cyclopentanone	2-Methylcyclopentanone
2-Butanon (Methyl-ethylketone) MEK	4-Methylpentan-2-on	Cyclohexanone	2-Methylcyclohexanone

2.3.10. Acids (detection threshold 0.010 mg/kg)

Acetic acid	Butyric acid	Hexane acid
Propionic acid	Dimethylpropion acid	Octane acid
Isobuthyl acid	Pentane acid	Hexadecane acid

2.3.11. Chlorinated hydrocarbons (detection threshold 0.010 mg/kg)

Dichlormethane	1.2 Dichlorethane	Tetrachlorethen PER
Tetrachlormethane TETRA	Trichlorethene TRI	1.4 Dichlorbenzene

2.3.12. Esters (detection threshold 0.010 mg/kg)

Methylacetate	Propylacetate	Butylacetate	1.6-Octadien-3-ol.-3.7 Dimethy-lacetate (Linaloolacetate)
Ethylacetate	Butylformiat	2-Methoxyethylacetate	
Vinylacetate	Methylmethacrylat	2-Ethoxyethylacetate	
Isopropylacetate	Isobutylacetate	2-Ethylhexylacetate	

2.3.13. Phthalates (detection threshold 0.010 mg/kg)

Dimethylphthalate	Dibutylphthalate	Alkylphthalate

2.3.14. Other substances (detection threshold 0.010 mg/kg)

1.4-Dioxane	N-Methyl-2-pyrolidone	Caprolactam	Indol

Evaluation: None of the substances tested for were found in concentrations above the detection threshold of the test procedure. This product is not expected to pose a hazard in terms of the solvents and aromatics (VOCs) tested for here.

2.4 Metals / Heavy metal content

2.4.1 Test carried out on the original in accordance with DIN 34806-E22, using ICP.

2.4.2 Test carried out on the eluate in accordance with DIN 38414-S4

This test procedure is designed to determine which substances contained in the test materials are soluble in water under these test conditions. The documentation of these substances in terms of type and mass provides useful information about possible threats to water courses or groundwater if the materials are stored or dumped in such a way that they come into contact with water.

Tests were carried out to detect the presence of the following:
Arsenic / Lead/ Cadmium / Chrome / Copper / Nickel / Mercury / Zinc / Cobalt / Iron / Manganese / Selenium / Tin

Evaluation: This product is not expected to pose a hazard due to the presence of metals or heavy metals.

2.5 Rate of heat storage S

Heating up an enclosed space with a heating system of a given thermal output takes less time the lower the heat penetration coefficient b of the surfaces enclosing the space, or the better the heat retention capacity (rate of heat storage S) of the building components concerned.

Evaluation: Based on the calculated rate of heat storage S of 1250 kJ/m³ this product exhibits a good heat retention capacity.

2.6 Determination of fine dusts in accordance with DIN 53482 P8, based on DIN 53811

Dusts are dispersed distributions of solid particles in gases, resulting from mechanical processes or turbulence. Dusts are classed with smokes and mists as aerosols. In order to evaluate the health risks posed by dusts, the factors that need to be considered include the specific effect of the harmful substance concerned, concentration, exposure time and particle size. The last-named makes dusts significantly different from gases and vapours.

Dusts are primarily absorbed into the human body by inhalation. The transport and deposition of the dust in the respiratory tract are largely determined by the behaviour of the particles in gas flows.

Evaluation: Pollution of the indoor air or the environment by fine dusts resulting from the use of the tested product is not expected to occur. Neither the dust nor the traces of fine dust exhibited the fibrous form that would be required for permeation of the alveoli.

2.7 Electrostatic behaviour

Constant exposure to an electrostatically charged atmosphere can cause irritation – and possibly result in actual sickness. The electrostatic behaviour is evaluated in terms of three test criteria, which are correlated with each other. The magnitude of the surface voltage provides a measure of the constant voltage state. The maximum attainable charge (threshold charge) provides a measure of transitory peak charge states. These conditions are never encountered in practice, and represent a theoretical test value indicating the maximum voltage state of a material. What is more important as far as the indoor air is concerned is how fast this static charge falls back to the so-called normal state. The time taken to fall back to half the threshold charge is known as the static charge half-life period. The longer the time taken to reach the static charge half-life value, the longer a person is exposed to the voltage field. The evaluation of materials for use in domestic interiors is therefore predicated on the selection of materials that have a low threshold charge and consequently a short static charge half-life.

Evaluation: The sample tested can be rated as a preferred environmental option on the basis of its electrostatic behaviour.

2.8 Evaluation of thermal behaviour

The physiological processes in living organisms are always associated with the production or exchange of heat. People feel comfortable indoors when the human body and its surroundings are in a state of thermal equilibrium. This means that the ambient temperature has to be adjusted to different requirements. Looking at the problem of managing heat loss and gain in humans in purely physical terms, the key variable to be considered is the thermal conductivity value. The thermal conductivity value indicates how much heat (measured in watts) passes through one square metre of a one-metre thick building material in the course of one hour if the temperature gradient in the direction of heat flow is 1 Kelvin (= 1ºC). The lower the thermal conductivity of a material, the better its insulating performance. The lamda value is a laboratory value relating to dry building materials. In practice the materials used in the construction of a house are generally exposed to constant moisture. Moisture is a good conductor of heat, which is why the thermal insulation capacity of building materials is influenced to a large degree by their moisture content.

Evaluation: The measured thermal conductivity value of 0.36 W/mK may be classed as “normal”.

2.9 Environmental behaviour

As a company, Xella Trockenbau-Systeme generally uses REA gypsum, but blends of REA gypsum and natural gypsum are also used, depending on the individual production plant. The use of REA gypsum helps to conserve natural gypsum resources.
REA gypsum is a by-product of the desulphurisation of flue gases. According to estimates by the Federal Ministry of the Environment, between three and four million tonnes of REA gypsum are produced in the whole of Germany each year. Natural gypsum and REA gypsum are chemically identical, and both are ecologically harmless.
Studies have shown overall that the differences between natural gypsum and REA gypsum in terms of chemical composition and trace element content are insignificant from a health point of view. The results of analyses would indicate that the tested samples of natural gypsum and REA gypsum may be used in the manufacture of building materials without giving rise to concerns on health grounds.

Evaluation: In our judgement the material is ecologically harmless.

2.10 Diffusion and resorptive capacity

A pleasant and healthy indoor climate in which we feel comfortable is dependent in part on the right level of atmospheric moisture. As the moisture content of the air is constantly changing for a wide range of reasons, it is necessary to establish an equilibrium. To some extent this can be achieved by ventilation of the space. However, the surfaces that enclose the living space – walls, ceilings, etc. – also have an important role to play here. These need to exhibit the best possible water vapour buffering capability. They must be able to absorb excess moisture from the air in the room and release it again later. This capability is decisively influenced by the physical characteristics of the surface finishing products and insulating materials and by the type of surface finish or coating used.

Evaluation: The measured value m = 13 for the resistance to diffusion of water vapour is rated as very good.

2.11 Salmonella test (Ames test)

The Ames test is designed to measure the mutagenic potential of substances and materials. The test procedure is based on OECD guideline 471. The test was performed with the two bacterial strains TA 98 and TA 100, with and without metabolic activation in each case. Each sample was analysed with

three repeats. A positive and a negative control were also analysed for each bacterial strain.

Evaluation: The eluate is non-mutagenic in the Ames test. The biocompatibility of the material is duly established.

3. Notes on the award and use of the IBR Seal of Approval

In the interests of neutrality and objectivity, the Rosenheim Institute for Building Biology contracts the tests and analyses out to various institutes and test laboratories, which are required to submit test reports for the tests they conduct. All the numerical values cited in this IBR Report are taken from the individual test reports. These reports are kept at the Institute, where they are available for inspection.

The test conditions, test procedures and evaluation of results are based on the current state of our scientific knowledge. They may consequently be altered, supplemented or enlarged in scope to take account of recent advances in technology, science and/or test methods. This applies particularly to advances in our knowledge relating to the detectability of biologically negative (and also positive) effects and to criteria for the documentation of ecological aspects, given that these areas of scientific study are still relatively in their infancy.

On the basis of the test results submitted to the Rosenheim Institute for Building Biology, the product known as

FERMACELL gypsum fibreboard

is hereby awarded the IBR Seal of Approval.

This Seal of Approval must always be used in conjunction with the full product name/designation.

The manufacturer may use the Seal of Approval only in advertising that relates strictly to those products for which it was awarded. It is under an obligation not to attempt to mislead the consumer by advertising that fails to make it absolutely clear which products the Seal of Approval was awarded for and which not. This applies also to the form of words “TESTED AND APPROVED BY THE IBR”. The “IBR” logo of the Institute may only be used as a constituent part of the Seal of Approval.

Application may be made for an extension prior to expiry of the term of validity. The continued use of the Seal of Approval is dependent on a positive outcome to the follow-up tests commissioned by the IBR. The follow-up tests will be carried out in accordance with the latest available test criteria.

Manufacturers who use the IBR Seal of Approval are under an obligation to inform the Institute in good time of any proposed product modifications that affect, or could affect, its biological impact on the domestic environment as previously tested. The Institute may prohibit the use of the Seal of Approval at any time in the event of abuse or misuse.

[Signed]
Uwe Rose, Executive Director
Institut für Baubiologie GmbH
Rosenheim, April 1004