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A New Type of Porous Absorber. Sintered expanded glass granulates as a high strength absorber.

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43.55.EV SOUND ABSORPTION PROPERTIES OF MATERIALS: THEORY AND MEASUREMENT OF SOUND ABSORPTION COEFFICIENTS; ACOUSTIC IMPEDANCE AND ADMITTANCE

ABSTRACT

Typically, there are two types of porous absorbers, cellular and fibrous. Cellular type absorbers typically cover products made from polymeric foams such as polyurethane. Fibrous absorbers typically use inorganic fibres such as glass or basalt, more recently polymeric fibres have become more popular. The new porous absorber is a combination of the two technologies. Using fully recycled glass as the based constituent, which is then foamed to create a porous glass bead. These beads go through a unique sintering process to bond them together to create a homogenous panel. The finished panel has a high absorption coefficient, NRC 90 and can be used in an open environment with no degradation, the panel is also non-combustible.

INTRODUCTION

The Fraunhofer Institute for Building Physics together with industry, worked on the development of alternative, fibre-free absorbers (ALFA). The aim was to reduce noise pollution with more efficient sound-proofing technologies in cases where traditional sound insulation materials are at a disadvantage as regards fitting and durability. Environmental noise control could expand its technological lead even further if it showed more confidence in innovative, environmentally compatible materials for acoustic building elements and in building methods that are installation – and maintenance friendly. This is particularly true in their treatment of noise issue under tough operating conditions, conventional sound absorbers employing synthetic mineral fibres and high resilient foams as absorption materials have several disadvantages.

The wide demand for non-fibrous absorber materials for noise control in many branches of industry prompted the Fraunhofer Institute for Building Physics (IBP), Stuttgart (Germany), to develop new materials as passive absorbers.

The IBP has been concerned with the use of porous bulk materials in technical acoustics. After some investigation expanded glass granulates where shown to demonstrate their particular suitability for acoustic use by virtue of their high sound absorption capacity.

However in view of the form taken by the product, such loosely packed materials have limited applications. In order to supply the demand for completely inorganic absorber materials with good production properties, a manufacturing process has been developed over the last decade. This process allows siliceous granules to be turned into open-pore, inorganic foams.

Within the framework of this research, a new pressure-resistant absorber material based on recycled glass (REAPOR®) was formulated.

REAPOR® Property Profile

For over 7000 years, man has known and used glass, constantly attempting to improve its properties. The concept ‘glass’ is often associated with the idea of transparency, and of water and gas proofness. REAPOR® is, by contrast, an opaque glass made of recycled glass with individually adjustable micro- and macropores [1)]. Figure 1 shows the microscopic structure. Both the pore spaces within the sintered granulates and in the intermediate spaces are clearly visible. By modifying the pore structure, the most important building physics properties such as sound absorption; calorific conductivity and compressive strength can be changed as required. Table 1 shows the REAPOR® property profile. Important features, as well as the high degree of sound absorption are its compressive strength as well as the resistance to temperature and chemicals. The graph in figure 2 shows the results of measuring the degree of sound by frequency for a REAPOR® panel 75mm thick (raw density 400 kg/m^3).

The good recyclability of the soda-lime glass used permits material cycles in the sense of true recycling which have so far only been achievable for building materials in individual cases, e.g. in the case of structural steel.

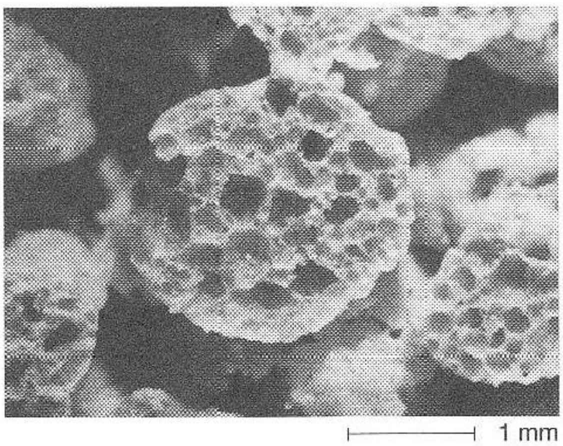

Figure 1. Microphotograph of a REAPOR®.

Overview of the most important properties of **REAPOR®**		
Tested properties	**Valuesdetermined for REAPOR®**	**Testing method**
Pressure resistance	0.7 to 9.0 N/mm^2	DIN 1164
Water proofness	0.0 wt %	Refractory guideline
Raw density	300 to 500 kg/m^3	DIN 51065
Caloric conductivity	0.078 W/(m*K)	DIN 52612
Water vapour permeability	25	DIN 52615
Sound absorption	NRC.90	
Softening temperature	540^{0}C	DIN 51045

Table 1

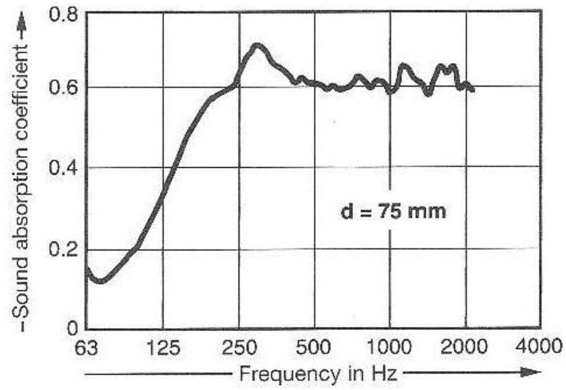

Figure 2. Sound absorption coefficient in dependence on frequency for a REAPOR® panel 75 mm thick (raw density 400 kg/m^3).

REAPOR® production

Starting with shards of recycled glass, a preliminary processing step is followed as schematically shown in figure 3, by a grinding and mixing process during which an expanding agent is added. Subsequently, the granules are thermally expanded and finally fractionated. These products are already commercially available and are used in many cases as light aggregates for mortars. In the production of REAPOR®, these expanded glass granules are coated with a sintering assistance agent. With the aid of a moulding procedure, the resultant mass is shaped into a panel, which is subsequently dried. The green product this produces can be mechanically processed and is subjected to a final thermal treatment during which it is fired like a brick. During this firing process, a kind of liquid-phase sintering takes place, which “glues” the expanded glass granules to one another at certain points. In the course of this sintering process, there is an exchange between the liquid phase and the granules, which results in a bonding of the materials themselves. The resulting fibre-free absorber material can subsequently be machine-cut, e.g. by drilling, sawing or milling on commercially available machines, permitting simple application. Its acoustic properties are optimized by adapting the flow resistance. [1]

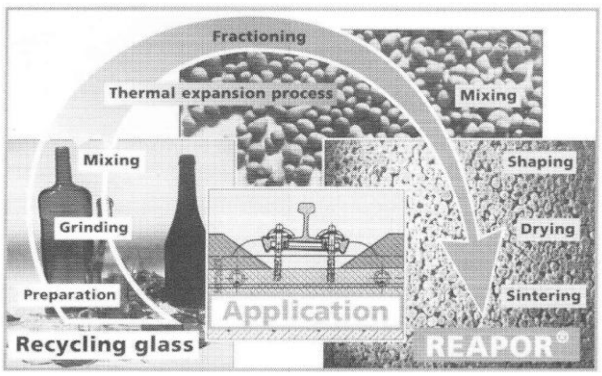

Figure 3 Production Process

Frequenz f [Hz]	α_s
100	0,04
125	0,06
160	0,08
200	0,13
250	0,13
315	0,23
400	0,35
500	0,52
630	0,67
800	0,90
1.000	1,05
1.250	1,13
1.600	1,05
2.000	0,97
2.500	0,93
3.150	0,98
4.000	0,99
5.000	0,94

Table 2 [2}

REFERENCES

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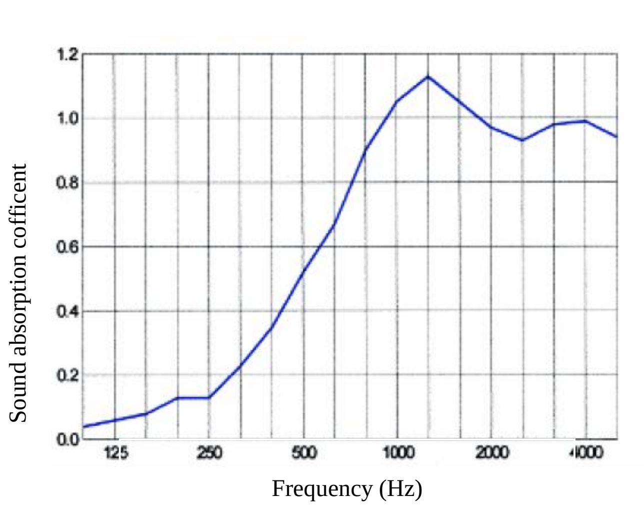

Figure 4 [2]

KEY FEATURES

- High sound absorption
- Non-combustible
- Fibre free
- Rigid and durable
- Not affected by water
- 100% recyclable
- Easily worked
- Lightweight
- Quick and simple to install
- Non toxic, VOC free
- Simply maintained and cleaned
- Paintable
- Simple to repair
- Safe to use

Reapor Installed in tunnel