MARSHALL DAY Acoustics

KNAUF INSULATION
CAVITY INFILL SUBSTITUTION

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Project: **EQUIVALENCE OF ACOUSTIC ABSORPTION MATERIALS USED AS CAVITY INFILLS**

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1.0 INTRODUCTION

Cavity infill materials can be an important component of walls and ceilings where sound insulation is important. Commercial cavity infill products are available in a range of different materials such as glass wool, mineral wool, polyester and other porous materials.

The inclusion of an acoustically absorptive infill material in wall and ceiling cavities, which would otherwise be filled simply with air, can lead to significant improvements in sound insulation performance. In particular, it can improve R_w and STC values relative to a cavity that is filled only with air.

Knauf Insulation Pty Ltd has commissioned Marshall Day Acoustics (MDA) to provide an expert opinion on objective criteria for substituting acoustically absorptive materials used as cavity infill in walls or ceilings.

A glossary of acoustic terms used throughout this report is provided in 0.

2.0 SUBSTITUTION

When a particular wall or ceiling construction is specified on a building project, it will commonly have specific infill materials nominated for inclusion in the wall/ceiling cavity. The nominated material is often the same material that was used when the overall wall/ceiling construction was tested for sound insulation performance in an acoustical laboratory.

It is common for commercial or practical reasons to wish to use an alternative infill material in lieu of the nominated product, provided that the sound insulation performance of the overall construction is not degraded.

In highly critical cases it may be necessary to carry out a laboratory test with the new infill material substituted, but in many situations, it is adequate to replace the specified material with a different material that has sufficiently similar acoustical properties.

3.0 FLOW RESISTIVITY

Research over many years has shown that two properties are sufficient to describe the acoustic performance of porous acoustical materials such as those used for cavity infill:

- The characteristic acoustic impedance; and
- The propagation coefficient.

These properties are complex and frequency dependent but fortunately it has been found that they can be predicted with good accuracy from the static flow resistivity of the material.

Static flow resistivity values can be measured according to ISO or ASTM standards and provide a very simple and accurate way of comparing and evaluating acoustically absorptive materials.

Two different porous (cavity infill) materials with the same flow resistivity can be expected to have the same acoustical properties provided that the following requirements are satisfied:

- The materials must have a high porosity (greater than about 90 %); and
- The materials must be mainly constructed of fibres (e.g. glass fibres, plastic fibres, mineral fibres).

In practice almost all commonly used and commercially available cavity infill products fulfil these requirements and so the flow resistivity is a useful and practical measure for comparing materials.

Outside of Europe, the flow resistivity of absorptive infills is not usually specified in tested constructions but the density and type of material usually are. The density and material type can be used to predict the flow resistivity with reasonable accuracy and so can be used as a basis for determining if a substitute material will achieve comparable sound insulation performance as the original specified material.

4.0 SOUND INSULATION AND FLOW RESISTIVITY

The acoustically absorptive infill material in a wall or ceiling cavity has two main effects on sound transmission through the cavity:

- The stiffness of the air in the cavity is reduced due to the compression and rarefaction in the cavity becoming isothermal rather than adiabatic
- Acoustic energy is dissipated due to thermal and viscous losses within the acoustic material.

The influence of each of these effects on the overall sound transmission of the wall/ceiling construction will depend on other elements of the construction. For instance, with smaller cavities the reduction of cavity stiffness may be the most significant effect while for larger cavities it may be the dissipative effect that is more important.

The nature of structural connections is also important as transmission through studs or joists may allow acoustic energy to bypass the acoustic infill.

Example constructions from the Marshall Day Acoustics database have been examined to see the influence of differing flow resistivities on identical constructions where the only variable was the cavity infill. The first was a single stud partition with a resilient rail used on one side to isolate the lining on one side. The second was a double stud partition with no structural connection between the faces. In the first case the STC varied by 3 STC points over a range of flow resistivities from 600 Rayl/m to 4000 Rayl/m. In the second case, the STC varied by 3 STC points over a range of flow resistivities from 5,000 Rayl/m to 50,000 Rayl/m. There can be a greater influence for other constructions but it is unlikely to exceed 5 STC points over the normal range of cavity infills (approximately 500 to 20,000 Rayl/m).

5.0 PROPERTIES OF KNAUF INSULATION GLASS WOOL

A study has been undertaken on the current range of glass wool products as manufactured by Knauf Insulation to determine the relationship between the density and the flow resistivity. This study is presented in Marshall Day Acoustics report Rp 001 20170139 dated 6 September 2019 and a simple relationship has been determined.

This relationship has been compared to glass wool from other manufacturers and for other types of materials (mineral fibre and polyester fibre). It has been found that for any given density, over the range from 5 kg/m^3 to 40 kg/m^3, Knauf Insulation glass wool products have on average the same or higher flow resistivity than other glass wools or mineral or polyester fibre products.

6.0 OPINION

When substituting a specified porous infill that is mainly manufactured from a fibrous product (glass wool, mineral wool, polyester, or natural fibres), providing the density and thickness of the Knauf Insulation product is the same or greater than the specified material, the acoustic properties of the infill are expected to be similar or better, and the sound insulation performance (that is STC/R_w values) of the overall wall/floor construction is expected to be comparable or better.

The tolerance on sound insulation performance after substituting the Knauf Insulation glass wool product is expected to be comparable to the tolerance of laboratory sound insulation measurements, that is, in the order of ±1 to 2 STC/R_w rating points.

GLOSSARY OF TERMINOLOGY

Flow resistance	Flow resistance is effectively a measure of how much resistance a material offers to the propagation of sound waves.
Flow resistivity (Rayls/m)	Specific flow resistance per unit thickness of material.
R_w	Weighted Sound Reduction Index A single number rating of the sound insulation performance of a specific building element. Rw is measured in a laboratory. Rw is commonly used by manufacturers to describe the sound insulation performance of building elements such as plasterboard and concrete.
Sound Insulation	When sound hits a surface, some of the sound energy travels through the material. 'Sound insulation' refers to ability of a material to stop sound travelling through it.
Specific flow resistance (Rayls)	Flow resistance per unit area of material.
STC	Sound Transmission Class A single number system for quantifying the transmission loss through a building element. STC is based upon typical speech and domestic noises, and thus is most applicable to these areas. STC of a building element is measured in approved testing laboratories under ideal conditions.