Perlite in Sound Insulation Applications

Discover the many sound-blocking and sound-absorbing uses for expanded perlite.

When it comes to noise protection in buildings, both sound-absorbing and sound-blocking (or soundproofing) materials come to mind. Each offers unique properties that make them suitable for specific applications.

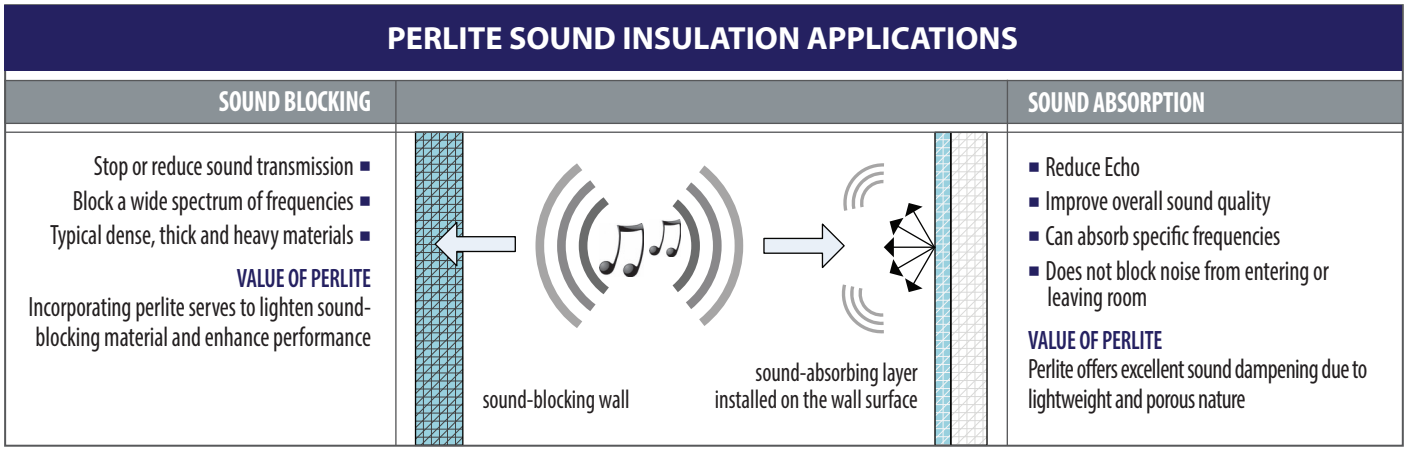
Processes that Govern the Absorption of Sound by Acoustic Materials

First, in porous materials, sound energy is transformed into heat by the viscous forces at work when sound propagates through materials. Second, sound is dissipated by frictional forces when acoustic materials are set into vibration by the incident sounds.

Types of Noise

Airborne Noise – When airborne noise strikes a floor or ceiling, the surface is set to vibration by the fluctuating pressure of the sound waves. This vibration is what radiates sound into the air on the other side.

Impact Noise – Impact noise is caused by an object striking or sliding on a floor, such as footsteps, moving furniture or a door slamming. It can also be caused by an appliance, such as a dishwasher or shower, which transmits its vibration to the building structure.



How Perlite Works as a Sound Absorption/Blocking Material

The characteristic cellular structure of perlite and the successive air compartments hinder the propagation of sound waves, rendering it an ideal filler for sound-blocking and sound-absorbing applications. When used as a filler, sound waves can be consumed and absorbed by multiple levels due to the combination of an interconnected pore structure and cavity resonance sound absorption structure, resulting in a higher performance, sound absorption/blocking material.

Measurement Techniques and Units

Reductions in unwanted sound transfer are typically expressed in terms of the Sound Transmission Class (or STC) in the U.S., or the Sound Reduction Index (SRI) outside the U.S. This is an integer rating how well a building partition reduces airborne sound. The STC rating roughly reflects the decibel reduction in noise that a partition provides.

In comparing sound absorbing materials for noise control purposes, the Noise Reduction Coefficient (NRC) is commonly used. NRC is the average usually stated to the nearest multiple of 0.05, of the coefficient at four frequencies 250, 500, 1000 and 2000 Hz.

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Applications

The versatile nature of expanded perlite allows it to be used in the manufacturing process of both sound-blocking and sound-absorbing products globally.

Sound-Absorbing Perlite-Based Products – Expanded perlite is traditionally used as a primary constituent in the production of lightweight sound insulating panels and ceiling tiles. The intrinsic porous nature of lightweight expanded perlite absorbs sound waves and reduces the reverberation time.

Another option is the use of perlite as filler in spray-on absorbers. During spraying, perlite is mixed with a binding agent and water to produce a soft lightweight material with a coarse surface texture and high sound absorption characteristics[1]. In one application, spray-on absorber containing perlite achieved a NRC value of 0.70[2].

Sound-Blocking Perlite Products – Expanded perlite is an essential constituent of perlite lightweight concrete. Densities greater than 1,000 kg/m^3 (62 lb/ft^3) offer a higher degree of sound-blocking. By varying the amount of perlite used in the mixture, one can achieve a balance between the weight of the overall structure, and the need for sound blocking

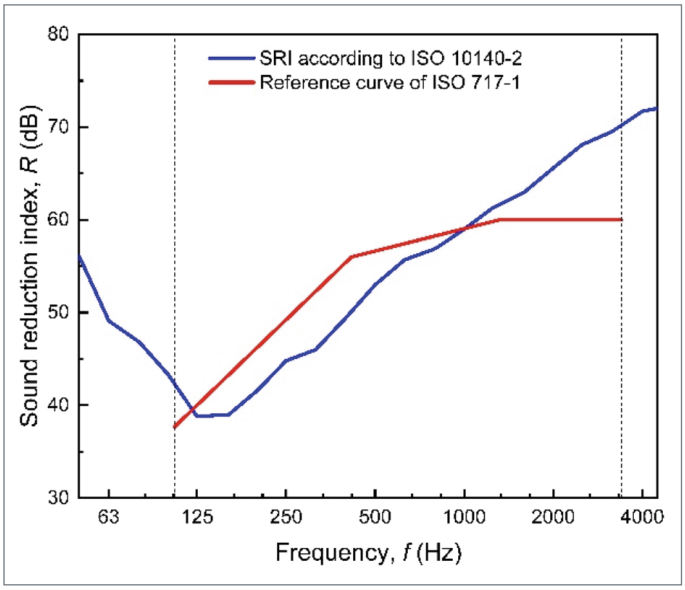

Figure 2 • A Sound Pressure Level graph showing performance results for a lightweight concrete sound-blocking floor at different frequencies. The higher the Sound Reduction Index (SRI), the greater the reduction in unwanted noise transfer (blue line). (Courtesy of Gulf Perlite LLC, Dubai)

levels of sound insulation. For example, the airborne sound insulation per Approved Document E–UK for new dwellings is 45 DnTw + Ctr dB. By definition, this is the weighted Sound Reduction Index with the addition of a low frequency sound correction factor (Ctr).

Perlite manufacturers have developed a variety of

SOUND PERFORMANCE OF WALL INSULATED WITH PERLITE LIGHTWEIGHT CONCRETE IN-FILL

SR.	DESCRIPTION	ACOUSTIC RATING		FIRE RATING
		(STC)	($D_{nTw} + C_u$)	
1	100 mm partition with two sides cement boards and Perlite LW Concrete In-fill	41 dB		4 hour min.
2	150 mm partition with two sides cement boards and Perlite LW Concrete In-fill	51 dB		4 hour min.
3	200 mm partition with two sides cement boards and Perlite LW Concrete In-fill	60 dB	>45 dB	4 hour min.

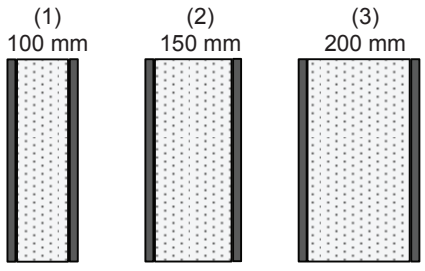

Table 1 • Sound performance of wall insulated with perlite lightweight concrete in-fill; effect of partition thickness (Data Courtesy of Whittemore Company Inc. and Gulf Perlite LLC)

performance. For a detailed explanation of perlite lightweight concrete, see Perlite Institute info sheet: *Transit Mix Perlite Lightweight Concrete*.

Most building codes now require floors, external walls, and intertenancy walls to comply with varying

solutions for harnessing the benefits of perlite lightweight concrete to meet the stringent local building code requirements. For example:

Perlite Lightweight Concrete Floor Sound-Blocking Solutions – Perlite lightweight concrete floor screed is used to reduce unwanted sound transfer between floors in a multilevel building. A typical perlite

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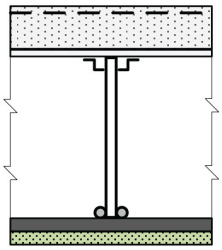
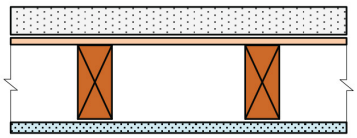
PERLITE SOUND PERFORMANCE IN FLOOR SYSTEMS



STEEL FORM UNITS

2 1/2 in. (63.5 mm) perlite/sand concrete (72 lb/ft^3, 1152 kg/m^3) on 28 ga. (0.4 mm) steel form units supported by bar joists. Ceiling: 3/4 in. (19.05 mm) perlite-gypsum plaster on metal lath tied to 3/4 in. (19.05 mm) furring channels attached to bottom chord of joists 13 1/2 in. (343 mm) o.c.

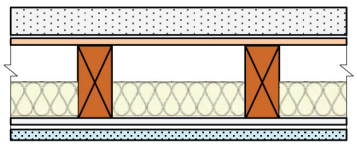
Sound Transmission Class	Impact Noise Rating
48	-14
48 (with carpeting)	-8



PLYWOOD SUBFLOORS

1 5/8 in. (41.28 mm) perlite/sand concrete (75 lb/ft^3, 1200 kg/m^3) on polyethylene film and 5/8 in. (15.9 mm) tongue and groove plywood supported by 2x8 in. (50.8 x 201.2 mm) or 2x10 in. (50.8x254 mm) wood joists 16 in. (406.4 mm) o.c. Ceiling: 5/8 in. (15.9 mm) gypsum boards nailed to joists.

Sound Transmission Class	Impact Noise Rating
47 (with carpeting)	-15



1 5/8 in. (41.28 mm) perlite/sand concrete (75 lb/ft^3, 1200 kg/m^3) on polyethylene film and 5/8 in. (15.9 mm) tongue and groove plywood supported by 2x8 in. (50.8 x 201.2 mm) or 2x10 in. (50.8x254 mm) wood joists 16 in. (406.4 mm) o.c. with 3 in. (76.2mm) fiberglass blanket stapled between joists. Ceiling: 5/8 in. (15.9 mm) gypsum boards screwed 12 in. (304.8 mm) o.c. to resilient channels attached to joists 24 in. (609.6 mm) o.c.

Sound Transmission Class	Impact Noise Rating
50	-4
53 (with carpeting)	-23

Figure 5 • Sound performance of steel form units and different plywood subfloor set-ups. Results are comparable to heavyweight concrete. (Courtesy of Kodaras Acoustical Laboratory)

SOUND-BLOCKING AND SOUND-ABSORPTION PROPERTIES OF EXPANDED PERLITE

PRODUCT TYPE	COMPOSITION / APPLICATION	KEY FINDINGS	REF.
Cement and/or gypsum based products	• Lightweight plaster and concrete for construction • Porous sound-absorbing concrete slabs for railways • Spray-on mixture • Formed products (boards, plates, tiles)	• Reduction of sonic and ultrasonic penetration velocity • Highest NRC compared to ceramsite • TL of 19 dB for 20 mm plaster • High sound absorption	[1] – [10]
Underfloor bulk insulation	• Lightweight concrete block floor • Cross laminated timber and timber-concrete composite floor	• Expanded perlite can be used as primary or secondary sound insulating material	[11], [12]
Composites	• Colemanite bricks • Geopolymer bricks • Coal/newspaper/ cellulose-based boards • Phosphogypsum based bricks • Polyurethane composites	• Enhanced acoustic performance and sound insulation • Reduction of sonic and ultrasonic speed • Increase of NRC • Higher STC and TL compared to pumice, sepiolite, vermiculite	[13] – [20]
Substrate on Green walls	• Green walls for indoor application • Modular system for vegetable panels (facades)	• Improvement of acoustic performance • Sound absorption coefficient reached 1.0 • Reduction of reverberation time (T30)	[21] – [22]

Table 2 • Review of independent research studies that investigate the outstanding sound-absorption/sound-blocking properties of expanded perlite when used as filler in various type of products for different applications.

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lightweight concrete floor installation with an oven dry density of 1,300 kg/m³, at a thickness of 50 mm (2 in.) applied directly (bonded) on 200 mm (8 in.) thick reinforced cement concrete (RCC) slab achieves an airborne sound rating of: Rw (C; Ctr) = 56,1 (-2 ; -6) dB. (Figure 2 and Figure 5).

Perlite Lightweight Concrete In-Fill Partition Wall Systems – A sustainable drywall partition developed using perlite lightweight concrete in-fill at a density of 1,000 kg/m³ gives this partition wall system a minimum 4-hour fire rating and complies to 45 DnTw + Ctr dB for intertenancy walls (Figure 3). This is achieved with a thickness of 200mm (8 in.). Table 1 illustrates the sound performance index of the perlite-based partition system with varying thicknesses.

Further Benefits of Perlite When Used as a Filler in Construction Applications:

- Excellent thermal insulation
- Lightweight
- Safe to handle; non-toxic, inert and inorganic material
- Fireproof and non-combustible
- Resistance from corrosion from most chemicals
- Cost effective
- Low environmental impact

Acoustical ceiling and wall panels now come in an array of shapes and sizes while offering excellent sound insulation properties. (Courtesy of Armstrong Ceiling Systems)

***Figure 3** • Perlite-based Ecowall Drywall System (Courtesy of Gulf Perlite LLC, Dubai)*

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