

SOUND ABSORPTION THROUGH POLYETHYLENE TEREPHTHALATE WOOL

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Abstract: In apartments or houses, it is common to have noise propagation, both external and internal. These events are commonplace between rooms and between different apartments in a building, affecting inhabitants' privacy, causing a general discomfort. In order to solve these problems, this study aims to highlight, through a literature review, an ecological and accessible alternative: the use of polyethylene terephthalate wool, or PET wool, to improve the acoustics in homes. It was observed, after research, that the use of PET wool is the best alternative to be adopted for sound absorption.

Keywords: Noise propagation; Acoustics; Polyethylene terephthalate (PET) wool.

REVISÃO DA LITERATURA SOBRE O USO DE LÃ DE POLIETILENO TEREFTALATO PARA A ABSORÇÃO SONORA

Resumo: Em apartamentos ou em casas, é comum ter propagação de ruídos e barulhos, externos e internos. Estes acontecimentos são corriqueiros entre os cômodos e entre apartamentos diferentes em um prédio, afetando a privacidade dos habitantes, causando um desconforto geral. Com o objetivo de resolver os problemas citados, este estudo visa evidenciar, por meio de revisão da literatura, uma alternativa ecológica e acessível: a utilização da lã de polietileno tereftalato, ou lã de PET, para a melhoria da acústica em residências. Observou-se, após pesquisas, que o uso da lã de PET é a melhor alternativa a ser adotada para a absorção sonora.

Palavras-chave: Propagação de ruídos; Acústica; Lã de polietileno tereftalato.

1. INTRODUCTION

The 'JusBrasil' website notes that there is a high rate of lawsuits related to noise pollution in residences in Brazil, complaints regarding the propagation of noise and excessive noise inside apartments, causing various damages to the body and life quality of people. [1]

Given these characteristics, the use of a resistant, ecological, and affordable material is proposed to solve the problems related to acoustics. Polyethylene terephthalate wool is a hypoallergenic material - eliminating the risk of insalubrity - that prolongs the life of an enterprise, does not absorb water, does not mold and, according to the manufacturer, represents the best cost-benefit in the market and ensures a healthier indoor environment. [2]

The use of this material allows the recycling of PET bottles, making harmful raw materials no longer used, saving natural resources. [3]

The purpose of this work is to highlight the effectiveness of PET wool use in relation to acoustic issues, using, in conjunction with the literature review, a high-fidelity project and simulations, demonstrating the benefits for the consumer and the environment.

1.1. Consequences of noise pollution

According to an interview at Pernambuco Diary in 2016, the harms that consist of noise pollution, both internally and externally, and what it causes in residents of buildings and terraced houses, were evident.

The businessman Gustavo Mendonça, 37, complains about the excess of noise in his condominium. "You can hear almost all the sound emitted by the neighboring apartments. And when there are parties in the hall of the building, it gets complicated. What bothers me the most is the fact that my one year and nine month old son can't sleep," says Gustavo, who has lived in the apartment for five years. [4]

As mentioned in the excerpt of the report, in addition to the nuisance caused to the residents, a poor-quality sound absorption favors the development of syndromes and diseases caused by it, which interferes with the tenant's day to day. Some examples are the sensation of stuffed ears, tinnitus, stress, headache, and even more serious symptoms, such as: high blood pressure, aggressiveness, fatigue, difficulty concentrating, insomnia, memory loss, depression, anxiety, gastritis, and may also lead to temporary or permanent hearing loss. [5]

1.2. Acoustic insulation

Knowing the noise nature, the way it is transmitted and the performance of the materials, acoustic insulation aims to reduce the transmission of sound energy that can occur by aerial and/or structural means. In addition, it has the function of controlling the environmental sound, for example, the indirect sounds, such as echoes and

vibrations to achieve the expected acoustic comfort in a house, apartment, or other place. [6]

According to FALCÃO, 2019, acoustic insulation is directly related to noise control, whether structural, when it propagates through the structures of a building, or environmental. [7]

The choice and method of arrangement of the material depend on whether it is intended to correct, reduce, or eliminate noise. One must take into consideration, when choosing the ceiling tile or lining, the occupancy rate, durability, stability, and fire resistance of the maintenance environment. [8]

1.3. PET wool

PET wool is a thermal acoustic insulation blanket, composed 100% of polyester fibers - a material that comes from recycling PET bottles -, with no added resins. The wool blankets are applicable for filling drywall walls, over lining systems, under screeds, or even as apparent coatings. [2]

During the manufacture of PET wool, natural gas is used, such as those used in the household stove. Therefore, there is ten times less CO₂ emission, unlike the production of other types of wool, such as glass and rock wool, which emit a larger amount into the atmosphere. As well as no water is required, thus saving on this aspect. [2]

In the transportation process, the cost reduction is very significant - because polyethylene terephthalate is considered weightless - and it can be compacted without losing its original characteristics. The application is simple, as it is a clean process that generates low waste, does not require much personal protective equipment (PPE), and don't require a high number of labors. In economic aspects, it helps several families that live from selective collection, because it's made exclusively from the bottle recycling. [2]

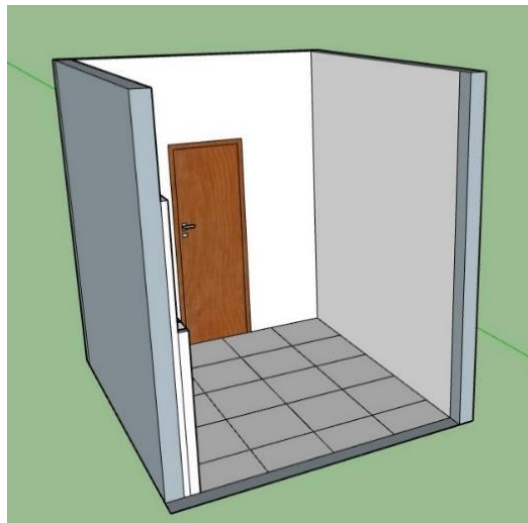
According to ARANHA, 2019, for every square meter of wall that is covered with polyethylene terephthalate wool, approximately 100 PET water bottles (500ml) are used - this prevents these bottles from being left in nature contributing to pollution. [9]

2. METHODOLOGY

This work was developed based on bibliographic research in articles, studies, and website articles, in addition to a high-fidelity prototype and an analysis using cell phone applications to compare information for our study.

The project was developed in the computer application "SketchUp", in order to demonstrate the structure suggested in our prototype. The room studied was a 2.80 m x 2.50 m room, i.e., 7 square meters. It's located in an apartment where privacy problems were identified for the inhabitant, due to the passage of sound both between two different apartments and between the rooms.

Figure 1. Demonstration of the studied room.



Source: own author, 2021

The research methodology used was a literature review. After researching the content presented, the project was developed in order to aggregate and complete the understanding of this article.

The main model that was used as a basis was the scientific paper written by Ricardo Vargas Aranha in 2019, "Technical analysis via impedance tube and sustainable study of pet wool as a substitute for commercial materials in acoustic applications". [9]

3. RESULTS AND DISCUSSION

According to the law 5354/98 - from Salvador, capital of the state of Bahia - which regulates urban sounds and times when they can be emitted, in art. 3: "The maximum levels of sounds and noises, from any source and nature, in enterprises or residential, commercial, service, institutional, industrial or special activities, public or private as well as in motor vehicles are 60 dB (sixty decibels), in the period between 10:00 pm and 7:00 am, and 70 dB (seventy decibels), in the period between 7:00 am and 10:00 pm."

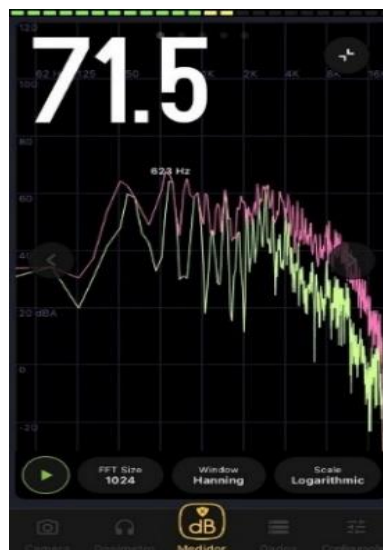
Using a portable speaker at its maximum level, we performed two measurements, using two mobile apps, which simulated a Sound Level Meter - decibel meter - where we noted an average of 75 decibels in the area around the analyzed room.

Test 1. Performed on the Decibelimeter app, Android.



Source: own author, 2021

Test 2. Performed on the Decibel X app, IOS.



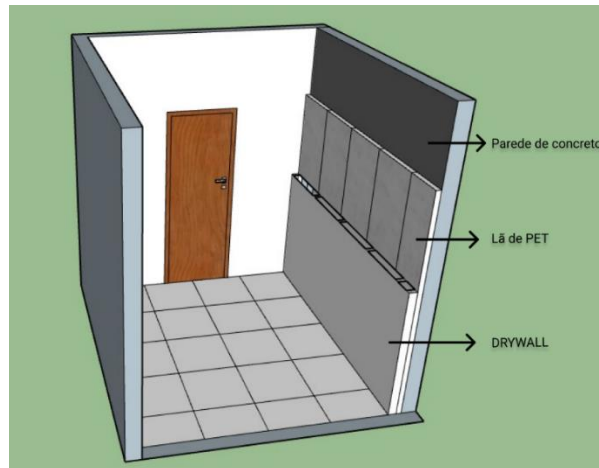
Source: own author, 2021

It is noticeable that it exceeds the limits set by law cited above, leading to the conclusion that PET wool would work as a solution to normalize the excessive passage of sound. Because according to a supplier, installing a double drywall counter wall with PET wool offers insulation of ± 30 dB.

As a demonstration of this solution, we performed the simulation, where a white PET wool blanket 0.60 x 12.50m was used, with a thickness of 50mm. In addition, a drywall wall was installed on top of the wool with the objective of finishing the room.

The room is 7 square meters, but after the installation of PET wool and drywall, the only consequence is the loss of space, there will be an expansion in the walls of 13 cm each, the room will be 6.58 square meters. However, considering the practicality of application and the result of acoustic comfort obtained through this method, will only be advantages for the resident.

Figure 2. Demonstration of the studied room.



Source: own author, 2021

Based on the research done, considering that 30 dB are annulled, it's possible to estimate that the effects of the material applied are positive, because a new value will be obtained and will reach the limits determined by law 5354/98.

4. CONCLUSION

Despite not being a popular thermoacoustic flooring option, its acquisition and installation costs are lower than several products of similar purpose and lower quality.

One of the positive points of installing the product is the increase in the residents' privacy, because it prevents sounds from getting through, avoiding conflicts and leakage of personal data. An example is residences that use drywall where generally the propagation of sound becomes easier, using a plasterboard, a layer of polyethylene terephthalate wool and another plasterboard, thus closing the wall in a way that the junctions of the boards are mismatched between one side and the other, the finishing can be done with any other type of material.

Not being directly related to acoustics, recycling is a positive consequence that the wool provides, because the raw material is PET bottles that will be recycled and reused, contributing to the environment.

PET wool is a proven innovation that contributes essentially to the area of civil construction, proving itself better every day and being increasingly used over time.

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