POTENTIAL USAGE OF AGRICULTURE WASTE (COCONUT COIR) FOR SOUND ABSORBING MATERIAL IN AUTOMOTIVE INDUSTRY

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Abstract

The increase in the amount of agricultural wastes (coconut coir) and production of rubber synthetics materials (recycled rubber) has contributed to various environmental problems. The automotive industry with the largest chain of automotive ecosystem is no exception to the contributors of environmental pollution. With hazardous substances used in the manufacturing plants, it is important that the hazardous substances and working conditions comply with various state and federal environmental requirements that should prevent hazardous release to the environment, protecting our health and natural sources. This has attracted to generate new solutions in order to overcome this problem. In this work, panel boards from coconut coir with added recycled rubber were investigated as absorbing material in acoustical application. The reinforcing of coconut coir with added recycled rubber in natural latex was evaluated at different ratios (0/100, 10/90, 20/80, 30/70, 40/60 by wt. % of coconut coir/ recycled rubber), whereas resins (natural latex) percentages of 25% and 35% was employed for composition comparison which is suitable to be used for good sound absorption. The results showed that the increase in frequency results in the increase in sound absorption which is related to content of filler with an average absorption coefficient of above 0.6. Thus, not only the hazardous working conditions in the automotive industry can benefit from this findings, this material can also be used to reduce pollution rate in apartments, aircrafts, ducts, enclosures, sub flooring, interior surface for wall.

Keyword: *Recycled Rubber, Coconut Coir, Natural Latex, Acoustical properties.*

1.0 Introduction

Recently, pollution has become one of the most critical problems in the whole world. It is identified that the noise contributes as the main source of pollution and it brings threat and hazards to the human beings [1]. Being one of the largest and fast moving industries in the world, the automotive industry is by far the largest contributor to pollution. With industrial parks being developed in smaller or remote residential areas, such automotive industry could be subject to lawsuits or movement by environmental activist when the activities conducted at the automotive industrial areas lead to sound pollution that could lead to potential health issues among the workers and local residents. The sound pollution comes from the big industrial production factories which produced sound higher than 80dB. Human normal listening limit is not exceeding 80dB. Thus, this causes listening impairments, stress, thyroid glands, increase heart rate etc. [2].

Air pollution is caused from disposable and open burning from industrial and living material waste such as recycled rubber (waste tire) and coir. Waste tires have been a major management and disposal problem in many countries for decades. Many waste tires are currently stockpiled in various countries around the globe. These stockpiles are dangerous because they pose a potential environmental concern, are fire hazards and provide breeding grounds for mosquitoes.

The practice of disposing waste tires in landfills is becoming unacceptable because of the rapid depletion of available landfill sites [3].

Coconut coir fibers at minimizing the negative impact of the residue products on the environment have been carried out extensively. The utilization of organic natural fiber as reinforcement as a potential reinforcement of polymer composites has attracted much attention by researchers in recent years due to its several advantages such as renewable, have a significantly lower density than mineral material, cost reduction, higher stiffness and biodegradable [4-6]. Coir is becoming a popular choice for making geo-textile because of its durability, eventual biodegradable-ability, ability to hold water, and hairy texture. Whereas the coconut coir is a natural fibre which it easy to crunch to be a particle, where it's similar with wood particle or rice straw, so it easy to produce sound absorbing material.

Natural latex, a naturally occurring polyisoprene elastomer, is obtained almost exclusively from the *Havea brasiliensis* tree when the bark of the tree is partially cut, or "tapped," a milky substance exudes and coagulates to form a rubbery film. Natural rubber latex adhesives have a variety of applications in industry and it's also is used for elastic thread, for garments, and foam, for mattresses and cushions [5].

The main reason of this investigation is to prepare composite boards of sound absorbing material based on recycled rubber and coconut coir for sound absorption application and determine the sound absorption of sound absorbing materials by using impedance tube. Then to reduce serious pollution issue which is caused by industrial and agricultural waste product from the waste tyre tube and coconut coir which it are burnt and disposed when it not use anymore.

2.0 Experimental Method

In this research, the agricultural lignocellulosic fibers used in this study were coconut coir and recycled rubber as addition material and type of adhesive were selected is rubber synthetic natural latex adhesive as used as binder.

Composite boards were manufactured at different composition such as in Table 1. The natural latex adhesive was mixed with particles recycled rubber and coconut coir. Sizes of recycled rubber particles ranges from 5 mm to 10 mm and coir fiber length from 10-20 mm were used The stainless steel mold which equipped with stops was used to press panel board with use hot press machine. The mixture of coir fiber with added recycled rubber and natural latex was hot pressed pressure at 10 ton and a temperature of 140°C The mold was allowed to cool down with water chilled platens (Wabash 50) for 5 min and then the pressure was release. Sample were removed manually from the molded after cold.

The method used to measure the acoustical properties of the panel board, the sound absorption coefficients were determined by the impedance tube based on method of ASTM E1050-98 and ISO 10534-2 [7]. According to this method, the sample is located at one end of the cylinder inside where standing waves are generated. The sound absorption coefficient can be computed from the ratio between the maximum and minimum values of the sound pressure field. The range of frequency to be tested sample depends on diameter of tube. Tube with variable diameter of 28mm is set up for testing the material sound absorption in the high frequency range of 800–6500 Hz and l00 mm is set up for measuring the nonwoven sound absorption in the low frequency range from 90 Hz to 1800 Hz.

Therefore, this method is particularly adequate to the measurement of sound absorption coefficient of porous materials.

Porosity is a measure of the void spaces in a material, and is a fraction of the volume of voids over the total volume, between 0–1, or as a percentage between 0 –100%. Density is a physical property of matter, as each element and compound has a unique density associated with it. Density defined in a qualitative manner as the measure of the relative "heaviness" of

objects with a constant volume. The densities of all were measured using a Mettler Toledo precision balance having a built-in programmer. Density is an important indicator of a composite's performance. It virtually affects all properties of the material. Scanning electronic microscopy (SEM) microphotographs of the samples were obtained by using a JEOL, JSM-638OLA.Scanning electron microscopy (SEM) showed that there is indication of filler and resin filling the void space in between fibres and can get information about of porosity and surface composite of coconut coir and tube tyre use to study and also complete view of the filler distribution.

Table 1: Composition of coconut coir, rubber waste with 25 and 35 percents of

	Coir Fibers (%)	**Recycled Rubber (%)**
(25% Urea-Formaldehyde)		
1	0	100
2	10	90
3	20	80
4	30	70
5	40	60
(35% Urea-Formaldehyde)		
1	0	100
2	10	90
3	20	80
4	30	70
5	40	60

3.0 Results and Discussion

3.1 Acoustics Properties

The sound absorption coefficient of the coconut coir with added recycled rubber was investigated with different percentage of filler. Both of different filler and resin show the good sound absorption from low until high frequency. All samples show with increasing coconut coir it have good performance for sound absorption. These materials have potential for sound absorbent material. However, samples with 25 percents natural latex demonstrated higher sound absorption coefficient than 35 percents natural latex. Most samples produced the absorption coefficient above 0.6 in wider frequency range 1000 to 6300 Hz. Though both samples works well in wider frequency range, sample 5^{th} of 25 percents natural latex obtained a higher absorption coefficient. The pattern both of graph show decrease at middle frequency and slight gradual increases in sound absorption coefficient up to a maximum level 0.9 at 5000Hz and smoothly steady increase 1.0 of this frequency afterward. It occurs due to specific characteristics of coconut coir and recycled rubber reflecting sound at 2000Hz-4000Hz but absorbing sound at high frequency (4000Hz-6300Hz).

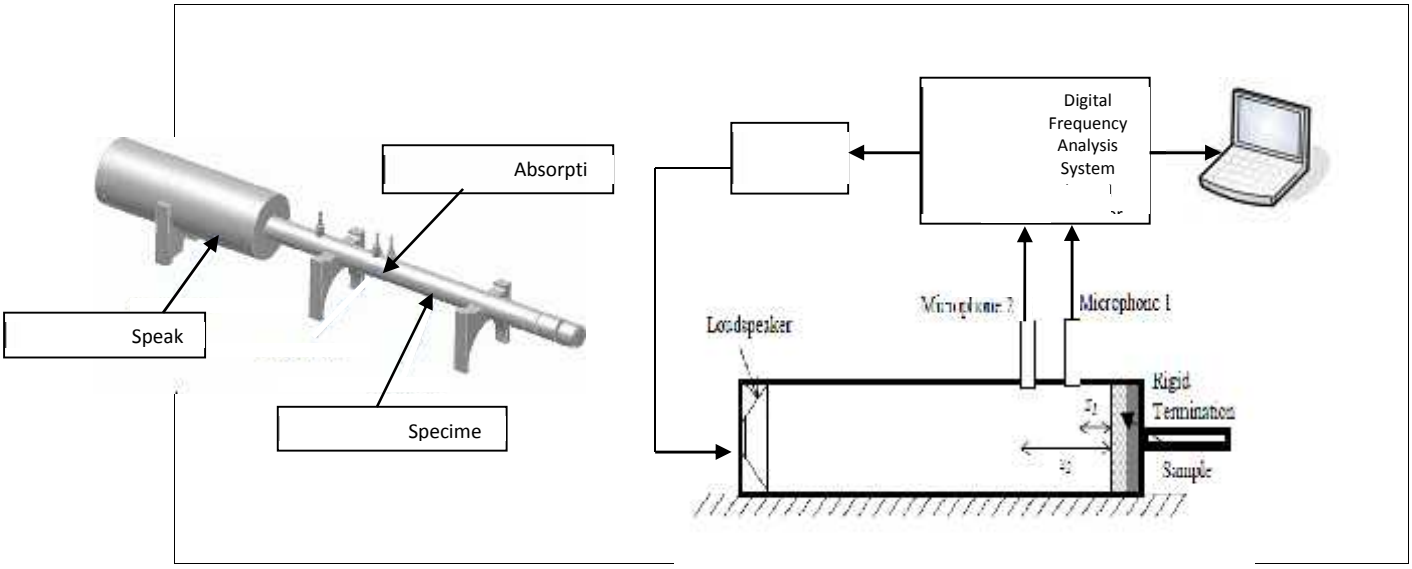

Figure 1: Schematics of an impedance tube used for measurement of acoustic absorption coefficient

The efficiency sound absorption of sample can also be determined by calculating the NRC values. Indicating the sound properties of materials using the α-values at different frequency ranges would be complex as it involved calculations over several frequencies Figure 4 shows the results of NRC values obtained for both types and samples. The NRC values obtained for 25 percents of natural latex content produce the values within 0.39 to 0.5. On the other hand, NRC values calculated for 35 percents of natural latex content yield the values from 0.38 to 0.46. As NRC increase, the coefficient numbers also increase. The higher the coefficient numbers the better the absorption. In other word, the sample with highest value of NRC shows better absorption criterion for the material. Hereby, different percentage of filler and resin make a good sound absorbent material.

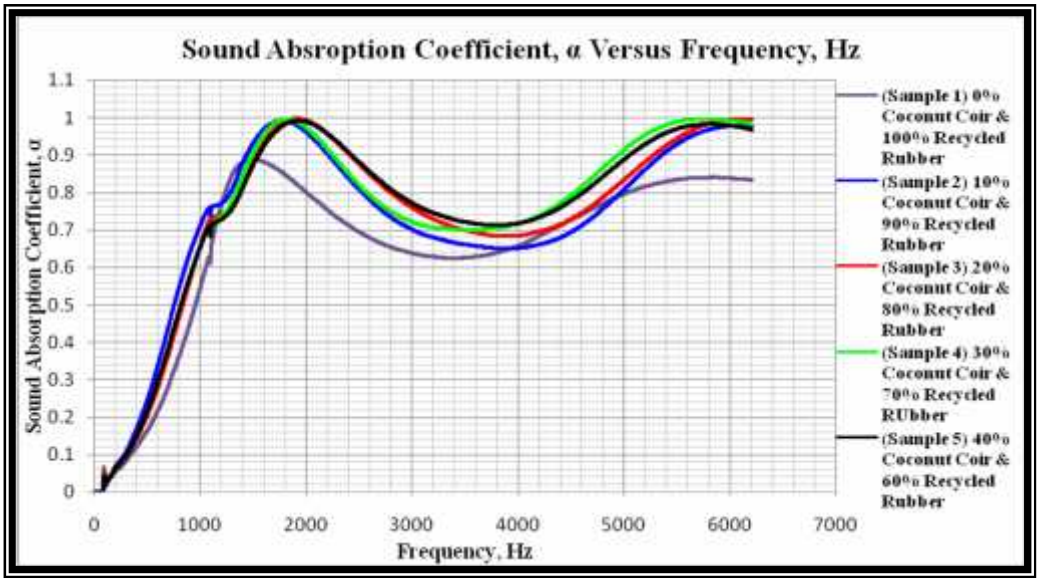

Figure 2: Sound absorption coefficient for various compositions with 25 percents of natural latex

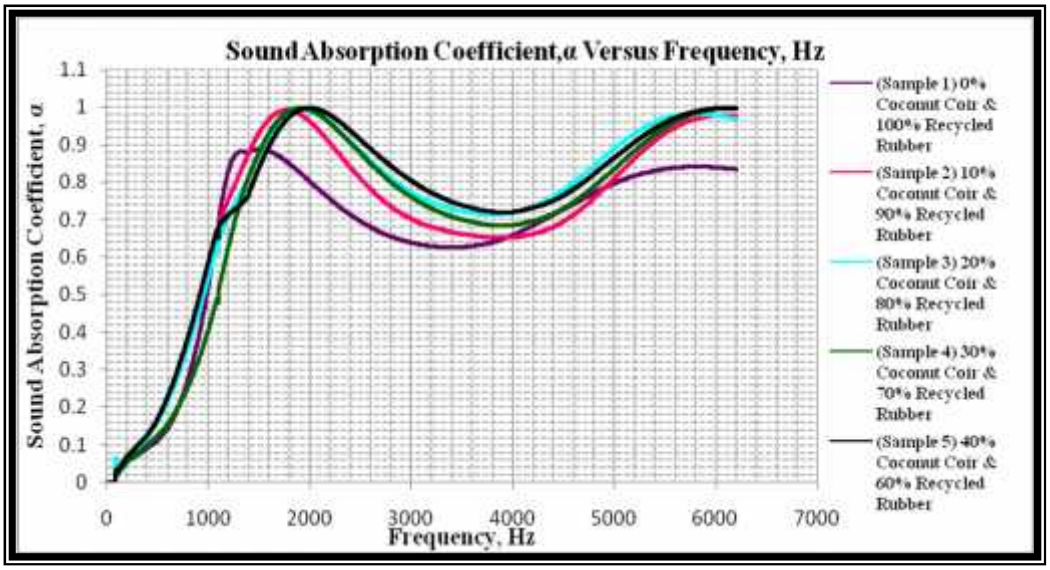

Figure 3: Sound absorption coefficient for various compositions with 35 percents of natural latex

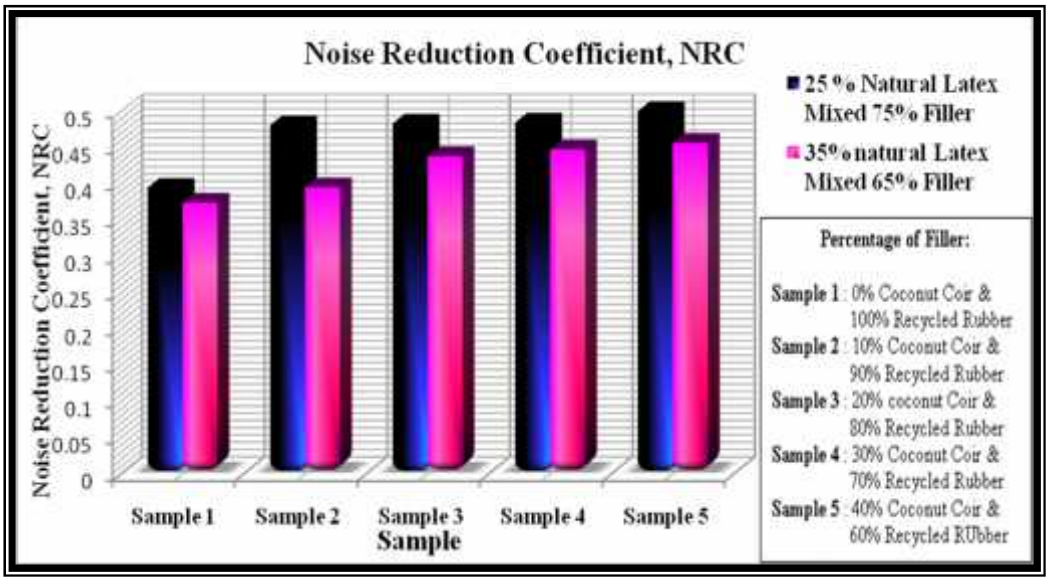

Figure 4: Noise reduction coefficient for various compositions of filler and resin

3.2 Physical Properties

The variation of density with different percentage of sample is illustrated in Figure 5 and porosity of specimen is presented in Figure 6. From data analysis about density and porosity below, it is shown that the relationship between density and porosity is inversely proportional in sound absorption coefficient. In addition, when sound absorption coefficient of the sample is high, so the density will be low whereas the porosity is high. This is because, when porosity of the sample is high, there will be more pores space inside the sample which will give the sample more ability to absorb sound particle. When density of the sample is low, the pores space inside the sample will be less that will produce low sound absorption coefficient for the sample.

From SEM test, sample with 25 percents natural latex yield a good bonding between the fibers where there is no big gap between the fiber linings, compared to 35 percents natural latex. The more and large pores will produce by 25 percents than 35 percents natural latex. The pores size varied and was estimated in a range of 131-150µm for 25 percents natural latex and 118-142µm for 35 percents natural latex. So, from microscopic view, the void that contained in the fiber and we can predict which sample has higher density and porosity.

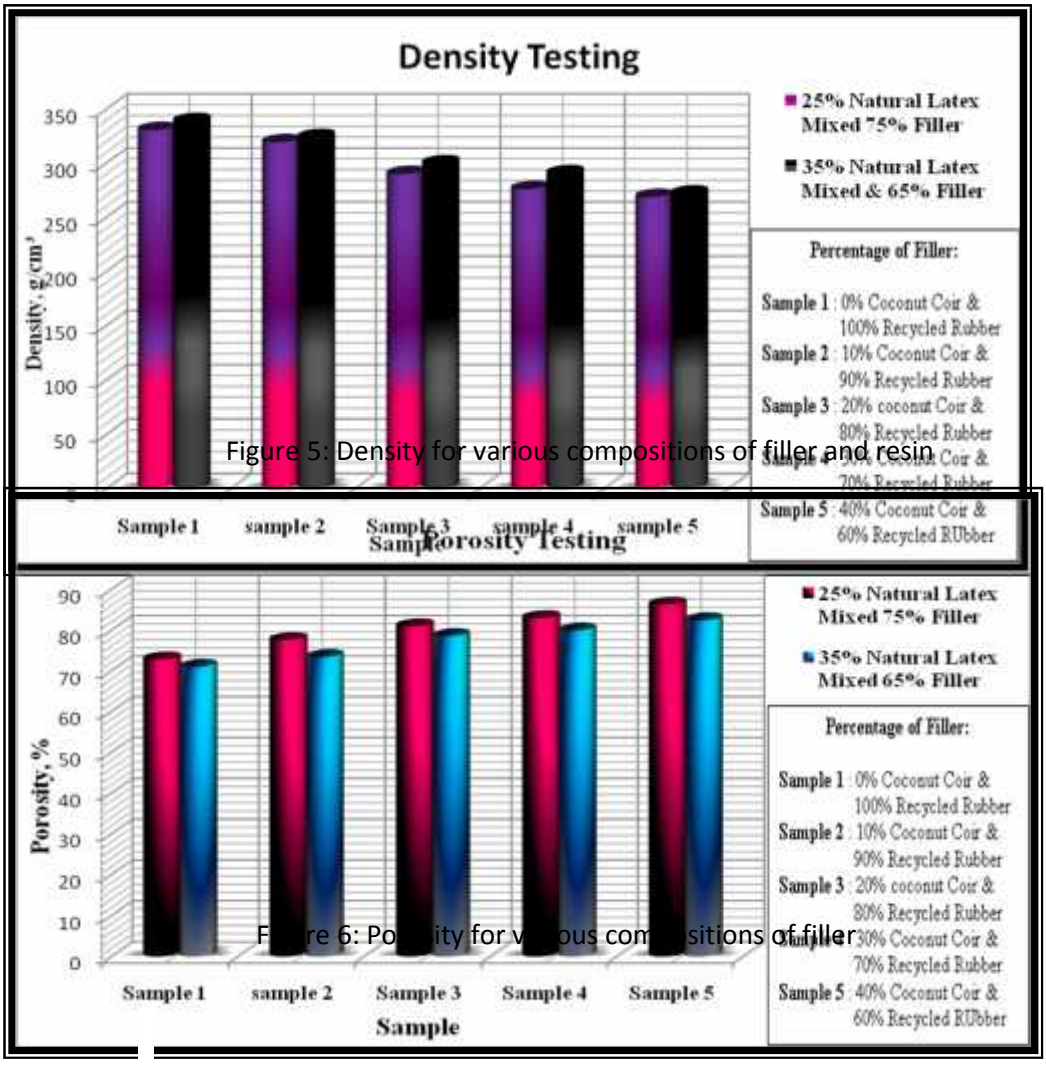

Figure 5: Density for various compositions of filler and resin

Figure 6: Porosity for various compositions of filler

Figure 7: Microstructure view for panel board with 25 percents of natural latex

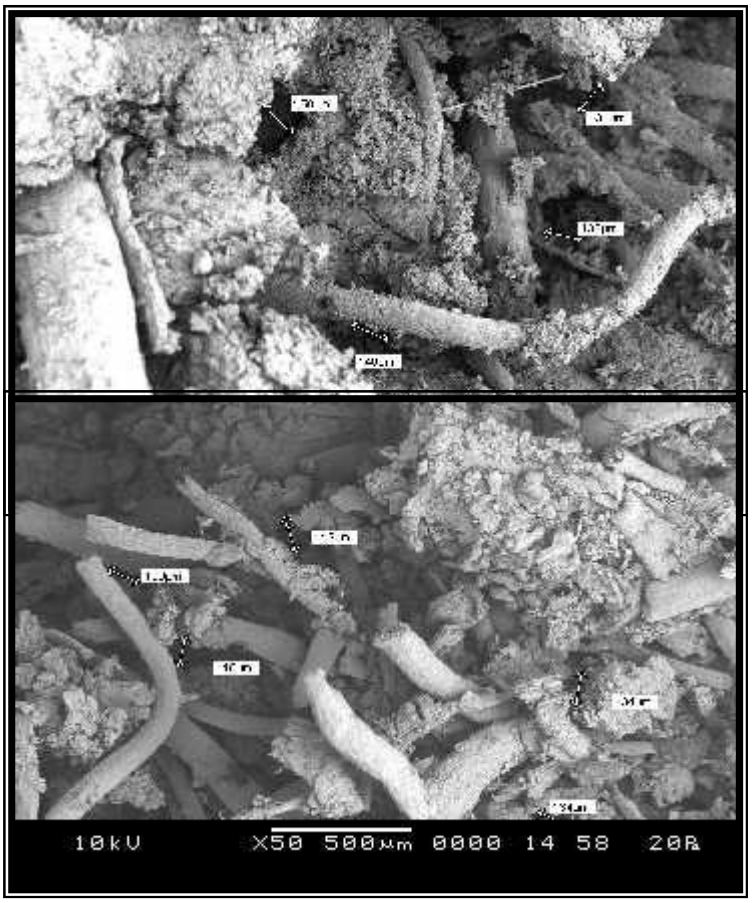

Figure 8: Microstructure view for panel board with 35 percents of natural latex

4.0 Conclusion

The use of coconut coir with added recycled rubber in natural latex, were found to be suitable for use as sound absorbing. With exists factor to the sample stated already to strengthen more decision that composition of 25% and 35% natural latex is suitable to be made as sound absorbing material because it have good characteristic such as light, porous, low density and also cellular which this factor cause have a good in sound absorption. As a pollution prevention for the automotive industry, for instance, the auto repair business which involves handling and managing a variety of regulated materials, such materials will reduce the harmful rate to both the auto technician's health and the environment. Additionally, with using this material (coconut coir and recycled rubber) as sound absorber it can reduce pollution rate rampant which this pollution is from industrial wastes and waste living materials, which known that this material is natural, renewable and is a waste produced during processing of coconut coir and tyre tube which does note pose harm to human health.. Therefore, apart from the automotive industry, this material make either alternative to reduce pollution rate and it can also be applied to interior lining for apartments, aircrafts, ducts, enclosures, sub flooring, interior surface for wall which can to reduce the reverberant.

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