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SOUND ABSORPTION FOR CONCRETE CONTAINING POLYETHYLENE TEREPHTHALATE WASTE

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Abstract
Plastic solid waste generation increases every year with the current consumption habit prevalent in society nowadays. The improper disposal of plastic has been a major concern to the environment as it is not easily degradable. The issue of environmental pollution caused by polyethene terephthalates (PET) has been extensively discussed and the best solution proposed is recycling. Fibre Concrete (FC) was a composite material resulting from the addition of fibres to ordinary concrete. The objective of this research was to determine the acoustic absorption coefficient of concrete containing 0%, 0.5%, 1.0%, 1.5%, 2.0% of PET fibre compared to normal concrete. In this study, straight and irregular recycled PET fibres were used. The fibres were simply cut from PET plastic bottles. The length and width of recycling PET fibre were fixed at 25 mm and 5 mm respectively. The chosen percentages were 0.5%, 1.0%, 1.5% and 2.0% of fiber. A water-cement ratio of 0.45 was acceptable for all ranges. The tests that were conduct include the slump test, compression test, and impedance tube test. The specimens were tested on day 7 and day 28 after the concrete is mixed. The end of this research results for the compressive strength of normal concrete after 28 days of curing was 48.2 MPa while concrete with 0.5% PET, 1.0 % PET, 1.5% PET and 2.0% PET recorded a compressive strength of 50.9 MPa, 49.8 MPa, 47.9 MPa and 46.6 MPa respectively. The result of the impedance test received at age 28 days was 0.13 for normal concrete and 0.16, 0.14, 0.16 MPa, and 0.14 for 0.5% PET, 1.0 % PET, 1.5% PET and 2.0% PET respectively. In conclusion, the aspect ratio of the fibres to the concrete must be correlated to avoid reducing durability. In conclusion, the addition of 0.5% PET recycled fibre into concrete showed the best value in terms of strength and 0.16 for the sound absorption coefficient.

Keywords-- PET fibre concrete, sound absorption, impedance tube test

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INTRODUCTION

Nowadays, the dramatic increase in noise intensity is affecting the lives of many people in urban societies and rural areas. Noise arising from different sources such as road traffic, factories and machinery is not only uncomfortable for humans but is also hazardous to human health [1]. The highest and lowest equivalent noise levels were recorded at commercial areas (96 dB (A)) and residential areas (52 dB (A)), respectively. The background noise level (L90) was the highest and lowest at commercial areas (77 dB (A)) and residential areas (44 dB (A)), respectively while the peak value (L10) was the highest and lowest at commercial areas (96 dB (A)) and residential areas (56 dB (A)). [2].

Besides that, the quantity of plastic consumption has been increasing at a fast rate annually according to [6 – 8]. Polyethylene terephthalate (PET) is one of the most common consumer plastics used in the world, especially for the manufacturing of beverage containers and other consumer goods [9-11]. The production of PET exceeds 6.7 million tons/year and has been dramatically increasing in the Asian region due to recent increasing demands in China and India [5]. Problems concerned with the management of numerous different types of waste, the scarcity of space for landfills and ever-increasing production costs have led to the search for alternative solutions such as the use of waste in concrete mixes [12-14].
According to [15], cement-wood composite was investigated as a potential sound absorbing material in highway sound barriers to reduce traffic noise emission. An effective solution to dampen sound waves is through the use of porous media. Various studies have been conducted to understand the noise-reducing mechanism within porous media.[4]. It has been found that the use of aggregates measuring 4–8mm and a water-cement ratio of less than 0.30 for concrete achieves an effective sound absorption capacity without significant loss in compressive strength.

The absorption coefficient of PET aerogels increases with an increase in PET fibre concentration [16]. Among the different fibre concentrations investigated, the 2.0 wt.% PET aerogels demonstrated the best acoustic absorption results and were about 20–30% better than that of the 1.0 wt.% aerogels across the entire range of frequencies [16-19]. A higher PET content in concrete will decrease the acoustic effect of the concrete matrix. Therefore, this study aims to prove that the density of PET in concrete affects its acoustic properties.

The main objective of this article was to investigate the acoustic effect of recycled hardened concrete containing PET fibres. To accomplish the goal, the following specific objectives are shown as follows; i) To determine the acoustic absorption coefficient of concrete containing 0%, 0.5%, 1.0%, 1.5%, 2.0% of PET fibre compared to normal concrete.; ii) To evaluate the percentage of effectiveness of PET concrete for acoustic absorption.

The noise that exceeds the permissible exposure limit harms the environment and human health. Besides that, the use of recycled PET fibres in concrete mixes can help reduce environmental issues. This is done by reducing the growing amount of PET plastic bottles thrown into landfills. Therefore, it is important to study the optimum amount of recycled PET fibres which can be added to a concrete mix so that it would be suitable for use in the construction industry.

Noise Pollution & Polyethylene Terephthalate（PET）

Noise Pollution

a) Introduction

Noise pollution had become one of the most serious environmental problems in front of the people worldwide, this situation usually causes various disorders and greatly affects the work efficiency and living standards of human beings [19]. [2] stated that the variations and comparison of equivalent noise level at commercial areas exceed the World Health Organization (WHO) standards. According to (WHO) the threshold level for A-weighted sound pressure level in the commercial area is 70 dBA. Noise pollution can affect the endocrine system, and immune system [17].

b) Sound Protection

The noise was mainly caused by the contact of tyres on the road, especially for speeds exceeding 40 km/h [18]. Therefore, the need for appropriate countermeasures has appeared. One of these methods consists in placing sound-absorbing panels as a noise barrier. The methods consist of placing sound-absorbing panels as a noise barrier. Such panels can be made from plastic composite materials [20-24] or materials containing recycled rubber [21-26].

c) Sound Absorption for Concrete

Pure concrete has very poor in sound absorption. According to [26], the addition of biochar resulted in a linear decrease in concrete density, with a concrete density of 1454 kg/m3 for 15 wt% biochar. The addition of biochar also considerably increased the sound absorption coefficient of concrete across the range of 200–2000 Hz, as it created pore networks within the concrete. When the density of concrete is low, the sound absorption of concrete will increase.

Polyethylene Terephthalate (PET)

a) Introduction

Polyethylene terephthalate (PET) was one of the most common consumer plastics used. Figure 2.1 (a) and Figure 2.1 (b) show recyclable PET plastic bottles.

(a)

(b)

Figure 2.1. (a) and (b): Recycled polyethylene terephthalate (PET) plastic bottles

Polyethylene terephthalate (PET) widely employed as a raw material to manufacture products such as blown bottles for soft drinks and containers for the packaging of food and other consumer good [11]. PET bottles had taken the place of glass bottles as a storing vessel for beverage due to the material was lightweight and the ease of handling and storage. The exponential growth in plastic waste from packaging incited a search for alternative means of recycling [22].

The sorted post-consumer PET waste was usually crushed, pressed into bales and offered for sale to recycling companies. Recycling companies will further treat the post-consumer PET waste by shredding the material into small fragments. PET flakes are used as raw material for a range of products. Thus, a lot of PET waste is available for recycling applications.

b) Properties of Polyethylene Terephthalate (PET)

PET was a hard, stiff, strong and dimensionally stable material that was usually used as packaging for carbonated beverages, water and many food products. Its crystallinity varies from amorphous to high crystalline. Polyethylene terephthalate polyester (PETP) can be highly transparent and colourless but thicker sections are usually opaque and off-white. Polyethylene terephthalate was produced from ethylene glycol and dimethyl terephthalate as shown in Figure 2.2[27]. PET consists of polymerized units of the monomer ethylene terephthalate, with repeating $C_{10}H_8O_4$ units [28]. Table 2.1 shows mechanical properties and physical properties of PET [28]

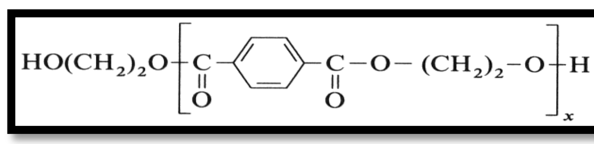


Figure 2.2. Chemical composition of polyethylene terephthalate fibre[27]

Table 2.1. Properties of PET [28]

Mechanical Properties	
Coefficient of friction	0.2-0.4
Hardness – Rockwell	M94-101
Poisson's ratio	0.37-0.44 (oriented)
Tensile modulus (GPa)	2-4
Tensile strength (GPa)	80
Physical Properties	
Density (g.cm^{-3})	1.3-1.4
Flammability	Self-Extinguishing
Limiting oxygen index (%)	21
Refractive index	1.58-1.64
Resistance to ultra-violet	Good
Water absorption - equilibrium (%)	<0.7
Water absorption - over 24 hours (%)	0.1

[29]discussed the thermal and mechanical properties of virgin PET, recycled PET and their blends. The study of thermal properties was based on differential scanning calorimetry (DSC) and thermogravimetric analysis (TGA). The tensile tests at ambient and elevated temperature were used to study the mechanical properties. Granules of three different grades of PET were supplied by Leading Synthetics Pty Ltd such as; i)100% virgin PET; ii)100% recycled food-grade PET; iii)100% recycled fibre grade PET.The procedures were the blends of virgin PET and recycled food-grade PET that was prepared in the following weight ratios; i) 90% virgin PET 10% recycled PET; ii)80% virgin PET 20% recycled PET; iii) 70% virgin PET 30% recycled PET; iv)50% virgin PET 50% recycled PET.

c) Advantages and Disadvantages of PET

Severe research had discussed the advantages and disadvantages of PET. The advantage of PET is very useful to business and society, under other condition the PET is harmful to health and the environment.

The growth in the use of plastic is due to its beneficial properties which include extreme versatility and ability to be tailored to meet specific technical needs, good safety and hygiene properties for food packaging, durability and longevity, resistance to chemicals, water and impact, excellent thermal and electrical insulation properties, comparatively lesser production cost and superior aesthetic appeal [25].

The disadvantages of used plastic include the use of potentially harmful chemicals which are added as stabilizers or colourants, environmental risks and their impact on human health [30]. Most plastics were non-degradable or take a long time to break down.

Method and Laboratory work

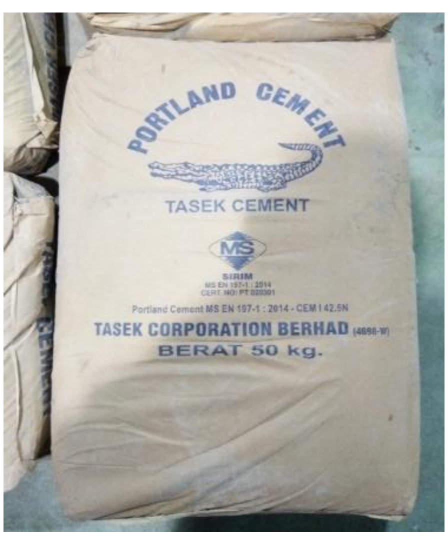
Material Preparation

Polyethylene terephthalate (PET) plastic bottles are collected and clean before being cut into fibres form. The procedures involved in cutting the recycled PET bottles are followed. Figure 3.1 shows the cutting processes of PET.

After the bottles were collected, the PET plastic bottles are clean and dry to get rid of any impurities. Next, the recycled PET bottles were cut into smaller pieces to make the next process easier. Finally, the recycled PET pieces were cut into the desired size and shape which was 25 mm in length and 5 mm in width.

Figure 3.1. The procedures involved in cutting the recycled PET

The ordinary Portland cement (OPC) used in this study the cement which was based on [13] with a grade of 42.5 N. Besides that, this type of cement is normally used for general purposes in construction work. The cement can be classified as(OPC) which was one of the several types of cement being manufactured throughout the world. This type of cement was usually used for general purposes in concrete construction. The chemical compounds in the cement include lime, silica, alumina, iron and sulphate. Magnesium is present in small quantities as an impurity associated with limestone. This type of cement was available in quantities of 50 kg per bag. Figure 3.2 shows the type of original Portland cement (OPC) that use in this study.



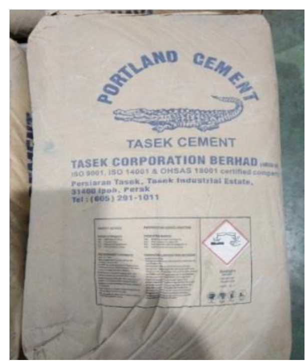


Figure 3.2. Cement

The coarse aggregates used was pass through a 20 mm sieve pan and later retain on a 5 mm sieve pan. The coarse aggregates used was ground granite which was obtained from the sieve analysis grading limits according to [14], the specification for aggregates from natural sources for concrete. All the aggregates are air-dried for 24 hours before mixing the concrete.

Figure 3.3. Coarse aggregates

The fine aggregates or sand used in this experiment has to go through a sieving process which complied with [14], the specification for aggregates from natural sources for concrete. The fine aggregates have used the sand that passes through a 5 mm sieve pan and later retains on a 0.075 mm sieve pan. All the fine aggregates have naturally dried in air for 24 hours before being used for mixing concrete. An example of fine aggregates as shown in Figure 3.3.

Figure 3.4. Fine aggregates

Specimen Preparation

The total number of samples was 60 specimens. Where 30 of them were cube for compression test and the rest were cylinders for the impedance tube test. In this research, there were five types of mixes that were prepared. First, there were control specimens prepared with 0% volume of fibres followed by 0.5%, 1.0%, 1.5% and 2.0% of recycled PET fibres added into the mix. The concrete properties were tested after a curing period of 7 days and 28 days respectively. Table 3.1 shows the total number of cylinder samples prepare.

Table 3.1. Total number of specimens for the compression test and impedance tube test.

Test	Compression test		Impedance tube test	
PET Content (%)	7 days	28 days	7 days	28 days
0	3	3	3	3
0.5	3	3	3	3
1.0	3	3	3	3
1.5	3	3	3	3
2.0	3	3	3	3
Total	60			

Mix design was the process conducted to select the most suitable ingredients of concrete and to determine their relative quantities to achieve the desired strength. In this study, the concrete proportioning was design using the Trial Mix. Table 3.2 shows the proportion of the materials need in this study.

Table 3.2. Mix design of concrete

Quantities	Cement (kg)	Water (kg)	Fine aggregates (kg)	Coarse aggregates (kg)	PET fibres (kg)
Per m³	500.00	225.00	505.00	1175.00	420.00

The purpose of the present investigation was to study the acoustic effect of recycled PET fibres in concrete. The 100mm x 100mm x 100mm cube mould was used for the compression test and the cylinder mould measuring 100 mm ø x 150 mm was used for the impedance tube test. Tests on the specimens were conducted using different percentages of recycled PET fibres by volume of concrete [23]. There are also specimens that did not contain any recycled PET fibres which are label as normal. The target means strength was 35Mpa in this research Figure 3.2 show the condition of the moulds that were used in this research.

Specimen Testing Method

The compressive strength of concrete samples was measured after the samples being removed from the water at the specified curing age. The wet perimeter and grit were wiped off and the concrete cube samples were placed in the compressive test machine as denoted in Figure 3.5. The test was carried out on concrete specimens measuring 100 mm x 100 mm x 100 mm. Certain loads were applied continuously with a constant loading rate of 7 kN/s. The tests were conducted after curing periods of 7, and 28 days.

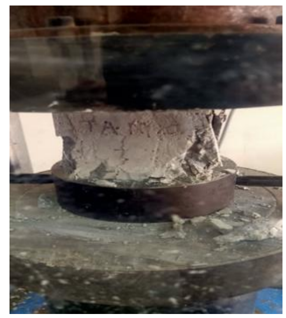


Figure 3.5. Sample being test on compression machine

Impedance tube used in this research is accompanied by AFD 1001 software which has several steps to carry out the test. Steps to use the software analysis consists of several parameters. Figure 3.6 shows an example of the impedance tube and setup the sampling process. There isa total of 30 samples cylinder sample with diameter 100mm were tested by using the impedance tube. The range for low frequency is between 250 Hz to 1750 Hz. This test was conducted at an acoustic laboratory using the impedance tube and the AFD1001 software.

Figure 3.6. (a) Impedance tube and (b) Setup sample process

RESULT AND DISCUSSION

This chapter discusses the analysis of the results obtained from the laboratory data. It describes the results of the fresh concrete test and the hardened concrete test. Fresh concrete samples underwent the slump test whereas hardened concrete samples were put through the compressive strength test and the impedance tube test. The analysis was done according to the parameters used in controlling the effect of the percentage of recycled PET fibres in concrete under curing periods of 7 days and 28 days, respectively.

The water-cement ratio was 0.45 for every concrete mix used in this study. The results were presented in the form of tables and graphs. In this research, the analysis of the results was based on the slump test for normal concrete and recycled PET fibre concrete, the compressive strength test for normal concrete and recycled PET fibre concrete and the impedance tube test for normal concrete and recycled PET fibre concrete.

Slump Test

The slump test was conducted to examine the workability of fresh concrete mixtures. The effect of PET fibre on concrete properties was observed and determined. The slump test is one of the most common tests applied to fresh mixes to obtain the consistency and workability of a concrete mix. Fortunately, the slump test included the effects of all parameters that affect the workability of a mix. Figure 4.1 shows the slump test results of normal concrete and PET fibre concrete.

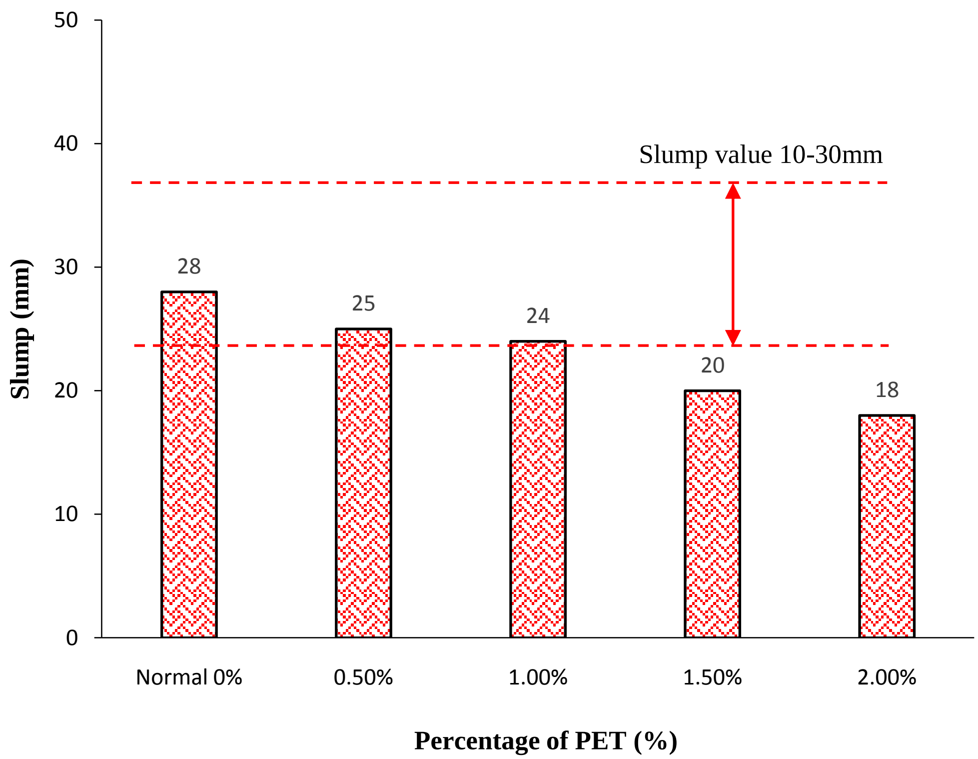


Figure 4.1. Slump test of normal concrete and PET fibre concrete

The slump values decreased for concrete samples containing 0.50% to 2.0% of PET fibre. The slump value in this research ranged between 10mm to 30mm.

The slump values of PET fibre concrete mixtures ranging from 0.50% to 2.0% were 28, 25, 24, 20, and 18mm respectively as compared to normal concrete which had a slump value of 28mm. All the slump values fell in the range of 10 – 30 mm according to the DOE method.

Dried Density Test

The results are presented in a graph as shown in Figure 4.2. According to BS EN 12390-7:2009, the standard hardened density of normal concrete lies within the range of 2300 kg/m3 to 2500 kg/m3 as shown by the dotted line in Figure 4.2. However, the hardened density of PET concrete in this study increases with curing age but decreases with the increasing volume of PET.

The hardened density of PET concrete decreases continuously as the percentage of PET increases.Concrete specimens containing PET recorded densities less than 2400 kg/m3 at a curing age of 7 days and 28 days.

PET concrete showed the lowest density when 2.0% of PET was added to the concrete at all curing ages. The density of PET concrete at 7 and 28 days decreased to 65 kg/m3 (2.81%), and 92 kg/m3 (8.00%), respectively.

At 28 days of curing age, the highest density of 2352 kg/m3 was achieved by normal concrete. As shown in Figure 4.2, increasing the percentage of PET will cause a decrease in concrete density.

From the graph, it can be observed that the density of PET concrete was less than 2300 kg/m3 when 1.5% (2275 kg/m3) and 2.0% (2260 kg/m3) of PET was added to concrete. This was because the density of PET is lower than cement, coarse aggregate and fine aggregate.

The densities of PET, cement, coarse aggregate and fine aggregate are 420 kg/m3, 500 kg/m3, 1175 kg/m3 and 505 kg/m3, respectively. According to [31], the range of normal concrete density lies between 2300 kg/m3 to 2500 kg/m3.

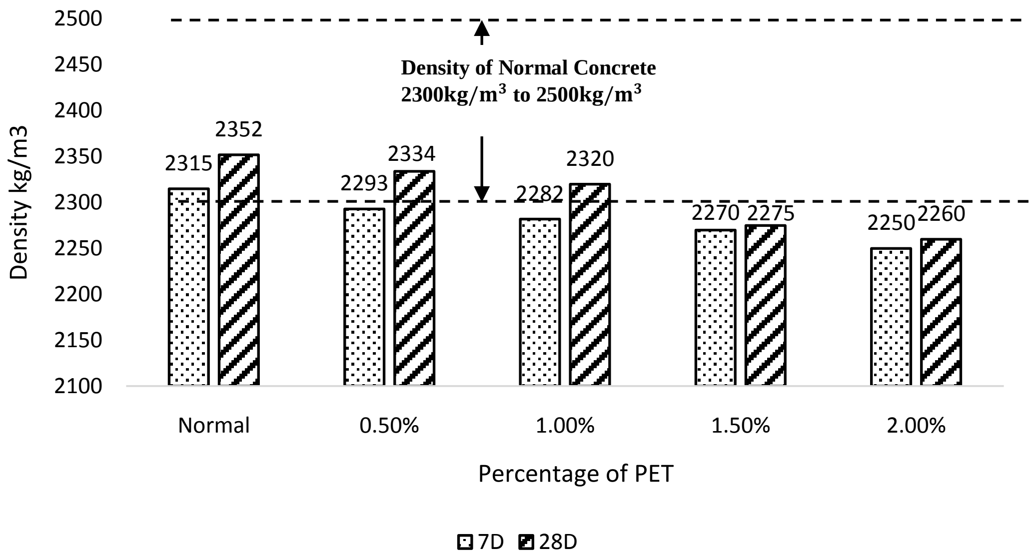


Figure 4.2. Density of concrete at different percentage

Compressive Strength Test
The compressive strength of concrete can be presented as the performance of concrete subjected to an ultimate load. The cube specimens were subjected to a compressive strength test to obtain the ultimate strength of concrete. This test was conducted on concrete samples cured for 7 days and 28 days only. The compressive strength test was carried out to find out the ultimate strength of normal concrete and concrete samples containing0.5%, 1.0%, 1.5% and 2.0% of PET fibre as presenting Figure 4.3 (a) to figure 4.3 (e)

(a) (b)

(c) (d)

(e)

Figure 4.3. Real observation of cube specimens: (a) 0% PET fiber, (b) 0.5% PET fiber, (c) 1.0% PET fiber, (d) 1.5% PET fiber, (e) 2.0% PET fiber

There were 3 samples for each batch, and the percentages used were 0, 0.5, 1.0, 1.5 and 2.0. Table 4.2 shows that the strength of concrete increases as the PET fibre content increases until a certain percentage. After that, the compressive strength of concrete starts to drop.

After a curing period of 7 days, concrete mixtures containing 0%, 0.5%, 1.0%, 1.5% and 2.0% of PET fiber obtained compressive strength values of 33.6MPa, 35.5MPa, 34.0MPa, 30.7MPa and 28.8 MPa. There was a significant increase in the compressive strength of concrete when 0.5% of PET fibre was added to the concrete mixture. The compressive strength of PET fibre concrete started to drop when 0.5% to 2.0% of PET fibre was added to concrete. The graph in Figure 4.4 depicts the compressive strength of concrete cured for 7 days.

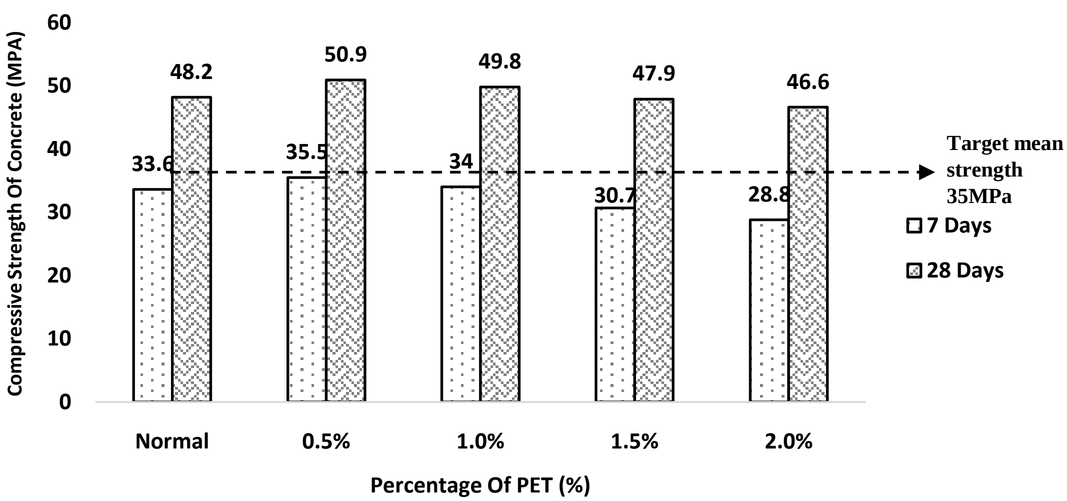


Figure 4.4. Compressive strength versus percentages of PET fibers

The trend of compressive strength of concrete samples at a curing age of 28 days proved to be similar to the samples at a curing age of 7 days. The concrete mixtures containing 0%, 0.5%, 1.0%, 1.5% and 2.0% of PET fiber obtained compressive strength values of 48.2MPa, 50.9MPa, 49.8MPa, 47.9MPa and 46.86MPa, respectively. There was a significant increase in the compressive strength of concrete when 0.5% of PET fibre was added to the concrete mixture. The graph pattern of concrete samples cured for 28 days was the same as the graph pattern obtained by concrete samples cured for 7 days. The compressive strength of PET fibre concrete started to drop when 0.5% to 2.0% of PET fibre was added to the concrete mixtures. The graph in Figure 4.4 denotes the compressive strength of concrete at 28 days. The compressive strength of PET concrete significantly improves as the curing period increases. The longer the curing period, the higher the compressive strength of concrete.

In this study, the highest strength of 35.5MPa was obtained by concrete containing 0.5% of PET fibre at 7 days, as shown in Figure 4.4. The maximum strength of 0.5% PET fibre concrete at 28 days was 50.9MPa. The compressive strength of concrete started to drop when 0.5% to 2.0% of PET fibre was used. This problem will decrease the adhesive strength between the surface of PET and cement. [23]. According to [32] the area between fibre surfaces is the weakest point in concrete; microcracks and macrocracks caused by compression loading easily appear in this area. On the other hand, [9 – 10] showed that plastic measuring 30 mm in length exhibited improvement in terms of compressive strength compared to PET fibre measuring 10 mm and 20 mm in length. Therefore, the development of PET concrete in this research was comparable to that of normal concrete.

Impedance Tube Test

The impedance tube test was carried out to test the acoustic performance of PET concrete. When the sound wave strikes a material, a portion of the sound energy is reflected, another portion is absorbed by the material while the rest is transmitted. 30 samples measuring 100mm in diameter were tested. 15 were tested at 7 days of curing age while the remaining were tested at 28 days. The influence of PET fibre on concrete was tested with low-frequency sound waves in an impedance tube. The acoustic measurement was done in the low-frequency range (150 Hz to 1500 Hz). The results were analyzed using the AFD-1001 Acoustic Tube Transfer Function software in the ratio of the amplitude of the reflected wave to the incident wave. Figure 4.5 shows the sample testing in the impedance tube.

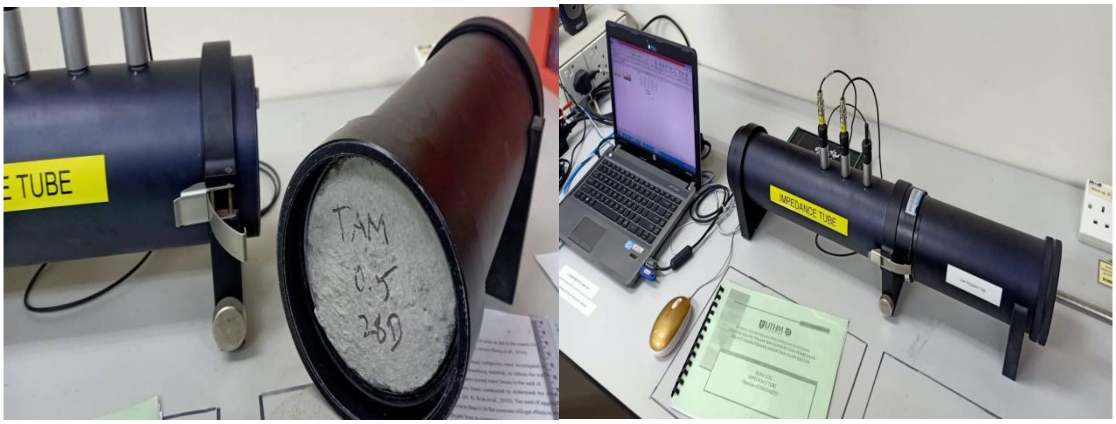


Figure 4.5. Shows the sample testing in the impedance tube.

During the impedance tube test, the sound is generated by a loudspeaker at one end of the tube and the concrete specimens are placed at the other end of the tube. Thus, sound absorption ability is measured by in-plane waves. A sound wave passes through the material where a portion of the sound wave hits the reflective wall and changes direction. The sound absorption coefficient refers to the absorbed friction on the concrete specimens.

The recorded values of the sound absorption coefficient by PET concrete samples. It was observed that all mean values were above the sound absorption coefficient of the normal sample. This proved that PET fibre concrete has better acoustic performance compared to the normal concrete sample.

The average sound absorption coefficient for each batch and the frequency samples were 250-1750 Hz. Normal concrete shows the lowest sound absorption coefficient compared to PET concrete. There was no significant difference compared to the normal concrete mixture. Hence, it is proven that PET fibre contributes to acoustic absorption.

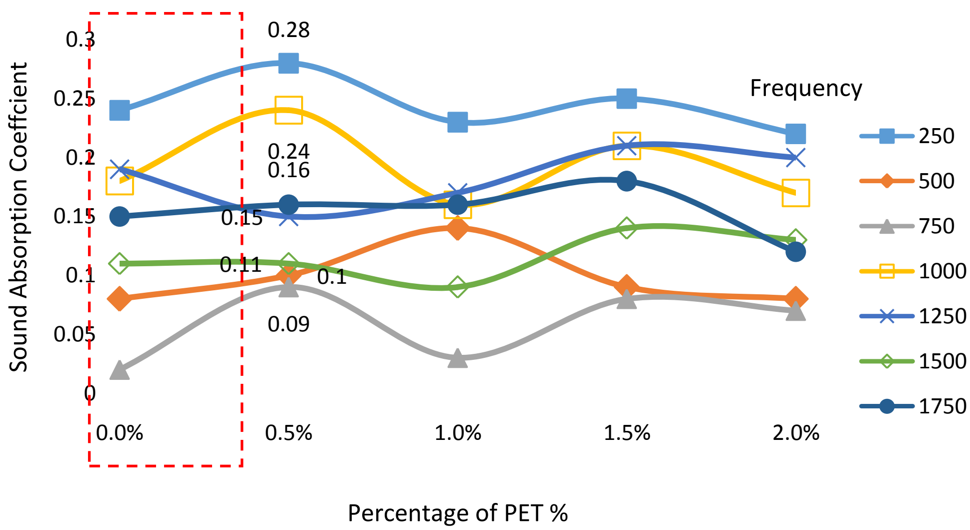


Figure 4.6. Sound absorption coefficient of the PET concrete mixture at 7 days

Figure 4.6 represents the value of sound absorption coefficients recorded by the PET concrete samples at 7 days. The highest sound absorption coefficient recorded by all PET concrete was at a sound frequency of 250Hz. This is because the sound absorption coefficient of concrete is correlated with frequency. [33]

It could be observed that all mean values were above the sound absorption coefficient of the normal sample. This is similar to the results obtained by PET concrete samples at 7 days. This proved that PET fibre concrete had better acoustic performance compared to the normal sample.

The normal concrete obtained the lowest sound absorption coefficient compared to PET concrete. There was no significant difference compared to the normal concrete mixture. Hence, this indicates that PET fibre is capable of a certain degree of acoustic absorption.

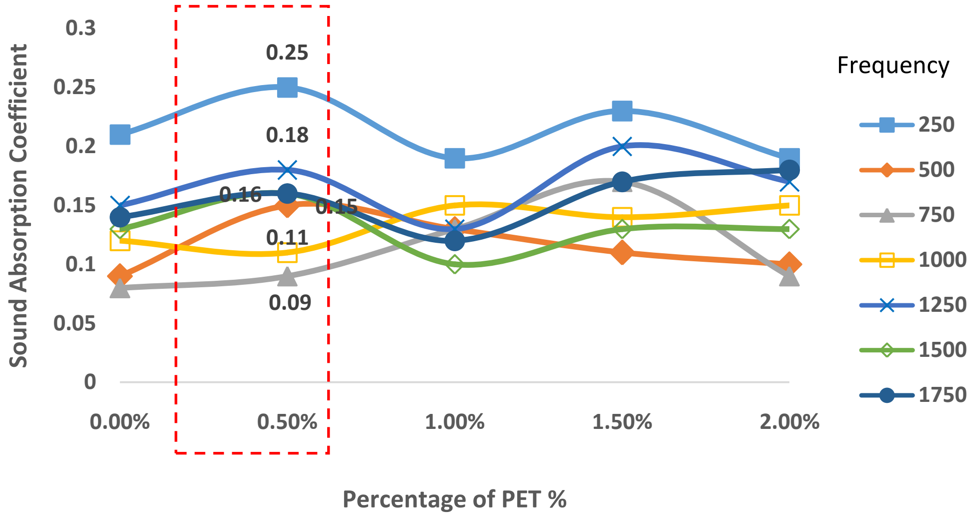


Figure 4.7. Sound absorption coefficient of the PET concrete mixture at 28 days

Figure 4.7 presents the sound absorption coefficient values recorded by the PET concrete samples. All sound absorption coefficients recorded were compared to that of the normal concrete sample. The highest sound absorption coefficient recorded by all percentages of PET concrete occurred at a sound frequency of 250Hz. However, the highest sound absorption coefficients for both the normal concrete sample and the PET concrete samples were recorded at 1750Hz. Figure 4.7 also reveals that the sound absorption coefficient was greater than normal concrete in the range of 250 – 1750Hz. This is due to the higher concrete density. According to [34], porous concrete significantly increases the reflection of sound waves in the concrete structure itself and dissipates sound energy into heat energy due to porosity which is good for acoustic performance.

Discussion

All the data from the tests conducted are summarized in Figure 4.8 and Figure 4.9. The summarized data include density (kg/m3), compressive strength (MPa) and sound absorption coefficient.

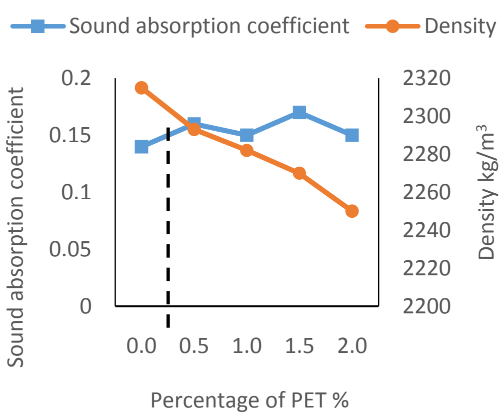


Figure 4.8 (a). Sound absorption coefficient versus density at 7 days

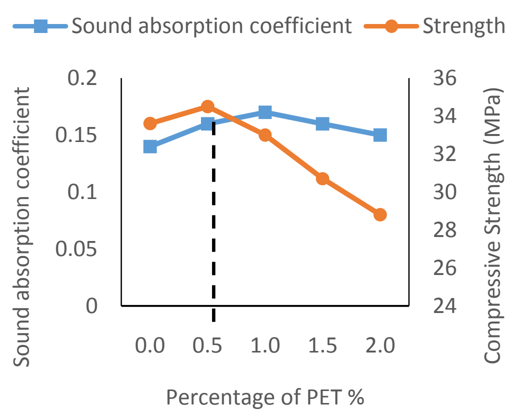


Figure 4.8 (b). Sound absorption coefficient versus compressive strength at 7 days

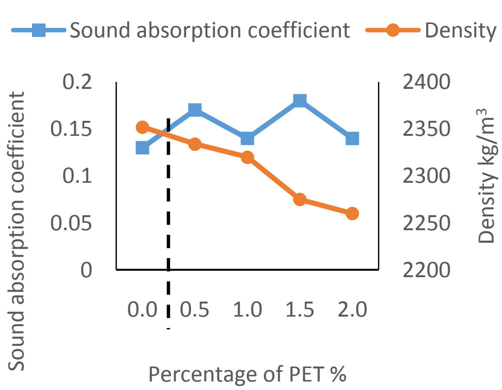


Figure 4.9 (a). Sound absorption coefficient versus density at 28 days

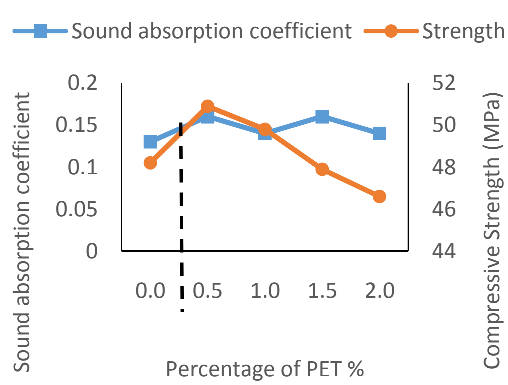


Figure 4.9 (b). Sound absorption coefficient versus compressive strength at 28 days

Based on all figure above, the compressive strength only increased when 0.5% of PET fibre was added to the concrete sample. The resulting compressive strength values of samples containing 0.5% of PET were 35.5MPa and 50.9MPa at a curing age of 7 days and 28 days, respectively. In the impedance tube test, the highest sound absorption coefficient recorded of 0.17 was recorded by a concrete sample containing 1.5% of PET fibre at 7 days. Besides that, the highest sound absorption coefficients recorded were 0.16 and 0.17 when 0.5% and 1.5% of PET were used, respectively, at 28 days. Meanwhile, the sound absorption coefficients of normal concrete at 7 days and 28 days were 0.14 and 0.13, respectively. It was observed that the sound absorption coefficient increases for PET fibre concrete compared to normal concrete.

Besides that, the decrease in concrete density leads to an increase in the sound absorption coefficient. According to [1], material properties vary with frequency and are also a function of material thickness, density and pore size. Void ratio leads to higher peak values in acoustic absorption coefficients and the peak of the coefficient shifts to higher frequencies[34-36].

CONCLUSION

In the impedance tube test, the highest sound absorption coefficient in 7 days of curing age was 0.16 when 0.5 and 1.5% of PET added into the concrete. Besides that, the sound absorption coefficient was recorded 0.17 when 1.5% of PET was added to concrete for 28 day of curing which is showed good sound absorption. Based on the tests that had been conducted in this research, the optimum percentage of recycled PET fibres to be added into concrete was 0.5%. Even though the slump test showed a decrease while the compressive strength test showed some fluctuation, the addition of 0.5% PET recycled fibre into concrete showed the best value in terms of strength. The optimum for sound absorption coefficient is 0.5% of PET recycled fibre into the concrete. Since 0.5% of PET has contributedtothe compressive strength of concrete while 1.5% of PET will decrease in strength even the sample had a significant higher about 0.1 of the sound absorptions.

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