Application of Pineapple Leaf Fiber reinforced Vinylester Based Hybrid Composite in Acoustic Barrier

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***Abstract*- Natural fibre based composites are under intensive study due to their eco friendly nature and peculiar properties. The advantage of natural fibres is their continuous supply, easy and safe handling, and biodegradable nature. Although natural fibres exhibit admirable physical and mechanical properties, it varies with the plant source, species, geography, and so forth. Pineapple leave fibre (PALF) is one of the abundantly available waste materials in India and has not been studied yet. The work has been carried out to experimental study on the application of Pineapple Leaf fiber reinforced Vinylester based hybrid composites in acoustic barrier. These results are compared with those of a similar set of glass fiber reinforced Vinylester based hybrid composites. It is evident that the values of Sound Pressure level (SPL) obtained in case of a Single cylinder 4S petrol engine, Vertical 4-S Diesel Engine and Air Compressor shows that the reduction in SPL can be achieved in its vicinity with maximum reduction at 1.5m from the source and a minimum reduction at 0.5m from the source for Pineapple leaf fiber (PALF) - Vinylester composites, thus after conducting the study we can say that the composites used can be recommended as a noise barrier also, and if the condition is erosion driven the composite material can sustain its property of reducing the Sound Pressure Level (SPL) dominantly and thus avoiding the sound levels. These instructions give you guidelines for preparing papers for the International Journal of Innovative Research in Technology (IJIRT). Use this document as a template if you are using Microsoft Word 6.0 or later. Otherwise, use this document as an instruction set. The electronic file of your paper will be formatted further at International Journal of Innovative Research in Technology. Define all symbols used in the abstract. Do not cite references in the abstract. Do not delete the blank line immediately above the abstract.**

Index Terms- acoustic barrier, Natural fibre, Pineapple leaf fiber (PALF), Polymer matrix composites, PALF based Hybrid composite, sound pressure level (SPL) Vinylester.

I. INTRODUCTION

Finding effective methods of noise control is an on going concern in manufacturing or a commercial locality. This is because excessive noise levels and environmental impact of such levels is the concern of every country. Efforts are on to develop various systems keeping in mind the environment around us follows the principles and practices with an obvious development of quieter technology. An acoustic barrier is an exterior structure designed to protect inhabitants from noise pollution. Acoustic barriers are the most effective method of mitigating industrial noise sources by absorbing the incident sound. Acoustic absorption refers to the process by which a material, structure, or object takes in sound energy when sound waves are encountered, as opposed to reflecting the energy. Part of the absorbed energy is transformed into heat and part is transmitted through the absorbing body. The energy transformed into heat is said to have been lost as shown in Figure 1.

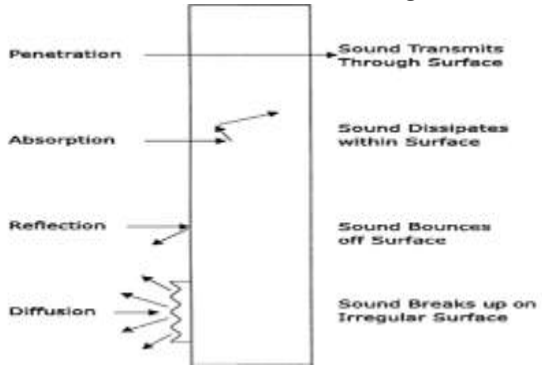

Figure 1. An acoustic barrier with properties

Table 1: Description of composite materials

Fiber material		Additive	Nomenclature
Natural fiber	Pineapple leaf	Fly ash 20%	NPF2
	Pineapple leaf	Red mud 10%	NPR1
	Pineapple leaf	Red mud 20%	NPR2
	Pineapple leaf	Alumina 20%	NPA2
	Pineapple leaf	Silicon carbide 20%	NPS2
Artificial fiber	E glass	Fly ash 20%	AEF2
	E glass	Red mud 10%	AER1
	E glass	Red mud 20%	AER2
	E glass	Alumina 20%	AEA2
	E glass	Silicon carbide 20%	AES2

The material selected had to prevent noise at the source and leading to passive noise cancellation. So a suitable combination of composites was considered for the study. Although the present work is concentrated primarily on the pineapple leaf fiber (PALF) reinforced composites, their absolute assessment can only be made on comparing them with a related set of composites with some conventional artificial fiber. In the present work, an E-glass fiber has been used as the reinforcing material in the composites.

II. PROCEDURE

The layout of the source will be marked at a distance of 1m around the source. The sensor is calibrated before the measurements are taken. The sensor will be placed at the marked location and the source is switched ON. The readings are taken after the value stabilizes. The procedure is repeated for the remaining points. The readings are recorded and tabulated, then the highest recorded value will be considered which corresponds to the location where the SPL is high from the source.

After pointing out the location with highest SPL values the layout will be marked to take the readings at considerable distance form source in a straight line, the marking will be done at a distance of 0.5m, 1m, 1.5m along a straight line perpendicular to the source as shown in Figure 2. The sensor will be placed at these locations and the SPL will be recorded, then the composite materials will be placed at a distance of 0.5m, 1m, 1.5m away from the source and the sensor will be placed next to these composite materials and the readings of the sound pressure level will be recorded. The same procedure will be followed for all chosen composite materials.

Figure 2: Layout marking for SPL readings

The study will be conducted for no load and full load condition for Air Compressor, Single cylinder 4S petrol engine, Vertical 4-S Diesel Engine and Diesel Engine with electrical loading.

III. RESULTS AND ANALYSIS

1. Single cylinder 4-stroke petrol engine

Figure 3: Single cylinder 4-stroke petrol engine

Engine details		Rope brake dynamometer	
BHP	: 2.5HP	Make	: TTE
No. Of cylinders	: ONE	Brake drum	: Mild steel
Compression ratio	: 4.67:1	Rope diameter	: 10mm
Bore	: 70 MM	Hanger weight	: 0.5 Kg
Stroke	: 66.7 MM		
Type	: Air cooled		
Air drum orifice	: 20 MM		
Make	: GREAVES		
Speed	: 3000 RPM		
Type of ignition	: Fly wheel magneto		
Type of starting	: Kick start		

Table 2: Sound pressure level (SPL) for Single cylinder 4-stroke petrol engine (no load)

SPECIMEN	DISTANCE FROM SOURCE		
	0.5m (73 dB)	1m (70 dB)	1.5m (66 dB)
NPF2	60	56	54
NPR1	59	56	53

NPR2	58	55	51
NPA2	59	57	56
NPS2	60	58	57
AEF2	60	58	57
AER1	59	57	55
AER2	60	59	58
AEA2	60	58	57
AES2	60	59	58

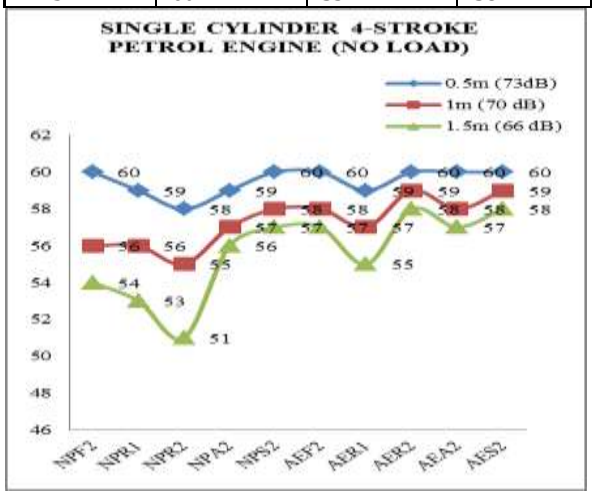

Figure 4: Variation of SPL for Single cylinder 4 stroke petrol engine (no load)

Table 3: Sound pressure level (SPL) for Single cylinder 4-stroke petrol engine (full load)

SPECIMEN	DISTANCE FROM SOURCE		
	0.5m(79 dB)	1m (74 dB)	1.5m (69 dB)
NPF2	70	65	62
NPR1	65	61	60
NPR2	63	60	58
NPA2	66	64	62
NPS2	67	63	63
AEF2	69	66	63
AER1	65	63	62
AER2	64	62	61
AEA2	69	66	62
AES2	71	65	63

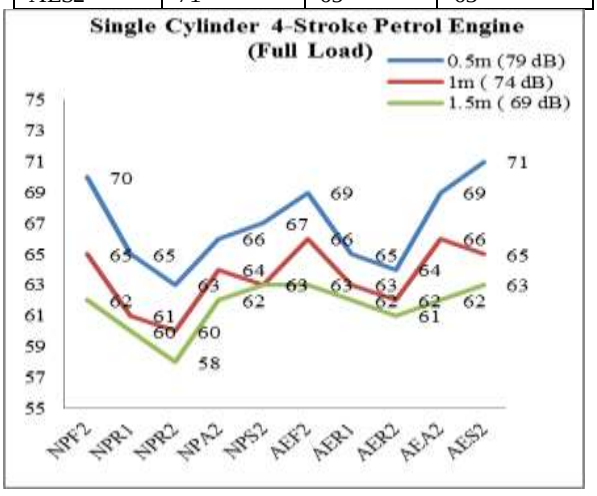

Figure 5: Variation of SPL for Single cylinder 4-stroke petrol engine (full load)

2. Vertical 4-stroke diesel engine with electrical loading

Figure 6: Vertical 4-stroke diesel engine with electrical loading

EINGINE DETAILS		GENERATOR	
Rated power	: 5 HP	Volts	: 230 volts
Rated speed	:1500 rotation/minute	Amperes	:220 amperes
Power	: 3.6 kilo watt	KVA	: 5 amperes

Table 3: Sound pressure level (SPL) for Vertical 4-stroke diesel engine (no load)

SPECIMEN	DISTANCE FROM SOURCE		
	0.5m (72 dB)	1m (70 dB)	1.5m (68 dB)
NPF2	60	58	57
NPR1	59	57	55
NPR2	58	56	54
NPA2	60	59	58
NPS2	60	58	57
AEF2	61	59	57
AER1	61	59	58
AER2	60	58	57
AEA2	60	59	57
AES2	61	59	58

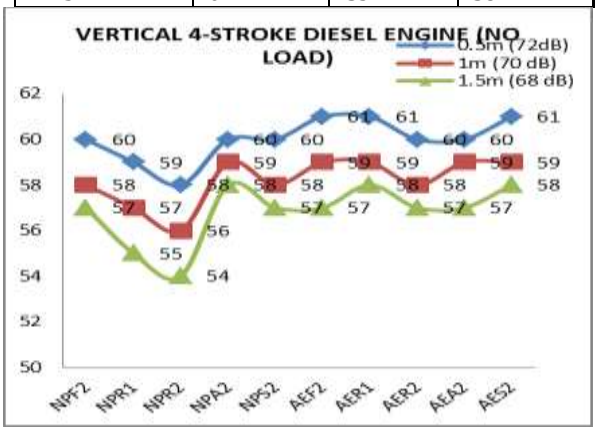

Figure 7: Variation of SPL for Vertical 4-stroke diesel engine (no load)

Table 4 : Sound pressure level (SPL) for Vertical 4-stroke diesel engine (full load)

SPECIMEN	DISTANCE FROM SOURCE		
	0.5m (89 dB)	1m (85 dB)	1.5m (82 dB)
NPF2	83	79	73
NPR1	81	77	72
NPR2	80	75	71
NPA2	82	77	73
NPS2	84	78	76
AEF2	84	77	75
AER1	82	76	72
AER2	81	75	71
AEA2	84	80	73
AES2	86	80	76

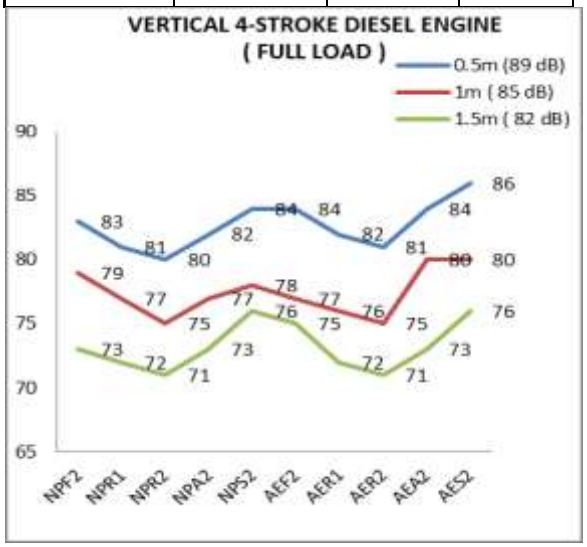

Figure 8: Variation of SPL for Vertical 4-stroke diesel engine (full load)

3. Vertical 4-stroke diesel engine with mechanical loading

Figure 9: Vertical 4-stroke diesel engine with mechanical loading

EINGINE DETAILS	
Rated power	: 7 HP
Rated speed	: 1500 rotation/minute
Power	: 5.2 kilo watts
SFC	: 251 grams/kilo watt hour
Lubricating oil	: SAE 30/40

Table 5: Sound pressure level (SPL) for Diesel Engine bio diesel fuel (Full Load)

SPECIMEN	DISTANCE FROM SOURCE		
	0.5m (91 dB)	1m (86 dB)	1.5m (83 dB)
NPF2	84	82	79
NPR1	83	80	78
NPR2	81	77	75
NPA2	83	82	78
NPS2	86	81	79
AEF2	85	81	79
AER1	84	80	79
AER2	83	79	78
AEA2	85	80	79
AES2	88	84	81

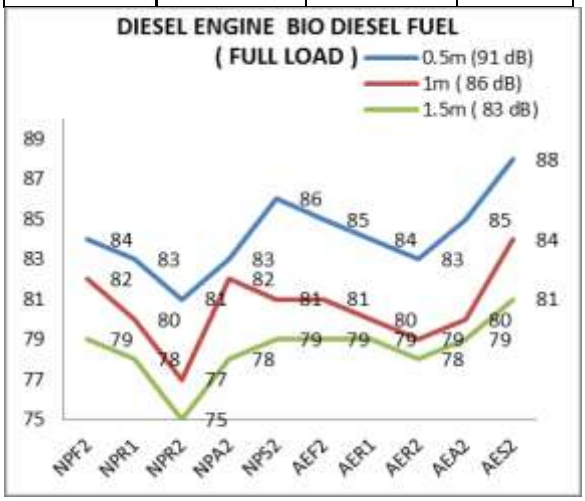

Figure 10 : Variation of SPL for Diesel Engine BIO DIESEL Fuel (Full Load)

4. Air compressor

Figure 11: Air compressor

Specifications of Air compressor	
Displacement volume	: 934 liters/minute
Working pressure	: 12 bar
Motor rated power	: 7.5 HP
Rated speed	: 950 rotation/minute

Current	: 9.7 amperes
Speed of motor	: 2900 rotation/minute
3 phase	: 420 volts
Tank capacity	: 500 liters

Table 6: Sound pressure level (SPL) for Air compressor

SPECIMEN	DISTANCE FROM SOURCE		
	0.5m (73 dB)	1m (70 dB)	1.5m (68 dB)
NPF2	62	60	58
NPR1	61	59	57
NPR2	59	55	52
NPA2	60	58	56
NPS2	62	59	57
AEF2	65	62	60
AER1	64	63	61
AER2	64	62	61
AEA2	63	62	60
AES2	64	63	62

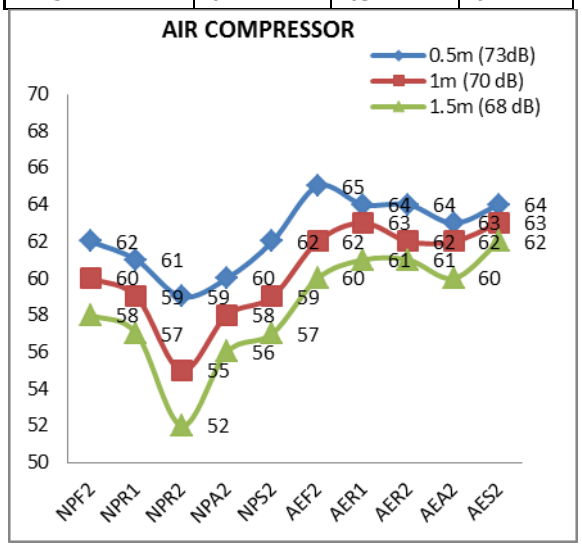

Figure 12: Variation of SPL for Air Compressor

Form the results and the values of Sound Pressure level (SPL) obtained in case of no load and full load conditions of Air Compressor, Single cylinder 4stroke petrol engine, Vertical 4-stroke Diesel engine, Diesel engine with electrical loading shows that:

- The reduction in SPL can be achieved in its vicinity with maximum reduction at 1.5m from the source and a minimum reduction at 0.5m from the source.
- The distance from the source plays a major role in reduction of SPL, as observed from the graph the values of SPL is drastically reducing form origin of source to its last point, in this case it is at 1.5m from the source.
- The achieved SPL values determine the rate of noise blocking capacity of the composites at different distance from the source and the reduction in SPL is around 13 dB in average for NPR2 specimen readings.

IV. CONCLUSION

The value of reduced SPL shows how the composite material is acting as an acoustic barrier in real time application. The distance plays a major role in propagation of the sound and thus is considered as one of the factors in the study, we can say that with increase in distance the SPL decreases, and by introducing the composite material as an acoustic barrier we can achieve a higher reduction in SPL values. The achieved SPL values determine the rate of noise blocking capacity of the composites at different distance from the source and the reduction in SPL is around 13 dB in average for NPR2 specimen readings.

The sample NPR2 has a highest range of reduction at respective distances of 0.5m, 1m, and 1.5m, for all the sources i.e. Air Compressor, Single cylinder 4S petrol engine, Vertical 4-S Diesel Engine, Diesel Engine with electrical loading with no load and loaded conditions. Finally concluded that the Pineapple leaf fiber reinforced Vinylester based hybrid composites material can be recommended as an acoustic barrier in near noise cancellation.

Thus the sample NPR2 is the best among all the composites tested and has a high endurance to deflect high sound pressure waves.

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