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Application and Future Prospectus 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.*

Keywords: Natural fibre, Pineapple leaf fiber (PALF), Polymer matrix composites, PALF based Hybrid composite, Vinylester, acoustic barrier

I. Introduction

Finding effective methods of noise control is an ongoing concern in any setting whether it is a manufacturing setting or a commercial setting. This is because excessive noise levels and environmental impact of such levels keeping in mind the occupational safety and health is the concern of every country and safety and health of all the human beings is the most important part which is stressed world over and 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 of sensitive land use areas from noise pollution. Acoustic barriers are the most effective method of mitigating roadway, railway, and 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.

The exterior structure exposed will be eroded drastically by wind, water, or other natural agents. Erosive wear can be defined as an extremely short sliding motion and is executed within a short time interval. Erosive wear is caused by the impact of particles of solid or liquid against the surface of an object. The impacting particles gradually remove material from the surface through repeated deformations and cutting actions. It is a widely encountered mechanism in industry. The rate of erosive wear is dependent upon a number of factors. The material characteristics of the particles, such as their shape, hardness, and the control factor as impact velocity, impingement angle, stand-off distance, erodent temperature and erodent size are primary factors along with the properties of the surface being eroded.

The study involves the application of Pineapple leaf fiber-Vinylester hybrid composites as acoustic barriers in real time by considering the erosion wear as the main factor. The composite material chosen has good erosion resistant property. This application level to study and describes how an erosion resistant material scopes in reducing the noise levels of the source and at different positions from the source.

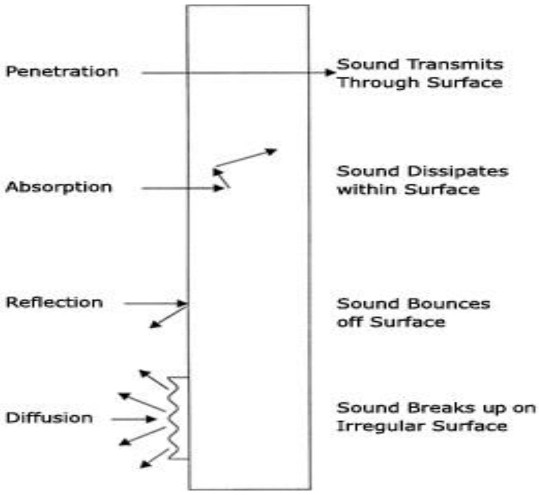

Figure 1. An acoustic barrier with properties

The material selected had to prevent noise and also bear the erosion caused along the surface of the material as it wears out substantially as the exposure to environment is more. So a various combination of Pineapple leaf fiber-Vinylester and E-glass fiber- Vinylester hybrid composites with and without filler material has been considered for the experimentation. The designation and description of materials as mentioned in the Table 1.

From the experimentation it provides the erosion wear rates for the PALF-Vinylester composites with the four different filler materials. On comparing these mean values it is found that the composite with red mud gives the minimum erosion rate. A similar comparison among the particulate fillers with respect to the erosion performance has been made for the Glass-Vinylester composites. It is noted in this case also that the composites with Red mud have minimum mean erosion rate. It is interesting to note that Red mud and Flyash in spite of being industrial wastes show lower erosion rates as compared to the conventional fillers i.e. Alumina and SiC. Further, among the four filler materials with hybrid composites materials are considered for experimentation to study the acoustic barrier. The combinations are preferred for the experimentation as mentioned in the Table 1.

Table 1. Description of hybrid composite materials for experimentation on acoustic barrier

Composition of Composites	Specimen Nomenclature
PALF (wt 30%) +Vinylester (wt 50%) +Fly ash (wt20%)	PVF20
PALF (wt 30%) + Vinylester (wt 60%) +Red mud (wt10%)	PVR10
PALF (wt 30%) +Vinylester (wt 50%) +Red mud (wt20%)	PVR20
PALF (wt 30%) +Vinylester (wt 50%) +Alumina (wt20%)	PVA20
PALF (wt 30%) +Vinylester (wt 50%) +Silicon carbide (wt20%)	PVS20
Glass Fiber (wt 30%) +Vinylester (wt 50%) +Fly ash (wt20%)	GVF20
Glass Fiber (wt 30%) +Vinylester (wt 60%) +Red mud (wt10%)	GVR10
Glass Fiber (wt 30%) +Vinylester (wt 50%) +Red mud (wt20%)	GVR20
Glass Fiber (wt 30%) +Vinylester (wt 50%) +Alumina (wt20%)	GVA20
Glass Fiber (wt 30%) +Vinylester (wt 50%) +Silicon carbide (wt20%)	GVS20

II. Experimental Details on Acoustic Barrier

An experimental study of acoustic barrier has been conducted on Single Cylinder 4-S Petrol Engine, Vertical 4-S Diesel Engine and an Air Compressor. The specifications of the Single Cylinder 4-S Petrol engines, Vertical 4-S Diesel Engine and Air Compressor are mentioned in the Table 2. Table 3. and Table 4. respectively.

Table 2 Specification of Single Cylinder 4-S Petrol Engine

Engine Type	**Single Cylinder 4-S Petrol Engine**
Engine Details	
BHP	2.5 HP
No. Of Cylinders	One
Bore	70 Mm
Stroke	66.7 Mm
Type	Air Cooled
Air Drum Orifice	20 Mm
Make	Greaves
Speed	3000 Rpm

Table 3 Specification of Vertical 4-S Diesel Engine

Engine Type	**Vertical 4-S Diesel Engine**
Engine Details	
Engine Rated Power	5 HP
Speed	1500 Rpm
Fuel	Diesel Oil

Table 4 Specification of Air Compressor

Source Type	**Air Compressor**
Motor	7.5 Hp
Tank Capacity	500 Liters
Speed	950 Rpm
Working Pressure	12 bar

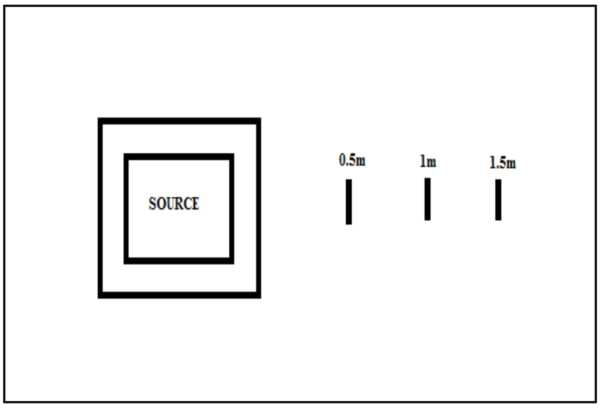

Figure 2. Layout of methods of Experiment of source with various distances

Figure 2. shows that layout of method of experiment set up at various positions around the source. The device is calibrated before the measurements are taken. The engines and the air compressor were turned ON one by one to find out the maximum permissible sound pressure level (SPL) and the readings were noted down directly from the sensor which is sensitive to sound pressure level. The maximum permissible sound pressure level (SPL) of various distance of 0.5m, 1m, and 1.5m along a straight line perpendicular to the engines and air compressor are mentioned in the Table 5, Table 6 and Table 7 respectively.

The various combination of preferred hybrid composite material without eroded surface has placed at 0.5m away from source and the sensor was placed next to it, the engine was turned on again and the readings of the drop in sound pressure level was tabulated. The same procedure was followed for all hybrid composite material as mentioned in the Table 1. The readings were taken again at different location along a straight line at 1m and 1.5m respectively. The various combination of composite material with eroded surface was considered and placed along the straight line perpendicular to the engine and compressor and the same procedure was followed with considerations of the distance from the source being 0.5m, 1m, and 1.5m.

III. Result and Discussion

The before erosion wear and after erosion wear characteristics of PALF-Vinylester composites and presents a comparison with those of a similar set of Glass-Vinylester composites under identical test conditions. The experimental results of before erosion and after erosion trials carried out on these hybrid composites are presented. The obtained readings were tabulated in the Table 5. for Single Cylinder 4-S Petrol Engine (No Load), Table 6. for Vertical 4-S Diesel Engine (No Load) and Table 7. for Air Compressor (No Load).

Their effect of sound pressure level (SPL) with various distance from the sources i.e. for Single Cylinder 4-S Petrol Engine (No Load), Vertical 4-S Diesel Engine (No Load) and Air Compressor (No Load) graphs were plotted in the Figure 3, Figure 4 and Figure 5 respectively.

Table 5 Sound Pressure Level (SPL) on Single Cylinder 4-S Petrol engine (No load) with various distances from the source

SPL on Single Cylinder 4-S Petrol Engine (No Load)						
Specimen Nomenclature	Distance from the Source					
	0.5m (73 db Max. Permissible)		1m (70 db Max. Permissible)		1.5m (66 db Max. Permissible)	
	BE(db)	*AE(db)*	*BE(db)*	*AE(db)*	*BE(db)*	*AE(db)*
PVF20	60	61	56	58	54	56
PVR10	59	60	56	58	53	57
PVR20	58	59	55	57	51	55
PVA20	59	61	57	59	56	56
PVS20	60	60	58	59	57	58
GVF20	60	60	58	59	57	58
GVR10	59	60	57	59	55	57
GVR20	60	60	59	58	58	57
GVA20	60	64	58	60	57	58
GVS20	60	62	59	61	58	59

* **SPL**- Sound Pressure Level, ***BE***-Before Erosion, ***AE***-After Erosion

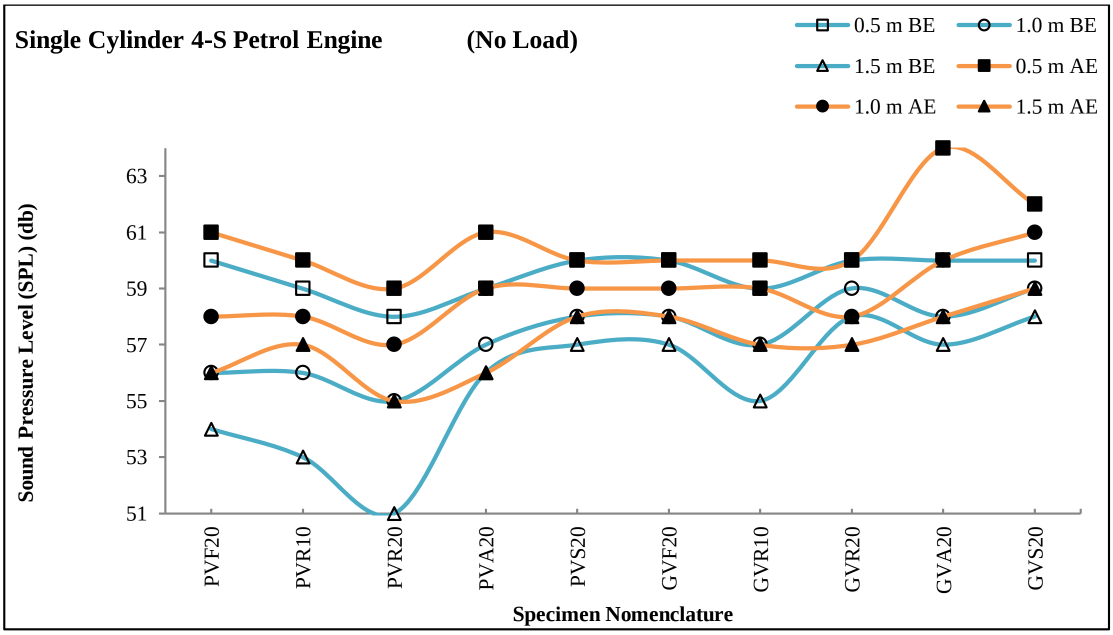

Figure 3 Effect of Sound pressure level on Single cylinder 4-S Petrol Engine (No Load) with various distances from the Source

Form the result 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. 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 being 0.5m, 1m, and 1.5m. The values obtained after exposing the eroded surface to the source at different distances provides the information on how even an eroded surface can sustain the SPL by blocking it and reducing the same at the other end of the material.

Table 6 Sound pressure level (SPL) on Vertical 4-S diesel engine (No load) with various distances from the source

SPL on Vertical 4-S Diesel Engine (No Load)						
Specimen Nomenclature	Distance from the Source					
	0.5m (72 db Max. Permissible)		1m (70 db Max. Permissible)		1.5m (68 db Max. Permissible)	
	BE(db)	*AE(db)*	*BE(db)*	*AE(db)*	*BE(db)*	*AE(db)*
PVF20	60	62	58	60	57	59
PVR10	59	60	57	59	55	57
PVR20	58	60	56	57	54	56
PVA20	60	62	59	60	58	57
PVS20	60	62	58	61	57	58
GVF20	61	61	59	59	57	58
GVR10	61	61	59	59	58	59
GVR20	60	60	58	59	57	58
GVA20	60	60	59	60	57	58
GVS20	61	62	59	59	58	60

* **SPL**- Sound Pressure Level, ***BE***-Before Erosion, ***AE***-After Erosion

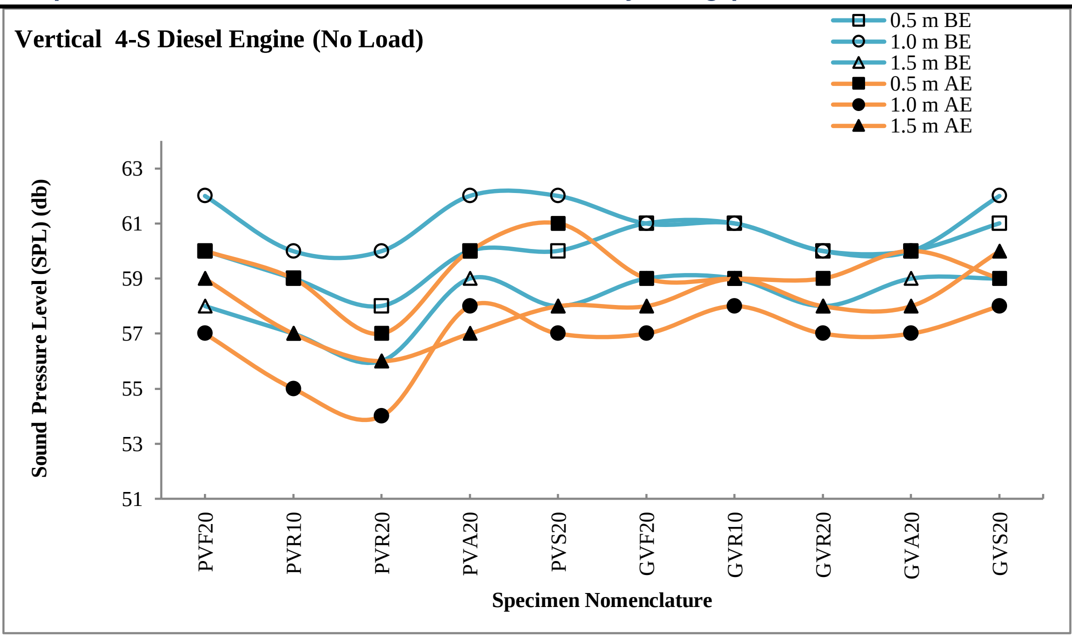

Figure 4 Effect of Sound pressure level on Vertical 4-S Diesel Engine (No Load) with various distances from the Source

Table 7 Sound pressure level (SPL) on Air Compressor (no load) with various distances from the source

SPL on Air Compressor (No Load)						
Specimen Nomenclature	Distance from the Source					
	0.5m (72 db Max. Permissible)		1m (70 db Max. Permissible)		1.5m (68 db Max. Permissible)	
	BE(db)	*AE(db)*	*BE(db)*	*AE(db)*	*BE(db)*	*AE(db)*
PVF20	65	66	60	64	58	61
PVR10	63	65	59	62	57	60
PVR20	60	64	55	61	52	57
PVA20	65	66	58	64	56	62
PVS20	63	68	59	65	57	61
GVF20	66	67	63	64	60	62
GVR10	65	67	64	65	61	62
GVR20	66	67	64	66	61	65
GVA20	65	66	63	64	60	62
GVS20	65	67	64	65	62	63

* **SPL**- Sound Pressure Level, ***BE***-Before Erosion, ***AE***-After Erosion

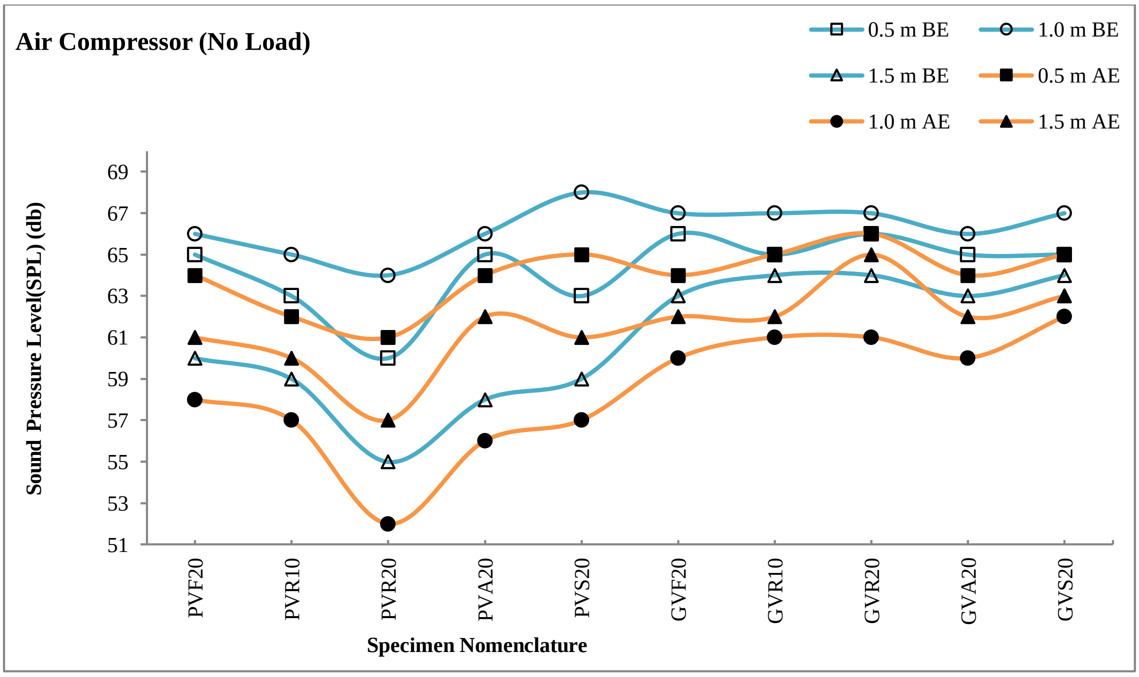

Figure 5 Effect of Sound pressure level on Air Compressor (No Load) with various distances from the Source

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.

IV. Conclusion

The conducting of the study provided information of how an erosion resistant composite material can be used as an acoustic barrier even before erosion and after the erosion. The value of reduced SPL shows how the composite material is acting as an acoustic barrier in real time application. The distance also 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 same applies to the eroded surface condition also but the achieved reduction is comparatively low as compared to non eroded condition with a drop in SPL of about 2-3dB.

The sample PVR20 has a highest range of reduction at respective distances of 0.5m, 1m, and 1.5m, for all the sources i.e. Single Cylinder 4-S Petrol Engine (No Load), Vertical 4-S Diesel Engine (No Load) and Air Compressor (No Load) are mentioned in the Table 8. Finally concluded that the Pineapple leaf fiber reinforced Vinylester based hybrid composites material can be recommended as an acoustic barrier at eroded as well as non eroded conditions.

Table 8 Consolidate result of Sound pressure level (SPL) on Various Sources for the Sample PVR20

Sound Pressure Level (SPL)						
PALF (wt30%) + Vinylester (wt50%) + Redmud (wt20%) **(PVR20)**						
SOURCE	DISTANCE FROM SOURCE					
	0.5m (72 -73 db Max. Permissible)		1m (70 db Max. Permissible)		1.5m (66 - 68 db Max. Permissible)	
	BE(db)	*AE(db)*	*BE(db)*	*AE(db)*	*BE(db)*	*AE(db)*
Petrol engine	58	59	55	57	51	55
Diesel engine	58	60	56	57	54	56
Air compressor	60	64	55	61	52	57

* **SPL**- Sound Pressure Level, ***BE***-Before Erosion, ***AE***-After Erosion

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References

[1] G.L . Chahine, P. Courbiere, Noise Erosion Of Self- Resonatig Cavitating Jets. *-Journal of fluid engineering, vol 109, December 1987, pp 429-435.*

[2] Tuler, M.V. & Kaewunruen, S., Life cycle analysis of mitigation methodologies for railway rolling noise and ground-bourne vibration. *Journal of Environmental Management Issue 493, 27july 2017, pp 75-82*

[3] Yogesh V Morankar , Prof. M. R. Khodke, *-Noise Reduction of a Diesel Engine A Review- International Journal of Engineering Research & Technology (IJERT), Vol. 3 Issue 5, May – 2014, pp 1289-1292*

[4] Praveen Kumar , Dr. Arun Kumar Mishra , Dr. Govind Pandey, *A Study of Noise Pollution in Some Highway Corridor Near Gorakhpur City-* International Journal of Engineering Research & Technology (IJERT). *Vol. 3 Issue 12, December-2014,pp 94-101*

[5] Urvi Pritam, Govind Pandey, Satya Pal Singh, Assessment of Outdoor and Indoor Noise Pollution in Commercial Areas of Gorakhpur City- *International Journal of Engineering Research & Technology (IJERT), Vol. 3 Issue 12, December-2014,pp 777-783*