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DIFFERENCES IN THE VARIATION OF SILENCER MEDIA THICKNESS FROM WASTE PATCHWORK AND PLYWOOD TO REDUCE THE NOISE INTENSITY

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ABSTRACT

Differences in the Variation of Silencer Media Thickness from Waste Patchwork and Plywood To Reduce The Noise Intensity. One of the most dangerous environmental factors is noise, which is crucial to control. This research aims to determine the differences in silencer media thickness between patchwork and plywood offsets to reduce noise intensity in cutting yarn engines. The method study characteristic experiment with design research conducted in this study used a design pretest-posttest without control. The population in this study is the whole room production source producing intensity noise by PT Trisula Textile Industries. Sample in the study This machine is cutting yarn, which produces the most noise. Purposive sampling is the technique used to conduct sample studies. e in six repetitions, with 36 temperature and moisture measurements. The measurement of the intensity of noise at the source of noise before being given treatment ranged from 97.26 to 97.43. The results of the decline in noise intensity after a given silencer show that variation 1 decreased the average by 5.66%, variation 2 decreased the average by 8.89%, and variation 3 lowered the average by 11.89% dB. We processed the data using the one-way ANOVA test, and the results showed a P value of 0.0001 (significant), which is less than 0.05, which indicates a significant difference in each variation of thickness. Industry can use thicker plywood thickness boards if applied in areas with a higher noise level and install a wheel on a tool reducer that can be used practically. Further, researchers can use different types of damping media and vary the thickness of the cloth patch.

INTRODUCTION

Controlling noise, one of the most dangerous workplace factors, is essential. [1] Hearing loss is the leading cause of disability globally, with a total of 466 million people experiencing it. Noise exposure in developing countries has functional, social, emotional, and economic impacts on industrial workers [2]. Noise is a cause of impaired health, whether for a short or long time [3]. Hearing loss must occur in terms of three aspects of noise waves, namely frequency, intensity, and time [4].

Workers who are exposed to noise for a certain time will experience physical and psychological disturbances. Noise pollution, whether from sound or other sources, has a significant impact on the environment. The impact of noise on health is a psychological

disturbance in the form of discomfort, difficulty concentrating, difficulty sleeping, and irritability. exposure noise Excessive exposure to noise can lead to psychosomatic diseases such as gastritis, heart disease, stress, and fatigue [5]. When physically stressed, noise can cause permanent or temporary ear damage, as can emotional stress, irritability, and insomnia [6]. Noise not only negatively affects the auditory system but also interferes with the vestibular system, increases blood pressure, increases heart rate, disturbs sleep, is associated with work-related stress, and causes fatigue when working in a noisy environment [7].

Previous research, conducted by [8], demonstrates a 5.79% decrease in noise intensity using patchwork media, from 89.7 dB to 84.5 dB, a decrease of 5.2 dB. Research was conducted by [9] using 3 cm foam media and patchwork variations of 3 cm, 6 cm, and 9 cm. The thickness of 3 cm decreased by 7.04–8.51%; at a thickness of 6 cm, it decreased by 11.39–13.29%; and at a thickness of 9 cm, it decreased by 14–44–15.68%, with a decrease rate of 12.89–14.19 dB. According to (10)'s research on the thickness of damping carpet, plywood, and glass wool, damping material can reduce the intensity by 33.29 dB, or 31.3%. The research conducted by [11] using 4 mm plywood media can reduce noise by ± 8.5 dB.

PT Trisula Textile Industries is an industry that produces finished fabrics from modern polyester fiber and a mixture of polyester rayon. The Texturizing Department's production process involves processing filament yarns in a machine. Any unused threads, which are not needed to produce finished fabrics, are then cut using a cutting yarn machine in the cutting waste room. A yarn-cutting machine uses hot steam and wind to cut yarn, resulting in noise. According to noise measurements in the cutting waste room, PT Trisula Textile Industries' cutting yarn machines have an average noise level of 97.70 dBA at point 1, 97.90 dBA at point 2, and 97.40 dBA at point 3.

According to Minister of Health Regulation Number 70 of 2016 concerning Health Standards and Industrial Work Environment Requirements, the NAV of noise allowed for 8 working hours per day is 85 dBA [12], so the noise intensity in the cutting waste room of the PT Trisula Textile Industries Cutting Yarn machine at all three points exceeds the NAV. Researchers will attempt to use patchwork waste as a medium to reduce noise intensity. They will use three thickness variations of 4 cm, 8 cm, and 12 cm to absorb or dampen the media, while the outer layer will be made of 9 mm plywood. Given this background, the authors are interested in investigating variations in the thickness of damping media made from patchwork waste and plywood to reduce noise intensity in the machine-cutting yarn at PT Trisula Textile Industries.

MATERIALS AND RESEARCH METHODS

In this study, the research design was a pre-test-post-test design without control. The study looked at how changing the thickness of the dampers affected the level of noise before and after treatment. To do this, the thickness of the media was changed from patchwork waste to plywood at thicknesses of 4 cm, 8 cm, and 12 cm, as well as 9 mm plywood with 36 measurements. Noise intensity measurements were conducted at PT Trisula Textile Industries, located in Jalan Mahar Martanegara No. 170 RT 001 RW 012 Baros Village, Central Cimahi District, Cimahi City, West Java 40521, Indonesia. Sampling for this study was carried out in the PT Trisula Textile Industries cutting waste room, which was held in May 2023. The types of data used in this study were primary and secondary. The primary data uses data from the results of noise intensity measurements on cutting yarn machines in the cutting waste room, and the secondary data uses data from the number of production rooms where there are machines that produce noise sources. The procedure for measuring noise takes into account variations in the thickness of the silencers made from patchwork waste and plywood. 4 cm: 9 mm, 8 cm: 9 mm, and 12 cm: 9 mm for 6 repetitions, according to 2017 National Standardization Body [13] determine the noise measurement point according to the type of zone to be measured near industrial boundaries with other areas or in an industrial environment where noise level measurements are taken, preferably near settlements, prepare a measurement tool, namely a sound level meter that has been calibrated and meets

standard requirements applicable national or international standards by pointing the microphone vertically, setting the height of the microphone 1.2 meters - 1.5 meters from the floor and taking measurements according to SNI 7231:2009 [14] noise measurements were carried out during the measurement, which was 10 minutes and recorded Once every 5 seconds the results of noise intensity in dBA units. We processed and analyzed the data using both univariate and bivariate methods, including the one-way Anova test and the post-hoc test.

RESEARCH RESULTS AND DISCUSSION

Temperature and Humidity Measurement Results

Temperature

Table 1. Temperature Measurements Before and After Treatment in the Cutting Yarn *Machine Area* of PT Trisula *Textile Industries*

Repetition	Thickness Media Variation					
	9 mm: 4 cm (◦ C)		9 mm : 8 cm (◦ C)		9 mm : 12 cm (◦ C)	
	Pre-Test	*Post-Test*	*Pre-Test*	*Post-Test*	*Pre-Test*	*Post-Test*
1	27,8	28,4	27,8	28,2	27,9	29,7
2	27,9	28,3	28,1	28,1	27,8	28,8
3	28.0	28,3	28,4	28,1	27,7	28,4
4	27,7	28.0	28,2	28.0	28,3	29.0
5	28,1	28,2	27,9	28.0	28,3	29,2
6	28,2	28,2	27,7	28,2	28,3	29.5
Min.	27,7	28	27,7	28	27,7	28,4
max.	28,2	28,4	28,4	28,2	28,3	29,7

Based on Table 1. According to Table 1, the study's air temperature measurements prior to the installation of the noise intensity muffler revealed a minimum temperature of 27.7 oC and a maximum temperFollowing the installation of the noise muffler, the lowest recorded air temperature was 28.2 oC, while the highest recorded temperature was 29.7 oC.that the lowest air temperature was 27.7 oCC. After the noise muffler was installed, the lowest air temperature measurement result was 28.2 oC,C.

Humidity

Table 2. Measurement of humidity before and after being given treatment in the *CuttingYarn Machine Area* of PT Trisula *Textile Industries*

Repetition	Thickness Media Variation					
	9mm: 4cm (%)		9mm : 8cm (%)		9mm : 12cm (%)	
	Pre-Test	*Post-Test*	*Pre-Test*	*Post-Test*	*Pre-Test*	*Post-Test*
1	64	65	60	63	55	50
2	64	65	63	64	53	48
3	64	64	63	64	53	48
4	63	64	63	63	53	55
5	63	64	64	64	55	55
6	63	65	64	64	55	53
Min.	63	64	60	63	53	48
max.	64	65	64	64	55	55

According to Table 2, the results of humidity measurements before the noise dampers were installed showed that the lowest humidity was 53% and the highest was 64%. After the noise dampers were installed, the lowest humidity measurement result was 48%, and the highest was 65%.

Noise Measurement Results

Table 3. Measurement of Noise Intensity Before and After the Silencer Is Given in the *Cutting Waste Room* on *Cutting Yarn Machines* in 2023

Repetition	Thickness Media Variation					
	9mm: 4cm (dB)		9mm : 8cm (dB)		9mm : 12cm (dB)	
	Pre-Test	*Post-Test*	*Pre-Test*	*Post-Test*	*Pre-Test*	*Post-Test*
1	97.30	91.80	97,27	88.63	97.31	85.71
2	97.43	91.83	97,26	88,68	97,28	85,73
3	97.40	91.87	97.32	88,60	97.33	85.78
4	97.33	91.85	97.33	88.65	97,29	85,74
5	97,28	91.84	97,27	88,67	97.34	85,76
6	97,29	91.81	97,28	88.62	97.32	85,72
Min.	97,28	91.80	97,26	88,60	97,28	85.71
max.	97.43	91.87	97.33	88,68	97.34	85.78
Average	97.34	91.83	97,29	88.64	97.31	85,74

Based on Table 3, the results show that the media thickness variation of 9 mm: 4 cm is 97.34 dB, reducing the average by 91.83 dB; for the media thickness variation of 9 mm: 8 cm, it is 97.29 dB, reducing the average by 88.64 dB; and for the media thickness variation of 9 mm: 12 cm, it is 97.31 dB, reducing the average by 85.74 dB. The noise measurements after using the silencer do not meet the threshold value according to Minister of Health Regulation Number 70 of 2017 for NAB noise, which is 85 dB/8 working hours.

Data analysis

Univariate analysis

Table 4. Univariate Test for Reducing Noise Intensity

Variable	N	Means	Min.	Max.	Standard Deviation
Thickness Variation 9 mm: 4 cm	6	5.5050	5,44	5.60	0.05505
Thickness Variation 9 mm: 8 cm	6	8.6467	8.58	8,72	0.05164
Thickness Variation 9 mm: 12 cm	6	11.5717	11.55	11.60	0.02483

According to Table 3, the results show that the media thickness variation of 9 mm: 4 cm is 97.34 dB, reducing the average by 91.83 dB; the media thickness variation of 9 mm: 8 cm is 97.29 dB, reducing the average by 88.64 dB; and the media thickness variation of 9 mm: 12 cm is 97.31 dB, reducing the average by 85.74 dB. After using the silencer, the noise measurements do not meet the threshold value for NAB noise, which is 85 dB/8 working hours, according to Minister of Health Regulation Number 70 of 2017.

Bivariate Analysis

a. *One Way Anova* test

Table 5. Noise Intensity Anova Test on PT Trisula *Textile Industries Cutting Yarn Machines*

	df	F	P Value
Differences in the variation of media on absorbers from patchwork and *plywood* on the reduction of noise intensity	2	26244,522	0.0001

The ANOVA test table above shows the P-value (0.0001) < α (0.05), and then Ho is rejected, indicating a difference in the decrease of the three treatments.

b. *Post Hoc* Test

Table 6. *LSD Post Hoc* Test for Reducing Noise Intensity at Noise Sources

(J) Thickness Media	(J) Thickness Media	*Mean Difference* (IJ)	P Value
4	8	-3.14167*	0.0001
	12	-6.06667*	0.0001
8	4	3.14167*	0.0001
	12	-2.92500*	0.0001
12	4	6.06667*	0.0001
	8	2.92500*	0.0001

The table above shows the results of bivariate analysis using the post-hoc test. It was found that on the P-value, if the P-value <α, there is a significant difference between groups. Post-hoc tests showed P < α values for all groups. You can observe that each variation exhibits a real or significant difference, and all three variations exhibit differences.

Temperature and Humidity

If the temperature ranges from -10 oC to 50 oC (SNI 7231:2009), it is acceptable. If the temperature in the room drops, the relative humidity will rise; if the temperature rises, the relative humidity will decrease. According to Mukono (2000), indoor humidity is one of the factors that affect room temperature [15].

The humidity level that is tolerated in the work environment is up to 90%, which does not affect the results of noise intensity measurements (SNI 7231:2009). According to research [16], the results of humidity measurements change due to a variety of factors. High and low humidity are influenced by several factors, including temperature, air pressure, wind movement, the amount and quality of irradiation, and vegetation.

According to research conducted by [17], temperature and humidity change after passing through the damper because an object's temperature determines its ability to transfer or receive heat from one object to another. Heat transfer is the transfer of energy from one area to another as a result of the temperature difference between these areas, from a fluid with a higher temperature to a fluid with a lower temperature. When an object with a high temperature is placed in a room with a lower temperature, the object's temperature will drop to equalize with the room temperature [18].

Noise Intensity Before and After Treatment

The noise intensity produced by the Cutting Yarn machine was measured using the measurement results obtained during the study before the addition of a good silencer on variations in media thickness of 9 mm: 4 cm, 9 mm: 8 cm, and 9 mm: 12 cm, each with an average intensity noise range of 97.26–97.43 dB. High noise levels cause stress by activating the sympathetic nervous system, messing up the endocrine and immune systems, and then vascular dysfunction. In this case, stress hormones, oxidative stress, and pro-inflammatory mediators damage tissue [19]. High-intensity noise will have an impact on health. In the study conducted [20], it was explained that out of a total of 55 respondents, it was known that 35 respondents (63.66%) had hearing loss due to prolonged and continuous exposure to noise, which caused work stress

According to [21]'s research, out of 32 respondents, 7 did not experience hearing loss, but 25 experienced hearing complaints. Out of the 25 respondents, 14 had hearing loss that did not interfere with their activities, while 11 had hearing loss that interfered with their work activities at noise intensities above the threshold (NAB) of 85 dB.

Noise risk control is carried out by engineering control, namely installing noise-dampening devices with damping media made from patchwork waste and *plywood*. One of the noise-absorbing materials is plywood and patchwork. The absorption mechanism occurs through porous materials, and then the absorbed energy is converted into heat due to friction between sound waves and porous cell walls, according to research conducted by [1]. So the researchers used patchwork media with thickness variations of 4 cm, 8 cm, and 12 cm to reduce noise. This is in line with research conducted by [8], which found that using patchwork media to reduce noise intensity reduced noise by 5.79%, resulting in a decrease of 5.2 dB from 89.7 dB to 84.5 dB. The researchers then used additional media to reduce the noise intensity, according to the research conducted by [10] with damping material on the thickness of damping carpet, plywood, and glass wool, which can reduce the intensity by 33.29 dB, or 31.3%.

Plywood and patchwork waste are combined to create different variations of silencers. The study's noise damper had four sides, each measuring 98 x 94 x 85 cm, and was supported by an iron frame at a height of 63 cm. The results of measuring the noise intensity on the cutting yarn machine show that adding damping media from patchwork waste and plywood, with various variations of different thickness media at 9 mm by 4 cm, can reduce the noise intensity from 97.28–97.43 dB to 91.80–91.87 dB. The noise intensity can be reduced from 97.26–97.33 dB to 88.60–88.68 dB after adding damping media from patchwork waste and plywood with various variations of different thickness media at variations of 9 mm and 8 cm. The results of noise intensity measurements show that the addition of damping media from patchwork waste and plywood, along with various variations of different thickness media at variations of 9 mm and 12 cm, can reduce the noise intensity from 97.28–97.34 dB to 85.71–85.78 dB.

The measurement results for each treatment decreased; this was because the noise damper was able to absorb noise from the cutting yarn machine. According to research [22] the sound absorption coefficient expresses the sound absorption efficiency of a material at a specific frequency. The absorption coefficient of incident sound is absorbed or not reflected by the surface. The results of measuring noise intensity exceed the threshold value when compared to the Minister of Health Regulation No. 70 of 2016 [12]. This is due to several factors that affect the process of reducing noise intensity, including the amount, size, and type of material, mass density, and surface impedance.

Differences in Noise Level Reduction

The decrease in noise intensity can be seen in the ANOVA test, where the P-value (0.0001) <0.05 is the difference in each thickness variation of patchwork waste and plywood to the decrease in noise intensity. Based on research conducted by [24] using fabric waste media resulting from the production process on different types of damping media thicknesses of 10 cm, 15 cm, and 20 cm, the average absorption was 12.33% of the highest media thickness of 87.80 dB to 77.01 dB, or a decrease of 10.79 dB.

The plywood material in the noise damper functions as a barrier or barrier that reflects sound waves. This is based on research conducted by [11] using 4 mm plywood media, which can reduce noise by approximately 8.5 dB. Based on research [10], plywood media was chosen because it is heat-resistant, ergonomic, and not easily cracked. Plywood has a large mass, so it can reduce vibration propagation [25].

CONCLUSIONS AND RECOMMENDATIONS

The cutting yarn machine's noise measurements were conducted both before and after treatment. The noise intensity at 9 mm: 4 cm drops from 97.28 – 97.43 dB to 91.80 – 91.87 dB, with an average of 5.55 dB. Similarly, at 9 mm: 8 cm, the noise intensity drops from 97.26 – 97.33 dB to 88.60 – 88.68 dB, with an average of 8.64 dB. Finally, at 9 mm: 12 cm, the noise intensity drops from 97.28 – 97.34 dB to 85.71 – 85.78 dB, with an average of 11.57 dB. Therefore, each variation exhibits a significant difference, as indicated by a P value of 0.0001 (less than 0.05). Some suggestions need to be carried out by further researchers, namely being able to use a thicker patchwork variation, using a thicker thickness of plywood boards, and paying attention to the density of the mass in the media so that there is no gap for air to enter the damping media.

REFERENCES

1. Jafari malekabad A, Zare S, Ghotbi ravandi MR, Ahmadi S, Esmaeili R, Mohammadi dameneh M. The noise absorption prediction of a combined and independent absorber under different conditions and at different frequencies, using the new Engineering Noise Control Software (ENC). Heliyon [Internet]. 2022;8(11):e11556. Available from: https://doi.org/10.1016/j.heliyon.2022.e11556
2. Zaw AK, Myat AM, Thandar M, Htun YM, Aung TH, Tun KM, et al. Assessment of Noise Exposure and Hearing Loss Among Workers in Textile Mill (Thamine), Myanmar: A Cross-Sectional Study. Saf Health Work. 2020;11(2):199–206.
3. Wilujeng AD, Ulfiyah L, Annafiyah A, Taqiuddin MH. Pembuatan Material Komposit Berbahan Dasar Sabut Kelapa Dan Jerami Padi Sebagai Peredam Kebisingan. J Technopreneur [Internet]. 2022 May 25;10(1):1–4. Available from: http://jurnal.poligon.ac.id/index.php/jtech/article/view/889
4. Septyana S. Usulan Rancangan Perbaikan Ruang Produksi Sarung Tenun untuk Mengurangi Kebisingan dan Temperatur Udara dengan Pendekatan Hierarchy Of Controls. 2022; Available from: http://repository.unissula.ac.id/28049/
5. Hutagalung R. Pengaruh Kebisingan Terhadap Aktivitas Masyarakat Di Terminal Mardika Ambon. Arika. 2017;11(1):83–8.
6. Khakim SN, Setraningsih Y, K B. Analisis Penggunaan Sekam Padi dan Jerami Sebagai Peredam Suara Mesin Diesel Pada Tingkat Kebisingan Lingkungan Kerja Penggilingan Padi. J Kesehat Masy [Internet]. 2019;7(4):354–61. Available from: http://ejournal3.undip.ac.id/index.php/jkm%0AANALISIS
7. Kahar, Iqbal M, Kamaludin A. Serbuk Gergaji Dan Papan Telur Sebagai Alternatif Noise Barrier Dalam Ruangan. 2022; Available from: http://ejournal.poltekkes-pontianak.ac.id/index.php/JVK%0ASERBUK
8. Natalia D. Efektifitas Berbagai Jenis Bahan Peredam Terhadap Penurunan Tingkat Kebisingan. J Ecolab. 2022;16(1):23–30.
9. Herlambang RY, Fikri E, Nurjaman U. Variasi Ketebalan Busa Dan Kain Perca Terhadap Penurunan Intensitas Kebisingan. 2020;30:2019–20. Available from: http://repo.poltekkesbandung.ac.id/id/eprint/1249
10. Indrianti N, Biru NB, Wibawa T. The Development of Compressor Noise Barrier in the Assembly Area (Case Study of PT Jawa Furni Lestari). Procedia CIRP [Internet]. 2016;40:705–10. Available from: http://dx.doi.org/10.1016/j.procir.2016.01.158
11. Sasmita A, Osmeiri B. Pemetaan Tingkat Kebisingan Dan Analisis Waktu Pemaparan Maksimum Pada Industri Pengolahan Karet. J Ind Hyg Occup Heal [Internet]. 2021 Oct 24;6(1):35. Available from: https://ejournal.unida.gontor.ac.id/index.php/JIHOH/article/view/6120
12. Permenkes. Peraturan Menteri Kesehatan No.70 Tahun 2016 tentang Standar dan Persyaratan Kesehatan Lingkungan Kerja Industri. 2016;
13. Badan Standardisasi Nasional. SNI 8427:2017 Tentang Pengukuran Tingkat Kebisingan Lingkungan. Standar Nas Indones. 2017;1–15.

14. Badan Standar Nasional. SNI 7231:2009 tentang metoda pengukuran intensitas kebisingan di tempat kerja. 2009;
15. Findhiawati MF, Yuniastuti T, Joegijantoro R. Hubungan Kualitas Fisik Udara Dan Bangunan Dengan Gejala Sick Building Syndrom (Sbs). Media Husada J Environ Heal [Internet]. 2022;2(2):189–200. Available from: https://mhjeh.widyagamahusada.ac.id/index.php/mhjeh/article/download/34/27
16. Edar AN. Pengaruh Suhu dan Kelembaban Terhadap Rasio Kelembaban dan Entalpi (Studi Kasus: Gedung UNIFA Makassar). LOSARI J Arsit Kota dan Pemukim. 2021;6(2):102–14.
17. Fadholi A. Study Pengaruh Suhu dan Tekanan Udara Terhadap Operasi Penerbangan di Bandara H.A.S. Hananjoeddin Buluh Tumbang Belitung Periode 1980-2010. J Penelit Fis dan Apl [Internet]. 2013 Jun 14;3(1):1. Available from: https://journal.unesa.ac.id/index.php/jpfa/article/view/191
18. Supu I, Usman B, Basri S, Sunarmi. Pengaruh Suhu Terhadap Perpindahan Panas pada Material yang Berbeda. Dinamika [Internet]. 2016;147(March):11–40. Available from: https://journal.uncp.ac.id/index.php/dinamika/article/view/612
19. Dzhambov AM, Dimitrova V, Germanova N, Burov A, Brezov D, Hlebarov I, et al. Joint associations and pathways from greenspace, traffic-related air pollution, and noise to poor self-rated general health: A population-based study in Sofia, Bulgaria. Environ Res. 2023;231(February).
20. Ella Anastasya Sinambela, Rahayu Mardikaningsih. Efek Tingkat Kebisingan Pada Masalah Pendengaran Pada Pekerja. Padur J Tek Sipil Univ Warmadewa. 2022;11(2):240–4.
21. Indrayani R, Aryatika K. Keluhan Pendengaran Dan Pemetaan Kebisingan Pada Industri Penggergajian Kayu Ud. Mayoa Kabupaten Jember. Ikesma. 2021;17(1):14.
22. Harjani C, Noviandri PP. Desain Partisi Penyerap Noise Berbahan Komposit Kain Perca. LINTAS RUANG J Pengetah dan Peranc Desain Inter. 2019;7(1):1–8.
23. Suardana NPG, Parwata IM, Lokantara IP, Sugita I. Panel Akustik Ramah Lingkungan Berbahan Dasar Limbah Batu Apung Dengan Pengikat Poliester. 2015; Available from: https://repo-dosen.ulm.ac.id/handle/123456789/9117
24. Rosdiyanti A. the Difference in the Thickness of Noise Reducer Media. 2017;28(July):2016–7. Available from: https://repository.poltekkesbdg.info/items/show/1132
25. Rindianti Wibowo, Samuel UB. Analisa Tingkat Kebisingan Kamar Mesin Pada Kapal Kmp. Muria. J Tek Perkapalan [Internet]. 2014;2(4):102–11. Available from: https://ejournal3.undip.ac.id/index.php/naval/article/view/7134