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Cleaner Production in the Marble Industry (Case Study: UD Warna Utama)

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Abstrak
UD Warna Utama merupakan salah satu industri batu marmer yang berada di Tulungagung, Jawa Timur. Pada proses batu marmer terdapat tiga tahapan proses produksi, yaitu penggergajian batu balok marmer, penggergajian batu slap marmer, dan pemolesan batu marmer. Dalam proses produksi, limbah yang dihasilkan terkadang dijual sebagai bahan pondasi bangunan dan sisa lainnya langsung dibuang ke lingkungan sekitar area pabrik dan menyebabkan pencemaran lingkungan. Penelitian ini bertujuan untuk mengidentifikasi peluang peningkatan efisiensi dan pengurangan dampak lingkungan serta memberikan alternatif usulan untuk meminimalisir dan memanfaatkan limbah yang dihasilkan sesuai dengan konsep produksi bersih. Analisis secara cepat aliran material menggunakan metode Quick Scan dan wawancara, diperoleh beberapa opsi penerapan produksi bersih yaitu mertode Recycle dan Reuse. Alternatif usulan menggunakan perhitungan analisis kelayakan B/C Ratio dan Payback Period dan diperoleh alternatif usulan yang layak untuk dijalankan, yaitu pembuatan penahan air proses penggergajian batu balok, penjualan limbah lumpur sebagai bahan bangungan, pembuatan mozaik, dan pembuatan terazo.

Kata kunci: *B/C ratio, industri marmer, payback period, produksi bersih, quick scan*

Abstract
UD Warna Utama is one of the marble stone industries located in Tulungagung, East Java. In the marble stone process, there are three stages of production, namely the sawing of marble blocks, the sawing of marble slabs, and the polishing of marble. In the production process, the waste generated is sometimes sold as building foundation material, while other residues are directly disposed of into the surrounding environment of the factory, causing environmental pollution. This research aims to identify opportunities for improving efficiency and reducing environmental impact, as well as providing alternative proposals to minimize and utilize the waste generated in accordance with the concept of clean production. A quick analysis of the material flow using the Quick Scan method and interviews yielded several options for implementing clean production, namely the Recycle and Reuse methods. The proposed alternatives were evaluated using the B/C Ratio and Payback Period feasibility analysis, resulting in viable proposals for implementation, including the creation of water retention systems for block stone sawing processes, selling sludge waste as construction material, making mosaics, and producing terrazzo.

Keywords: *B/C ratio, cleaner production, marble industry, payback period, quick scan*

1. Introduction

Clean production is an environmental processing strategy that is preventive and integrated, which needs to be continuously applied in the production process and life cycle with the aim of reducing risks to humans and the environment (Fitriyanti & Fatimura, 2019). Clean production is an action of efficiency in the use of raw materials, water, and energy, as well as pollution prevention, to increase productivity and minimize waste generation. In the implementation of clean production, Indonesia established a legal foundation in the form of Law of the Republic of Indonesia No. 32 of 2009 concerning Environmental Protection and Management. Clean production is necessary in the industry because by implementing clean production strategies, it is expected to reduce environmental pollution caused during production activities and simultaneously reduce resource consumption. Clean production aims to minimize the use of resources and energy to prevent environmental pollution, reduce waste generation, and increase the company's revenue (Rochyani *et al.*, 2023).

UD Warna Utama is one of the marble-producing industries located in Gamping Village, Campurdarat District, Tulungagung Regency, East Java. In the marble production process, the stages involved are block stone sawing, slab stone sawing, and stone polishing. This factory produces products in the form of floor tiles and tables made from marble and onyx stones in various attractive colors. The marble industry, in one production cycle, produces 43.2 m² per day or 1,123.2 m² per month of marble and generates waste in the form of stone chips and sludge amounting to approximately 92,326 Kg each

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month. UD Warna Utama, waste in the form of stone chips and sludge is produced from the remnants of marble sawing to marble polishing, with various sizes ranging from small to large pieces. The waste from marble stone chips each month amounts to around 23,400 Kg and sludge waste to 68,811.6 Kg, where the stone chip and sludge waste are directly disposed of in the surrounding empty area of the factory without any processing or storage facilities provided. Marble chips and sludge have not been maximally utilized by the company and are sometimes only sold as foundation material for house construction or as a cement mixture if there are buyers interested. The production waste of marble, such as stone chips and mud that have not been utilized, is ultimately discarded in the factory's surrounding area without any processing or storage, leading to environmental pollution. Marble waste contains lime, which not only causes environmental pollution but can also be hazardous to health if it enters water channels and is consumed by the community. The vacant land used for dumping sludge waste will also cause the soil to become barren due to the alkaline nature of the lime (Videsia *et al*., 2017).

In previous research, it was found that marble waste, both stone chips and sludge, increases over time. It is known that the marble production process generates more waste compared to the actual production output (Simao et al., 2021). The increasing amount of stone chips and mud waste has forced the company to use the nearest vacant land or agricultural land as a waste disposal site (Simao et al., 2021). This also happens with the marble waste from UD Warna Utama, where the production waste in the form of sludge is channeled to the area near the factory and vacant land and left to dry. Mud that does not have its own storage place can overflow and increase environmental pollution because it contains lime, which can contaminate water and soil, and if it rains, it can disrupt the activities of the local community. In addition, the production results in stone fragments, which also do not have a storage place and are left along the marble production area without being utilized, can cause injuries to people passing through the factory area due to the sharp stone fragments. With its interesting types and colors, the company should be able to utilize it by further processing, thereby increasing its economic value. The lack of financial capability, awareness, and knowledge in handling industrial waste becomes a significant obstacle. With the increasing number of marble industries, it is possible that the waste produced will also increase and have a more detrimental impact on the environment. It is often found that marble industries only focus on the quantity of production without considering ways to minimize the waste generated.

Based on this, a plan is needed that can minimize the amount of waste, maximize marble waste into valuable products, and reduce the environmental impact of marble waste while providing additional benefits. Therefore, a suitable production planning system is needed, leading towards the concept of clean production. In previous research suggesting marble stone sludge waste to be made into a reservoir, in addition, marble stone fragments are used for decorating house fences (Videsia *et al*., 2017). Furthermore, previous research suggested a clean production concept in the marble industry using the principles of reuse, recycling, and disposal in landfills (Simao et al., 2021). Where previous researchers suggested using marble waste as a material for ceramic production, cement mixtures, and the creation of waste storage containers for both stone cuttings and sludge.

This research focuses on the application of clean production and feasibility analysis at UD Warna Utama. In this study, the Quick Scan method can be used to thoroughly identify the causes of problems occurring at each stage of the production process, as well as the impacts and improvement alternatives that align with clean production techniques. Based on previous research by (Sirait et al., 2018), Quick Scan is the stage of identifying the flow of materials from the production unit, as well as the output of liquid waste and losses generated. By implementing clean production, it is hoped to become a solution to the problems faced by UD Warna Utama to minimize waste, maximize marble waste into valuable products, reduce risks to humans and the surrounding environment, and provide additional income benefits.

2. Research Methods

This research uses the Quick Scan method, according to Buser and Walder in (Wicaksana et al., 2022) where this method produces an overview of the overall material flow and aspects that can be the subject of more specific studies for the potential application of clean production and pollution prevention. This research was conducted in the marble stone industry located in Tulungagung. The following is Figure 1, which contains the research stages depicted through a flowchart.

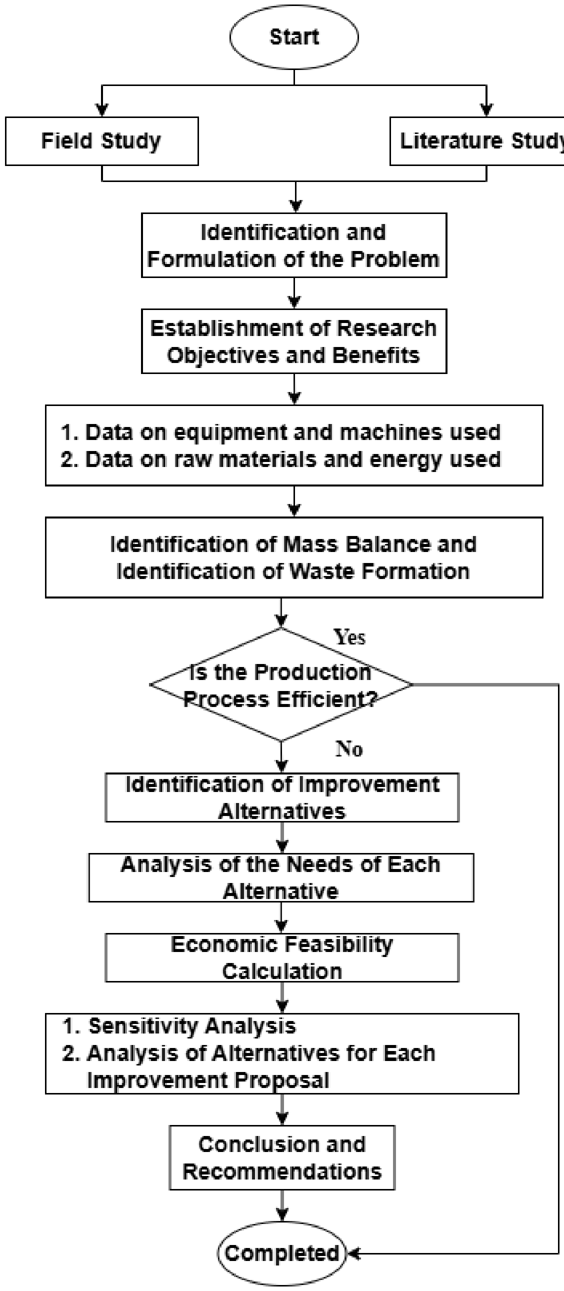

Figure 1. Research Methodology Flowchart

In this research, the initial step taken was conducting direct field observations to identify problems. Next, data collection was carried out in the form of production equipment and machines, raw materials, and the energy used. Subsequently, waste formation was identified, and a mass balance calculation was performed to determine the amount of waste generated in each process that experienced inefficiency. The next step is to plan alternative improvements and plan the necessary tools and materials to design the improvement proposal.

The proposed improvement alternatives are then subjected to a feasibility analysis using B/C Ratio and Payback Period calculations. The calculations are conducted to determine whether the proposed improvement alternatives are feasible to implement.

Here is the formula for calculating the B/C Ratio (Khotimah & Sutiono, 2014) :

$$B/C\ Ratio = \frac{\text{PW of benefit}}{\text{PW of cost}} \quad (1)$$

Explanation:

B/C Ratio > 1, the business is feasible to run

B/C Ratio < 1, the business is not feasible to run

Here is the formula for calculating the *Payback Period* (Rachadian et al., 2013):

$$\text{PP} = \frac{\text{Investasi}}{\text{Annual Benefit}} \quad (2)$$

Explanation:

If the Payback Period is shorter than the maximum payback period, then the investment is worth pursuing.

If the Payback Period is longer than the maximum payback period, then the investment is not worth pursuing.

After conducting the economic feasibility analysis for each proposed alternative, the implementation procedure is carried out for the selected alternative. To Mass Diagram of the Marble Polishing Process determine the feasibility of each selected proposed alternative in the event of unexpected parameter changes, a sensitivity analysis is conducted. By performing a sensitivity analysis, the company can determine the extent of changes that can be tolerated for the business to remain viable.

3. Results and Discussion

The marble stone production process at UD Warna Utama consists of the sawing of marble block stones, the sawing of slab stones, and the polishing of marble stones.

3.1. Identification of Issues

The problem identification process is carried out by calculating the mass balance. In the mass diagram, the input and output as well as the waste generated from the marble production process are identified.

The following Figure 2, the mass balance of the marble block sawing process at UD Warna Utama.

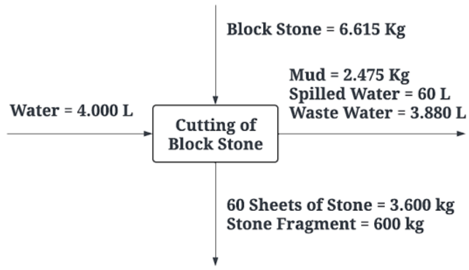

Figure 2. Block Stone Sawing Process Mass Diagram

The following is Figure 3, the mass balance of the marble slab sawing process at UD Warna Utama.

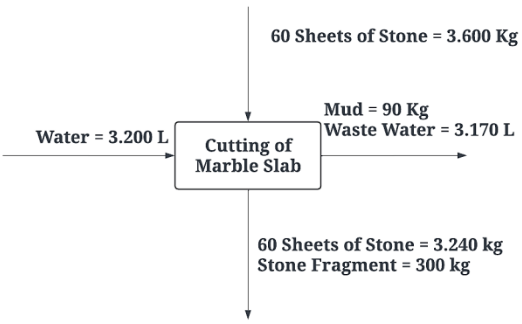

Figure 3. Slab Stone Sawing Process Mass Diagram

The following is Figure 4, the mass balance of the marble slab sawing process at UD Warna Utama.

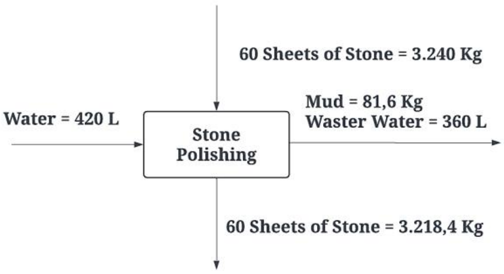

Figure 4. Marble Polishing Process Mass Diagram

Based on the mass balance calculations, it is known that the process of sawing block stones weighing 6,615 Kg and 4,000 L of water produces 60 sheets of stone weighing 3,600 Kg, sludge waste 2,475 Kg, stone chips 600 Kg, and spilled water 60 Kg. In the process of sawing slab stones, it produces 60 sheets of stone weighing 3,240 Kg, sludge waste 90 Kg, and stone chips 300 Kg. In the polishing process of marble stones, it produces 60 sheets of stone weighing 3,218.4 Kg and sludge waste 81.6 Kg.

Besides the waste that is commonly found in the marble stone production process. Problems were also found in the process of sawing marble blocks; during this process, the water used in the sawing process spilled because there was no containment.

3.2. Alternative Improvement Proposals

Based on the issues from the UD Warna Utama marble industry, five alternative proposals with a clean production concept were provided. The proposed alternatives are the creation of sludge waste filtration, the construction of water retention for the block stone sawing process, the sale of sludge waste as building material, the creation of mosaics, and the production of terrazzo.

Figure 5 is the water retention design for the marble block sawing process.

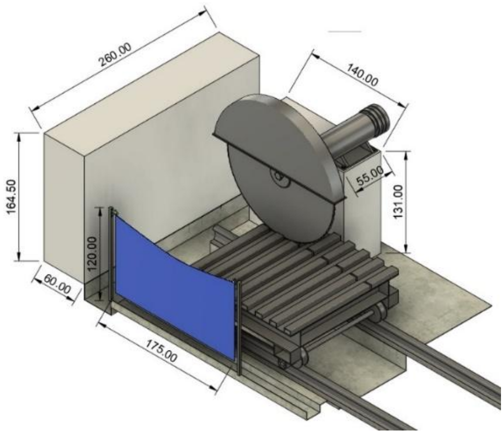

Figure 5. Water Retention Design for the Marble Block sawing process..
Source: Personal Design (Inventor 2024)

Table 1. Initial Investment Calculation

Tool	Volume	Unit	Unit Price	Total
Tarpaulin	4	Meter	Rp 5,000	IDR 20,000
Guter Iron	4	Pieces	IDR 9,000	IDR 36,000
Hanger	4	Pieces	IDR 3,800	IDR 15,200
Total Investment				IDR 71,200

Table 2. Calculation of B/C Ratio and Payback Period

Description	Total
Water stored by 3 machines	0.057
Price of water/m3	IDR 2,000
Additional Savings/year	IDR 32,832
Payback Period	2.17
PW of cost	IDR 71,200
PW of benefit	IDR 113,763
B/C Ratio	1.60

Based on the calculations in Table 2, it is known that the B/C Ratio calculation yields a value of 1.60, where the proposed alternative is feasible because it is > 1, and the Payback Period is 2.17, which means the capital will be recovered in 2.17 years. (2 years). With this proposed alternative, the industry will experience additional savings of IDR 32,832.

Figure 6. Sale of Sludge Waste as Building Material
Source: (Videsia *et al*., 2017)

Table 3. Initial Investment Calculation

Tools	Volume	Unit	Unit Price	Total
Goods scale	2	Pieces	IDR 478,000	IDR 957,000
Hoe	2	Pieces	IDR 35,000	IDR 70,000
Scissors	2	Pieces	IDR 11,700	IDR 23,400
Bamboo Cicada	2	Pieces	IDR 12,000	IDR 24,000
Total Investment				IDR 1,074,200

Table 4. Calculation of B/C Ratio and Payback Period

Description		Total
Mud produced		230
Price of Mud/Bag	IDR	2,500
Total Revenue/year	IDR	165,600,000
Total Cost of Materials and Labor/year	IDR	159,799,680
Net Cash/year	IDR	5,800,320
Payback Period		0.19
PW of cost	IDR	1,074,400
PW of benefit	IDR	20,098,109
B/C Ratio		18.71

Based on the calculations in Table 2, it is known that the B/C Ratio calculation yields a value of 18.71, where the proposed alternative is feasible because it is > 1, and the Payback Period is 0.19, which means the capital will be recovered in 0.19 years.

Figure 7: Mosaics from Marble Stone Fragment
Source: (Pranoto & Sudarsono, 2016)

Table 5. Initial Investment Calculation

Tool	Volume	Unit	Unit Price	Total
Cutting machine	1	Pieces	IDR 5,000,000	IDR 957,000
Cutting blade	1	Pieces	IDR 169,000	IDR 70,000
CaIDRet runner	12	Meter	IDR 7,800	IDR 23,400
Cap	2	Pieces	IDR 13,500	IDR 24,000
Basin	2	Pieces	IDR 8,000	IDR 37,400
Coaster	300	Pieces	IDR 18,000	IDR 7,200,000
Stamp	120	Pieces	IDR 272,700	IDR 32,724,000
Total Investment				IDR 38,065,600

Table 6. Calculation of B/C Ratio and Payback Period

Description		Total
Produced Mosaic		120
Price per Mosaic/Unit	IDR	10,500
Total Revenue/year	IDR	362,880,000
Total Cost of Materials and Labor/year	IDR	226,333,440
Net Cash/year	IDR	136,546,560
Payback Period		0.28
PW of cost	IDR	38,065,600
PW of benefit	IDR	473,133,830
B/C Ratio		12.43

Based on the calculations in Table 6, it is known that the B/C Ratio calculation yields a value of 12.43, where the proposed alternative is feasible because it is > 1, and the Payback Period is 0.28, which means the capital will be recovered in 0.28 years.

Figure 8. Terrazzo from Marble Stone Chips
Source: Blogspot (Dewi, 2024)

Table 7. Initial Investment Calculation

Tool	Volume	Unit	Unit Price	Total
Scale	2	Pieces	IDR 478,000	IDR 957,000
Measuring cup	2	Pieces	IDR 35,000	IDR 70,000
Spatula	2	Pieces	IDR 11,700	IDR 23,400
Hammer	2	Pieces	IDR 12,000	IDR 24,000
Brush	2	Pieces	IDR 18,700	IDR 37,400
Mold	300	Pieces	IDR 24,000	IDR 7,200,000
Total Investment				IDR 7,772,200

Table 8. Calculation of B/C Ratio and Payback Period

Description		Total
Produced Terrazzo		100
Price per Terrazzo/Unit	IDR	20,000
Total Revenue/year	IDR	576,000,000
Total Cost of Materials and Labor/year	IDR	543,051,648
Net Cash/year	IDR	32,948,352
Payback Period		0.24
PW of cost	IDR	7,772,000
PW of benefit	IDR	114,166,040
B/C Ratio		14.69

Based on the calculations in Table 8, it is known that the B/C Ratio calculation yielded a value of 14.69, where the proposed alternative is feasible because it is > 1, and the Payback Period is 0.24, which means the capital will be recovered in year 0.24.

3.3. Sensitivity Analysis

Sensitivity analysis is an analysis related to changes in parameters to determine how sensitive a decision is to changes in the factors or parameters that influence it. This analysis is conducted on feasible proposed alternatives, namely the sale of sludge waste as building materials, the creation of mosaics, and the production of terrazzo. The parameter used in this analysis is the volume of product sales generated, as the volume of sales is the main factor in generating revenue. If the sales do not meet the initial target, the revenue obtained will decrease. Therefore, further analysis is needed to determine the minimum sales quantity that must be met for the proposed alternative to remain feasible. In this sensitivity analysis, the creation of water barriers in the sawing process was not included because the proposed alternative is not sold and utilized by the company.

Figure 9 is a simulation image of the sensitivity of sludge waste sales to the B/C Ratio value with a range of -50% to 50% in one day.

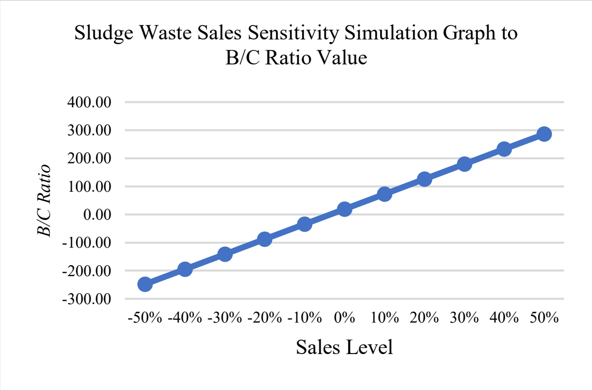

Figure 9. Sludge Waste Sales Sensitivity Simulation Graph to *B/C Ratio Value*

Based on Figure 9, it can be seen that at the sales level, a decrease in sales by 10% can make the proposed alternative unfeasible to implement because at a 10% decrease, the B/C Ratio value is -34.70 or < 1. Meanwhile, an increase in sales can make the proposed alternative highly feasible to invest in because it has a B/C Ratio value far above the minimum threshold of 1.

Figure 10 is a simulation image of the sensitivity of sludge waste sales to the Payback Period value with a range of 10% to 50% in one day.

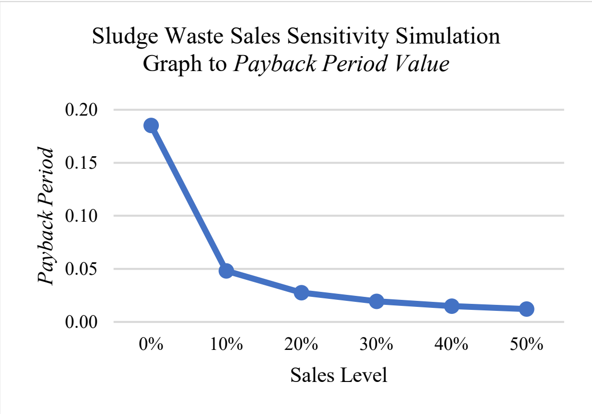

Figure 10. Sludge Waste Sales Sensitivity Simulation Graph to *Payback Period Value*

Based on Figure 10, it can be seen that the Payback Period value at a 10% increase is 0.05; at 20% is 0.03; at 30% is 0.02; at 40% is 0.01; and at 50% is 0.01. Based on this, it is known that as the increase in sales becomes larger, the capital will be recovered more quickly, and the business will become more feasible to run.

Figure 11 is a simulation image of the sensitivity of mosaic creation to the B/C Ratio value with a range of -50% to 50% in one day.

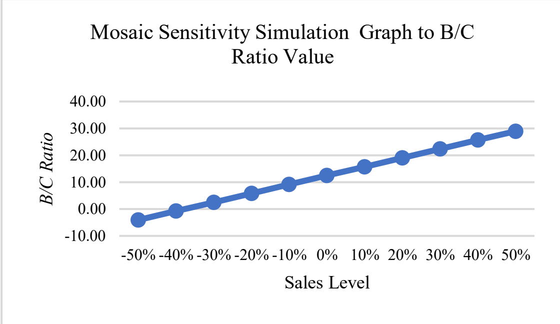

Figure 11. Mosaic Sensitivity Simulation Graph to B/C Ratio Value

Based on Figure 11, the proposed mosaic sales alternative is feasible for changes in quantity up to a decrease of 30% and not feasible if greater than 30% because at a 40% decrease, the B/C Ratio value is -0.78 or < 1. Meanwhile, when there is an increase in sales quantity, the proposed alternative becomes highly feasible for investment because it has a B/C Ratio value far above the minimum threshold of 1.

Figure 12 is a simulation of the sensitivity of mosaic production to the Payback Period value with a range of -30% to 50% in one day.

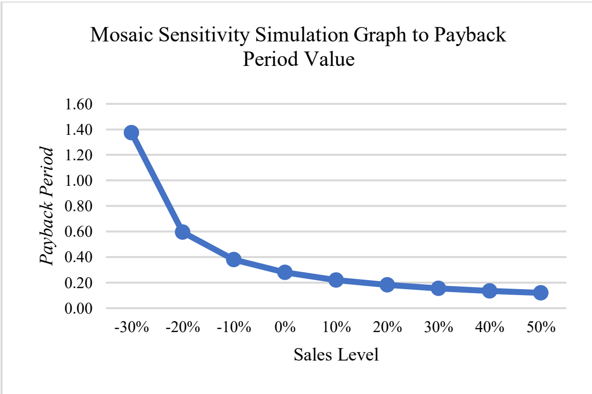

Figure 12. Mosaic Sensitivity Simulation Graph to Payback Period Value

Based on Figure 12, the Payback Period value during a 30% decrease is 1.38; a 20% decrease is 0.60; and a 10% decrease is 0.38. During a 10% increase, the value is 0.22; a 20% increase is 0.18; a 30% increase is 0.16; a 40% increase is 0.14; and a 50% increase is 0.12. Based on this, it is known that when the decrease reaches 30%, the Payback Period value of 1.38 > 1 indicates it is feasible to run, and when sales increase, the Payback Period will return faster, the capital will be recovered more quickly, and the business will become increasingly feasible to operate.

Figure 13 is a simulation of the sensitivity of terrazzo production to the B/C Ratio value with a range of -50% to 50% in one day.

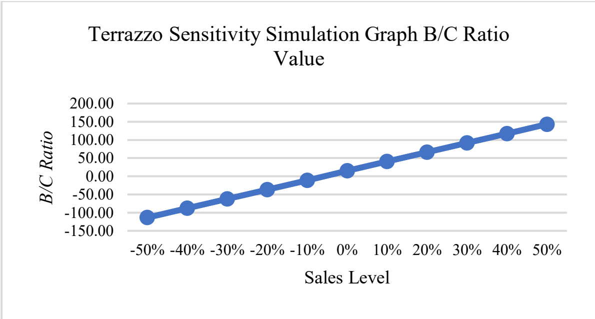

Figure 13. *Terrazzo Sensitivity Simulation Graph to Payback Period Value*

Based on Figure 13, it is known that a 10% decrease in sales can make the proposed alternative unfeasible to implement because at a 10% decrease, the B/C Ratio value is -10.99 or < 1. Meanwhile, an increase in sales can make the proposed alternative highly feasible to invest in because it has a B/C Ratio value far above the minimum threshold of 1.

Figure 14 is a simulation image of the sensitivity of terrazzo production to the Payback Period value with a range of 10% to 50% in one day.

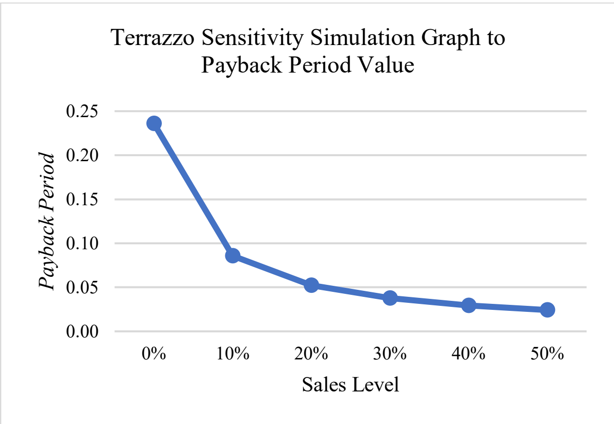

Figure 14. *Mosaic Sensitivity Simulation Graph to Payback Period Value*

Based on Figure 14, it is known that the Payback Period Value at a 10% increase is 0.09; 20% is 0.05; 30% is 0.04; 40% is 0.03; and 50% is 0.02. Based on this, it is known that as the increase in sales becomes larger, the Payback Period will return more quickly, the capital will be recovered faster, and the business will become more feasible to run.

4. Conclusion

Based on the research results that have been conducted, the following conclusions can be drawn:

1. At UD Warna Utama, there are two types of waste produced, namely marble stone chips and sludge. Marble stone chips are produced from the process of sawing marble blocks and sawing marble slabs, while sludge is produced from the process of sawing marble blocks, sawing marble slabs, and polishing marble.
2. From the calculations performed, four feasible proposals and one infeasible proposal were obtained. The feasible proposals are the construction of a water barrier with a payback period of 2.17, a B/C Ratio of 1.53, and an average annual profit of IDR 15,032; the sale of sludge waste as building material with a payback period of 0.19, a B/C Ratio of 17.87, and an average annual profit of IDR 5,531,720; the creation of mosaics with a payback period of 0.28, a B/C Ratio of 11.88, and an average annual profit of IDR 127,030,160; and the creation of terrazzo with a payback period of 0.24, a B/C Ratio of 14.04, and an average annual profit of IDR 31,005,352. Meanwhile, the proposal that is not feasible is the filtration of sludge waste with a payback period of 32.11, a B/C Ratio of 0.31, and an average annual loss of IDR 2,675,750.The conclusion section must be able to address the research objectives.

This research is still limited and only at the conceptual stage, not reaching the implementation phase. Future research is recommended to test the concepts and implementation to see the effectiveness and feasibility of the system in a real-world environment.

Acknowledgement

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References

Dewi, P. C. A. (2024). *MarmorStuff, Bisnis Furnitur Limbah Marmer Karya Mahasiswa ITS*. Itsreg. https://www.its.ac.id/news/2024/01/15/marmorstuff-bisnis-furnitur-limbah-marmer-karya-mahasiswa-its/

Fitriyanti, R., & Fatimura, M. (2019). *Aplikasi produksi bersih pada industri semen*. *3*(1), 10–15.

Khotimah, H., & Sutiono. (2014). Analisis Kelayakan Finansial Usaha Budidaya Bambu. *Jurnal Ilmu Kehutanan*, *8*(1), 1–11.

Pranoto, A., & Sudarsono. (2016). *Pemberdayaan Masyarakat Melalui Pemanfaatan Limbah Gergajian Batu Alam Di Desa Madurejo Kecamatan Prambanan Kabupaten Sleman Daerah Istimewa Yogyakarta*. 120–128.

Rachadian, F. M., Agassi, E. A., & Sutopo, W. (2013). Analisis Kelayakan Investasi Penambahan Mesin Frais Baru Pada Cv. Xyz. *J@Ti Undip : Jurnal Teknik Industri*, *8*(1), 15–20. https://doi.org/10.12777/jati.8.1.15-20

Rochyani, N., Suryani, S., Aziz, W. A., Ndari, P. W., Lestari, R. A., Setiawan, H., Suhartawan, B., Roesdianto, R., & Suyasa, W. B. (2023). Sistem Lingkungan Industri. In M. Sari & R. M. Sahara (Eds.), *Get Press Indonesia* (First Edit).

Simao, L., Souza, M. T., Ribeiro, M. J., Klegues Montedo, O. R., Hotza, D., Novais, R. M., & Raupp-Pereira, F. (2021). Assessment of the Recycling Potential of Stone Processing Plant Wastes Based on Physicochemical Features and

Market Opportunities. *Journal of Cleaner Production*, *319*(December 2020). https://doi.org/10.1016/j.jclepro.2021.128678

Sirait, A. T., Noor, E., & Ismayana, A. (2018). Penerapan Produksi Bersih untuk Meningkatkan Efisiensi Proses Pelapisan Logam. *Journal of Natural Resources and Environmental Management*, *9*(3), 700–709.

Videsia, V., Pujiati, R. S., & Moelyaningrum, A. D. (2017). Produksi Marmer dan Pengolahan Limbah di Sentra Industri Marmer Kabupaten Tulungagung *Artikel Ilmiah Hasil Penelitian Mahasiswa*, 1–5.

Wicaksana, B., Utomo, T. P., Warji, W., Suroso, E., & Subekti. (2022). Analisis Quick Scan Pada Proses Produksi Sari Lemon Untuk Menghasilkan Opsi Penerapan Produksi Bersih. *Jurnal Agroindustri*, *1*(1), 91–98. https://doi.org/10.23960/jab.v1i1.5635