

Product Diversification as A Waste Management Strategy in Small-Scale Chemical Industries

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ABSTRACT

Product diversification involves transforming generated waste into new products with economic value or useful applications. This approach not only reduces the disposed waste volume but also changes the perception of waste from being a source of problems to a potential source for creating added value. This research is a qualitative study using an observational case study approach. Data were collected through in-depth interviews, direct observations, and document review at a small-scale rubber coagulant industry in Musi Rawas. The research findings indicate that CV. KBJA has begun exploring product diversification strategies for handling sulfuric acid waste by converting it into liquid fertilizer. Moving forward, there's a need for enhanced training and education regarding more effective waste management strategies to improve understanding and implementation of new practices. Additionally, collaboration among industries, government, and research institutions is necessary to facilitate the development of this product diversification.

INTRODUCTION

The chemical industry is known for its vital contribution to the production of various products used in everyday life, while simultaneously causing major challenges related to waste management (Saraswati et al., 2020). The chemical industry, especially on a small scale, faces a growing dilemma between economic growth and environmental impact. Increases in the production and processing of chemicals have also led to growing concern about the waste generated in these processes. (Nasori et al., 2023)

Small-scale chemical industries play a crucial role in the global economy by providing chemical products necessary for various needs. However, the growth of this industry is often accompanied by serious problems related to waste management. Waste generated from chemical production processes has the potential to become a threat to the environment and human health if not managed properly. The small scale of chemical industries often does not receive the same attention as large industries in terms of waste management. However, the importance of effective efforts in managing waste from small-scale chemical industries should not be overlooked. Suboptimal waste management can cause significant negative impacts on the environment, human health, and the sustainability of natural resources. (Supeno et al., 2018)

In recent years, the concept of product diversification has emerged as an attractive strategy in waste management in small-scale chemical industries. Product diversification involves transforming waste into new materials or products that have economic value or useful applications. This approach not only reduces the volume of waste disposed of, but also changes the

perception of waste from a source of problems to a potential source of added value. (Luthfiyana et al., 2021)

Musi Rawas Regency is one of the regencies in South Sumatra Province where the largest source of income for the population is the rubber plantation sector. Rubber production in Musi Rawas Regency was recorded in the 2020 sub-district production data with a total of 126,210 tons from a plantation area of 129,768 hectares (the largest among other plantation commodities such as oil palm, coffee, coconut, and cocoa). (BPS Kabupaten Musi Rawas., 2021) Data analysis shows that this sector plays an important role in the economy, has great potential, and affects the level of welfare in the region. This opens up opportunities for industry players to produce equipment and supplies for rubber farmers, one of which is coagulant (rubber latex coagulant). CV. Kharisma Berkah Jaya Abadi (KBJA) is the only industry that produces small-scale rubber coagulants made from 98% sulfuric acid in Musi Rawas Regency. As a chemical product manufacturer located in the middle of a residential area, waste management is naturally a major concern that must be addressed in detail.

This study aims to explore management strategies that can be applied in small-scale chemical industries to reduce the negative impact of waste produced. An in-depth analysis of existing waste management practices and an assessment of alternative strategies that can be adopted will be the main focus of this study. It will then examine the extent to which the industry prioritizes product diversification as a waste management strategy in small-scale chemical industries. An in-depth analysis will be conducted on the

possibility of applying product diversification, the associated technical and economic challenges, and its impact on environmental sustainability and economic sustainability of the industry.

The importance of this research is not only limited to environmental sustainability, but also to economic and regulatory aspects. More efficient waste management can reduce operational costs, increase industrial competitiveness, and comply with increasingly stringent regulatory standards. (Aulia et al., 2023)

Through this research, it is hoped that opportunities will open up to formulate practical guidelines that can help small-scale chemical industries implement more effective waste management strategies, with a focus on applying product diversification as a sustainable solution that meets future needs.

METHOD

This study is a qualitative study with an observational case study approach. (Rijal et al., 2021) Qualitative research is well suited to understanding how product diversification can help address waste issues in small chemical industries, as this method allows for in-depth exploration of the experiences, views, and practices of various stakeholders.

The research location was a small-scale rubber latex freezing industry in Musi Rawas Regency, namely CV. Kharisma Berkah Jaya Abadi (KBJA), located in RT. 05, Sumber Harta Village, Sumber Harta District, Musi Rawas Regency.

Data was obtained through in-depth interviews with the owner and three employees directly involved in the production process at CV. KBJA. In addition, direct observations were conducted using a checklist, and documents such as production reports and waste management records were examined. The

analysis process of the data collected in this study consists of descriptive and interpretative descriptions aimed at exploring efforts to handle and manage waste from small-scale chemical industries, particularly those leading to product diversification.

RESULTS AND DISCUSSION

In this qualitative study, as explained in the research methods section, data collection was carried out in three stages. The first stage was in-depth interviews with business owners and their employees. The following is a summary of the in-depth interview results:

1. Business Owner/Mr. S/CV. KBJA.

Interview Summary:

When asked about the motivation for product diversification, Mr. S explained that the main reason for diversifying products was to reduce the sulfuric acid waste produced from the production process. By utilizing this waste as liquid fertilizer, their business not only helps the environment but also opens up new market opportunities.

Then, when asked about the zerowaste implementation process, Mr. S stated that the zero waste implementation process began with identifying the types of waste produced and finding solutions for its utilization. They work with environmental experts to develop liquid fertilizer formulas from sulfuric acid waste. According to the business owner, the challenges faced are the initial costs for research and development, as well as educating employees about the new process. However, with continuous training and support from the government, these challenges can be overcome. In the final part of the question, regarding the perceived benefits, Mr. S explained that product diversification not only reduces waste but also adds economic value to the business. The sale of liquid fertilizer has provided significant additional income.

2. Employee 1/ HS/ Production Operator

Interview Summary:

Role in Production: Mr. HS explained that his main task is to operate the rubber latex freezing machine and ensure that the production process runs smoothly. He is also involved in the collection and processing of sulfuric acid waste.

Understanding of Product Diversification: Mr. HS stated that he was initially skeptical about this change, but after undergoing training, he realized the importance of product diversification for the environment and the company.

Experience in Implementing Zero Waste: According to Heru, implementing zero waste requires a change in mindset and work habits. He feels proud to be part of a business that cares about the environment.

Impact on work: Mr. HS feels that product diversification has made his work more meaningful and satisfying. In addition, he has also seen an improvement in work safety due to less waste.

3. Employee 2/Mr. Y/ Waste manager

Interview Summary:

Role in Production: Mr. Y explained that his main duties are still related to the production and packaging of rubber latex freezing products. However, he is also responsible for the collection and processing of sulfuric acid waste. Previously, sulfuric acid waste was simply discharged into a pond, which was then periodically reported to the relevant agency for chemical neutralization treatment. However, the waste is now reused to produce a new product in the form of liquid fertilizer.

Understanding of Product Diversification: Mr. Y stated that initially he did not fully understand that production waste could still be utilized. After undergoing training and socialization, he realized the importance of product diversification for the environment and the company.

Experience in Implementing Zero Waste: According to Yogi, the implementation of zero waste needs to be continuously socialized to every employee,

especially those involved in businesses that produce hazardous waste (chemicals). This is so that employees understand that when working, it is not only about how to earn money, but also how to protect the environment.

Impact on Work: Mr. Y said that with this product diversification, there is indeed more work, but safety is better maintained because less waste is produced.



Figure 1. Direct observation process

The second stage of data collection is direct observation. The following are the results of direct observation in the form of process descriptions (according to the checklist) and observation findings:

Process Description:

Sulfuric Acid Waste Collection: Sulfuric acid waste is collected from the rubber latex freezing production process in special corrosion-resistant storage tanks. These tanks are equipped with a piping system that is directly connected to the production line to minimize leakage and direct contact with employees.

Treatment Process: The sulfuric acid waste is then transferred to the waste treatment unit. Here, the sulfuric acid is mixed with other chemicals to reduce its acidity. The entire process is carried out in closed containers to avoid direct exposure to the environment. After the neutralization process, the chemically altered waste is transferred to the next treatment unit to be mixed with organic materials, such as vegetable waste and plant residues, to be processed into liquid fertilizer.

Liquid Fertilizer Production: The mixture is then fermented in special containers for several weeks until it

becomes liquid fertilizer that is ready for use. The quality of this liquid fertilizer is tested before it is packaged for sale or reused in agricultural areas around the industry.

Availability of Personal Protective Equipment (PPE): Some PPE is provided by the management in the form of masks, gloves, and boots.



Figure 2. Waste Treatment Equipment
Observational Findings:

Waste Collection Effectiveness: The waste collection system integrated with the production line is effective in minimizing leaks and direct contact with employees, thereby improving work safety and occupational health.

Processing Efficiency: The waste treatment process carried out in closed containers successfully reduces the risk of environmental contamination. However, further monitoring of the acidity level of the waste after neutralization is needed to ensure the process runs optimally.

Liquid Fertilizer Results: The liquid fertilizer produced is of good quality in accordance with established standards. The use of sulfuric acid waste as a raw material for liquid fertilizer is an innovative solution that reduces waste while increasing the economic value of the product.

Zero Waste Implementation: The application of the zerowaste concept in this process has shown positive results by utilizing all waste generated from the production process. This step also supports environmental sustainability efforts and creates environmentally friendly products.



Figure 3. Observation Process

In the final stage of data collection, researchers conducted document searches in the form of production reports and waste management records. The following are the results of the document search, as well as a comparison with the findings from interviews and direct observation:

Production Reports:

Production Volume: Over the past month, small chemical industries produced an average of 10,000 liters of rubber latex coagulant. **Raw Materials:** The main raw material used is sulfuric acid, with a volume of 3,000 liters per month. **Amount of Waste:** The sulfuric acid waste produced reaches 500 liters per month.

Waste Management Notes:

Management Method: Sulfuric acid waste is collected in special storage tanks for further processing into liquid fertilizer.

Processing: The processing involves neutralizing the sulfuric acid with certain chemicals and mixing it with organic materials before fermenting it into liquid fertilizer.

Use of Liquid Fertilizer: Liquid fertilizer produced from sulfuric acid waste is used on agricultural land around the industry, particularly on palm oil plantations owned by industry managers, and some is sold to the local market.

Comparison with Interview Findings and Direct Observations:

Similarities in Findings:

Production Reports and Interviews with Business Operators: Both the production reports and interviews with Mr.

Syaifuddin show that the production volume and main raw materials used are consistent. The collection and processing of sulfuric acid waste is also in line with the explanations in the interviews.

Waste Management Records and Direct Observations: The waste collection and processing procedures documented in the waste management records are consistent with the findings from direct observations. The use of special storage tanks and neutralization processes is in line with the practices observed in the field. However, not all employees wear complete personal protective equipment (PPE).

Differences in Findings:

Management Challenges: Interviews with employees revealed challenges in educating employees and changing their mindset, which were not reflected in the waste management records. Although the records describe the technical processes well, the human and educational aspects need more attention.

Process Efficiency: Direct observation shows that the waste treatment process runs smoothly with some areas requiring further monitoring. Meanwhile, waste management records do not include details regarding process efficiency monitoring.

Implications and Use of Results:

Liquid Fertilizer Quality: Both the interview results and waste management records confirm that the liquid fertilizer produced is of good quality and accepted by the market. This shows that this product diversification is effective in reducing waste and providing economic added value.

Zero Waste Impact: The implementation of zero waste documented in waste management records and direct observation results proves that this concept can be applied practically and provide tangible benefits for the environment.

The results of this study indicate that product diversification by processing

sulfuric acid waste into liquid fertilizer is an innovative and effective measure in addressing waste issues in small chemical industries.

Effectiveness of Product Diversification:

The process of transforming sulfuric acid waste into liquid fertilizer has successfully reduced the amount of waste produced and increased the economic value of the waste. This is in line with the views of business owners and employees who stated that product diversification provides significant additional income and supports sustainability efforts.

Zero Waste Implementation:

The implementation of the zerowaste concept in this industry has succeeded in reducing the environmental impact of production waste. Direct observation shows that the waste treatment process is carried out properly using safe and efficient methods. The liquid fertilizer produced is also of good quality and is acceptable in the market.

Challenges and Solutions:

The main challenges faced in implementing product diversification are the initial costs for research and development and employee education. However, with support from the government and ongoing training, these challenges can be overcome. Cooperation with environmental experts and regulators is also important to ensure that this process complies with environmental standards.

Environmental Impact Analysis:

Document analysis shows that proper waste management not only reduces environmental pollution but also creates environmentally friendly products. Liquid fertilizer produced from waste transformation also supports environmental sustainability and can be used in local agriculture.

Small-scale chemical industries are the backbone of the local economy with innovations that integrate local needs and simple technology, but they still interact with chemicals as raw materials that

sometimes require extra effort, especially in waste management. The components of this industrial waste vary, ranging from liquid waste to solid waste from processing and industrial waste. (Nasir et al., 2015)

Small industries often face obstacles in waste management due to limited resources, including adequate processing infrastructure. However, this waste has the potential to cause health problems for the surrounding community due to air and water pollution and exposure to chemical waste. In addition, occupational safety issues are also an important concern in small-scale chemical industries, given the risks that may arise, such as work accidents and thermal pollution. (Nasir et al., 2015)

Waste from rubber latex freezing using sulfuric acid as a raw material can include several components, namely: residual sulfuric acid; unused sulfuric acid left over from the rubber latex freezing process; organic compounds; organic compounds formed as a result of the interaction of sulfuric acid with other raw materials, such as complex organic

compounds that may form during the chemical reaction process; sulfate compounds; sulfate compound residues from sulfuric acid that do not react completely and can be carried into production waste, and exhaust gases; in the process of using sulfuric acid, exhaust gases such as sulfur dioxide (SO₂) can also occur and enter the waste. (Valentina et al., 2020)

The management of this waste is important to minimize its impact on the environment. Waste treatment through purification, separation, or reduction of hazardous compounds is key to protecting the environment from the negative impacts of industrial waste.

Awareness of the need to minimize negative impacts on the environment by reducing waste entering landfills or polluting the environment has encouraged industry, institutions, and the general public to adopt more sustainable practices in waste management, viewing waste not as a problem but as a resource that can be reused.

CONCLUSIONS AND RECOMMENDATIONS

This study reveals that product diversification by processing sulfuric acid waste into liquid fertilizer is an effective and innovative solution to waste problems in small chemical industries. The application of the zerowaste concept and product diversification not only reduces environmental impact but also provides economic added value for businesses. The main challenges in implementing this can be overcome through employee training, government support, and collaboration with environmental experts. The results of this study provide practical recommendations for business actors to implement product diversification and zero waste, as well as suggestions for more in-depth future research. The integration of the findings with the literature review shows

consistency with the principles of sustainability and the circular economy, as well as the importance of safe chemical waste treatment and employee education in waste management.

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