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DESIGN PRACTICE AS A CULTURAL RESPONSE TO TEXTILE WASTE AND SUSTAINABILITY VALUES

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Abstract

Textile waste generated by the fashion industry represents not only an environmental challenge but also a cultural outcome of contemporary production systems and consumption values. In Indonesia, the dominance of synthetic materials and fast fashion practices has intensified the accumulation of textile waste, reflecting a linear perception of material use and disposal. This study explores synthetic fleece textile waste through a design-led approach, positioning design practice as a cultural and reflective response to sustainability issues rather than a purely technical solution. Using qualitative methods including field observation, interviews, visual documentation, and design-driven material exploration, the research examines fleece waste sourced from garment production in Bandung. Material exploration combines fleece fibers with potato starch as a natural binder, guided by Material Driven Design and Cradle-to-Cradle principles. Rather than emphasizing technical optimization, the study focuses on how material behavior, surface expression, and limitations inform design decisions and sustainability narratives. The findings show that fleece waste can be reframed as a meaningful material within non-structural interior applications when approached through design practice. The resulting wall clock serves as a reflective artifact that communicates material origin, transformation processes, and sustainability values within a familiar domestic context. This research contributes to design and sustainability discourse by demonstrating how design practice can transform textile waste into culturally relevant material narratives, fostering material awareness and alternative value systems in everyday life.

Keywords: textile waste, material driven design, sustainability, material culture, biocomposite.

INTRODUCTION

Solid waste generated by the textile industry has become an increasingly prominent environmental concern within global and local sustainability discourses. The complexity of textile production processes, ranging from fiber production and fabric cutting to dyeing and finishing, results in substantial waste generation at almost every stage. In Indonesia, this condition has intensified alongside the rapid growth of fast fashion consumption and the widespread use of synthetic materials, which encourage short product lifecycles and reinforce linear production systems. Data from the National Development Planning Agency indicate that Indonesia produces approximately 2.3 million tons of textile waste annually, accounting for around 2.63 to 2.87 percent of total national waste, with projections reaching 3.9 million tons by 2030 if current practices persist. These figures highlight that textile waste management in Indonesia remains predominantly disposal-oriented and has yet to embrace a sustainable material life cycle perspective.

Textile waste should not be understood solely as an environmental issue but also as a cultural outcome of production and consumption systems. Poorly managed textile waste contributes to soil and water pollution through chemical residues from dyeing processes and microplastic release from synthetic fibers. However, beyond these environmental impacts, textile waste reflects social values that prioritize speed, efficiency, and novelty over longevity, care, and responsibility. Waste, therefore, functions as a material trace of how society values materials, how products are designed and used, and how quickly they are discarded within everyday life.

Within this context, design holds a strategic position as a practice capable of responding to environmental challenges through social and cultural lenses. Design is not limited to problem solving or product creation but operates as a reflective practice that shapes meanings, values, and perceptions. Fletcher argues that textile waste, whether derived from natural or synthetic fibers, retains material qualities that allow it to be reused or transformed through appropriate design approaches. From this perspective, design practice enables waste to be reintroduced into everyday contexts in ways that provoke reflection on sustainability, ethics, and material responsibility.

Polyester represents one of the most dominant synthetic materials in the global textile industry. Its widespread use is driven by its durability, lightweight properties, ease of maintenance, and relatively low production cost. More than half of global textile fiber production is derived from polyester and its derivatives, making it a central contributor to synthetic textile waste. While polyester’s durability ensures long-term use during its functional lifespan, it also results in environmental persistence when discarded, positioning polyester waste as a critical issue within sustainability discourse.

Figure 1. Fleece textile waste
Source: Fikroh, 2026

One common form of polyester-based textile waste is fleece fabric, widely used in garments, sportswear, and household textiles. Preliminary observations conducted in garment workshops in Baros Village, Bandung, identified fleece as one of the most dominant waste materials generated during production processes. Fleece waste typically originates from pattern-cutting offcuts and is often discarded without further consideration. Despite its association with environmental pollution, fleece fibers possess structural stability and consistency, suggesting potential for alternative material applications through design-led exploration.

Existing approaches to textile waste management increasingly promote sustainable strategies such as recycling and material substitution. One such approach is upcycling, defined as the process of reusing waste materials while maintaining or increasing their value without degrading material quality. Unlike recycling, which often removes traces of material origin, upcycling allows material histories and transformations to remain visible. In design practice, these visible traces function as expressive elements that communicate sustainability narratives and ethical considerations.

Although previous studies have explored textile-based biocomposites, much of this research prioritizes technical performance and material optimization, often detached from design contexts and everyday use. Such approaches tend to overlook experiential, visual, and interpretative dimensions central to design practice. This gap highlights the need for research that situates material exploration within design processes, where material behavior, surface qualities, and limitations actively inform design decisions and cultural meaning.

To frame material transformation within a broader sustainability perspective, this research adopts the Cradle-to-Cradle approach, which emphasizes continuous material cycles rather than linear life cycles. Within this framework, synthetic textile waste such as fleece cannot return to biological cycles but can be repositioned within technical cycles through material transformation. Combined with a Material Driven

Design approach, this study positions material characteristics as the starting point of design, allowing materials to guide form, application, and meaning.

Grounded in production contexts in Bandung, where textile waste is abundant and underutilized, this research positions design practice as a cultural response to textile waste. Rather than proposing a singular technical solution, the study frames design outcomes as reflective artifacts that mediate material transformation, sustainability values, and everyday life.

RESEARCH METHOD

This research employs a qualitative and exploratory approach that positions design practice as the primary mode of inquiry. The study does not aim to produce a technically optimized material solution but instead seeks to explore how material characteristics, transformation processes, and sustainability values emerge through design-led experimentation. Knowledge is generated through iterative cycles of making, observing, and reflecting, where material exploration itself becomes a method of investigation. Material exploration focuses on the development of a biocomposite material derived from synthetic textile waste, specifically polyester fleece, combined with potato starch as a natural binding agent. The exploration involves varying material compositions, forming techniques, and drying methods to produce a series of material samples, each treated as a design artifact rather than a final product. These samples serve as physical records of design decisions and material responses.

Data collection includes field observation in garment production environments, informal interviews with production actors, visual documentation of waste handling practices and material processes, and literature review to establish theoretical and contextual grounding. Data analysis is conducted qualitatively and descriptively by comparing material samples based on visual appearance, tactile qualities, structural behavior, and response to environmental conditions. Sustainability principles, particularly the Cradle-to-Cradle framework, are used as reflective tools to evaluate material transformation and potential application contexts. Through this method, design practice functions as a mediating process that connects material experimentation, sustainability considerations, and culturally grounded product development.

RESULT AND DISCUSSION

Textile Waste as a Cultural Outcome of Production Practices

Field observations and interviews conducted in fashion production environments in Bandung reveal that textile waste, particularly fleece offcuts, is a direct outcome of prevailing production practices and value systems. In small-scale garment workshops in Baros Village, fleece waste consistently emerges during the pattern-cutting stage and is commonly treated as residual material with no further use. These remnants are classified as pre-consumer waste, characterized by minimal contamination and intact material condition, indicating that disposal is driven by routine and efficiency-oriented priorities rather than material degradation.

Similar patterns were observed at an industrial scale in a Bandung-based fashion brand with long-term and consistent use of fleece materials. Standardized cutting processes systematically generate fleece waste, demonstrating that waste production is structurally embedded within fashion systems across different scales. Despite variations in waste size and form, the treatment of fleece remnants as discardable material remains consistent, highlighting the normalization of textile waste within fashion production culture. Interviews with production actors further indicate limited awareness and infrastructure for textile waste management, reinforcing linear material perceptions within the industry.

Material Exploration as Design Interpretation

Material exploration was conducted as a design-driven response to textile waste conditions by combining fleece textile waste with potato starch through an iterative process of preparation, transformation, and evaluation. As illustrated in Figure 2, the exploration process began with material sorting, shredding, and fiber refinement of synthetic fleece waste, conducted in parallel with the preparation and gelatinization of the natural matrix derived from potato starch. These two material streams were subsequently brought together through mixing, followed by molding, drying, testing, and evaluation stages, ultimately producing a series of biocomposite material outcomes.

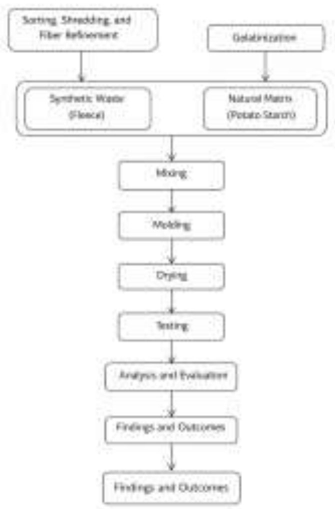

Figure 2. Biocomposite Material Exploration Process
Source: Fikroh, 2026

Rather than approaching these stages as purely technical procedures, the exploration was framed as a sequence of reflective design actions. Each step was intended to reveal how material behavior, surface qualities, and structural tendencies emerge through transformation processes. The diagram in Figure 2 visualizes the overall flow of material exploration, while Table 1 details each stage of the process and its corresponding documentation, emphasizing the gradual material transition from raw textile waste to a formed biocomposite sheet.

Table 1. Biocomposite Material Exploration Process
Source: Fikroh, 2026

No.	Exploration Process	Documentation
1.	Fiber (Synthetic Waste)	
2.	Material Sorting	
4.	Shredding and Refinement	
5.	Potato Starch	

6.	Gelatinization	
7.	Mixing	
8.	Molding	
9.	Drying	
10.	Final Result	

As summarized in Table 1, the exploration process includes the preparation of synthetic waste fibers, material sorting, shredding and refinement, matrix preparation using potato starch, gelatinization, mixing, molding, drying, and the production of final material outcomes. This structured yet iterative process allowed material characteristics to be observed at each stage, ensuring that design decisions remained grounded in material response rather than predefined product expectations.

Figure 3. Exploration of matrix types in samples (P1) and (P2).
Source: Fikroh, 2026

Figure 3 presents the exploration of two different matrix types applied to the biocomposite samples, namely P1 and P2. This exploration was conducted to examine how variations in matrix formulation influence material behavior, surface characteristics, and overall stability within a design context. Based on the experimental results, a comparative analysis was carried out to clarify the rationale behind the selection and application of each biocomposite matrix formulation.

Two matrix systems were explored: a starch-based biopolymer matrix (P1) composed of potato starch, glycerin, vinegar, and water, and a porous starch-based biopolymer matrix (P2) incorporating potato starch, sodium alginate, and calcium chloride. Existing literature indicates that potato starch exhibits a high gelatinization capacity, allowing the formation of a relatively homogeneous biopolymer matrix, while its amylose content contributes to improved mechanical integrity. In contrast, the modification of starch using alginate and calcium chloride enables the formation of porous matrix structures, resulting in distinct visual and structural characteristics.

The visual and structural outcomes of this exploration, as shown in Figure 3, indicate that the P1 matrix exhibited more consistent bonding, surface integrity, and formation stability compared to the P2 matrix. The P2 samples, while demonstrating potential for porous structure development, showed less stable formation under the explored conditions. These findings suggest that matrix formulation plays a critical role in shaping not only technical performance but also the expressive and functional qualities of the biocomposite material.

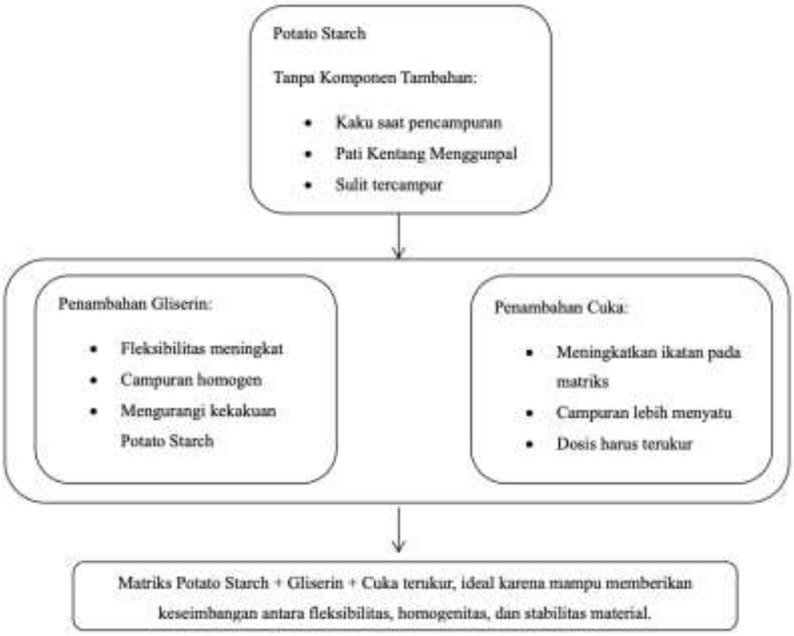

Figure 4. Biocomposite Binders.
Source: Fikroh, 2026

Based on this comparative evaluation, the P1 formulation was selected as the primary matrix system for subsequent material development and further testing. Figure 4 illustrates the biocomposite binder systems used in this study, emphasizing the role of binder composition as a design decision that mediates between material behavior, processability, and intended application. Rather than being treated solely as a technical component, the binder is positioned as an integral part of the design process that influences material interpretation, stability, and suitability for non-structural interior applications.

Table 2. Biocomposite matrix comparation
Source: Fikroh, 2026

Image	Sample Code	Thickness	Size
	K1	11 mm (Thin)	20x20 cm

	K2	12 mm (Medium)	
	K3	13 mm (Thick)	

Table 2 presents a comparison of biocomposite material samples produced at different thicknesses, namely K1 (11 mm), K2 (12 mm), and K3 (13 mm), each developed in a consistent 20 × 20 cm format. This comparison was conducted to examine how variations in thickness influence material behavior, surface quality, and structural stability within the context of design-oriented material exploration.

The observed variations demonstrate that material qualities emerge through an ongoing negotiation between waste textile fibers and the binding matrix. Differences in thickness affected not only visual density but also perceived rigidity and cohesion, reinforcing the role of design experimentation as a means of understanding material response rather than optimizing a single performance parameter. Thinner samples tended to exhibit greater flexibility, while thicker samples showed increased stiffness and visual compactness.

In addition to thickness variation, forming and drying methods significantly influenced the resulting material characteristics. Pressed forming produced denser and more stable biocomposite sheets compared to manual forming, indicating that applied pressure plays a key role in material consolidation. Drying conditions further affected surface quality and dimensional stability, with controlled drying resulting in more consistent outcomes. These processes were not treated as isolated technical variables but were understood as interconnected stages within a continuous design process, where material behavior is shaped cumulatively through making, observation, and adjustment.

DESIGN PROCESS

The design process in this study is positioned as a direct continuation of the material exploration stage, where design does not begin with a predetermined form or function, but emerges from an in-depth understanding of the characteristics, limitations, and potentials of the developed biocomposite material. A Material Driven Design (MDD) approach is employed to place material as the primary driver of the design process, ensuring that all design decisions respond directly to material behavior rather than conventional aesthetic or functional assumptions. Within this framework, the design process functions as an interpretative practice that translates material findings into product context and everyday use.

Material Understanding

The design process begins with a comprehensive understanding of the biocomposite material characteristics derived from the material exploration stage. The biocomposite was developed in the form of flat sheets measuring 20 × 20 cm, with thickness variations of 1.1 cm, 1.2 cm, and 1.3 cm, as presented in Table 3. These variations were intentionally produced to observe how changes in thickness influence material behavior, flexibility, and visual density within a design context.

Table 3. Material Result
Source: Fikroh, 2026

		
20cm x 20 cm x 1,3 cm	20 cm x 20 cm x 1,2 cm	20 cm x 20 cm x 1,1 cm

The exploration results indicate that the biocomposite material, composed of synthetic textile waste as reinforcement and potato starch as a natural binder, exhibits rigid to semi-flexible behavior, strong stability when applied in flat forms, and clear limitations with regard to structural loading and water exposure. The molding process produces sheets with relatively uniform thickness and visual stability; however, the surface remains partially heterogeneous and visibly reveals fiber traces from the textile waste. Rather than being treated as defects, these surface characteristics are understood as expressive material qualities that communicate the material's origin and transformation process.

These material characteristics form the primary basis for design decision-making. The biocomposite is not approached as a universal solution that can be freely applied across product categories, but as a material with specific capacities and constraints that require contextual interpretation. This understanding establishes the foundation for a design direction that aligns application, form, and function with material behavior, rather than forcing performance beyond the material's inherent capabilities. Through this material-driven approach, design emerges as a response to material conditions, positioning material understanding as a critical step in shaping responsible and meaningful design outcomes

SWOT Analysis

To translate material understanding into structured design implications, a SWOT analysis was conducted to identify the strengths, weaknesses, opportunities, and threats of the developed biocomposite material within a product design context. This analysis functions as a reflective tool that ensures design decisions are analytically grounded rather than purely intuitive, allowing material characteristics to directly inform design direction.

Table 4. SWOT Analysis
Source: Fikroh, 2026

Aspect	Description
Strength	The material exhibits good stability in flat forms, distinctive visual texture, and originates from synthetic textile waste.
Weakness	Limited resistance to water, unsuitable for structural load-bearing applications, and restricted flexibility.
Opportunity	Potential application in non-structural interior products and material-driven exploratory design objects.
Threat	Risk of degradation in humid environments and the perception of waste-based materials as inferior.

The analysis identifies the material's primary strengths in its stability when applied in flat forms, its distinctive surface texture, and its sustainability value derived from synthetic textile waste. Conversely, the material demonstrates clear weaknesses related to moisture sensitivity, limited flexibility, and its inability to support structural loads. Opportunities emerge in the development of non-structural interior products and material-driven exploratory objects that prioritize visual and narrative value. Meanwhile, threats are associated with potential degradation in humid environments and the persistent perception of waste-based materials as inferior within mainstream product culture.

To translate these findings into design strategies, a SWOT strategy matrix was formulated, as presented in Table 5.

Table 5. SWOT strategy matrix
Source: Fikroh, 2026

	S	**W**
O	SO The strengths of the biocomposite material, particularly its stability in flat forms and distinctive visual character, are leveraged to respond to opportunities for developing sustainability-oriented interior products. The biocomposite is positioned as the primary design element by highlighting surface texture and visible fiber traces as the visual and narrative value of the product.	WO The limitations of the biocomposite material in relation to water resistance and structural load are minimized by selecting product applications that operate passively and are situated within interior contexts. Opportunities for material-driven product development are addressed by aligning product function with the material's capacity, avoiding the imposition of excessive technical performance.
T	ST The distinctive visual character of the biocomposite material and its sustainability narrative are utilized to counter negative perceptions of waste-based materials. By honestly exposing the material's texture and characteristics, the biocomposite is positioned as an alternative material with design value rather than as an inferior substitute.	WT The material's limitations in relation to water exposure and challenges in quality consistency are anticipated by restricting product use to dry interior environments and avoiding applications that require high precision or structural strength. This strategy aims to maintain material performance while reducing the risk of product failure.

Based on the SWOT strategy matrix, the overall design direction focuses on maximizing the biocomposite's visual and formal strengths while carefully managing its limitations through contextual application and functional restraint. The material is deliberately positioned as the primary design element, with its texture, fiber traces, and material honesty exposed rather than concealed. Through this approach, the biocomposite is framed not merely as a substitute material, but as a meaningful design medium capable of communicating sustainability values through form, surface, and use.

Terms of Reference (ToR)

The design implications derived from the SWOT analysis are then formulated into a Terms of Reference (ToR) that serves as a guiding framework throughout the design process. The ToR functions as a bridge between material exploration and product development, ensuring consistency from conceptualization to prototyping. The product is defined as a non-structural interior object that operates passively without receiving significant mechanical loads. The dominant form is flat, and application is directed toward dry interior environments. The biocomposite material is positioned as the main design element, with its visual character, surface texture, and fiber traces exposed as part of the design language. The ToR also emphasizes avoiding over-design by not imposing functions beyond the material's capacity, framing the product as a medium for material exploration rather than a purely functional object. This framework supports material transparency, future material development potential, and feasibility in prototyping based on the results of material exploration.

Design Brief

Based on the established ToR, a design brief is formulated to guide product development. The design aims to create a non-structural interior product derived from the explored biocomposite material, operating passively and dominated by flat geometry. The product is intended for dry interior use with minimal physical interaction, allowing visual engagement and material expression to become the primary focus. The design outcome is realized through conceptual development, visual representation, technical drawings, and prototyping, functioning as research artifacts that validate the relationship between material exploration and design practice. In this context, the design brief serves not only as a technical guideline but also as a conceptual statement positioning the product as an extension of material research.

Prototype

Figure 5. Prototype
Source: Fikroh, 2026

Prototype represents the culmination of the material-driven design process. The wall clock is conceived as a medium for biocomposite material exploration, with surfaces that reveal natural texture and fiber traces as an integral part of the aesthetic. Each piece is visually unique, reflecting the material's origin and transformation process. The rigid to semi-flexible character of the material makes flat geometry the most stable design approach, consistent with material exploration and testing results. The sheet-based molding process enables consistent thickness and sufficient structural integrity for non-structural interior applications that operate passively with minimal physical interaction. The design remains simple and functional, employing a circular form to maintain visual balance and reduce the risk of material failure at corners. The clock mechanism is kept minimal to ensure the material surface remains the focal point. Rather than concealing material limitations, the Wall Clock embraces them as part of its design identity, presenting an intersection between material research and everyday interior objects that communicates narratives of sustainability, material transformation, and design responsibility.

CONCLUSION

This study demonstrates that synthetic textile waste, particularly fleece, can be repositioned through design practice as a culturally meaningful material resource rather than residual production output. By engaging textile waste through a design-led material exploration process, the research highlights that material value is not inherent but constructed through decisions related to composition, processing, and contextual application. The findings emphasize that material characteristics are shaped by production practices and transformation processes, reinforcing the role of design as a mediating practice that connects material experimentation with sustainability values. While the developed biocomposite exhibits limitations, particularly regarding moisture sensitivity, its stability in flat, non-structural forms provides a clear and responsible direction for application. The wall clock developed in this research illustrates how everyday objects can function as carriers of sustainability narratives by integrating material reuse into familiar domestic contexts. Rather than concealing material limitations, the design embraces them as generative conditions that shape meaning and direction. Through a Material Driven Design approach, this study positions design practice as a cultural response to textile waste, contributing to broader discussions on material culture, sustainability, and the role of design in shaping alternative value systems in everyday life.

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