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Processing Purple Sweet Potato Peel as Alternative Material of Textile and Fashion Products with Circular Economic Principles

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The textile and fashion industries are the most polluting industry in the world. This is because the industries driven by the fashion trend which is rapidly change. During the production and distribution process, the fashion and textile industries produce waste that can damage the air, water and soil. Moreover, the industries use non-renewable materials, and the life span of their product is short, eventually it will end up on the landfill. The application of circular economic principles on the textile and fashion industry is a step in an effort to reduce the level of environmental pollution. In this study, the principles that applied are, using biomaterial, obtain it from local resources, producing less waste, and after use the material can be naturally decomposed. The method used in this research is a qualitative method with an experimental approach. Data collected through a several exploration stages, processing purple sweet potato peel into composite materials. Processing purple sweet potato peel in this study is to produce an alternative raw material for the industries, so that they can use a more environmentally friendly material. Using biomaterials also can adding value to the textile and fashion products, so it can foster awareness to the consumer, in aim to make a systemic social behavioral change. The output of this study is the design of fashion products made of composite materials from purple sweet potato peel which are carried out using digital simulation sketches. The design was made based on the consideration of the character and potential of the composite material from the results of a series of experimental processes, so that the product sketch made is an accessory product consisting of earrings with a relatively small size.

Keywords: fashion, textile, purple sweet potato, circular economy

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INTRODUCTION

The fashion industry is one of the creative industry sectors that has a significant impact on Indonesia's economic growth. Based on data from the Ministry of Industry in 2018, the national textile and textile product (TPT) industry, the apparel industry recorded the largest export value. Throughout 2018, the apparel industry recorded exports of US\$8.62 billion with a growth of 8.9%. On the other hand, textile industry exports last year were valued at US\$4,651 billion, down 0.1% compared to 2017 which was valued at US\$4,655 billion (<https://www.kemenperin.go.id/artikel/20641/Indus-tri-Pakaian-Jadi-Catatkan-Pertumbuhan-Paling-Tinggi>).

Although it generates huge profits from an economic point of view, the fashion and also its closest related industry, which is textile industry, are the industries that produce the most pollution to the environment. During the production process to distribution, the fashion and textile industries produce waste that can damage air, water and soil. According to [Maity \(2020: 242\)](#), the textile and fashion industries also have negative impacts on the environment indirectly, workers in these industries spend long working hours, in an unhealthy working environment. In many cases, these workers put their health into producing more clothes at a lower cost. In addition, after the life of fashion and textile products has run out, there is often a buildup of waste that is difficult to decompose. Fashion trends continue to change in a short period of time. This has resulted in fashion products from large industries piling up just like that in a condition that is still very usable, but no longer sells when thrown into the market. As also stated by [Maity \(2020: 242\)](#), that the textile industry is part of a fashion system that promotes mass and fast consumption, people buy clothes to wear in a short period of time, so these fashion products quickly become textile waste.

The circular economy principles applied to the textile and fashion industry is a step in an effort to reduce the level of environmental pollution. Stated by [Siderius \(2020:1\)](#), the circular economy attempts to reconcile the extraction, production and usage of goods and resources with the limited availability of those resources and nature's regenerative capabilities. This perspective entails a shift throughout the supply chain, from material science (e.g., non-toxic, regenerative biomaterials) to novel logistical systems (e.g., low-carbon reverse logistics). In this study, purple sweet potato peel which is a waste will be processed into an alternative textile material that is more environmentally

friendly, and is expected to become a raw material for fashion products. With the application of the principle of circular economy, the purple sweet potato peel will be processed using additional materials that can be decomposed properly after its useful life is over. The circular management of textiles requires the creation of safe product and material cycles, encouraging reuse and recycling, while avoiding waste incineration and landfilling (Global Fashion Agenda in Eionet, 2019:3). According to [Jönsson \(2021:2\)](#), only 27% of textile waste is recycled, and the remaining 73% is disposed of. Therefore, finding alternative materials that are environmentally friendly, made from renewable natural resources, and can be obtained in large quantities from local plantation, is an attempt to apply the principles of a circular economy to the fashion and textile industries in Indonesia in particular.

The objectives of this study are knowing the potential of purple sweet potato peel as an alternative material for environmentally friendly textiles, and also to identify how to process purple sweet potato peel so that it can be used as raw material for fashion products. Moreover, the experimental method which organized knowledge of design fundamentals and principles of visual media, onto natural materials can hone the creativity of industry players in producing innovative products ([Andriana, 2021:79](#) and [Hendriyana, 2022:124](#)).

RESEARCH METHODOLOGY

This research is qualitative research. The approach uses an experimental method, by conducting a several exploration processes to identify the most proper method in processing purple sweet potato peel. The exploration stages aim to processing the purple sweet potato peel so it can be used as an alternative material for textiles and raw materials for fashion products in accordance with the circular economy principles.

RESULT AND DISCUSSION

Circular Economy

According to [Maity \(2020:238-241\)](#) the fundamental concept of a circular economy is the extension of the lifetime of goods. It is a gradual transition towards a sustainable society by making use of the world's limited resources and various strategies adopted by industry to regenerate resources consistently. A circular economy is defined as a restorative or regenerative industrial system by intention and design. It replaces the concept of "end of life" with restoration, shifts

towards the use of renewable energy, eliminates the use of toxic chemicals, interferes with reuse, and aims for waste elimination through the design of materials, products, systems and, business models.

"Circular Economics" is a broad concept that includes many ideas related to a number of disciplines. Concern for health, environmental and social issues has led designers and design researchers to explore different ways of relating these connected ideas, from service design to design for emotional resilience ([Hornbuckle, 2018:5](#)).

The circular economy concept consists of 3 main principles, namely:

1. Redesigning waste or garbage so that it can be reused
2. Use products and materials as long as possible
3. Regenerate natural system (Rijksoverheid in [Siderius, 2020:1](#))

Circular economies try to reconcile the extraction, production and use of goods and resources with the limited availability of those resources and the regenerative capabilities of nature. This perspective requires a shift across the supply chain, from materials science for example, non-toxic, regenerative biomaterials, to new logistics systems for example, low-carbon reverse logistics ([Siderius, 2020:1](#))

Circular Economy within The Textile and Fashion Industries

The fashion and textile industries are the industries that produce the most pollution to the environment. During the production and distribution process, the fashion and textile industries generate waste that can damage the air, water and soil. According to [Maity \(2020:242\)](#), the textile and fashion industry also has a negative impact on the environment indirectly, workers in these industries spend long working hours, in an unhealthy work environment. In many cases, these workers put their health into producing more clothes at a lower cost. In addition, only a small fraction of all used textiles worldwide is recycled and about 73% are incinerated or disposed of in landfills after use. Due to the low recycling rate, approximately 350 Mt of petroleum is required annually to sustain the polymer industry with new base materials; that number is expected to double in the next few decades ([Jönsson, 2021:2](#)).

Systemic change is needed, involving more stakeholders in the fashion industry. Among the various textile sectors, the fashion industry must take the initiative to improve the sustainability of its supply chain and production processes. In the short term, the focus will be primarily on implementing efficiency measures to reduce water, energy and chemical use, while improving supply chain traceability and working conditions. In parallel, real work towards long-term goals must start now, namely changing the fashion industry to a circular economy system, embracing digitalization opportunities and sustainable fiber development (Global Fashion Agenda in Eionet, 2019:3).

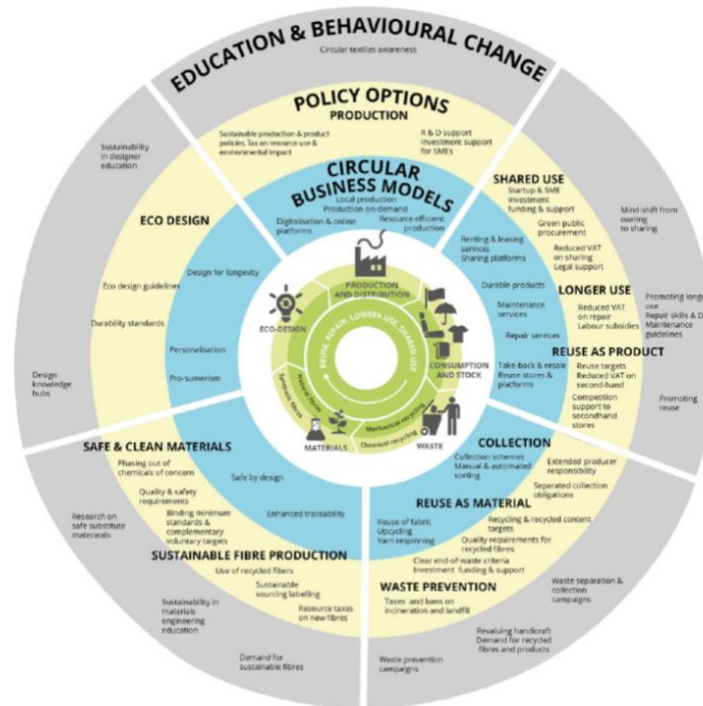


Figure 1. Vision of a circular textiles system
(source: EEA/Eionet, 2019)

In addition, fast fashion has a big role in affecting the demand of consumer, urges industry to produce in large quantities, and end up producing more pollution. For this case, social innovation related is needed, for example, to how consumers interact and share clothing, how they end up make a purchase decision. To foster profound behavioural change, the scaling of sustainable, circular business models is key

(Elander et al., 2017; Watson et al., 2017 in Eionet, 2019:3). Furthermore, community participation in managing waste is a potential that must be integrated with the development of environmentally friendly creative industries (Wahida, 2022:272)

Purple Sweet Potato

In Indonesia, purple sweet potato plants spread from Sumatra to Papua. This plant does not require high maintenance and it is not difficult to be taken care. Moreover, purple sweet potato can be harvested all year round, even in the dry season. 89% of sweet potato production is used as food with a consumption rate of 7.9 kg/capita/year, while the rest is used for industrial raw materials, especially sauces and animal feed (Qinah in Fatimatzahro, 2019). In addition, because of high demand of purple sweet potato, the price of this tubers is stable in the market. Hence, the production amount of purple sweet potato is enormous for the whole year.

Meanwhile, in the fashion and textile industries,

purple sweet potato, which has a tremendous amount of anthocyanin pigment, still rarely used as natural dyes for textile. Furthermore, textile material and fashion products made of purple sweet potato peel still not found.

The current textile industry uses large amounts of non-renewable resources and applies hazardous substances and polluting processes (Harmsen, Scheffer, Bos, 2021:1). Using natural fibers as the raw material for textile is not better that far, this is due to the fact that a huge amount of water is use mainly related to the growing of fiber crops, such as cotton, which is mostly takes place elsewhere in the world. This impact is further exacerbated when cotton production occurs in locations with water scarcity, and its use for agriculture competes with demands for drinking and sanitation as well as the production of other crops (Eionet, 2019:20).

Furthermore, the textile and fashion industries these days driven by the trend that is rapidly change. The ever-spreading trend of fast fashion has led to fast-fashion retailers selling clothing expected to be discarded after being worn only a few times (Carr in Harmsen, Scheffer, Bos, 2021:1). Fast fashion focuses mainly on time, cost efficiency and high volumes (Dan & Østergaard, 2021:11). Over the past 15 years, clothing production has approximately doubled, mainly due to the 'fast fashion' trend, with more rapid changes of styles and collections. Large amounts of non-renewable

resources are extracted to produce clothes that are often used for only a short period after which the materials are sent to landfill or incinerated. As consumers we buy much more clothes, of lesser quality and we wear them much shorter (Siderius,

2021:5-6). In term to achieve the production quantity, workers in these industries spend long working hours, in an unhealthy work environment (Maity, 2020:242). In general, the cycle of the industries can be seen on the scheme below,

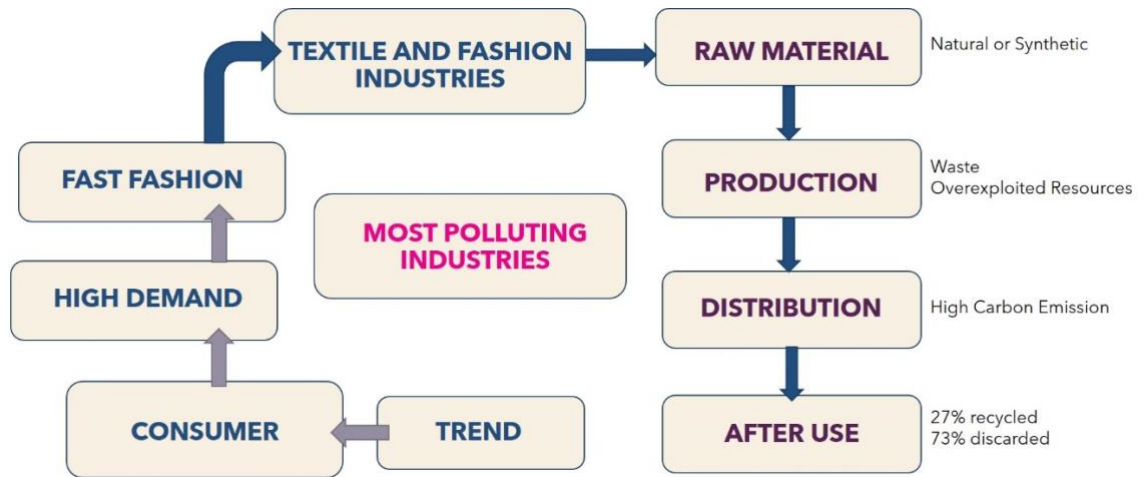


Figure 2. Textile and Fashion Industry Cycle (source: personal documentation)

The textile and fashion industry need a systemic change, it is intended so that the industries produce less pollution that is harmful to the environment and humans. In achieving this aim, circular economy

principles can be applied to the lifecycle of the fashion and textile industry as shown in the following chart:

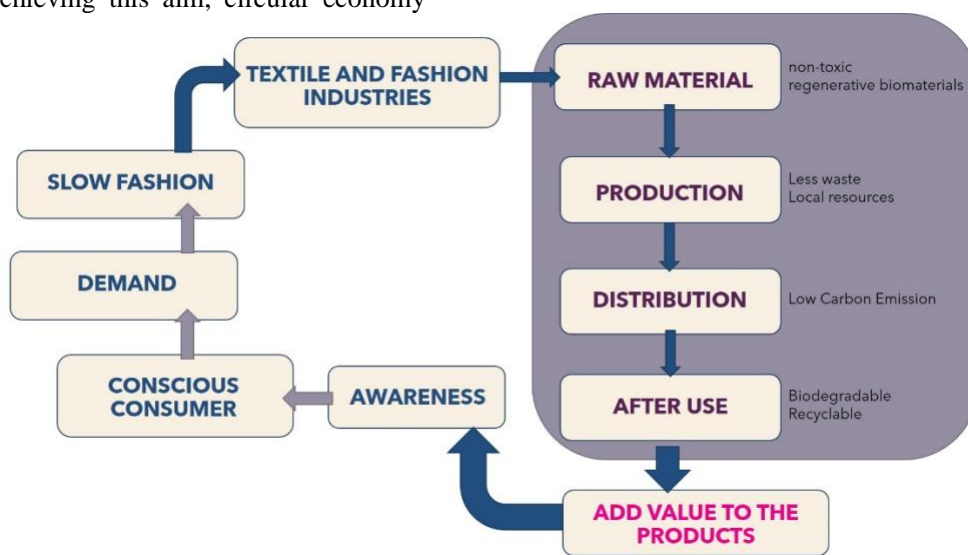


Figure 3. Circular Economy Principles Applied on Textile and Fashion Industry Cycle (source: personal documentation)

As seen in figure 3, the application of circular economy principles lies in the selection and processing of raw materials, the production process, the distribution stage and after the product's useful life is over. The main aim on applying the circular economy principles on the industry cycle is to utilize local resources in term of empowering local economy. As stated by Wall in Widari (2022:62) local economy is the production, distribution and consumption activities of the community with local

content that are carried out and controlled by the community directly and provide benefits to the region and local communities on an ongoing basis. Therefore, as stated by Wahida (2022:272) community participation in managing waste is a potential that must be integrated with the development of environmentally friendly creative industries. Furthermore, if the principles of circular economy successfully applied, social innovation related will eventually emerged. The impact of

clothing is not only limited to how other people perceive and judge, but it also influences the wearer themselves in certain ways (Dewayanti, 2023:86). In this study, the application of the circular economy principle focusing in the selection and processing stage of raw materials.

Processing Purple Sweet Potato Peel

In this study, processing sweet potato peel into a composite is by adding some adhesive. Before that, purple sweet potato peel is dried under the sunlight. After dried, crush it until it formed into small flakes.








Figure 4. Dried and Crushed Purple Sweet Potato Peel (source: personal documentation)

As seen in the figure 4, the color of purple sweet potato peel flakes is remaining the same. On the next steps, the flakes are mixed with 5 different adhesives with equal proportions. Those adhesives are liquid latex, wood glue, epoxy resin, tapioca flour, and

paper pulp. After mixed the flakes with adhesives, spread the mixture on a sheet of plastic and let it dry. Some mixture needs longer time to get dry, and some other get dry quickly. The results seen on the table 1

Table 1. Purple Sweet Potato Peel Composites

No.	Composite	Adhesive	Characteristics
1.		Wood glue Ratio Sweet Potato Peel : Wood Glue = 3:1	<ul style="list-style-type: none"> • Coarse but the texture has no contour • Hard and not flexible • Purple sweet potato peel colour changed to dark reddish brown
2.		Liquid latex Ration Sweet Potato Peel : Liquid Latex = 2:1	<ul style="list-style-type: none"> • Smooth and slightly contoured texture • Soft and supple • Purple sweet potato peel colour changed to dark reddish brown
3.		Paper pulp Ratio Sweet Potato Peel : Paper Pulp = 1:2	<ul style="list-style-type: none"> • Smooth, slightly contoured • Flexible • Brittle • The colour of the purple sweet potato skin does not change, but the colour of the paper pulp is more dominant
4.		Tapioca flour Ratio Sweet Potato Peel : Tapioca Fluor = 3:1	<ul style="list-style-type: none"> • Smooth and slightly contoured • Hard but easy to break • Purple sweet potato peel colour does not change
5.		Epoxy resin Ratio Sweet Potato Peel : Epoxy Resin = 2:1	<ul style="list-style-type: none"> • Smooth, non-contoured texture • Hard and not easy to break • Purple sweet potato peel colour changed to dark brown

From the table above, it can be concluded that the results of processing sweet potato peel with 5 different adhesives as follows:

1. Purple sweet potato peel color changed when mixed with liquid latex, epoxy resin and wood glue. This does not happen when the peel mixed with tapioca flour and paper pulp
2. Composite materials made of purple sweet

potato peel tend to be contoured, brittle, easy to break and easily damaged

3. As a raw material for fashion products, its hard character makes this material possible to be used as a raw material for accessories such as earrings, bracelets and rings. The following is an example of a product sketch using raw materials from purple sweet potato peel composites:

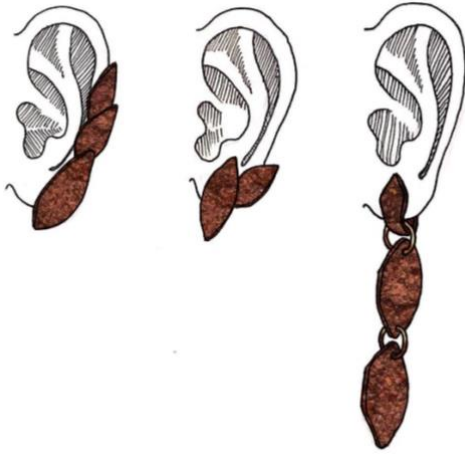


Figure 5. Fashion Product Made from Sweet Potato Peel
(source: personal documentation)

CONCLUSION

As a composite material purple sweet potato peel still needs to be explored further. Especially in terms of flexibility, resistance to water, as well as durability. In addition, it is also necessary to analyze the comfort if the material will be used for fashion products that are directly in contact with the user's skin. In the term of circular economy principles, the composites have some points which are in accordance with the principles, those are biomaterials, less waste, obtained from local resources, and biodegradable. As an alternative material, the purple sweet potato composites also can be an adding value to the products, and it can foster awareness to the consumer.

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