Engineering Design of Zero Waste Clothing in Sustainable Environment

abstract

As life becomes more convenient and abundant, human pollution is far beyond our imagination. The present study focuses on the garment industry, closely related to human life, and its ecological pollution and resource waste. It tries to combine environmental issues to create costumes that convey the sustainable environment and the more friendly concept of Earth 2050: The Future of Energy.

Unlike previous green designs, the current fashion trend is not only to promote environmental protection, but also to emphasize the blue economy. In terms of environmental protection, identify the industrial and economic values that meet various costs to achieve sustainable operation.

In this study, the concept of environmental sustainability was introduced into the clothing project. The goal is to make the manufacturing process not produce fabric waste. All the fabric runs through the entire life course of the costume. Construction of a "zero-waste" clothing project. The resources consumed will be fully utilized. In the design of this study, water resources, which is the most serious problem in the sustainable human environment. The pollution and optimization problems faced by water resources are applied to the thinking of clothing design, presenting a series of clothing with zero-waste structure, and implementing the good behavior of "sustainable" environment in daily life.

1. introduct

This study aims to promote progress in science and technology, which not only accelerated economic growth, but also changed the pattern of human life.

While people enjoy the comfort and convenience brought by economic development, our natural environment has been destroyed bit by bit, such as the ozone layer hole, the disappearance of the rainforest, the greenhouse effect and so on. The imbalance of the ecosystem. In the face of the environmental crisis, as a fashion designer, how to reduce and slow down the impact of clothing on the environment, and hope to remind consumers to the issues related to the sustainable and friendly environment. Therefore, this study hopes to explore the relevant importance of garment design and design and production in

sustainable environments, and to understand the environmental influencing factors caused by the current production and consumption patterns in the garment industry. More importantly, starting from the design thinking before the formation of clothing, the concept of environmental protection and sustainability is introduced into the actual behavior of fashion engineering through the use of materials and fabrics, style design and layout structure. Not only to reduce the waste of resources and harm to the environment, but also to design clothes with fashion functions and the concept of environmental sustainability.

2. literature review

Understand the development of the clothing industry, the general situation of the environmental changes and the environmental problems faced by today, and summarize the causes of the environmental problems caused by the clothing industry.

2.1. Development of clothing industry

Clothing consumes a large amount of natural resources in the production process, and discharges many pollutants into the natural environment.

By understanding how designers lead the trend after the industrial revolution, the development of synthetic fiber cloth, the rise of fashion democratization in the garment industry, the development process of the garment industry in the era of transnational cooperation, especially in the middle of the 20th century, the invention of material science, human engineering research, mechanical automation, etc. The achievements of the scientific and technological revolution have been widely used in the garment industry, making the development of ready-to-wear clothing leap forward rapidly. In just 200 years, it has overturned the previous all-manual production model. With the popularization of information, multimedia makes the dissemination of fashion information more rapid through newspapers, the Internet, press conferences and other ways. In order to promote fashion to the extreme, the popularity of ready-to-wear is becoming more and more fast, and its rise and rapid development have almost dominated the development of the clothing industry since the late 20th century, so it is called the "ready-to-wear era". It became the beginning of a rapid popularity in the 21st century (Lin Song, 2005).

2.2. environmental aspect

After the industrial Revolution, due to the high development of machinery and the large-scale energy development, it provided a great impetus for production and life. Then, many countries are eager to develop their natural resources in order to increase their output value. Due to the growth of the population, human needs promote the continuous progress of science and technology. After the industrial Revolution, human damage to the environment is far more than any previous time. Currently, the major environmental problems are substantial resource consumption, artificial waste, and the accumulation of compounds that outweigh the ability to break down and regenerate naturally. In the case that nature cannot bear, human pollution accelerates the impact on the environment, and the threat to human

living space gradually changes from a region to a region, and even expands to a global environmental problem, such as global warming. The pollution and consumption of water resources, and the relationship between human behavior and environmental degradation are shown in Figure 1:

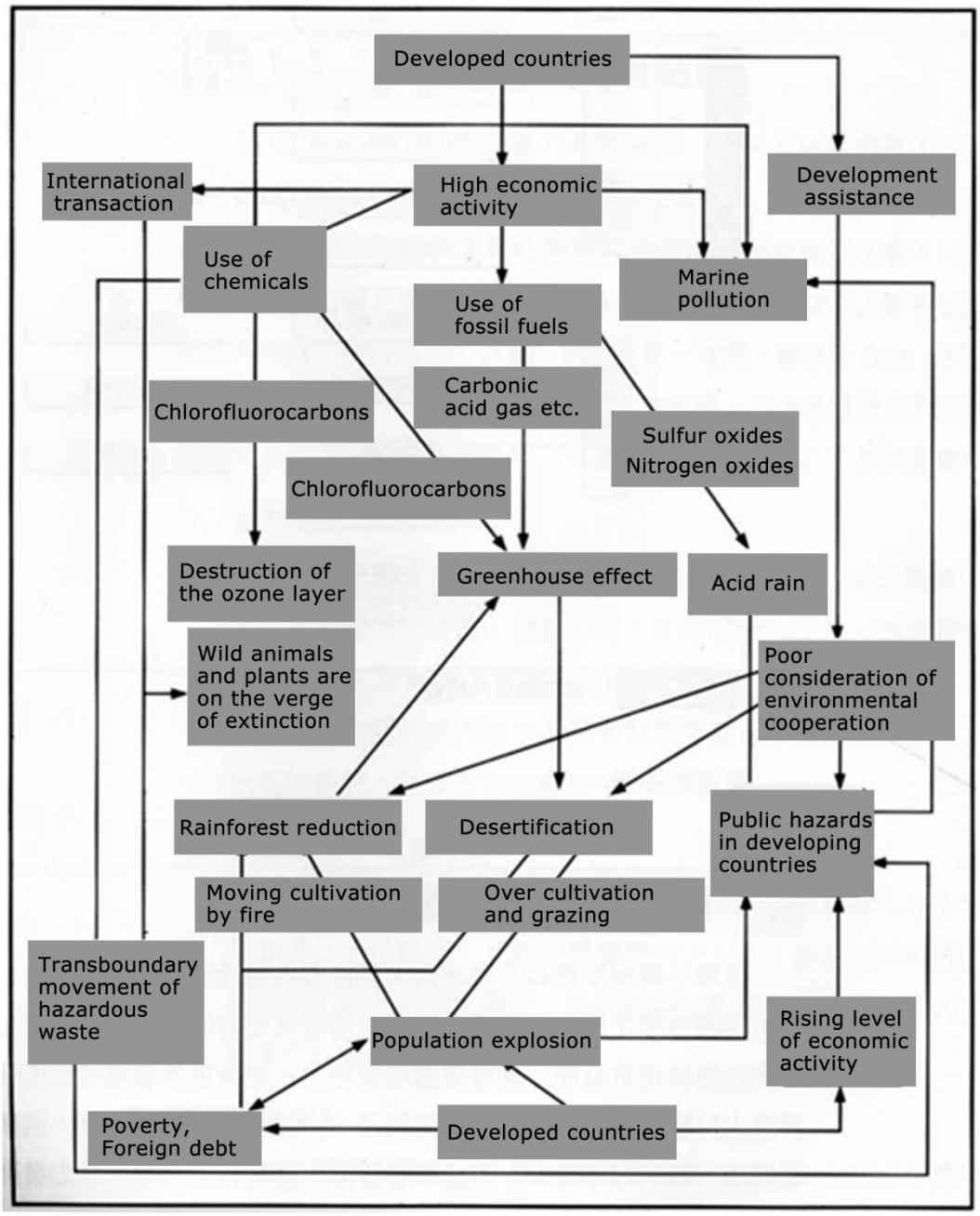

Figure 1: Relationship between human behavior and environmental deterioration
Photo source: 2008 Environmental Education Course Editorial Group

2.3. Sustainable environmental development

The UN General Assembly first proposed the concept of "sustainable development" in 1980. It calls on the world to study the interrelationship between natural, social, ecological, economic and natural resources to ensure the sustainable

development of the planet. The current sustainable development includes four aspects:

2.3.1. The concept of unsustainable development of natural ecology was first proposed by ecologists. The sustainable development of ecology is designed to protect and strengthen the production and regeneration of environmental ecosystems.

2.3.2. According to the economic development proposed by the World Resources Institute in 1992, economic sustainability should be based on not damaging natural resources and not environmental quality.

2.3.3. social development. The 1991 sustainable survival strategy to protect the Earth stated that the sustainability of society is to survive without exceeding the viability to survive and improve the quality of life, emphasizing that "life forms and the scale of production must balance the carrying capacity of the Earth".

2.3.4. In 1992, the World Resources Institute proposed that sustainable science and technology is based on generating minimal waste and pollution.

2.4. Fast fashion and the environment

The term "fast fashion" originated from the rapid development of ready-to-wear products in Europe in the 20th century, while the United States called it "fast going to the market". The Guardian has also coined a new word, "Mic fashion"."Mc" was taken from McDonald to express rapid fashion sales like McDonald's. Traditional clothing brands usually take several months from design and release to circulation and sale, while fast fashion brands can initially complete the production cycle in about 50 days. As Internet information and transportation evolve, they can even spread quickly within a week; they are close to fashion; they are more affordable and cheaper, thus enabling product development, production, distribution, and sales.

The life cycle of clothing, from the cultivation and adoption of raw materials, fiber production, manufacturing to end consumers, requires a lot of natural resources: the global textile industry uses about 37.8 billion litres of water a year. The World Bank estimates that textile dyeing, finishing, and treatment represent 17-20% of the total industrial water pollution, and that nearly 8,000 synthetic chemicals are used in the conversion of raw materials into textiles. Most of them will be discharged into the fresh water system after use. Fashion and textile industries are one of the most energy-consuming industries in the world. Fast fashion design is closely related to fashion and at a low price, enabling the public to enjoy the sense of fashion timely and easily. But due to the low price, the manufacturer reduced the production process, produced formaldehyde content, color fastness, fiber content of unqualified fabrics. The cost control of fast

fashion leads to product quality problems. The main reason for this problem is that poor quality has almost become a feature of fast fashion brands, which makes the life cycle of clothing very short. With fast fashion brands launching new clothes almost every week, large amounts of textile waste will be generated under conditions of mass production, consumption and discarding conditions. In 2005, Timo Rsanan, an assistant professor of Fashion Design and Sustainability at the Parson School of Design, noted that about 15 percent of fabrics were left in the garment cutting process, discarded before entering the market, causing environmental problems and wasting resources.

2.5. Green Action in the Clothing Industry

More and more people are realizing that environmental protection requires practical action from everyone. Fashion has always been in the controversy of environmental protection, promoting the development of green fashion. The concept of environmental protection is really very popular with consumers. With the trend of environmental protection, many brands have launched green fashion products. Thanks to the promotion of many folk forces, green fashion moves to the world, and consumption will not only bring a beautiful appearance, but also bring a new and healthy outlook on life. Environmental sustainability will become the trend of the future (Zheng Ting, 2010). Christina Dean, a non-profit charity founded in Hong Kong in 2007, said sustainability is just a discussion in fashion, but little action needs to take. Not enough action has yet been taken to reduce waste. Therefore, restoration is committed to education to reduce textile waste and save energy saving, and cooperate with many organizations to promote the sustainable development of Asian fashion industry, and hope to inspire fashion designers and students through its annual "(ecological fashion) regeneration fashion design competition" held every year from 2011, to change the fashion landscape, create a conform with the public and change mode least wasteful fashion.

3. research technique

Starting with the handling of the raw material, a garment is bleached and dyed into yarn and fabric.

After garment production and logistics, it is recycled and even burned and decomposed. Every link has carbon emissions. What can a clothing designer do in the face of an environmental crisis? In the cutting of ready-made fabrics, about 15% of the fabric is wasted. If the designer can notice the wasted parts and materials in the design, this will not only increase value, but also reduce waste. Through the literature to find the direction of discussion, reduce the waste of cloth, and even create zero waste as the goal of fashion, using literature analysis method, analyze the contemporary popular trend, explore the "zero waste cutting" structure of clothing case, and can be applied to no waste

design method, and its characteristics as a reference for subsequent clothing design.

3.1. Contemporary trend

In recent years, WGSN has proposed its dominant "ecological awakening" trend (as shown in Figure 2). Through the awakening of human environmental awareness, we explore how the whole society solves the adverse effects on ecology. Then in the autumn and winter proposed the "big reset" (as shown in Figure 3) —— we will press the restart button to reverse our life, design, and work. Consumers will reduce their pursuit of brands and turn to an environmentally friendly life. Future values will focus on the product life cycle and human characteristics, not just the economic benefits. The spring and summer trends of the seasonal theme "mindset" release (as shown in Figure 4): Technology makes many industries advancing, expanding new business opportunities, and the importance of connectivity is no doubt, but at the same time, it promotes reverse motion —— with nature to once again create a healthy body, mind, and environment.

From the analysis of ongoing trends and future trends in recent quarters, environmental sustainability has become an important and necessary trend. With various technologies, we must enable us to treat the environment in a new way, see nature as partners, incorporate environmental care into the design process, and promote us to protect the world we live in and create a sustainable industry.

Figure 2: Ecological awakening
Photo credit: WGSN

Figure 3: Big reset
Photo credit: WGSN

Figure 4: Mentality
Photo credit: WGSN

3.2. Sustainable clothing design methods

The basic elements of clothing design are the application and combinatorial changes of body structure, color matching, materials and fabrics. According to the design of the "transformation" and "upgrading" technologies proposed by the restoration company and the "zero waste structure clothing", the accumulation of textile waste can be reduced by extending the life cycle of textile fabrics. "Reorganization" is breaking down existing and no longer worn clothes into new ones; "upgrade" means recycling unused fabrics into products of higher value. Zero waste structure clothing "is through the design of clothing modeling structure, namely the so-called" clothing version ", in order to avoid 15% to 21% of the

leftovers cut clothing industry production cut clothing fabrics, in order to achieve the goal of zero waste. Timo Rsanin, an assistant professor of the Department of Fashion Design and Sustainability at the Parson School of Design and a member of the School of Restoration, studied a group of designers between the 19th to 20th centuries. For example, from Madeline's deviation cutting (oblique cutting method), it was found that the fabric twill were used to fit the human body, and the characteristics of the different weaving directions between the fabric were used to increase the feasibility of zero waste clothing created mainly using "puzzles" and "cutting methods".

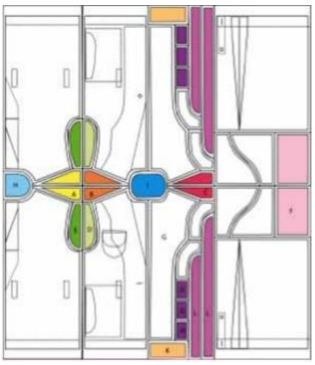

Figure 5 A charming lake costume pattern
Photo source: The official website of the Eco-Chic Design Award

Figure 6 Zero Waste Structure Clothing
Photo credit: The official website of Chanin, Alabama

4. Results and Discussion

Through the literature discussion, it can be understood that the environmental problems caused by the clothing industry are mainly three major crises, namely "global warming", "water shortage" and "textile waste". From these three crises, it is necessary to consider sustainable environmental directions, theme design should be targeted, analyzing fashion styles and contemporary fashion trends, and essential elements of clothing design that produce and shape, will be a friendly environment to be positive, rather than a waste of resources. The designer has a high degree of autonomy of the "zero-waste cutting" design method, and has developed the design theme of this study, and specially created the fashion clothing with the concept of sustainable environment.

4.1. Creative theme

Unlike green, which was used to convey environmental protection in the past, blue also pays more attention to environmental regeneration and non-waste besides environmental protection, and according to the literature, the water crisis is a major factor in contemporary environmental sustainability. Therefore, the creation of this study is consistent with the blue sustainability theme: the "optimization" of water resources (Figure 7), hoping to emphasize the anaerobic asphyxia of

living organisms due to water resources destruction. Communication about sustainable environmental behavior requires immediate vigilance.

The application of zero-waste cutting clothing structure is full of uncertainty in the design process, so the design must be completed in the production process, rather than the traditional garment drawing construction mode. This feature and the challenge is that it could not be fully conceived in the first draft of the design. We need to design the outline of the clothing first, roughly cut the distribution, and then consider how the unused fabric should not be wasted. In addition to the configuration in the detailed design, it can be adjusted as the design change function of the clothing, so that the fabric use is not wasted. The preliminary design of the clothing style (as shown in Figure 8) is based on the loose straight version and umbrella outline, responding to the static and flowing water flow, and can be matched with different upper and lower clothes to present different faces.

Figure 7 Creative design theme: anaerobic design
Photo credit: the drawings included in this study

Figure 8. Draft Clothing Style
Photo credit: the drawings included in this study

4.2. Zero waste themes and fashion design

After clothing shape design, sample design, final structure design modification and complete design (Figure 9), this series has completed the production of skirt (Figure 10), skirt, four top (Figure 11), four pants and three clothes (Figure 12) and 13 other zero-cost clothing single design, transforming the optimization of water crisis into the image of clothing fabrics. Leisure style is mainly concentrated in line with the trend of contemporary life, and casual style is the main style, which can present the matching function of a dress and multiple clothes. A single product can match each other in a variety of appearance, can meet the needs of various living occasions, and provide practical convenience for the contemporary sustainable living environment.

Figure 9. The "Anaerobic" series design drawing
Photo credit: the drawings included in this study

Figure 10: Design and manufacturing of zero-waste edition clothing
Photo credit: the drawings included in this study

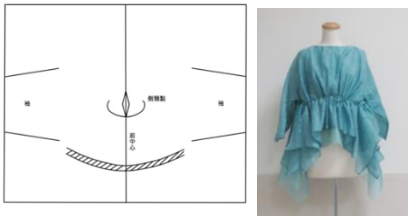

Figure 11: Design and manufacture of zero-waste sheath
Photo credit: the drawings included in this study

Figure 12: Design and manufacture of zero-waste coating
Photo credit: the drawings included in this study

4.3. Series of clothing design and finished products

In this study, a series of clothing styles (figure 13) are designed as zero waste version (figure 10mur12), to echo the sustainable behavior of the environment, not only actually reduce textile waste, and after many samples, design, production procedures, after finishing the work, invite model wear, appropriate makeup and hairstyle, create consistent with creating concept atmosphere. With the combination of these works, it will present a variety of styles of dress.

Figure 13 shows the finished clothing designed with a zero-waste version in the "nitrogen dioxide" series
Photo source: Shooting situation in this study

5. Another part of your paper

The environmental damage caused by fast fashion is already overloaded. Many clothing brands will incorporate sustainability into their business strategies and propose many recycling plans to rebuild waste into new products.

But in these waste fabrics, about 15 percent to 21 percent of the rags are cut during the manufacturing process, consuming a lot of resources, but they are scrapped without entering the life course of the clothing. This study achieves the goal of environmental protection and fashion with a zero-waste layout structure. The comprehensive application of cloth in clothing production not only reduces the production of textile waste, but also does not waste the resources consumed in the process of fabric production.

This series of creative designs will be able to form a zero-waste fabric clothing structure method, combined with the water quality optimization of the water source crisis image, and finally present 13 complete clothing projects. The combination of these items can create multiple ways of wearing, and successfully enable the wearer to wear a variety of different clothes depending on the different life situations. In the process of implementing this study and design, it was found that because the zero waste structure is not conducive to the use of different fabric splicing design materials, so using the fabric length and short, transparent, opaque to show the hierarchy of clothing, and show the clarity and pollution of water quality. Since the series of clothing is made of existing fabrics on the market, the effect of the cloth table is difficult to be directly linked to the picture of water quality improvement. Although the overall effect can show the flow and stillness of the water, a strong sense of warning is lacking after water quality optimization. The theme emphasizes that the "anaerobic asphyxia" of water resources is expressed in color and text symbols, and the image of endangering water resources is also weak. In subsequent studies, the best picture of human beings damaging water quality could be better displayed if the digital printed fabric and fabric surface texture treatments designed for the subject could be added. The outlines and structures of each style completed in this series are mostly overall loose or overall fit. If it can show the fit of the clothing style, it will strengthen the tension because of the lack of oxygen, and even suffocation tension.

This study used a zero-waste version of the clothing design to echo the sustainable behavior of the environment, which not only actually reduces the textile waste, but also does not waste resources. It is suggested that if the subsequent development can use functional fabrics as the main fabric, use clothing to regulate human body temperature, reduce the use of electricity, and

recycled material fabrics or natural organic fabrics, will be more actively in line with the main concept of environmental sustainability.

In this study, the pattern of clothing single product recorded in the creation could provide the basis for subsequent design modification, and self-expect the sustainable design and development of fashion clothing in a more sustainable environment. It also provides references to clothing designers who want to undertake environmental issues in the future zero waste pattern structure of clothing formation, which not only hopes more designers to join the concept of creating popular products, but also hopes that humans will achieve the good behavior of a "sustainable" environment in their lives.

reference documentation

[1] A reference
This reference has two entries, but the second entry is not numbered (it uses the Reference (no Number) style.

[2] Another reference

[3] More references

[4] Shen Shihong, 2013, Towards a Green and Sustainable Future, The Environmental Protection Department, Taipei City Administrative Office.P.19-P.82

[5] Lin Song, 2005, The Development and Evolution of the Modern Garment Industry, Decoration, Issue 11, p. 50

[6] Mr Zhu Qin, 2007, The British Industrial Revolution-The Plan to Change the World, Shakespeare Culture Company Limited, Taichung.P.11-14.

[7] Feng Jiuling, 2002, culture is a good business, and urban culture is published. Taipei P.1

[8] Ye Xincheng Town, 2010, Anti Warming Key Report, New Naturalist Co., Ltd., Taipei.P.64-P.169.

[9] Zheng Ting, 2010, environmental protection leads the global fashion, Green China version A, issue 1st P.54-P.56。

[10] Environmental Education Curriculum Editorial Group, 2008, Environmental Protection & Living, Princeton International Ltd., Taipei City.P.4-P.330.

[11] Ecological Science Design, Awakening, 2016, from:

[12] Zero Waste Structural Clothing, 2016, from:

[13] WGSN's future of vision, 2016, from: https: / / www.wgsn.com/en/