Textile Waste in Mainland China
An Analysis of the Circular Practices of Post-Consumer Textile Waste in Mainland China

Commissioned by the Netherlands Enterprise Agency
Textile Waste in Mainland China

An Analysis of the Circular Practices of Post-Consumer Textile Waste in Mainland China

Marlous Spuijbroek
Supervised by Anne te Velde and Wang Jia
Intern Embassy of the Kingdom of the Netherlands in China
Infrastructure and Water Management Department
June 2019
# Table of Contents

**Introduction** ............................................................................................................................................. 3

1. **Current Textile Waste Situation in Mainland China** ........................................................................ 4

   Data on Textile Waste ................................................................................................................................. 4

   Legislation & Regulations ............................................................................................................................ 6

   Waste-to-Energy ......................................................................................................................................... 8

2. **Collection of Textile Waste** ............................................................................................................... 10

   Collection from Non-Separated Disposal ................................................................................................. 10

   Collection from Separated Disposal ......................................................................................................... 11

   Textile Waste Collection Methods ......................................................................................................... 11

3. **Sorting of Collected Materials** ........................................................................................................ 22

   Manual Sorting ......................................................................................................................................... 23

   Automated Sorting .................................................................................................................................... 24

4. **Reuse or Resale** .................................................................................................................................. 27

   Charities and Export ................................................................................................................................. 27

   Second-hand Sales and Vintage .................................................................................................................. 28

   Sharing, Renting and Leasing ..................................................................................................................... 30

5. **Recycle Industry** .............................................................................................................................. 33

   Mechanical Recycling ............................................................................................................................... 33

   Chemical Recycling .................................................................................................................................. 34

   Down-cycle ................................................................................................................................................. 35

   Upcycle ...................................................................................................................................................... 36

**Conclusions** .......................................................................................................................................... 37

**Appendix A**  
Market Share China’s Textile Industry ........................................................................................................ 39

**Bibliography** ........................................................................................................................................... 41
Introduction

Textile Waste in Mainland China

The textile and clothing industries have long been recognized as pillars of China’s economy, providing employment opportunities and having a significant market share both globally as domestically. But the textile industry puts great pressure on the environment: the manufacturing process is highly toxic-, water- and greenhouse gas intensive, and millions of tons of textile waste end up in landfills in China annually.

The Chinese government has taken notice of the unsustainable and damaging effects of the way the textile industry operates. Reducing the industry’s pressure on natural resources is essential for a durable living on earth. Besides, a circular economy approach would not only be beneficial for the environment, the market for the recycling of textiles has great potential. In 2013, China’s State Council required 10 industries, among which the textile industry, to develop a circular value chain.

So far, little research has been conducted on the circularity of the textile value chain. In order to have a better understanding of the circular practices in the management of waste textiles and to identify opportunities in optimizing this process, this report aims to give an overview of and share insights on the current textile waste situation in Mainland China.

Research Scope & Content

The scope of this report is to analyze what is happening in regard to circularity in the textile sector in Mainland China. The focus lies on textile products after their manufacturing process: post-consumer textiles. The report concentrates on steps that have to be - and are being taken - to prolong the life cycle of textile materials and make them go circular, thus reducing the amount of used raw materials and newly produced goods, and minimizing the environmental impact of the industry. Furthermore, important players and initiatives that are being taken in Mainland China are highlighted.

By looking at data about waste textiles in Mainland China, the standard routine for waste management flows and relevant laws and regulations related to textile waste treatment, chapter 1 describes the current textile waste situation in Mainland China. In addition, appendix A provides insights about China’s market share in the textile industry worldwide. Chapter 2 looks at the collection of waste textiles, and chapter 3 subsequently at the sorting of these materials. Because recycling is quite an energy consuming procedure, chapter 4 first looks at two destinations of the textiles which do not necessarily require treatment: reuse and remanufacturing. Other circular models, such as sharing and renting are also discussed in chapter 4. Chapter 5 examines the status of the recycling of textiles in Mainland China. Afterwards, a conclusion is drawn and opportunities for optimizing the transition towards a circular value chain for waste textiles are suggested.
1. Current Textile Waste Situation in Mainland China

To assess whether there are opportunities to improve the value chain of waste textiles, it is beneficial to have knowledge about the composition of waste textiles in Mainland China. In this chapter, available data – and reasons for the lack of sufficient data – about waste textiles in China is discussed, as well as regulations relating to textile waste.

Data on Textile Waste

Figures about the amount of waste textiles in Mainland China vary from 20-26 million tonnes (US) to 26 million tons annually (UK). In comparison, according to MVO Nederland, in the Netherlands 194.000 tons of post-consumer textile waste are produced on a yearly basis.\(^1\) Besides this inconsistency in volume, the terms textile, clothing, waste, dumped and landfilled are often mixed-up. The China Association for Circular Economy estimates that around 10-15% of the discarded textiles are collected for reutilization, which are partly recycled and partly resold or donated.\(^2\) Xinhuanet, an official news information portal in China, reported that of the 26 million tons thrown away used clothing, the utilization rate was less than 1% in 2016.\(^3\)

There are a few reasons due to which data about waste textiles, and their collection, reuse and recycling rates are limited and often inaccurate. The main reason are the existing waste management structures in China. Figure 1 below depicts the two waste management flows in Chinese cities.\(^4\) With regard to textile waste, these flows apply to post-consumer wastes. Pre-consumer wastes, such as cutting leftovers and overproduction, are easier to collect and to be kept separate from other waste materials.

---

2 The Circular Economy Opportunity for Urban and Industrial Innovation in China, publication (Ellen MacArthur Foundation, 2018), 94.
Figure 1: General waste management streams in Mainland China, via Global Alliance of Waste Pickers. The main part of textile waste follows the official waste management system, but part of it is collected by either commercial companies or charities.

**Official Waste Management System**

After waste is disposed and brought to community bins, municipality trucks collect these bins and bring them to transfer centers. Hereafter, most part of the waste is transported to landfills, and the rest to either incinerators or waste-to-energy plants.

**Informal Recycling Sector**

Informal recyclers primarily focus on the community bins for the collection of recyclable materials, or they buy recyclable wastes directly from households. They sell the materials to traders, after which the materials end up in the recycling market. Since the informal waste pickers do not keep records of their collected recyclables, it is hard to estimate both the actual amount of disposed wastes, as the amount of collected recyclable materials. It is estimated that this way of collection accounts for 17%-35% of all municipal recycling activities in urban China. In 2015, Liu et al. conducted research about the collection of recyclable household waste in Beijing. They show that a large proportion of old textiles were discarded, but due to low recycling prices, some of the informal recyclers even refused to recycle them.

Feimayi, a collection company for old clothes in China, estimates that the largest number of old clothes is discarded as garbage, followed by ‘other’ ways of disposal. 18.9% of the residents sold their clothes to recycling stations. Their estimations are based on results from several academic papers, see figure 2 below.

---


Another reason which makes it difficult to obtain accurate data about waste textiles is that there are different stakeholders involved in the collection process. In principal, there are two structures:
- Commercial companies
- Charities
They operate within different legal frameworks and they have different methods of collection, which are both explained later on in this report. Commercial companies do not get public funding for their work, due to competition with other companies, they prefer not to share their data with the public. Another reason for not revealing their data is the destination of the textiles. Some companies’ profiting business model is export of second-hand clothing to underdeveloped regions or countries. Because this topic is quite controversial in China, for example in the wake of hygiene concerns, data is not published.

Legislation & Regulations

For decades, China has been the world’s largest importer of garbage, but at the start of 2018, China put a ban on the import of 24 different types of foreign waste, including waste textiles. This embargo affects the value chains in the recycling industry. At the same time, the Chinese government has set a target to reach 4.5 million tons of recycled textile production by 2020.\(^7\) Because of the waste ban, China’s textile recycling industry has to get its recyclable materials entirely from domestic sources. Government regulations impact waste management streams. This section covers the most relevant regulations related to circularity of textiles.

Circular Economy Development Strategies and Action Plan 2013

In 2013, the State Council launched the Circular Economy Development Strategies and Action Plan, which appoints 10 industries as key sectors to make the transition to a circular economy. The textile industry is one of the industries. For each of the industries, the State Council’s plans are described and a diagram of the circular process is given, see figure 3 on

---

the next page. The plan states that classification of waste textiles will be promoted, and that the use of waste textiles for the production of insulation materials ‘and other products’ will be encouraged.

The 13th Five-Year Plan for Economic and Social Development of the People’s Republic of China (2016-2020)
The 13th Five-Year Plan set the framework for China’s development for the year 2016 till 2020. Besides strategies and pathways, it includes environmental targets. It states that the establishment of recycling systems for textile waste will be accelerated and that an Extended Producer Responsibility system will be put in effect (EPR). Furthermore, the recycled textile production is targeted to reach 4.5 million tons by 2020.

Figure 3: Circular Flow of Textiles, via China Water Risk

Besides the above 13th Five-Year plan, the Ministry of Industry and Information Technology of the People’s Republic of China released the Development Plan for the Textile Industry for the years 2016-2020. The industry is set to focus on innovation and the plan promotes green manufacturing, such as energy conservation and consumption reduction. It states that the proportion of recycled fibers increased from 9.6% in 2010 to 11.3% in 2015 and that this amount is expected to increase. Along with that, the construction of recycling systems, sorting and utilization mechanisms should be accelerated according to the plan. It
specifically mentions that equipment for detection, separation and crushing equipment for domestic waste textiles should be developed. With regard to innovation, the development of bio-based fiber technologies is promoted, including some examples: shrimp or crab shells, seaweed and other marine bio-based fibers.

Domestic Waste Classification System Implementation Plan
In March 2017, the State Council launched the Domestic Waste Classification System Implementation Plan. This plan promotes the classification of garbage and formulates a roadmap for the implementation. The goal of the plan is that by the end of 2020, basic laws, regulations and standards related to waste separation are established. The main responsibilities for the implementation lie with the urban governments. Three different categories of waste are set: hazardous waste, kitchen waste and recyclable materials. Textiles are classified as recyclable materials.

Charity Law
The Charity Law of the People’s Republic of China, promulgated in 2016, regulates domestic charitable organizations and their activities. According to this law, public donation events, such as collecting old clothes through donation bins to help people in need, can only be held by registered organizations. The law mandates for organizations that they can only register if they do not have a profit motive. Charity organizations that collect clothing have two options. They either send the donated clothes they received directly to people in need, or they sell the clothes to recycling companies. In the last case, the ‘profit’ the organizations makes has to be spent on charities abided by the Charity Law. The market for donation is strictly regulated by the government. Collective Responsibility writes that there are 14,000 donation stations and 10,100 registered charity shops.9

Waste to Energy
One of the characteristics of (household) waste in China is that its composition is quite wet due to a lack of sorting and the amount of disposed kitchen waste. The wet composition is not favorable for incineration, while in recent years, more preference is given to this method of disposal instead of landfills.10 This is the main reason that in most residential areas, a distinction is made for the disposal of other waste and kitchen waste. A particular popular method of incineration is Waste-to-energy (WTE) incineration. The WTE incinerators are considered a source of renewable energy generators, and they are expected to play an increasingly important role in China’s municipal solid waste management.11 To solve the problem of the rather wet collected waste which is to be sent to the WTE-plants, used clothes are cut and shredded to small pieces, to compensate for the wet solid waste and

increase the burning efficiency.\textsuperscript{12} China had 339 WTE power plants in 2017, an amount which is expected to grow to 600 plants by 2020.\textsuperscript{13}


2. Collection of Textile Waste

In this chapter, the current collection methods of waste textiles in Mainland China is discussed. First, the distinction between single- and dual-stream collection is explained. Textile waste collection applies to dual-stream collection. Hereafter, different ways of disposal/collection of textile materials are discussed. In the end of this chapter, examples of companies that are involved in the collection of textile waste materials are provided.

Moving away from the current take-make-dispose model and implement a circular approach with a closed loop for the textile industry requires a new paradigm, innovation and changes in both production and consumption models. To keep resources in use for as long as possible and to extract their highest value, materials should re-enter the economy after use instead of just being discarded. There are several ways to do so, for example repair products if they are broken, reuse, remanufacture or recycle them. Whichever method is applied, collection of the materials is essential to ensure that they do not end up in landfills or incinerators.

In a report about circular economy opportunities in China, the Ellen MacArthur Foundation writes that both the recycling as the collection infrastructure in China are still in their early stages of development. There are two primary approaches for the collection and processing of recyclable wastes: single- and dual-stream practices. Both systems are common in Mainland China and are discussed in this chapter.

These two methods apply to post-consumer wastes. However, as mentioned earlier, another type of textile waste that should be taken into account are pre-consumer waste textiles. As these materials do not end up in regular dustbins, their route to reuse or recycling is different. Little research has been conducted about the quantities of pre-consumer waste textiles, but it is estimated that roughly 30% of the produced clothes are never sold.

Collection from Non-Seperated Disposal (Single-Stream)

In a single-stream recycling system, consumers put all kind of materials in the same bin. If extracting recyclables is a goal, hereafter, the mixed waste is transported to a Material Recycling Factory where the waste is sorted and processed. Single stream recycling is convenient for consumers and the collection costs are rather low, but the quality of the recovered materials is not as high as recovered materials from dual stream collection.

---

14 The Circular Economy Opportunity for Urban and Industrial Innovation in China, publication (Ellen MacArthur Foundation, 2018), 94.
17 Idem.
While the Chinese government is taking measures to address classification of different categories of waste, Mian et al. write that in general, China works with a mixed collection system. They note that many municipalities have waste sorting facilities, but that their efficiency rate is quite low. Mian et al. attribute the fact that about 20% of the discarded waste is recovered for recycling to the informal sector, which way of operating is explained in chapter 1.

Collection from Separated Disposal (Dual-Stream)

Dual-stream recycling is also known as source separation. It is done by individuals or businesses at the location where the waste is generated. The dual stream method requires participation from residents, who actively have to separate their waste into different containers. Because in this way the sorting has already been done before collection, processing costs are considerably lower than for single-stream recycling.

As explained in chapter 1, there are two principal entities that are involved in the collection of waste textiles: commercial companies and charity organizations. If operating in name of a charity, the organization needs a legal license and is subject to the Charity Law. On the contrary, there are commercial companies involved, whom work on a for-profit basis. Sometimes, such companies hand out coupons or points in exchange of people their old clothing, which gives them a certain discount on future purchases.

Textile Waste Collection Methods

The way of disposal depends on existing facilities, the availability of collection and infrastructure as well as logistics. Of these services, a distinction can be made between online- and offline practices.

There are two types of offline disposal: collection containers in residential communities and take-back collection initiatives at retailers (EPR).

To place the collection containers in public areas, a company needs permission from the local government. When placed in residential communities, the companies need permission from the community and they sometimes need to pay some sort of rent. The companies themselves are responsible for the maintenance and management of the containers.

---

19 Idem.
20 Idem.
22 Idem.
Some retailers, like H&M and Zara, work with Extended Producer Responsibility systems. This means that they take responsibility for the end-of-life stage of the products they sold. By taking back old clothing from customers, these companies try to minimize their environmental footprint. A way of doing this, is by placing collection boxes in their stores.

**Baosquared**

Baosquared is an organization that is involved in collecting waste textiles in Shanghai, and it was established in 2014. Through their Fiber Project they have already collected over 48,000 kg of clothes by February 2019, the website tells. Not only does the organization receive old clothes by the 27 recycling boxes they have set up in public places in Shanghai, Baosquared also partners with warehouses and manufacturers. The quality of 25%-35% of the clothing they receive is still of high standards, and this part is sent to less-developed areas in China. 8%-10% is upcycled, which means that the materials are re-used and transformed into new products while using less or no other resources. 45%-55% of the clothing is broken down, after which the raw fiber is used to make new garments. The remaining part that is not suitable for recycling is converted into non-woven textiles, a process that is also known as downcycling. These non-woven textiles are then used as for example insulation materials, stuffing for couches and toys, or the construction industry.

Figure 4: The Fiber Project’s loop, via Baosquared

---

Little Yellow Dog, Xiaohuanggou 小黄狗
Xiaohuanggou works with a new mode of waste classification and collection: smart recycling. The company was established in 2017 and is now operating in 34 cities in China, where recycling stations are placed in commercial- and residential areas. Xiaohuanggou uses artificial intelligence powered sorting bins, which can identify waste and its composition. The recycling stations work with six different categories of waste, among which textile waste. Through Xiaohuanggou’s online application and WeChat (a multipurpose Chinese app for messaging, social media and mobile payments), users can locate those recycling stations In return for their recyclable materials, residents receive money on their Xiaohuanggou account, which can be exchanged for cash. Hereafter, the collected materials are send to specialized recycling organizations. The company plans to place one million recycling stations across China in early 2021.

Xiaohuanggou also offers door-recycling for specific materials, where people can make an appointment through their mobile app and the recyclables are picked up at their houses. Textile waste is one of the accepted categories, but only in amounts of more than 15 kg.

I:CO
I:Collect, or I:CO, is responsible for in-store collection of disposed clothing. I:CO is part of SOEX group, a Swiss world-leading company for the recycling of used textiles. Fashion houses and retailers collect used clothing in their stores and I:CO takes care of the logistics and sorting. The incentive for consumers to put their old clothes in I:CO’s collection boxes is a form of discount they can get on the next purchase they do, based on I:CO’s partner’s individual wishes. I:CO works with a variety of companies, including various global players.

---

28 Idem.
The company has collection points in stores all over the world, and in 2016 I:CO started operating in China. In May 2017, I:CO’s first office in China was opened. I:CO’s aim is to work with international brands and the company’s biggest partner is H&M. In an interview, the deputy general manager of I:CO in Beijing, said that in every H&M store in China there are collection bins. Another partner with whom I:CO works in China is Okaidi, a French brand for children’s wear. I:CO doesn’t only collect the clothes that customers bring back to the shops, but they also collect leftovers (dead stock) from the companies. This market is a lot bigger, with more chance to make money. In China, I:CO is not making any profits yet and the amount of collected clothes has been quite stable. H&M and Okaidi collect the clothes in their stores and transport them to a warehouse where they store the collectables. When a certain amount is reached, I:CO picks them up. I:CO has to compensate for the costs of the logistics that the companies make (transport and storing).

In China, I:CO partners with Purelink, whom they sell the collected clothes to. Purelink takes the responsibility for the sorting and recycling. More information about this company can be found in chapter 3.

According to the deputy general manager in Beijing, there is a lot of competition on the market for clothing collection. This is partly because residents use collection boxes in residential areas for the disposal of their used clothing, and partly because I:CO has to compete with online collection platforms. The working method of such online collection platforms is explained later on in this chapter. In the end of March/beginning of April 2019, I:CO started cooperating with Xianyu to set up a similar online collection system. Xianyu is part of Alibaba Group, China’s biggest e-commerce company. Xianyu serves as an online platform where users can sell and buy second-hand items. In the first month of the cooperation, I:CO collected 12 tons of used clothing via Xianyu.

Figure 6: I:CO’s take-back system, via I:CO’s website

---

31 Interview with Joy Lixin Zhou, deputy general manager at I:CO, March 26, 2019.
32 Idem.
Case Study: Shanghai Yuanyuan Industrial Co., Ltd.

According to the Law on Prevention and Control of Environmental Pollution Caused by Solid Waste of the People’s Republic of China (2007), the local government is responsible for the supervision and management for disposal of solid waste. In the year 2000, the Chinese government selected a few cities, among which Shanghai, to pioneer in the classification of garbage. When the Shanghai Municipal Government started to foster the separation and recycling of municipal waste, textile waste was selected as one of the priority categories. Because of this reason, the Shanghai Municipal Government and related leading departments carried out a program for the recycling of waste clothing in 2010. The company in charge of, and established for this task was Yuanyuan, working directly under government authorization.

Yuanyuan started off with 28 collection containers. The coordination office, which consisted of factions from different governmental departments, decided the location of the boxes. Due to Yuanyuan’s direct link with the governmental departments, Yuanyuan doesn’t have to negotiate with for instance managers of residential areas for the allocation of containers. The first 28 containers were placed near government buildings, schools and industrial parks. In 2019, the number of boxes in Shanghai reached about 1900.

In the previous years, the collection of the donated clothes was done in fixed areas, on set periods, by specific people and in fixed vehicles. In 2017, after conducting research for a few months, Yuanyuan established the “Textile Collection Box Internet of Things Monitoring and Management System.” Through GPS sensors and a monitoring system (among other features), the collectors are informed when the boxes have reached a capacity of 80%.

1800 tons of clothes were collected in 2016, 2000 tons in 2017 and 1800 tons again in 2018. The decline between 2017 and 2018 can be attributed both to other companies entering the market, as illegal plundering actions. Officially, 25 other companies are active in the collection of old clothes in Shanghai, Yuanyuan being the only government program. The municipal government is investigating the illegally operating companies.

After the clothes are picked up from the 1.8-meter-tall panda-shaped boxes, that can hold 60 to 80 kilograms, they are transported to Yuanyuan’s own separation factory. This separation factory has a big capacity: 3000 m2.

50% of the collected clothes go to charities, 12% is exported as summer clothing to African and Southeast-Asian countries, 30% is exported as winter clothing. The rest of the clothes are being recycled. This last part is one of the key tasks of Yuanyuan: creating technical standards for the reuse and recycling of clothes. Because the government supports this, Yuanyuan can also contribute to policy development in this field.

The company already has the techniques to sterilize the clothing to such a clean extent that they could be sold as second-hand clothing. Yuanyuan’s sterilizing technique is certified by the
government. While Yuanyuan doesn’t have the qualification ‘charity,’ they do sort and clean the clothes after which they can be used by actual charities.

For the recycling part, Yuanyuan classifies the clothing based on the fabrics it consists of. The main difference in textile fabrics is between natural fibers and chemical fibers, which are sometimes blended. If blended, it is difficult to convert them back into natural fibers. The quality of recycled, blended fabrics is generally quite low and used for low-end purposes such as agricultural greenhouse materials.

The value of non-blended recycled materials is much higher and can be used for higher quality purposes. Since 2015, Yuanyuan has been commissioned by the Shanghai Municipal Public Security Bureau to recycle old police uniforms into new ones.

Yuanyuan works together with another company for the treatment of the clothes, Zhejiang Huading Group. The two companies established a joint-venture to focus on the research and development of recycling techniques for textile waste: Dingyuan Textile Technology Co., Ltd (Hangzhou). So far, the recycling technologies are not very developed and the recycled materials are not of high value. The goal of Dingyuan is to improve this. The Ministry of Industry and Information Technology (MIIT) has listed Dingyuan as a “large demonstration project for the recycling of textile resources.”

The materials coming from the recycling factory have a few destinations:

- Recycled wool is used as a raw material to manufacture civil servants’ uniforms;
- Recycled denim is used to manufacture interior parts for the automotive industry;
- Sound insulation and decorative materials for buildings;
- Some materials are used as soil or they serve other ecological purposes such as the agricultural greenhouse shade net;
- Cooperation with clothing companies to recycle their dead/defective stock, after which the company itself takes responsibility for what happens next.

In an interview, Mr. Yang Yinghong, Chairman of Board of Yuanyuan, notes that a collaboration with European countries could work to improve the quality of the recycled fabrics. Because the agricultural sector in the Netherlands is well developed, he mentioned that cooperation in the field of soil-from-recycled-textile-waste could be useful.

The fact that Yuanyuan is deeply involved with the government and at the same time operates within market mechanisms is visible in the following pilot program. Legally, sale of second-hand clothing is not authorized by the Chinese government. This mainly has to do with hygiene issues. However, because Dingyuan has the qualifications for their way of treatment, the Ministry of Commerce (MOFCOM) and other relevant ministries have approved a pilot program wherein Yuanyuan will experiment with the sale of second-hand clothing. Not only is this beneficial for Yuanyuan, the government will also see how the public perceives second-hand clothing.

Another example of a brand that works with in-store collection of clothing is Uniqlo. The brand Uniqlo ranks top for both male and female clothes in China. Uniqlo works together with NGOs and partners to separate and sort the collected items. Wearable items are
distributed to people in need and unwearable clothing is recycled into refuse paper and plastic fuel pellets for fuel.\textsuperscript{33}

\textit{Issues with Collection Boxes}

China Daily reports that the destination of disposed garments is often unclear for people who put their old clothes in these boxes. There seems to be a general misunderstanding that people expect their “donated” clothes to go to poor communities or people in need, while the majority of these clothes are disassembled in factories and recycled for profit.\textsuperscript{34} China Daily writes that this misunderstanding happens due to inconsistent labels on collection boxes, saying “donation boxes” instead of “recycle boxes”, whereas these clothes often end up in factories.\textsuperscript{35} The Straits Times notices that this problem also works the other way around, whereas in Qingdao local residents discovered that the clothes that they gave away for recycling purposes were actually sold to African countries with huge profits for the so called “recycling” company.\textsuperscript{36} These discoveries caused anger among residents all over China, whose intention was to do something good for the environment and help those in need.\textsuperscript{37}

Sixth Tone, an online publication platform providing insights on contemporary China, writes that these phenomena reflect a common misconception about organizations that are engaged in public benefit.\textsuperscript{38} In China, they say, these organizations must be entirely non-profit and transparent, otherwise the public loses trust in the organization.\textsuperscript{39} But operating in this business without making any profit is very hard, because of the involved costs like logistics and storage.\textsuperscript{40}

\textbf{Zara}

Just like H&M, Zara has a take-back system in selected stores in mainland China. The program started in 2017. In 2017, 7,985 kgs of clothes where collected, and in 2018 over 10,000 kgs. Unlike the donation system at H&M, customers do not get something in exchange for their items.\textsuperscript{41} Apart from this way of clothing collection, Zara launched a home

\begin{itemize}
\item \textsuperscript{34} Zhouxiang Zhang, “People need to be more rational about clothes donations,” China Daily, March 6, 2019, accessed March 28, 2019, http://www.chinadaily.com.cn/a/201903/06/WS5c7f0706a3106c34ecf69.html.
\item \textsuperscript{35} Idem.
\item \textsuperscript{37} Idem.
\item \textsuperscript{39} Idem.
\item \textsuperscript{40} Idem.
\end{itemize}
pick-up service in Mainland China in September 2018. Instead of visiting a Zara store to donate clothes, customers in Shanghai and Beijing can request a free home pick-up whenever they order anything else from Zara’s website. SF Express, China’s second largest delivery service company, takes care of the logistics and brings both the collected items from the stores as from the home pick-up service to processing centers from China Environmental Protection Foundation. Part of the clothes are donated to people in need, and part of the clothes are recycled. Clothes that are 100% cotton, wool or polyester will be recycled into new fabrics, and clothes from mixed materials are used for construction and automotive sectors.

44 Idem.
Case Study: Flying Ants, 飞蚂蚁

Launched in 2014, Flying Ants was the first online platform to provide a door-to-door service for the collection of old clothes in Mainland China. Up to date, Flying Ants is still the largest internet platform to offer a home collection system. The company operates in over 300 cities across the country and has 2 million active users, most of them are based in Guangzhou, Beijing and Shanghai. Not only does Flying Ants work with its own online application, it also operates on WeChat (China’s most popular messaging, social media and mobile payment app with a monthly user base of 1 billion active users) and other popular networks and brands. The main users are between 25 and 35 years old and 84% of them are female.

Over the past 4 years, the number of clothes collected by Flying Ants has grown a lot:

- 1000 tons in 2015
- 3000 tons in 2016
- 7000 tons in 2017
- 40,000 tons in 2018

There are a few reasons for the extensive growth between 2017 and 2018. Awareness of environmental issues is increasing, thus more and more people want to dispose their waste products in an environmental friendly way. Flying Ants service is not only available on the company’s own platform, it also expanded to other networks such as China’s largest platforms for second-hand sales: Xianyu, 飞鱼, and Wuba, 58. Due to these expansions and the scale of these companies, Flying Ants can reach a lot more consumers. The door-to-door service is very popular in China, which makes Flying Ant’s way of collection very efficient. While environmental awareness is increasing, for some consumers it is too inconvenient to bring their old clothes to specific collection boxes. Flying Ants’ model offers them a good solution, as they can just make an appointment and the clothes will be picked up at their house.

After being collected, the clothes are sorted by one of the 61 separation companies with whom Flying Ants cooperates. Before the cooperation starts, Flying Ants checks whether the companies have the right licenses to do the work and whether they comply with Corporate Social Responsibility standards. In every province in the country, there are about 2 companies with whom Flying Ants collaborates. As the business is bigger in the area surrounding Shanghai, Flying Ants has more alliances with sorting companies there.

The destinations of Flying Ants clothes after they have been sorted:

- 75% of the clothes are suitable for recycling. After being processed, the materials are used for the following purposes:
  o Insulation materials for the agricultural sector;
  o Construction and insulation materials;
  o Filling materials;
  o Raw polyester materials or recycled cotton canvas which can be reused.
- 10% of the clothes meet the criteria for donation. These clothes, mainly winter clothes and children’s wear, are cleaned and disinfected, after which they are donated to less-developed areas or public welfare organizations within China;
- The remaining 15%, good quality summer clothes, is cleaned and handed over to foreign trade companies to be exported to either Africa, South-East Asian countries or countries in war.

Flying Ants has two recycling companies in Guangzhou and Hunan. These two factories can produce canvas fabrics from the recycled materials, from which for example shoes and umbrellas can be made. Of the clothes that get recycled, 50% is treated by these two companies. The rest, mainly clothes that consist of mixed materials, are sold or given to other factories. These factories turn the materials into lower-quality products such as insolation material and materials which can be used in the automotive industry.

The treatment of the exported and donated clothes is done by companies with whom Flying Ants has a contract.

In contrast to the previous discussed collection company Yuanyuan, Flying Ants is a private company. With regard to profit, most of Flying Ants’ profits come from the export, advertisements on Flying Ant’s mobile application and collaboration with e-commerce shops on Flying Ants’ application. As the company gains more and more users, other companies are interested in advertising on Flying Ant’s mobile app. Apart from that, Flying Ants cooperates with e-commerce shops. For example, in May 2019 they cooperated with an agricultural store which offered products on Flying Ants app. Whenever people donated clothes, they would get reward points on the app in return. These points could then be used to buy some agricultural products with a discount. In the recycling part, the profit is quite low and the company focusses on not making any losses.

As the business model is fairly unique and successful, there are a lot more businesses coming up who provide a similar door-to-door service. However, as Flying Ants brand name is quite famous and widely known, these companies do not necessarily form a threat to Flying Ants.

Apart from the online-to-offline pick-up service, Flying Ants also works with a few clothing brands to collect waste clothes in their stores. These brands want to work on their image and become more sustainable, so – together with Flying Ants – they set up collection boxes in their stores. If customers drop off their old clothes, they get a coupon in return which gives them a discount in the store. This is also a pleasant way for people to get rid of their old clothes, because if they want to make an appointment for Flying Ants’ pick-up service, the number of clothes has to exceed 5 kgs.

Awareness of environmental issues is quite low with domestic clothing companies and there are hardly any policies or incentives to encourage them to become more sustainable. When dealing with overstock, the companies try to sell it anywhere else, even for very low prices, rather than recycling the materials. Often times, these companies keep the overstocked materials for too long, so the quality of the material degrades and the clothes cannot be used for recycling purposes anymore. Because of this, Flying Ants rather works with international partners, as they are more willing to pursue sustainable practices. However, international companies tend to prefer to cooperate with international partners. This is a difficulty Flying Ants faces, because the company does want to cooperate in this business.
Another difficulty for Flying Ants has to do with the collection logistics. For this, the company works together with postal delivery companies. As Flying Ants wants to give their users a good experience when donating clothes, they give training to the logistic companies they work with. However, this, and the logistics in general are rather costly. The market is growing, but at the same time the delivery business is not stable at all, which might be reflected on Flying Ants’ users experience. Because the staff of the delivery companies keeps changing, Flying Ants keeps spending money on trainings. This provides a business opportunity, which the company is open to: optimizing the logistics situation.

One of the next steps for Flying Ants is setting up more partnerships for collection on spot. As the market size for reusing old clothes is large, China has a large population and public awareness is growing, there is big potential. Another aspect the company is working on is the set-up of smart bins, such as the previous discussed Little Yellow Dog. Fling Ants is based in Shanghai, and the Shanghai government is quite ambitious and driven to set up a comprehensive waste management system. Flying Ants is negotiating with the municipal government to set up smart bins for the sorting and collection of waste. While the Shanghai government promotes the separation of waste, setting up the smart collection system is an expensive investment. Working together with Flying Ants would be a win-win-situation for both parties.
3. Sorting of Collected Materials

This chapter gives an overview of the existing sorting methods in Mainland China. There are two forms of sorting: manual and automated. Both forms are explained and examples of companies that either work with the manual or automated sorting of textiles are provided.

To make waste textiles go circular, the sorting process is essential. Some discarded materials can be given a second-life, and different destinations require different conditions of the products. Furthermore, the composition of the materials influences which recycling method can be used.

In 2018, the Department of Circulation Development of the Ministry of Commerce released the “China Renewable Resources Recycling Industry Development Report (2018).”\textsuperscript{45} The report states that since 2012, central and local administrative agencies have subsidized a number of non-profit organizations and industry associations to carry out the recycling and reuse of old clothes. At the same time, the report tells, private enterprises are getting involved in the textile recycling bin \textit{community}, which has promoted the development of the waste textile recycling industry. As the amount of waste textiles will continue to grow, so is the amount of recycling activities, the report says. According to the report, it is therefore necessary to solve the problem of sorting on basis of fibre components.

To assess whether waste textiles can be reused, send to charity or recycled, the sorting process is essential to identify the quality of the materials, optimize waste textiles’ value and to prolong their life cycle. As said by Gu Mingming, vice secretary general of Technology Innovation Strategic Alliance for Waste Textiles Comprehensive Utilization Industry at the China Association of Circular Economy, there is no independent separation industry for waste textiles in China.\textsuperscript{46} Most companies that work in the sorting business are also involved in or manage either the collection, donation or export process of the waste textiles, as illustrated by the company descriptions in chapter 2.

Because the marketing approaches of sorting centres vary, the classification criteria for the sorting also vary. For example, a sorting company that exports clothes to South East Asian countries mainly focusses on good quality summer clothing, while a sorting company that is working in the actual recycling industry pays more attention to the composition of the used fibres. There are different criteria, which depend on the intended destination of the materials:

1. Wearable (clothes that can be worn again) – unwearable items (e.g. broken clothes, household textiles);
2. Wearable items are sorted on different norms such as type, design, condition, quality, etc.;

\textsuperscript{46} Interview with Gu Mingming, vice secretary general of Technology Innovation Strategic Alliance for Waste Textiles Comprehensive Utilization Industry at the China Association of Circular Economy, March 21, 2019.
3. Unwearable items that are destined for recycling can be sorted on basis of their composition such as fibre type or colour.

The value of the recovered materials depends on the accuracy of the classification. This is especially important for textile-to-textile recycling, which is explained in chapter 5. There are two methods involved in sorting waste textiles, which are discussed hereafter.

![Figure 7: Sorting streams of collected textile waste, via Trash-2-Cash. The red fraction is the part where automated sorting systems can play a role.](image)

**Manual sorting**

According to Gu Mingming, the sorting of waste textiles in China mainly happens by humans, because the automatic sorting equipment is not well developed yet.47 Elsewhere in the world, manual sorting is also the most common way for sorting, although there are several automatic sorting technologies emerging. The manual sorting of textile materials is a labour-intensive process, and the outcome depends on several factors.

The manual detection of different material is based on variables that humans can determine. Thus, the identification is limited to information on labels and humans’ senses sight and touch. Besides, the Ellen MacArthur Foundation writes that labels in clothing do not always represent accurate information.48 This is not problematic for the separation of wearable/unwearable items. But if the sorted clothes are destined for textile-to-textile recycling, incorrect identification of the fibres could disrupt the recycling process and lead to lower quality of recycled materials. Inadequately sorted textiles are generally used for low-grade applications, rather than recovered for higher grade applications where the materials could supplement the use of virgin fibres (textile-to-textile recycling).49

---

47 Idem.
However, to sort donated clothing that can be reused and will be given a second life on either the vintage or second-hand market, or for export purposes, manual sorting is crucial. So far, no automated techniques exist which can determine whether clothes are still wearable or not.

SunFire Garment Factory

The SunFire Garment Factory is an example of a company that, according to its website, is working in the field of collecting, sorting, packing and exporting used clothes. Set up in 2008 in Zhengzhou, in the province of Henan, SunFire Garment Factory is mainly exporting goods to Africa, the Middle East and South-East Asia.

Purelink 普联

Purelink is the sorting and recycling partner of the collection company I:CO, whose working method is explained in chapter 2. The company was established in 2017 and is based in Guangzhou. Purelink has 21 factories all around the country. Besides the clothes Purelink receives from I:CO, Purelink collects used clothes from communities and schools. Local authorities that have collected clothes which cannot be donated to areas in poverty also give the clothes to Purelink so that they can be used for recycling purposes. The company also receives clothes from online partners, such as Xianyu (see chapter 2) and JD, one of China’s largest e-commerce platforms. In 2018, they processed 150,000 tons of used clothes. The clothes are sorted manually by different colors and materials, after which they are treated mechanically by recycling machines. Some examples from the new products made from the recycled materials are pillows, gloves, apron and storage bags. Because of the growth of fast fashion and e-commerce platforms, people buy more clothes, which are also thrown away more frequently. This is one of the reasons Purelink has been growing in the past years. Another reason is that the company is becoming well-known among the sector. On top of that, a spokesman from Purelink says, the government pays more and more attention to environmental protection and there are a lot of more used clothes to be dealt with.

Automated/automatic sorting

Another way for textile waste to re-enter the economy and regain its value is by recycling the materials and converting them back into their original form. This can either be down-cycling or textile-to-textile recycling. The recycling practices are explained in more detail in chapter 5. Nonetheless, accurate knowledge on the composition of waste textiles is essential to increase the efficiency of the recycling process and the quality of recycled materials. Mistakes in identification can lead to lower quality recycled materials. Because of the

---

described obstacles deriving when manually separated, innovation plays an important role to optimize the sorting process.

Technologies for automated sorting offer solutions to overcome identification difficulties. Automated sorting means that software is used to determine certain characteristics of the textiles, in the form of sensors. Knowledge about composition of the textile materials makes it easier to decide whether they can be successfully used for the textile-to-textile recycling process or for other lower-grade recycling purposes. Besides being able to provide detailed information about the materials, automated sorting makes it possible to handle large flows of textile in a shorter and less-labour-intensive procedure than the manual method. However, not only in China, but also in the rest of the world, these technologies are still in its development phase and are not widely used yet.

The frontrunners in the automated sorting business operating in Mainland China are discussed hereafter.

---

**TOMRA Asia**

TOMRA Recycling Sorting is a Norwegian company that, in addition to other machines, manufactures sorting machinery. TOMRA established a branch in Xiamen (Fujian province, People’s Republic of China) in 2010, where municipal solid waste (MSW) is sorted and recycled. The Ministry of Housing and Urban-Rural Development (MOHURD) listed the MSW plant as a demonstration plant, which also gained some financial aid from the central government. Two years later, in 2012, the company also received financial support from the Ministry of Industry and Information Technology (MIIT). TOMRA’s sorting technologies work with Near Infrared sensors (NIR), which can identify the characteristics of certain types of waste. While the machines deal with plastic, metal, paper and glass, Mr. Chang, who works at TOMRA Asia notes that there is big potential for textiles as well. Due to the fact that 63% of textile raw materials consist of plastics, the machines can sort out polyester based fibre textiles from other textiles. The raw material used to make these fibres is plastic, and these fibres are also called synthetic fibres. Of the 20.073 million tons of waste textiles in China in 2013, synthetic fibres accounted for 13.777 million tons. Setting up a waste treatment plant in Xiamen was possible because of the Chinese government’s decision to give priority to technological innovation and the country’s transition to sustainable development. The company Xiamen Alee was selected to operate the MSW sorting plant in

---

54 Idem.
Xiamen for 25 years, after which the ownership will be transferred to the municipal government.57

Fibersort – valvan

Fibersort is a technology that sorts textiles by their fibre type. The scanning technology that is used by the Fibersort to identify the different types of fibre is Near Infrared Spectroscopy.58 The machines are also operating in China.59
4. Reuse or Resale

Minimizing the use of raw materials is a way to reduce the textile industry’s pressure on the environment. This can be achieved by recycling, but the recycling process itself is energy-consuming. Reusing textiles does not require treatment, thus reusing the materials is less depleting for the environment than recycling them. On top of that, reusing the materials leads to a limited loss in primary resources. When the quality of the textiles is good, they can even be reused several times. This reduces the amount of newly produced goods and extraction of raw materials. In this chapter, existing methods to reuse textiles in Mainland China are discussed.

Charities and Export

Giving clothes to charities that donate them to people in need prolongs the life of clothes and prevents them from ending up in landfills. As explained in chapter 1, the market for donating clothes is strictly regulated by the government through the Charity Law. As the sale of used-clothing is not allowed in China, wearable items can follow two legal paths after being sorted. They are either handled by charity organizations or they are exported to other countries. The export of used clothes has been growing rapidly in the recent years, as can be seen in figure 8 below.60 The main markets for the export of used clothes are Africa and South-East Asia.

![Figure 8: Global exports and imports of used clothing, via Shenglu Fashion](https://shenglufashion.com/2015/09/30/global-trade-of-used-clothing/)

---

Second-hand Sales and Vintage

Another way to reuse old textiles is to give them a second-life by selling them again. This increases the number of times the products are used or worn and offers customers affordable access to textile products.\textsuperscript{61} However, the sale of second-hand clothes is not prohibited in Mainland China.\textsuperscript{62} On top of that, most Chinese consumers, especially the older generation, perceive wearing secondhand clothing as a taboo. Because traditionally the clothing of a deceased person is burned, a superstition exists that wearing secondhand clothes would bring bad luck and evil spirits.\textsuperscript{63} In addition, wearing secondhand or recycled clothes could sometimes be considered as poverty or having a low class status.

Xu et al. note that another reason for Chinese consumers to not purchase second-hand clothing is the abundance of low priced new apparel products.\textsuperscript{64} In their article, Xu et al. compare second-hand clothing consumption patterns between the US and China. They mention that in the US, the – generally lower – price of second-hand clothing counts as an incentive for consumers to buy second-hand clothing. The large quantity of low prices apparel products in China might cause Chinese consumers to see less economic value in purchasing second-hand clothing, Xu et al. write. On the basis of 262 questionnaires which Xu et al. conducted in China, they conclude that respondents perceived a high level of environmental value for the purchase of second-hand clothing.\textsuperscript{65}

While selling clothing on the second-hand market is forbidden in China, there is a kind of grey area within this prohibit. Some examples are discussed below.

---

Xianyu 闲鱼

Xianyu is an online platform where users can sell second-hand goods, from electronics to clothing. The mobile app was launched in 2014 by Alibaba Group, China’s biggest e-commerce company.\textsuperscript{66} The platform has over 200 million active users.\textsuperscript{67} The main users of Xianyu are students and office workers whom are under the age of 30 years.\textsuperscript{68} Beside the

\textsuperscript{61} \textit{The Circular Economy Opportunity for Urban and Industrial Innovation in China}, publication (Ellen MacArthur Foundation, 2018), 93.


\textsuperscript{65} Idem, 676.


\textsuperscript{67} Idem.

option to buy and sell second-hand clothing, Xianyu partners with Ant Financial to recycle unwanted clothes.\(^69\) Ant Financial is a technology company that operates Alipay, one of China’s largest online mobile payments platforms. The cooperation started in 2016 and Xianyu rewards recyclers with points, with whom Ants Financial tracks a person’s carbon footprint.\(^70\) If a person collects enough points, Ant Financial, together with its NGO partners, plants a tree on the person’s behalf.\(^71\)

Next to Xianyu, the other big second-hand trading platform in China is **Zhuanzhuan.**\(^72\) In the year 2018, Zhuanzhuan surpassed 200 million users.\(^73\) Clothing was among the top three of most popular second-hand goods on the app.\(^74\)

**Share2 只二**\(^75\)

Share2 is another online platform on which uses can buy and sell second-hand clothing.\(^76\) The company takes care of the processing of the items, such as cleaning, photographing, estimating the product’s value and providing details about the items on Share2’s platform.\(^77\) In an article on Technode, the founder of Share2 explains that marketing second-hand goods to Chinese consumers is the key: “The platform is advertised as a money saving tool, (…). Instead of using the Chinese word for “second-hand”, Share2 opts for the term “old love.”\(^78\)

Another phenomenon where it is possible to buy and second-hand clothes in China is in **vintage stores.** Some retailers found out that this market has potential in China, and instead of identifying their stores as second-hand shops, they call them vintage.\(^79\) On the one hand naming the stores “vintage stores” attracts a certain type of customers, while on the other hand, using the term vintage hides the fact that the clothes are actually second-hand goods which conceals their inferior reputation. Insights shared by a vintage store owner in Beijing


\(^70\) Idem.

\(^71\) Idem.


\(^74\) Idem.


\(^77\) Idem.

\(^78\) Idem.

learned that this is also a way to avoid government interference, as the sale of second-hand goods is actually not allowed. By making sure the clothes in the store do not look old, properly cleaning them and putting labels with price tags and information on the garments, the store has got a legal license for existence. When the store is checked upon, the owner shows the inspectors the labels and says the items are new. This is the only way the vintage business can exist, the owner explained. The store in Beijing was opened about 15 years ago, as one of the frontrunners in the business. Besides the owners personal interest in the 70s/80s/90s, the fact that the market for clothing from this period was empty was another motive to set it up. In the first two or three years, the concept did not really work and the store made hardly any profit. People were not used to the concept and they were slightly suspicious about the market. However, as media began to play a prominent role in people their lives, that mindset changed and the number of customers has been growing and growing. The clothing sold in this store in Beijing mainly come from the United States and Europe. The owner buys items in wholesale from markets or recycling companies, who sort out the items they have collected and grade the items by quality. The main customers are people who are either interested in the culture of the 70s/80s/90s, and young people ranging from 16 to 25 years old who want to be original and try different styles than the styles offers at big brands. They are not necessarily driven by environmental factors.

![Figure 9: Chinese consumers’ motives for buying second-hand items via Vogue Business](image)

**Sharing, Renting and Leasing**

China’s sharing economy is the largest in the world. Services such as sharing, renting and leasing offer customers access to products rather than ownership.80 These business models increase the average time goods are used, and for textiles extend the use of fabrics. However, according to a report by the Ellen MacArthur Foundation the sharing market for textiles in China is still in its infancy, mainly due to hygiene issues.81

---

81 Idem, 94, 100.
In their article about second-hand clothing acquisition, with a specific focus on clothing-swaps, Lang and Zhang write that Chinese consumers have displayed high intention to buy less environmentally harmful products.\(^8\) However, while swapping clothing can extend the lifespan of materials, this method of sustainable purchasing behavior is not popular among Chinese consumers they conclude. But there are also opportunities, according to an article on Vogue Business: “The desire to display their lifestyle on social media and the pressure of keeping up with fast-changing trends fuels the need for a fast turnover of outfits. (...) They want to be able to wear different outfits, but need to do so with their current budget.”\(^9\)

There are a few promising emerging business models in China’s sharing market for the clothing industry which are discussed below.

**YCloset 衣二三\(^8\)**

YCloset is an online rental platform for women clothing. The platform was founded in Beijing in 2015, as one of the earliest successful cases of a business model in the retail sector for clothing based on shared economy values in Mainland China. The platform operates in 40 cities in China and has over 1 million users.\(^5\) For a subscription fee of 499 yuan per month (about 72 USD), users can rent an unlimited amount of clothes and accessories.\(^6\) The main users of the online app are women aging from 22 to 30 years, living in first and second-tier cities in China.\(^7\) Items that are suitable for day-to-day wear are the most popular items on the online app.\(^8\) According to an article on Vogue Business, this is a difference with Western rental clothing platforms, that do not necessarily focus on casualwear but rather on formalwear.\(^9\) YCloset does not position itself as a clothing-sharing app, but as an e-

---


commerce company that links customers with brands and designers.90 Besides, customers also have the option to buy items through the platform. Key challenges for the company include logistics, optimizing recommendation algorithms for users and hygiene, which remains a key barrier and concern for customers.91 To solve the hygiene issues and ensure the high quality of clothes, YCloset collaborates with a cleaning company.92 Durable clothes can be used by up to 40 different people before they are worn-out.93

Ms. Paris 女神派

Ms. Paris is another clothing rental platform, established in Shanghai in 2015. In contrast to YCloset, Ms. Paris is more focused on the special occasion market instead of daily wear, with designer dresses as main items.95 A membership on Ms. Paris’ platform costs 518 yuan per month (about 85 USD). Each dress on Ms. Paris’ platform is leased a maximum of 10 times.96 Most members of the platform live in major cities such as Beijing, Shanghai and Guangzhou.97 Difficulties for the company include inventory, delivery, quality guarantee and concerns over health and hygiene issues.98

91 Idem.
93 Idem.
96 Idem.
97 Idem.
5. Recycle Industry

If the collected waste textiles are destined for recycling purposes, there are two different ways in which this can be accomplished. These two ways are mechanical and chemical recycling. These methods are discussed in this chapter, as well as their use in China.

In 2018, the Department of Circulation Industry Development of the Ministry of Commerce reported that the recycling rate of waste textiles had grown by 29.6% between 2016 and 2017. While the report does not tell which method of recycling was used, it can be assumed that the main part was recycled mechanically. In general, mechanical recycling is more common than chemical recycling. Chemical recycling is not well developed yet and less cost-effective for most companies.

Textiles, especially clothes, are often quite complex. They are made of different fibers and fabrics, contain buttons, zippers, different prints etc. The complexity makes it costly to recycle textiles and impacts the recycling processes. However, the recycling processes are important for the industry to become circular. If the quality of the recycled materials is sufficient, the market demand for the materials gets higher as well. This will improve recycled textiles materials’ competitiveness with virgin materials.

Mechanical Recycling

According to the China Association for Circular Economy, about 40-50% of the collected waste textiles are mechanically recycled, and the remainder is either donated or resold. The mechanical recycling process consists of the following steps: cutting of the textiles, unraveling, shredding, reprocessing and then spinning the fibers into yarn. The shredding process not only reduces the quality of the fibers, it also shortens their length. Because of this degradation, the output fibers are often used for lower-value applications such as products for agricultural and gardening use, cleaning cloths, insulation materials and fillings. Generally, these applications are not recyclable after use, so this just adds an additional use and expands the lifetime of the materials before they are discarded. In order to reach certain quality standards, the mechanically recycled textiles require being mixed with other

---

100 Interview with Gu Mingming, vice secretary general of Technology Innovation Strategic Alliance for Waste Textiles Comprehensive Utilization Industry at the China Association of Circular Economy, March 21, 2019.
101 The Circular Economy Opportunity for Urban and Industrial Innovation in China, publication (Ellen MacArthur Foundation, 2018), 94.
102 Idem.
fibers to guarantee the durability of the resulting textile.\textsuperscript{104} On the other hand, the process requires relatively little energy.\textsuperscript{105}

Chemical Recycling

Chemical recycling can produce fibers of equal quality compared to virgin materials.\textsuperscript{106} When chemically recycled, the textile materials go through a chemical process to transform them into a liquid substance from which new yarns and fabrics can be made.\textsuperscript{107} The requirements for the textiles to be chemically recycled are very high: over 90% of the product has to consist of one material.\textsuperscript{108} Without prior separation of the fiber fractions, the more and more existing mixed fibers cannot be chemically recycled.\textsuperscript{109}

Polyester is the most popular fabric used to manufacture garments, and it can be found in approximately 60% of the material that makes up clothes worldwide.\textsuperscript{110} According to an article by Flying Ants, in 2013 18 million tons of the 26 million tons disposed textiles in China were chemical fibers, of which polyester forms a large amount.\textsuperscript{111} Fabrics that consist of 100% polyester can be treated chemically to break them down to their original components, after which they can be reassembled and reused. These processes are known as depolymerization and re-polymerization. After being purified, new, virgin quality PET can be created, from which new chemical fibres can be manufactured. Research is being conducted on recycling materials that consist of a smaller fraction of polyester than 100%, with positive results.

While it is practicable to recycle textiles made of polyester, the use of PET as source for the construction of fibres also has its complications. When plastic-based items are washed, microfibers leach into the environment. It is estimated that each year, half a million tonnes of microfibers are released into the ocean resulting from the washing of textiles.\textsuperscript{112} This amount is equivalent to more than 50 billion plastic bottles.\textsuperscript{113}

\textsuperscript{108} Interview with Gu Mingming, vice secretary general of Technology Innovation Strategic Alliance for Waste Textiles Comprehensive Utilization Industry at the China Association of Circular Economy, March 21, 2019.
\textsuperscript{109} Timeout For Fast Fashion, publication (Greenpeace, 2016), 7.
\textsuperscript{112} A New Textiles Economy: Redesigning Fashion’s Future, publication (Ellen MacArthur Foundation, 2017), 20.
\textsuperscript{113} Idem.
In China, there is one company that works with the chemical recycling of waste textiles: Zhejiang Jiaren New Materials. The company was co-founded in 2012 by Jinggong Holding Group and the Japanese company Teijin.\(^{114}\) Zhejiang Jiaren New Materials uses a technology to convert waste polyester textiles into new polyester fibers called Eco Circle, owned by the Japanese Teijing Company.\(^{115}\) The resulting fibers are sold and used to create different kinds of textile materials. Zhejiang Jiaren New Materials mainly works with international companies, such as Adidas, Nike, H&M and Ikea.\(^{116}\) In 2013, Li Ning, a popular Chinese sportswear brand, manufactured uniforms for the China Basketball Association from the Eco Circle Fibers.\(^{117}\)

**Down-cycle**

If the recycled material is of lower-value or lower-quality than the original material, the recycling process is also known as down-cycling. Mechanical textile recycling often leads to down-cycling, because the shredding process reduces the quality and the length of the fibers.\(^{118}\) Some examples of down-cycled textiles:

- Fillings;
- Insulation materials;
- Industrial rags;
- Greenhouse fabrics for agriculture (see figure 10).\(^{119}\)

Another classification for down-cycling is open-loop recycling. Open-loop recycling refers to when the material from a product is recycled and used in another – not identical to the original – product.\(^{120}\)

An example of a company that works with down-cycling is **Ikea China**. The company’s 2016 sustainability report tells that a mattress take-back system is operating in Ikea’s stores in China. The mattress are either sent back for energy recovery or for material recycling. In 2016, 23,018 mattresses were reclaimed at stores from Ikea in China. In the same year, Ikea also launched a rug made from leftover materials from the production of Ikea’s fabric and quilt covers.

\(^{114}\) [佳人新材料](http://www.jiarencycle.com/en/index.php/recovery)

\(^{115}\) Idem.

\(^{116}\) Idem.


\(^{118}\) The Circular Economy Opportunity for Urban and Industrial Innovation in China, publication (Ellen MacArthur Foundation, 2018), 94.


Up-cycle

Up-cycling refers to items made from recycled materials that have an equal or even higher value or quality than the original product.

An example of an up-cycling project of waste textiles in China is UseDem. The project was started in Shanghai in 2015. UseDem focusses on denim jeans to turn them into backpacks, but they use different fabrics as well. UseDem does not only source the materials from customers, the company also receives donated jeans from factories and charities.

Another example is The Squirrelz. Launched in 2013, the Squirrelz began as an upcycle store selling sustainable produced goods from local designers in Shanghai. In 2016, the Squirrelz also launched a platform which connects Chinese factories who camp with overstock or defective items with designers and brands. The company sources from manufacturers around Shanghai and Zhejiang province. In an interview in 2016, Yan, the founder of the Squirrelz, says that import-export agents from the United States and South American countries responded very well to their wholesale project.

---

122 Idem.
123 Idem.
Conclusions

In this report, the current management streams of post-consumer textile waste in Mainland China have been analyzed. Specifically, the report focused on the circularity of waste textiles. In general, the manufacturing process of textiles is environmental unfriendly and disposal of post-consumer textiles shortens the materials’ life span. But sometimes, post-consumer textiles can be reused or recycled, which reduces the textiles industry’s pressure on the environment. Little research has been done on this topic, thus in this report first insights on the status of textile waste management in Mainland China have been shared.

While it is hard to give a precise amount of waste textiles in China, it is certain that the volume is large. Estimates vary from 20 to 26 million tons of waste textiles per year, of which the utilization rate is low. Looking at consumption patterns, it is quite likely that this amount will keep growing. Reasons for the unprecise amount of waste textiles are described in chapter 1. They range from a lack of transparency in the industry to influence from different stakeholders who are involved in collection activities of textile materials. However, the large estimated number means that there is quite some potential for the process of moving to a more circular textile industry. The majority of post-consumer textile materials are being thrown away rather than reused or recycled, which leaves room for significant improvement. Besides, the proximity to the different stages of the supply chains in China is an advantage to transform the regular – mostly environmental unfriendly – practices in the textiles industry.

For materials to re-enter the economy and extract their highest value, collection is essential to prevent them from ending up in landfills or incinerators. In chapter 2, the collection methods of textile waste are discussed. The way of disposal depends on existing facilities, the availability of collection and infrastructure as well as logistics. A distinction can be made between online- and offline collection services. Offline methods consist of disposal containers in residential areas and collection initiatives at retailers or organizations. In the last case, customers are sometimes rewarded with gifts or coupons as incentive for them to donate their used textiles. This also happens with online collection methods, where customers make an appointment after which their used textiles are being picked-up at their house. The largest company in China that is working in this field is Flying Ants. From 2015 to 2018, the number of clothes that the company collected rose from 1000 tons to 40,000 tons. In relation to the estimated 20-26 million tons this number is not large, but the rise over the past years is significant. According to a representative of Flying Ants, the rise has to do with growing awareness among Chinese consumers and the door-to-door pick-up service, which is very popular in China.

Chapter 3 describes the sorting methods of textile waste, which are essential to make the materials go circular. The composition of the materials effects which recycling method can be used. Besides, some discarded materials can be given a second-life, and different destinations require different conditions of the products, thus the collected materials have to be sorted. There is no independent sorting industry for waste textiles in China. Most companies that work in the sorting business are also involved in or manage either the
collection, donation or export process of the waste textiles. Like elsewhere in the world, the sorting of textiles mainly happens by humans. This impacts the outcome of the sorting process, because the manual detection process is based on humans’ senses. Technologies for automated sorting offer solutions to overcome identification difficulties, but these technologies are still in its development phase.

The sorted materials have different destinations, which are described in chapter 4. The sale of second-hand clothing is not allowed in China, so a lot of the collected clothing is exported to other countries or donated to people in need. The donation of clothing is strictly regulated by the Chinese government. While selling clothing on the second-hand market is forbidden in China, there is a grey area within this prohibit. This grey area consists of online applications on which users sell used materials and vintage stores. Other practices where clothes are given a second-life are sharing, renting and leasing services. However, due to hygiene issues, these services are still in their infancy in China.

If the collected waste textiles are destined for recycling purposes, they can either be recycled chemically or mechanically. These methods are described in chapter 5. In general, mechanical recycling is more common than chemical recycling. Mechanical recycling often leads to down-cycling, which means that the output materials are of lower value than the input materials. Chemical recycling can create materials of equal quality to virgin materials, but the requirements for textiles to be eligible for chemically recycling are very high. In China, there is one company that works with the chemical recycling of waste textiles.

While uncertain, the large number of post-consumer waste textiles shows that there is a lot of potential to move to more circular waste management streams. The companies discussed in this report provide useful examples of the current streams and show that there is a lot more possible and needed than what is happening now. The company Yuanyuan, operating directly under government authorization, also illustrates the Chinese government’s interest in investing in more environmental friendly ways of disposal of post-consumer textiles. More transparency in the industry would be beneficial to create more targeted policies in going circular.
Appendix A: Market Share Mainland China’s Textile Industry

As the world’s largest exporter and manufacturer of textiles, China plays a significant role in the global supply chains. But the value of China’s market share in the global apparel industry is declining. In 2014, China’s market share in the world accounted for 38.6 percent, but that value fell to 33.7 percent in 2017. Main reasons for this, South China Morning Post reports, are growing labour costs and restructuring of the industry. Yet, due to the expansion of the Chinese middle class, the country itself is now one of the world’s biggest markets for fashion. It is even estimated that 65% of the world’s clothes are manufactured in China.

While China is still the largest clothing exporter in the world, the average annual growth of the industry is declining. Due to competitiveness because of among others lower wages, the growth of the garment industry in surrounding countries such as Bangladesh, India and Vietnam is booming. However Sheng Lu, associate professor of fashion and apparel studies, notices that China is playing an increasingly important role as textile supplier for these Asian countries. Sheng Lu writes that while almost any country in the world can make apparel, not all countries have the capacity to produce textiles. China’s leading role in the global apparel exports might be declining, other prominent apparel-exporting countries like Bangladesh and Vietnam heavily rely on imported textiles. The importance of China as textile supplier is unavoidable: in 2017 47% of Bangladesh’s textile imports came from China, as well as 65% of Cambodia’s and 50% of Vietnam’s.

---

133 Idem.
134 Idem.
Apart from playing an important role in the country’s foreign trade and providing a lot of employment opportunities, the production value of the textile industry accounts for about 7% of China’s GDP.136

Another factor which impacts the textile industry are consumption patterns. China is known for having an enormous population, reaching over 1.3 billion people in 2017. China’s population is still increasing, but the growth rate is slowing down. Due to low birthrates, China’s population could start shrinking from 2027 onwards. While the country declares itself as a developing nation, China’s GDP has significantly grown since China joined the WTO in 1986.137 People’s Daily Online, China’s biggest newspaper group, reports that the largest power for this growth is the consumption market.138 In addition, McKinsey & Company report that by 2022, 45% of China’s population will earn between 60,000 and 229,000 RMB annually, making the country the world’s fastest-growing consumer market.139 In the year 2000, this was only 4%.140 An increase in income naturally leads to growth of consumption levels. Undeniably, the expansion of both population and purchasing power comes with its environmental impacts. This is illustrated by the fact that the amount of disposed waste almost doubled from 2004 till 2013.141 With regard to textiles: the global average of clothing consumption is 5 kg per person per year, but a rapport by Greenpeace from 2015 points that people in China were already consuming 6.5 kg of clothes per year, an amount which could rise to 11-16 kg by 2030.142

Along with increasing consumption, income and globalization, new markets emerge. For instance, the fast-fashion market. The fast-fashion business model is known for being inexpensive, produced rapidly and in huge amounts, to meet the ever changing preferences of consumers.

---

139 The Rise of the Middle Class in China and Its Impact on the Chinese and World Economies, publication, Dominic Barton (China US focus), 2.
140 Idem.
142 Timeout For Fast Fashion, publication (Greenpeace, 2016), 2.
143 Idem.
Bibliography


Interview list


Mr. Yang Yinghong, Chairman of Board, Shanghai Yuanyuan Industrial Co., Ltd. May 7, 2019.
