

A Little Story about a Monstrous Mess

Investigation on the toxic residues in children's clothing
from China's largest manufacturing towns

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Executive summary

Consecutive investigations commissioned by Greenpeace International¹ in 2011² and 2012³ exposed the presence of hazardous chemical residues in the clothing products of many global fashion brands, including some samples of children's clothing. Therefore in 2013, Greenpeace launched a follow-up study to further investigate the hazardous chemical residues present in children's clothing. A set of 85 clothing items from Zhili Town of Huzhou in Zhejiang Province and Shishi in Fujian Province - two largest production bases for children's clothing in China - were tested for nonylphenol ethoxylates (NPEs), phthalates, antimony and other toxic chemicals.

Key findings

- 26 samples were tested positive for NPEs with the detection rate reaching more than 50% and the highest concentration hitting 1,800 mg/kg;
- 2 samples were tested positive for phthalates with a concentration above 1,000 mg/kg⁴, and the highest reached 1,7000 mg/kg;
- More than 90% of the samples, all of which contained polyester fabric, tested positive for antimony, with the highest concentration reaching 208 mg/kg.

Zhili Town and Shishi City account for approximately 40% of China's total production of children's clothing, with the latter having already expanded its sales to overseas markets. The manufacture of children's clothing deserves special attention, yet there are currently no adequate regulations in place to strictly oversee the use of hazardous substances in these products in China. China needs to improve its chemical management regulations to ensure the elimination of these chemicals at source so as to better protect children.

The problems of Zhili and Shishi are just snapshots of the problem in textile industry. Only by establishing proper chemical management regulations, can hazardous chemicals be completely removed from children's clothing.

I. Profile of the children's clothing industry in China

Children that are under and including 14 years of age in China have exceeded 220 million, accounting for 16.6%⁵ of the total population. Such a large population has led to a huge market demand for children's clothing. Statistics show that the market volume of infants and children's products in China hit the value of one trillion RMB in 2011⁶. It is estimated in the 12th Five Year Plan period that the children's clothing market would maintain an annual growth rate of 30%⁷, making it one of the fastest growing sections of the clothing industry. Currently, this industry is in a stage of initial development with medium, small and micro-sized enterprises as key players.

The use of hazardous chemicals during the manufacture of children's clothing can leave residues of toxic substances on the final product, posing potential health risks for children through multiple routes of exposure. These substances can be readily released to the environment during the manufacturing stage and also in the process of washing clothes, thereby threatening people's health. To address this issue, responsible management from manufacturers is required, whereas the most important step is the adoption of chemical management regulation from government at the national level to keep hazardous and toxic substances out of children's lives.

Box 1: Hazardous chemicals and children's health

There are approximately seven million different chemicals known in the world, out of which 70,000 are commonly used. In addition, more than 1,000 new chemicals are developed worldwide each year⁸. A large number of hazardous chemicals exist, and may leave residues in the final product, or are directly released into the environment. And humans are exposed to and threatened by these chemicals in many ways. Compared to the adult, children in their growing and development stage will experience multiple routes of exposure, and can be more sensitive to some effects of certain hazardous chemicals.

Endocrine disruptors are chemicals with the ability to interfere with the endocrine or hormone system, including those in humans⁹. They may interfere with children's normal hormone function and affect the development of the genital system, immune system and nervous system¹⁰. The use of such chemicals in products, including children's toys, clothing and other products, will increase the release of these chemicals into the environment either during manufacturing or from the products directly. In some instances, there may be the potential risk for additional routes of exposure for children.

II. Children's clothing in Zhili Town, Huzhou

Zhili Town, Wuxing District of Huzhou in Zhejiang Province, is historically known for its prosperous textile industry, thus gained its name "Zhili", literally meaning "textile hometown" in Chinese¹¹. Zhili began production of children's clothing with small embroidery products in the 1970s, and later became China's largest production area for children's clothing. It has previously been awarded the titles "China's Top Town of Children's Clothing¹²" and "Key Development Base for Children's Clothing Brands in China¹³".

Zhili boasts a complete production chain for the manufacture of children's clothing. There are more than 8,000 manufacturers in the central region, and another 2,000 accessory suppliers for children's clothing. The Zhili Children's Clothing Mall, a large-scale market, was also built in the city. By the end of 2011, local sales revenue for children's clothing had reached 30 billion RMB, with 1.15 billion items produced annually, accounting for one third of total production and 98% of the domestic market coverage in China. Today its products are sold to 117 cities in China, and exported to more than 15 countries and regions worldwide. It is also the largest production and marketing base, and the largest fabric and accessories trading center, for children's clothing in China¹⁴.

III. Children's clothing in Fengli, Shishi

Located in the southwest costal area of Fujian Province, Shishi has long been an important clothing production and export base¹⁵ in China. Shishi started its children's clothing production in the 1980s in the downtown Fengli Street area. As the nation's oldest distribution centre for children's clothing, it earned the title "China's Top Town of Children's Clothing" granted by China's Textile Industry Association in 2005. During its peak it alone accounted for 80% of the market share in China¹⁶.

According to statistics, Shishi produced at least 0.2-0.3 billion children's clothing items in 2011, with annual production valued at 26 billion RMB, making up half of the total clothing industry in Shishi. There are over 3,000 manufacturers¹⁷ of children's clothing present. And 70-80% of its products are exported, with the Middle East being the largest buyer, but also to Europe, the United States, Southeast Asia and African countries¹⁸.

Dabao, Wubao and Jinshan dyeing and printing centres have been built for the integrated purposes of dyeing, weaving, bleaching and printing in the costal towns of Xiangzhi, Hongshan and Jinshan in Shishi. There are several dozens of textile dyeing manufacturers that distribute here, functioning as upstream suppliers in the local clothing production chain.

Box 2: New age of children's clothing: online business and fast fashion

As two of the nation's largest textile production bases, Zhili and Shishi have led the industry development with their online business and fast fashion approach. There are now more than 2,000 manufacturers operating their businesses online from Zhili¹⁹, with online transactions hitting 1.5 billion RMB in 2012²⁰. One of the most significant innovations to take place in the children's clothing industry in Zhili has been

the adoption of the Internet to conduct business. Meanwhile, its competitor in Fujian Province introduced the concept “fast fashion” to children’s clothing in order to respond to changing preferences from young parents for clothing with more vivid colors and styles. Production has rapidly adjusted to specific needs, with hundreds of children’s clothing delivering products that match the fast changing market and fashion trends of each season.

Box 3: Taobao.com

Under the "maternity and baby products" category on the Taobao front page, a search for “baby and children’s clothing” turned up 1.95 million items and 2,600 shops originating from Huzhou, Zhejiang Province, and accounting for 14% of the website’s total. In addition, the monthly sales of top ten products have ranged from 9,000 to 23,000 pieces. 23,000 items of children’s clothing were from Shishi, Fujian Province. And the maximum monthly sales of single item amounts to thousands of pieces. In short, Taobao.com has become a new sales platform for children’s clothing in the two towns²¹.

Box 4: Fast fashion

“Fast fashion” clothing products have been introduced to respond to customer preference, delivering new fashion trends in increasingly short production and sales cycles. It is this increase in volumes of clothing being made, sold and thrown away that will magnify the human and environmental costs of our clothes at every stage of their life cycle. This will eventually cause more toxic chemicals to be used, released and left in the clothing. Investigations commissioned by Greenpeace in 2012 have exposed the use of hazardous chemicals in the clothing production of 20 global fast fashion brands, which has led to serious water pollution in China²². Fast fashion clothing items, when tested, have turned up an array of toxic chemicals.

VI. Investigation methods and results

Investigations have discovered that the majority of samples manufactured in Zhili and Shishi tested positive for residues of hazardous and toxic chemicals.

Methods:

All 85 children’s clothing articles from Zhili Town and Shishi City were purchased either at stores or online. The first set of samples were bought from local stores and online stores in June 2013, including five samples from Zhili Town, and another five from Shishi City; the second set of samples were purchased from only online stores in October 2013, including 47 samples from Zhili Town and 28 samples from Shishi City. The age groups of these samples ranged from 6 months to 10 years of age. The samples included children’s t-shirts, suits, dresses and pants. The online samples were all chosen from the monthly top sales list²³.

All 85 products were sealed immediately upon purchase in two batches, and shipped to independent accredited laboratories for chemical analysis in Europe and Hong Kong.

Key findings:

NPEs

- In the first set of samples, all articles tested positive for the presence of NPEs (with a detection limit of 1 mg/kg), and the highest concentration reached 1,800 mg/kg.
- In the second set of samples, 40% of articles tested positive for the presence of NPEs (with a detection limit of 50 mg/kg), and the highest concentration reached 860 mg/kg.

Phthalates

- In both sets of samples, two articles exceeded 1000mg/kg by mass, with a phthalate concentration of 17,000 mg/kg (and a detection limit of 3 mg/kg)²⁴ and 5,300 mg/kg (here the detection limit was 50 mg/kg)²⁵.

Antimony

- In the first set of samples, the polyester parts of two articles tested positive for antimony with concentrations of 102 mg/kg and 159 mg/kg respectively.
- In the second set of samples, 90% of the articles (polyester parts) tested positive for antimony with concentrations in the range of 15-208 mg/kg.

PFCs

- Only one article from the first set of samples, a jacket made of polyester, was analyzed with the volatile PFCs reaching 1,010 ug/kg and ionic PFCs reaching 7.97 ug/kg.²⁶

Box 5:

NPEs and NP

NPEs are a group of chemicals often used as surfactants or detergents in the manufacture of textiles, and widely used in the textile industry. Where NPEs are released, they can break down to form NP, an endocrine disruptor. Nonyl phenol (NP) is known as a group of persistent, bio accumulative and toxic chemicals with the ability to mimic natural estrogen hormones²⁷. The use of NPEs and NP has effectively been banned in most industries including textile manufacture within EU. NP and NPEs have been included on the *List of Toxic Chemicals Severely Restricted for Import and Export* in China. And NP has been included on the *Dangerous Chemicals Catalogue(Draft)* and the *Key Restricted and Controlled List of Chemicals* in the 12th Five Year Plan for *Environmental Risk Prevention & Control*.

Box 6

Phthalates:

Phthalates are a group of chemicals predominantly used as plasticizers in plastics. It is used in plastisol prints of the textile industry. Certain phthalates are also regarded as an endocrine disruptor with estrogen

or anti-androgen impact. Scientific research has linked exposure to certain phthalates with decrease of sperm counts, female infertility and abnormal development of reproductive organs²⁸. Under the EU regulation REACH, four kinds of phthalates have been required to be eliminated. In China, two kinds of phthalates are included on the 12th Five-Year-Plan for Prevention and Control of *Environmental Risk of Chemicals*, and one phthalate is included on the *Dangerous Chemicals Catalogue (Draft)*.

Box 7

Antimony:

In the polyester industry, antimony trioxide (Sb_2O_3) is commonly used as a catalyst to produce polyester fiber. As a result, polyester fabric products often contain the presence of antimony. Antimony shows many similarities in its toxicity to arsenic. Scientific studies have proven that it is carcinogenic to animals and possibly carcinogenic to humans as well²⁹. The main exposure of antimony for human is inhalation in occupational settings. There is no research yet to indicate that antimony on clothes would pose a direct risk on people who wear it.

Box 8

PFCs:

PFCs are a group of very persistent man-made chemicals, with the ability to repel both water and oil. They are widely used to waterproof and oil-proof clothing. Different PFCs have a range of hazardous properties, including some that may interfere with the endocrine system of humans and other animals³⁰.

V. Hazardous chemicals used in manufacturing processes

It is estimated that around 25% of the chemical compounds produced worldwide are used in the textile industry³¹. China is now the largest consumer of textile chemicals, mainly dyes and formulations, occupying 42% of global consumption³². Every process of clothing manufacture may involve the use of chemical substances which could potentially be a threat to human health, for example phthalates and heavy metals. Also, some toxic substances like NPEs are released into water ways during production of the clothes and washing of the clothes after purchase, causing pollution.

- **Starching/desizing**

Function: increase the abrasion resistance of fabrics and make it easier for coloring;

Hazardous chemicals used: starching agent and chemical formulations (adhesives, surfactants, preservatives etc.) may contain cancer-causing chemicals like formaldehyde and chloride compounds³³, both leading to a negative impact on humans and the environment. In addition, alkali solution used to enhance the effect may leave residue in the clothing and cause skin irritation.

- **Boiling off**

Function: further remove sizing starch and any impurities in the fabrics;

Hazardous chemicals used: the presence of alkali solution and additives (surfactants, for instance) enables the boiling off reaction. Large use of NPEs as surfactant in the clothing manufacture will leave residues in the final products, and these residues may eventually be released to the environment, posing threats to both humans and the environment.

- **Dyeing**

Function: to color the fabrics with dye and dye auxiliaries;

Hazardous chemicals used: some azo dyes may leave residues in the clothing and produce cancer-causing amines after reacting, threatening human health. Other dyes, including sulfur dyes, mordant dyes and vat dyes may also leave residues of hazardous substances such as sulphide and heavy chemicals. Most dye formulations are surfactants containing NPEs and formaldehyde.

- **Printing**

Function: to apply a range of different colors on certain spots on the clothing. It may be supplied by plastisol print or pigment print.

Hazardous chemicals used: the use of solvent-based ink containing plasticizer as adhesives leaves phthalates residue in the printing; heavy metals may also be used for vivid color impact. In addition, the use of azo dyes results in the residue and release of cancer-causing amines, whereas surfactants may contain NPEs and formaldehyde.

Box 9: It should be noted the more vivid the colors and more printed designs on clothing are usually associated with a heavy use of printing and dyeing processes in manufacturing, resulting in more hazardous chemical residues.

- **Functional finishing**

Function: to improve the performance of textiles with crease-resistant, shrink-proof, flame retardant, iron-free and waterproof functions after dyeing and printing.

Hazardous chemicals used: antibacterial formulations may include the organotin compounds; PFCs are used to increase waterproof performance; crease-resistance performance implies the possible presence of formaldehyde; antimony is used for flame retardant functions; and surfactants added for better softness are usually associated with the presence of alkylphenol substance like NPEs.

Hazardous chemicals used in the manufacture of clothing will either be left as residues in the products, or be released to the environment through waste water discharge and washing of clothing, leading to environmental and human health loss.

To fully address this problem, manufacturers need to take environmentally responsible practices in order to end the use of these hazardous chemicals. The textile industry needs to improve the overall

manufacturing practices of chemical dyes and agents. Most importantly, the government should develop proper chemical management and supervision policies to eliminate toxic substances at source.

*Some parts of the above contents are provided by Professor Gong Yan and graduate student Ao Jianfang from the Beijing Institute of Clothing Technology.

VI. Comparison of chemical management policies between China and other regions

The EU, United States, China and international conventions have adopted different regulations regarding three hazardous chemical substances investigated in this study. Compared to the EU and United States, China has been left far behind in chemical management policies, with inadequate regulations on the management of children's products, not to mention action to eliminate the use of such chemicals at their source.

NPEs

- OSPAR Convention³⁴: NPEs was included on the *List of Chemicals for Priority Action* in the OSPAR Convention for the Protection of the Marine Environment of the North-East Atlantic.
- EU: Under EU REACH³⁵ regulations, deliberate use of NP and NPEs is banned in the textile industry and many other industries. 4-NP and 4-OP have also been included in the list of "Substances of Very High Concern" to be progressively eliminated from the market³⁶.
- US: The Environmental Protection Agency has banned the use of NP and NPEs in detergents, and also included both chemicals on the *Toxics Release Inventory* to monitor its industrial release.
- China: NP and NPEs have been included on the *List of Toxic Chemicals Severely Restricted for Import and Export* in China. And NP has been included on the *List of Dangerous Chemicals Catalogue (Draft)* and the 12th Five-Year-Plan for Prevention and Control of *Environmental Risk of Chemicals*.

Phthalates

- EU: Under the EU regulation REACH, deliberate use of six phthalates (DEHP, DBP, BBP, DiNP, DiDP and DnOP) in children's toys and childcare articles has been banned³⁷. And four phthalates (DBP, BBP, DEHP and DIBP) have been included on the candidate list of "Substances of Very High Concern" to be eliminated.
- US: Use of six phthalates (DEHP, DBP, BBP, DiNP, DiDP and DnOP) in children's toys and childcare articles are banned in the US.³⁸
- China: China has restricted the total amount of six phthalates (DEHP, DBP, BBP, DiNP, DiDP and DnOP) used in the coating of toys. DEHP and DBP are included on the 12th Five-Year-Plan for

Prevention and Control of *Environmental Risk of Chemicals*. The drafted ***Safety Technical Code for Infants and Children Textile Products*** has banned the deliberate use of six phthalates, although has yet to be promulgated.

Antimony

- EU: The *EC Directive 2009/567/EC* on organic textile products requires that antimony content in polyester fibers does not exceed 260 mg/kg.
- **China: The drafted *Safety Technical Code for Infants and Children Textile Products* has restricted the antimony content, although has yet to be released officially.**

Detox children's clothing

As China's children's clothing industry is mainly constituted by medium and small enterprises, it is becoming increasingly necessary for the government to employ effective management and supervision to oversee the overall manufacturing processes and textile safety. Thus, Greenpeace is urging:

- The government should improve its chemicals management regulations on baby and children's textile products by releasing a strict *Safety Technical Code for Infants and Children Textile Products* and other relevant regulations;
- The elimination of hazardous chemicals needs to start from the source of manufacture. Government should adopt comprehensive chemical policies to manage the life-cycle of the chemicals (including manufacture, use, discharge and disposal), through registration, disclosure of chemical use, release and transfer information and risk evaluation, with a goal to eliminating the chemicals which threaten human health and the environment.