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Introduction of Relevant Policies for Integrated Use of Industrial Resources in China
Luo Xiaoli, Division Chief, Energy-saving and Comprehensive Utilization Department of MIIT

Ladies and gentlemen, good morning!

Nice to meet you in the 14th China International Recycled Polyester Conference & Exhibition! Taking this opportunity, I would like to share with you some opinions about integrated resource utilization and green development of industry.

I. New requirements on integrated resource utilization
China’s economy has entered a new stage, in which high-quality is pursued, and higher requirement on environment protection is posed. As it was emphasized during the 19th National Congress of the Communist Party of China, resource and environment protecting is of vital importance to a country, and it is essential to unswervingly implement the policy of resource saving and recycling. As pointed out by President Xi, green development is a necessity for construction of high-quality modern economic system, and the final solution to the problem of pollution.

Integrated resource utilization is a key solution to solid pollution, and is also an important approach to sustainable development, ecologic culture construction and environment protection. In the year 2017, recycled resources under 10 major categories totals 282 million ton in China, with an 11% increase year on year. Recyclable resources are playing increasing important roles in easing resource shortage, raising resource efficiency, reducing pollution, and encouraging green production and green consumption. With China’s economy taking the New Normal, it’s an urgent task for domestic industries to improve quality and efficiency, and conduct structural reformation. Against such a backdrop, recycling industry is of huge potentiality. Stricter restriction on solid waste import issued last year by central authority of China, targeting totally replacing import solid wastes with domestic resource, also calls for better resource utilization and waste management.

II. Practices of Energy-saving and Comprehensive Utilization Department of MIIT
To introduce some of practices in comprehensive resource utilization we carried out:


2. **Category for Advanced Equipments for Integrated Utilization of National Industry Resources**, relevant guidance and case studies to encourage R&D and promotion of technologies of flake processing, high-efficient continuous spinning, high value-added recycling, etc. We encourage development of new recycling methods based on internet plus. Industrial energy-saving campaign and standardization of green development, to improve integrated utilization and promote products to wider market.

3. Supports to key enterprises. Concrete requirements were put down to standardize location, production scale, equipments, management and product quality of recycling enterprises.
Publishing the list of qualified enterprises, and tracking the performance, thus to help enterprises to improve their management and production.

4. Forging a better environment for development. Effective communication with financial and tax departments to carry out integrated resource utilization assessment and provide tax preferences. Participating in revise of solid waste management regulations, to search for legal solution to problems faced by recycling industry.

III. In the future
There are still many works for us to promote the concept of recycling to consumers, to construct a sound collecting system, enhance integration of the industry, upgrade equipments and provide more legal solutions.
Problems in the development of circular economy in a new era

Qi Jianguo
Tel: 13601352250
Email: jgq222@163.com
13 September 2018
Comrades. The eco civilization system reform can not only contribute to contemporary times, but also bring benefits for future centuries. We need to firmly establish the concept of socialistic eco civilization and promote the formation of a new pattern of modernization for the harmonious development between human and nature. We should put forth the efforts of our generation to protect the ecological environment.
Policy news related to circular economy mentioned in the report of the 19th National Congress

The principal contradiction facing Chinese society has evolved. As socialism with Chinese characteristics has entered a new era, the principal contradiction facing Chinese society has evolved. What we now face is the contradiction between unbalanced and inadequate development and the people’s ever-growing needs for a better life. The unbalance between a better life and ecological environment and the inadequate capability of the environment to safeguard the health of human turn to be one of key problems that need to be solved in a new era. Under this circumstance, it's an inevitable choice to put more efforts into developing circular economy.
An important task put forward in the report to the 19th National Congress: Speed up the reform to ecological civilization system and build a beautiful China

Hold on to the principle of giving high priority to conserving resources, protecting the environment and promoting its natural restoration, and improve our industrial structure, way of production and way of life in the interest of conserving resources and protecting the environment, so as to restore a peaceful, harmonious and beautiful nature.
Speed up the reform to ecological civilization system and build a beautiful China

1. Boost a green development. Speed up the establishment of legal system and policy orientation for green production and consumption. Put in place the economic system of green low-carbon and circular development. Carry forward comprehensive saving and recycling of resources, carry out national water-saving action, cut down energy and material consumption, so as to realize a circular linkage between production system and life system.

2. Solving prominent environmental problems. We will get everyone involved in improving the environment and address environmental issues at the root. We will enforce stricter pollutants discharge standards and see to it that polluters are held accountable. We will improve our systems for imposing severe punishment for environmental violations.
Natural ecology------human source

Human society: Survival and development

Mode of thinking and behavior paradigm

Cultural construction

Political construction

Resource and environment

Economic construction

The sixth technological revolution

The fifth technological revolution

The fourth technological revolution

The third technological revolution

The second technological revolution

The first technological revolution

Bow and arrow technology

Ironware Technology

Hunting civilization

Agricultural civilization

Industrial civilization

Eco civilization

Information civilization

Biological civilization

Low material flow leads to safe environment

High material flow leads to unsafe environment

Reduced material flow leads to safe environment

Universe civilization

Low material flow leads to safe environment

High material flow leads to unsafe environment

Reduced material flow leads to safe environment

Interest adjustment and economic regulation

Eco environment regulation

Interest adjustment and economic regulation

Eco environment regulation

Cultural construction

Political construction

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Interest adjustment and economic regulation

Eco environment regulation

Interest adjustment and economic regulation

Eco environment regulation
The status of China's economy in the world economy in history
average annual income per capital in the year of 1000
China : Western Europe = 1.2 : 1

China's GDP share of the world: 32.9% in 1820

Modern times
Reform and opening up

Non-globalization era
Modern times
Reform and opening up

Historical background for China's national rejuvenation
Stage characteristics of China’s economic and social development VS modernization path of advanced countries

Agricultural era → Industrialization → Informatization → Urbanization

150-200 year

More than 40 year

Modernization path of China

Agricultural era

Industrialization

Urbanization

Informatization

Ecological civilization construction and low carbon economy

Began in 1979: 38 years

Began in 2000: 17 years

Began in 1990: 27 years

Began in 2008: 9 years
A. Changes on the characters of China's economic development during the 13th five-year-plan period and in the future

- Growth rate of industry
- Growth rate of GDP
- Growth rate of the world economy
The contribution of industrial added value to GDP:
Structural change
The demand from heavy chemical industry reaches a ceiling
B. Changing trend for the output of wastes
Yielding and disposing of metallurgical slag
Recycling of waste plastics
The theoretic number of discarded television, refrigerator, washing machine, air conditioning and computer
2013年—2016年我国五种废弃电器电子产品资质企业回收处理量
2011年 餐厨垃圾产生量为3782万吨；2012年为3897万吨；2013年为4003万吨；2014年为4102万吨；2015年为4222万吨；2016年为4347万吨。
Annual sales volume of automobiles in China
Ownership of automobiles in China
Theoretic number of discarded automobiles in China
C. New problem faced by the development of China's circular economy

1. The decline of market price of renewable resources leads to the decrease of economic benefit of recycling enterprises.

2. The producer responsibility extension system and the consumer payment system are imperfect, and enterprises are bidding to buy waste.

3. Recycling enterprises access to high cost of resources because of imperfect recycling system.
C. New problem faced by the development of China's circular economy

4. The technological level residual error is uneven, so the environmental protection pressure is big.

5. The increase of labor cost leads to the decrease of the benefit of recycling enterprises.

6. The government is weakening the positive incentive, and the reverse incentive is strengthened. The enterprises of renewable resource utilization are facing more pressure.
D. Change on policy mix for circular economy during 13th five-year-plan period

(a) Policy point up

The policy point has been lifted up from the section of resource recycling to a total solution.

For example, agricultural circular economy changed from the application of crop straw to an integration demonstration of industrial and agricultural complex circular economy.
D. Change on policy mix for circular economy during 13th five-year-plan period

(b) The leading work changes from positive incentive to two-way combination incentive.

The policies stimulating the development of circular economy before the 12th five-year-plan period mainly aimed at positive incentive like demonstration pilot first and financial subsidies and support.

From the 13th five-year-plan period, the positive incentive weakened, while the reverse incentive strengthened. A new and stricter environmental protection law will be enforced soon.
Extended Producer Responsibility policy is firstly carried out in the fields like electrical and electronic products, automobile, lead storage battery, beverage-using paper-based composite package. The varieties and fields of such products will be expanded in a good time based on the experience from the pilot.
E. Key policies for circular economy development during the 13th five-year-plan period

1. Fund system for electronic and electrical products

Coverage extended to 14 categories of electronic and electrical products.

To work out guiding policies of extended responsibility and evaluation criterion for electronic and electrical product manufacturers, to encourage eco design, and increase initiative of manufactures to utilize recycled raw materials and take part in waste electronic and electrical product recycling.
E. Key policies for circular economy development during the 13th five-year-plan period

2. Automobiles

To work out guiding policies of extended responsibility and evaluation criterion for automobile manufacturers. Post-consumer recycling and dismantling should be taken into consideration at the design stage. Recycled and environment-friendly raw materials should be preferred. Technology info and diagnostic equipment for maintenance purpose should be available to independent maintenance service providers (including reproducing enterprises). To encourage manufacturers to utilize after-sale network, and cooperate with qualified dismantling and reproducing enterprises to establish backward recycling system. To encourage the recycling of automobile scrap and promote reproduced products.

To establish a recycling system for electromobile traction battery. Electromobile and traction battery manufacturers should establish post-consumer battery recycling system based on after-sale network, and publish recycling date. Battery manufacturers should establish product code system and life-cycle tracing system. Pilot of electromobile traction battery recycling system shall be taken in Shenzhen and some other cities, and will be carried in out all of the country.
E. Key policies for circular economy development during the 13th five-year-plan period

3. Lead-acid battery: target system

To encourage lead-acid battery manufacturers to establish life-cycle tracing system. In the form of independent-recycling, joint recycling or commissioned recycling, manufacturers shall ensure recycling of post-consumer lead-acid batteries through end-user network. New for old is a good way to be promoted to raise recycling rate. Post-consumer back-up storage battery and energy storage battery should be delivered to enterprises with expertise to deal with them. To develop methods of concentrated collection and trans-regional transportation. Shanghai shall take pilot of lead-acid battery recycling system. Post-consumer lead-acid battery recollected in a one-out-and-one-in mode should be treated with standard progress.
E. Key policies for circular economy development during the 13th five-year-plan period

Paper-based soft drink packages: target system

Enterprises should forge an alliance to take pilot with recycling of paper-based soft drink packages. To encourage paper-based soft drink packages manufacturers, filling and recycling enterprises to join hands under market rules, to collect post-consumer paper-based soft drink packages through sales channel, existing collecting system and recycling network, etc. To support manufacturers in the form of technology and fund to remedy for weak points in the recycling chain.
E. Key policies for circular economy development during the 13th five-year-plan period

(b) Ban on import garbage and push forward reformation of solid waste import management

*Program to Push Forward Reformation of Solid Waste Import Management, in order to Deter Overseas Garbage from Entering China (No.70 Document of State Council, 2017)*

1. To improve the system of solid wastes import license. Traders shall be forbidden from importing as agencies. Ban on import broker shall be put clearly.

2. Import of 24 kinds of solid wastes under 4 categories, mainly from household sources, are added.
E. Key policies for circular economy development during the 13th five-year-plan period


Environmental taxes are collected and managed by taxation authorities in accordance with the "Taxation Collection and Management Law of the People's Republic of China" and relevant provisions of this Law.

In accordance with the provisions of this Law, and of relevant laws and regulations on environmental protection, the competent departments for environmental protection are responsible for managing the monitoring of pollutants.

Local people's governments at or above the county level shall establish working mechanisms of coordinating and distributing responsibilities among taxation authorities, the competent departments for environmental protection, and other relevant units, strengthen the management of environmental protection tax collection, and ensure that tax payments are turned into the Treasury in time and in full.
E. Key policies for circular economy development during the 13th five-year-plan period

(d) Strengthen circular economy standard and identification system

Build and perfect the eco-design standards for related products and improve the comprehensive application of industrial wastes and renewable resources, speed up the establishment of standard for renewable raw materials and regenerated products, kitchen waste recycling products as well as waste building materials.

Set up normative identification and acceptance system for circular economy, inspection and metrology guarantee system.
E. Key policies for circular economy development during the 13th five-year-plan period

(e) Build the promotion and application system for regenerated products and renewable raw materials

Guide enterprises to expand the proportion of the consumption of renewable raw materials. The government gives priority to the procurement of regenerated products. A certain proportion of construction waste-based regenerated products are required to be used in government-invested public buildings and roads. Limit the exploitation of natural construction materials and propel the application of substitutions like bulk solid wastes.
E. Key policies for circular economy development during the 13th five-year-plan period

(f) Related price and tax policies need to be perfected and strengthened.

The added-value tax policies and the enterprise income tax preferential policies for the comprehensive utilization of resources as well as special equipment for energy saving and water saving need to be strengthened and enforced.
Circular economy cuts down environment impact through innovation

Polluting strength curve in developed countries

Expected polluting strength curve in China

Per capita GDP

Pollution per unit of GDP

Innovation tunnel
Pollution control and cost-benefit analysis amid circular economy

Margin cost of pollution control

Margin benefit of pollution control

Zero profit point C1 for pollution control

Zero profit point C2 for pollution control

Proportion of pollution under control
Reserve of known green resources

Exploitation of new resources and recycling

$T_1$ Economy

$T_2$ Economy

Green ecological environment

Release of harmful pollutants = Environment absorption capability
In 1957, 52% of all people in the United Kingdom said they felt very happy, while in 2005, only 36% felt happy. During the same period, the average GDP in the United Kingdom was lifted up by three times.
Thank You!
Green Fiber Certificate and Green Development of Chemical Fiber Industry

Xia Zhilin, Counselor for Green Fiber Certificate
China Chemical Fibers Association

September 13th, 2018
Main content

- The Origin of Green Fiber
- What is Green Fiber
- Conditions Required to Apply for Green Fiber Certificate
- Process of Applying for Green Fiber Certificate
- Rights and Obligations Attached to Green Fiber Certificate
The Origin of Green Fiber

• "Green development" is the basic guideline and key project of “Made in China 2025".
• “Supporting green and cleaner production, advancing the green transformation of traditional manufacturing industry, and promoting the establishment of a green and low-carbon industrial system for circular development" are major tasks in the 13th Five-Year-Plan period and in the longer-term period.
• China’s chemical fiber industry has entered a critical stage of transformation and upgrading. The development concept of green and environmental protection is not only an important factor to establish a new image of China’s textile and chemical fiber country, but also a necessary condition for enterprises to secure a place in the industry.
• As the source of textile industry chain development, fiber's green development process is of great significance to promote the sustainable development of textile industry and society as a whole.
• The green fiber logo is designed to advocate green design, green materials and green manufacturing of products, to promote environmental protection and public health, and thus to achieve the dual goals of enterprise development and social responsibility.
Origin of Green Fiber

- China Chemical Fibers Association (CCFA) and National Textile and Chemical Fiber Product Development Center jointly created green fiber brand logo.
- To regulate the market through third-party certification and management.
- To further motivate enterprises to develop green fiber.
- To improve the social awareness of green fiber and the credibility of related products.
- To effectively enhance the competitiveness of enterprises and products in the domestic and foreign markets.

The green fiber certificate logo is registered by the State Administration for Industry and Commerce. CCFA is the holder of the green fiber logo and enjoys the exclusive right to use the green fiber logo.
What is Green Fiber

- Green fiber refers to chemical fiber that is derived from biomass and recyclable raw materials, low-carbon and environmentally friendly in the production process, and its finished goods are non-polluting or recyclable after being discarded.
What is Green Fiber

- Each ton of fiber processed into textiles will achieve a reduction in waste water and CO2 emissions of 32 and 1.2 tons, as well as a reduction in electricity and steam consumption of 230KWh and 3.5 cubic meters.
- Fabric made from dope-dyed yarn is 30%~50% less in cost per ton than the fabric made through dyeing and finishing process. (e.g., the production of fabric with medium color depth can save electricity of 11,000 degrees, water of 100 tons, dyes of 150 kg per ton).
- Twenty 500ml polyester bottles can be made into a jacket, five 2L polyester bottles can be recycled into carpet of 0.09 square meters, and thirty-five 2L polyester bottles can be made into the filling materials needed for a complete sleeping bag.
- One ton of recycled polyester fiber can reduce CO2 emission by 3.2 tons, while one ton of post-consumer polyester bottle can produce about 0.9 tons of recycled polyester fiber, saving 6 tons of oil and 3 cubic meters of landfill space.
Any enterprise that is registered in the territory of the People's Republic of China in accordance with the law, engaged in the production and operation of chemical fiber products, and has independent civil liability may apply to the China Chemical Fibers Association for the use of the green fiber logo. The application for the use of green fiber logo by downstream users of green fiber manufacturers shall be implemented in accordance with the "Management Rules for the Use of Green Fiber Logo by Downstream User (Trial)".

Conditions Required to Apply for Green Fiber Certificate
Conditions Required to Apply for Green Fiber Certificate

- **Enterprises applying for green fiber logo shall meet the following requirements:**
  1. Production and operation that last for more than two years;
  2. ISO9001 quality management system certification and ISO14001 environmental management system certification;
  3. Effective after-sales service system;
  4. Advanced production technology and complete detection means, with a good healthy and safe working environment;
  5. To strictly abide by the relevant laws and regulations of the state, and ensure that the employees shall enjoy the lawful rights and interests, labor income, welfare benefits and social security as stipulated by the state.
  6. To respect intellectual property rights and consumers’ interests, stick to honesty, and maintain the market order of fair competition.
Conditions Required to Apply for Green Fiber Certificate

- **Products using the green fiber logo should have the following conditions:**
  1. The main raw materials and auxiliary materials used in green fiber products shall refer to requirements of the Green Purchasing Standards for Recycled Chemical Fiber (Polyester) Industry (T/CCFA 00006-2016).
  2. The indicators of energy consumption, material consumption, water consumption, reuse rate of industrial water and three wastes (waste gas, waste water and waste residues) discharge in the production process of green fiber logo products shall meet the requirements of level 2 or above of the cleaner production evaluation index system.
  3. Green fiber logo products are medium- and high-end ones, and their quality features are in line with the Green Fiber Logo Product Evaluation System (Trial) and the relevant national standards, industry standards, and association standards.
Conditions Required to Apply for Green Fiber Certificate

- **Product performance index:**
  1. Bio-based chemical fiber (breaking strength, elongation at break, characteristic index)
  2. Recycled chemical fiber: Imitation down fiber (linear density deviation rate, length deviation rate, defect content)
     - 2D/3D hollow fiber (hollow ratio, defect content, compression elastic recovery rate)
     - Cotton/wool-type fibers (fiber fineness, breaking strength, elongation at break)
     - Filament yarn (linear density unevenness, breaking strength, elongation at break)
  3. Colored chemical fiber (breaking strength, dry and heat shrinkage rate, color fastness)
Conditions Required to Apply for Green Fiber Certificate

**Resource consumption:**
- Fresh water intake per unit of product
- Power consumption per unit of product
- Coal (gas) consumption per unit of product
- Steam consumption per unit of product
- Comprehensive energy consumption per unit of product
- Raw material consumption per unit of product
- Reuse rate of industrial water

**Environmental Management:**
- To be certified by the ISO14001 Environmental Management System
- To conduct energy audits as required
- To conduct a cleaner production audit
- To establish an energy and environmental management agency
- To set up an energy conservation and environmental management check-up system
- Implementation of the “Three Simultaneous” Check and Acceptance System for EIA Approval
- Environmental management system and construction of emergency response system
- Environmental compliance certificate
- Sewage declaration and payment of sewage charges
Conditions Required to Apply for Green Fiber Certificate

• **Quality Management:**
  - To be certified by ISO9001 Quality Management System
  - To establish the quality management assessment system
  - To set up full-time organization or personnel
  - To implement three-level measurement management

• **Safety and occupational hygiene:**
  - To establish a safety production responsibility system, and make safety production rules and regulations and operating procedures
  - To comply with the relevant provisions on the safe use of hazardous chemicals, implement occupational-disease-prevention measures in accordance with the law, and formulate emergency plans and safety production certificate

• **Social responsibility:**
  - To insure for pension, unemployment, medical care, work injury, etc. according to law, and pay relevant insurance fees for employees in full
  - To be certified in the Management System of Occupational Health and Safety, and own social security payment certificate
The Process of Applying for Green Fiber Certificate

1. Enterprise Application
2. Formal Review
   - Declared product testing
   - On-site verification
   - Management Committee of Green Fiber Logo
3. Disqualified
4. Qualified
   - Certificate Granted
   - Signing the Agreement
5. Case Concluded
Process of Applying for Green Fiber Certificate

- **Certification application:** Enterprises should apply to China Chemical Fibers Association for the use of green fiber logo and fill in the Application for Certification of Green Fiber Logo.

- **Formal Review:** Formal review by the Office of the Green Fiber Logo Management Committee is restricted to eligible enterprises.

- **Product testing:** After the confirmation of material review, the third-party testing organization designated by the China Chemical Fibers Association shall, in accordance with the relevant national standards, industry standards or association standards of the declared products of the enterprise, test the declared products and the raw materials and auxiliary materials required for production. The test is conducted directly between enterprises and testing organization, and can be exempted if enterprises have passed the detection of the third-party testing organization accredited by the China Chemical Fibers Association.

- **Field verification:** The Green Fiber Logo Management Office organizes three to five experts to conduct on-site verification, and comprehensively evaluate the actual conditions of raw material sources, production processes, product development, laboratory configuration, quality management and marketing system construction.
Process of Applying for Green Fiber Certificate

- **General review and evaluation:** The Green Fiber Logo Management Office will submit the audit report and annex of all enterprises that have passed the formal review, product testing and field assessment, to the management committee for general review and evaluation.

- **Written notice:** The Green Fiber Logo Management Office will notify the applicant enterprises of the result of the review, and notify the enterprise that has passed the general review and evaluation of going through the following procedures: 1. Signing the “Green Fiber Logo Usage Agreement”; 2. Paying the certification fee; 3. Receiving the Certification of “Green Fiber” Certificate; 4. Ordering green fiber logo in the related form.

- **Product certification:** The enterprises that have paid the certification management fee, will be granted the certificate by China Chemical Fibers Association and the National Textile and Chemical Fiber Product Development Center. The certification is valid for three years, and the annual review will determine whether the certification contents will continue to be valid.
Process of Applying for Green Fiber Certificate

- **No. Input:** The certified enterprises and products will be entered into the green fiber logo certification database on the official website of China Chemical Fibers Association (http://www.ccfa.com.cn/) according to the unique registration number, and the authenticity of the certification information can be directly inquired through the QR code on the logo.
Process of Applying for Green Fiber Certificate

- **Form and content of certification mark:** The mark form includes tag, packing box, packing bag, packing film, etc. Mark content consists of green fiber logo pattern and certification unit’s name (China Chemical Fiber Association, Product Development Center), certification category (bio-based chemical fiber/recycled chemical fiber/Colored chemical fiber), certification validity period, QR code, etc.
Rights and Obligations Attached to Green Fiber Certificate

- **Rights:**
  1. Enterprises granted green fiber certificate have the right to use green fiber logo and their products are protected by relevant laws in the sales activities.
  2. The green fiber logo can be used as the product certification of the enterprise in domestic and foreign business activities.
  3. Enterprises with green fiber logo enjoy the priority to participate in domestic and international professional conferences, exhibitions, matchmaking meetings, technical information exchange and consulting services hosted or co-organized by China Chemical Fibers Association.
  4. Enterprises with green fiber logo gain access to and conduct publicity and promotion by the media resources of China Chemical Fibers Association, such as magazines, websites, mobile newspapers, WeChat and other forms, etc.
Rights and Obligations Attached to Green Fiber Certificate

- **Obligations:** 1. The products using the green fiber logo must be consistent with the ones that have been declared and certified. If the enterprise changes the product category and variety using the green fiber logo, the application procedure should be conducted again.
2. Enterprises that use green fiber logo shall ensure that the production and inspection of certified products are organized in accordance with relevant national standards, industrial standards, association standards and the provisions of the Regulations on the Use of Green Fiber Logo.
3. Enterprises using the green fiber logo shall accept the random sampling inspection by the Green Fiber Logo Management Committee, and the sampling fee will be paid by the China Chemical Fibers Association. Sampling inspection includes the purchase of raw materials, processing and production, enterprise quality assurance system, environmental protection system, R&D and design, inspection and testing and marketing system construction, etc.
4. Enterprises using the green fiber logo shall cooperate with the distributors to provide after-sale service for the products.
Rights and Obligations Attached to Green Fiber Certificate

- **Obligations:** 5. Enterprises using green fiber logo should actively cooperate with the Green Fiber Logo Management Committee to promote the green fiber logo products and expand their popularity.

6. The unit that uses the green fiber logo shall have a special person or specialized agency responsible for the storage and use of the green fiber logo, and the full-time staff shall report to the Green Fiber Logo Management Committee for the record. The full-time staff, entrusted by the Green Fiber Logo Management Committee, shall be responsible for supervising the use of the green fiber logo of the enterprise.

7. The units using the green fiber logo shall not make the green fiber logo in any form without authorization, nor shall they transfer, sell or gift the green fiber logo to others. In the case of the violation of the regulations, the China Chemical Fibers Association will pursue corresponding legal obligations of the involved enterprises and have the right to terminate their use of the green fiber mark unilaterally.
Thank You!
Chemical-based High-quality Recycling Project of Waste Textiles

Fu Xuezhong

Chief Engineer
Zhejiang Jiaren New Materials Co., Ltd.
China, with a population of 1.4 billion, produces a large amount of waste textiles each year. Among all these waste textiles, polyester fiber-based textiles cannot be degraded by nature. If being sent into landfill, such waste textiles not only occupy large areas of land, but also contaminate water source and soil continuously. If being burnt, Not only energies like coal and electric power are consumed, but also a lot of pollutants like carbon dioxide and PM 2.5 are produced. While in the whole world, there are 7 billion citizens.
The chemical-based recycling systematic technology, a particular process of Jiaren, is disruptive innovative and also one of the most advanced technologies in the whole world. Such kind of technology is able to recycle waste polyester-based textiles that are originally unable to be degraded and regenerate new products. In this way, the conception of the recycling economy for chemical fiber industry is transformed into reality, which enables Jiaren to contribute to the environmental protection of human.
About Jinggong Holding Group

Jiaren New Materials Company is affiliated with Jinggong Holding Group, which has been listed into Top 500 China’s Enterprises, Top 500 China’s Private Enterprises, Top 500 China’s Enterprise Groups, Top 100 China's Private Integrity Enterprises for many years. Jinggong Holding Group’s business cover five leading industries, including steel structure construction, equipment manufacturing, Shaoxing rice wine, general aviation and new materials, as well as two major cultivating and developing industries learnt as financial investment and big data. This group owns three listed companies and 17 state-level high-tech enterprises.
Zhejiang Jiaren New Materials Co., Ltd was established in 2012 and located in Paojiang Economic and Technological Development Zone of Shaoxing, Zhejiang province. Our company is the unique chemical-based recycling PET enterprise in China and also the largest one in the whole world. It's a state-level high-tech enterprise and a research and development base for chemical-based recycling polyester fibers with waste textiles as raw materials. As one green enterprise in Zhejiang province, Zhejiang Jiaren has brought 25 kt/yr first-phase project into operation completely, and its 160 kt/yr second-phase recycling differentiated fiber project has come onstream as well.
Jiaren aims to become the leader of chemical-based recycling industry and works actively to promote sustained development of our company and the environment.
1. Jiaren can wipe out impurities and non-polyester contents and remove staining completely.

**Key technology**

**01** Remove non-polyester contents by means of filtering

**02** Remove colors through high temperature, filtering and centrifugal separation

**03** Get high-purity DMT by means of rectification

**Sketch map for the reaction**

- **Solid layer with non-polyester contents like impurities and cotton**
- **Liquid layer of polyester raw materials with colors**
- **Gas layer of polyester raw materials**
The quality of our products is consistent with that of virgin products.
2. Jiaren is able to realize the recycling of waste textiles for unlimited times.

Jiaren is working actively to promote the construction of a close-loop recycling for waste textiles.
3. Traceability of Jiaren's products

There is unique traceability for products through chemical-based recycling process of Jiaren. The laboratory of Jiaren can verify whether these polyester fibers, polyester fiber-based textiles and garments are produced by Jiaren or not, and which batch of waste and used clothes are used as raw materials.
The product safety of Jiaren can meet the safety standard for baby products stipulated in Regulation No.112 of Japan and the requirement for Children products mentioned in the Consumer Product Safety Improvement Act (CPSIA) of the United States.
The actual production capacity has been improved by 60% after more than two years of independent innovation that led to a breakthrough on the production bottleneck.

The technological process has been shortened by 1/5 following a breakthrough on original technology, and the utilization ratio from raw materials to products have been lifted up by 20%.

We set up 10 problem and technology tackling teams, which gained 4 national invention patents and 15 utility model patents. Our intellectual property rights have been under protection and the production costs have been cut down by 70%.
Advantages for our products

1. The controlling standard for key indicators like viscosity and color hue is higher than the national standard for regenerated polyester fiber.

2. Our products cover the whole series, and are particular suit to making fine denier fabric and superfine multi-end fabric.

3. There is a great variety of new products in our company: regenerated high-quality colored yarn series, composite series like regenerated ITY, regenerated T400 and cationic polyester yarn, regenerated non-antimony product series, regenerated functional product series, anti-bacterial fabric products, anti-UV products as well as moisture wicking fabric products.
Chemical-based regenerated products of Jiaren are widely used in high-end sportswear, leisure clothes, underwear, fashion clothing for men and women, uniform clothes, work clothes, home textile bedding and so on based on the high quality.
Jiaren has developed cooperation with near 100 brand enterprises

- adidas
- Nike
- H&M
- O'NEILL
- Li-Ning
- Zara
- Gap
- Anta
- Decathlon
- 361°
- KappAhl
- Calvin Klein
- C&A
- The North Face
- Puma
Status quo for recycling

There are more than 20 million tons of used clothes in China each year, most of which are disposed of as daily city trash.

- **Landfill**
  - Occupy land resource
  - It takes 100 years to degrade 1 ton of chemical fiber.

- **Incineration**
  - Pollute the air
  - It results in the release of a large amount of air pollutants like nitrogen oxide, dust and dioxin.
The status quo of waste textiles in China has raised concern of China Central Television (CCTV). At the end of May 2018, the Economic News column of CCTV-2 made a news probe program named as "Used clothes-Difficult to recycle" and sought outstanding enterprises that can recycle waste textiles in the whole China. Jiaren New Materials turned to be a key enterprise being interviewed based on its advanced chemical-based polyester fiber recycling technology which makes it stand out from the crowd.
Recycling channels

Social recycling channel: with government institutions and enterprises as representatives

Directional recycling channel: mainly rely on public security systems, schools and enterprises that mainly make textiles and garments

Commonweal organization-based recycling channel: mainly get waste textiles from commonweal organizations

Internet-based recycling channel: with Flymayi, a platform for making an appointment on internet for recycling used clothes, as the representative
"Green campus starts from me" School uniform-donating ceremony held in Yuezhou Senior High School of Shaoxing

Jiaren New Materials develops "polyester recycling" cooperation with Shenzhou International, the largest vertically integrated knitwear manufacturer in China, to build a close-loop recycling circle.
Reclamation of police uniforms, school uniforms and other uniforms
Used working clothes of Jingdong couriers sent to Jiaren

Regenerated polyester fiber-based new working clothes of Jingdong couriers
On 13 December 2017, Jiaren New Materials Co., Ltd held a news conference titled as “Recycling brings beauty to used clothes and new life to human -- Oriented Recycling of Used Clothes” in Beijing under the guidance of China Chemical Fiber Association. The ceremony of awarding a nameplate learnt as “The National Research and Development Base for Chemical-based Recycling Polyester Fiber Production of Waste Textile” was also held on the spot.
In August 2018, Jiaren, together with many industrial associations like China Association of Circular Economy, China National Resources Recycling Association and China Chemical Fiber Association as well as many well-known enterprises like Ikea, Tetra Pak, Procter & Gamble and Mobike, held a Circular Economy Seminar titled as "Regeneration of good thing and a new life for all things".
假设，使用「ECO CIRCLE」来制作3000件T恤（约1吨）进行循环利用的话...

用石油开始新制作的聚酯原料作为比较

下降
CO₂排出量
52% CUT

相当于杉树154棵
154 cedars

约21.6吨

下降
能源消耗量
39% CUT

相当于
一户普通家庭
半年所消耗的热量
Energy consumption of one family in half a year

约27825千焦

与用石油生产聚酯原料相比，能大量减少CO₂排放与能源浪费
Environmental efficiency

Reduce the impact of waste textiles and garments against the environment

Chemical-based recycling technology of Jiaren New Materials

Meet the requirement for recycling of resources and Civil-military Integration development

Be completely in line with national strategic requirement for ecological civilization construction, green development and low carbon development.

Play an important exemplary and leading role for regenerated polyester industry and achieve both economic and social benefits
Make overall arrangements towards the whole country, and guide regenerated fiber production into large-scale development

In the future, Jiaren plans to distribute its projects in the whole country. With the Green Recycling Product Research and Development Base in Zhejiang as the inner circle, Jiaren will build some 500 kt/yr to 1,000 kt/yr projects, so as to make recycling polyester fiber industry bigger and stronger. Meanwhile, Jiaren will carry out shareholding system reform and strive to be listed on growth enterprise market and main board market in 3 to 5 years.
让我们一同携手，用绿色环保的方式守护绿水青山，共建美丽中国

循环纤维 生生不息

Recycle Fiber Recycle Life
Establishment of R-PET fiber System for High-quality Development and Strict Environmental Protection

Wang Huaping
Donghua University

13 Sep 2018
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01 Resource & Environmental Protection: New Knowledge
02 Recycling & Utilization: New Technology
03 Construction & Development: New Thought
1. Resource & Environmental Protection: New Knowledge
Recycled Fibers

**Definition**
Recycled fiber refers to the fiber spun with melted or dissolved waste textiles and other waste high-polymer materials, or with the materials polymerized by micromolecules cracked from recycled high-polymer materials. Moreover, that realizing fiber to fiber is also known as circular recycled fiber.

**Characteristics**
Circular recycled fiber is generally the same as virgin fiber in terms of composition, structure and physico-chemical properties, and is also able to be processed into textiles or composite materials via spinning.

**Technology**
Circular recycled fiber based on physical-chemical method and chemical method with Chinese characteristics is an improvement for the recycling based on mechanical method and physical method. The product not only meets the international textile raw material quality and eco-safety standards, but also endows the finished products with various functions like high color fastness, moisture absorption and sweat releasing, flame-retardant, etc. So, it will become a key promotion for famous brands at home and abroad in apparel, home textile, automobile trim, constructional engineering and so on, as well as a market highlight.

**Meaning**
China is the world largest producer of circular recycled fiber; hereinto, the output of polyester one ranks the first, with annual output at over 10 million tons. The most outstanding feature of the fiber lies in the cyclic utilization of resources and an obvious reduction of municipal solid wastes. The comprehensive energy consumption and carbon emission of circular recycled fiber are only the half or even lower of that of virgin fiber, which complies with the idea of sustainable development, namely ‘green, low-carbon and cyclic’, and reflects the social responsibility of manufacturers and consumers. So, circular recycled fiber is a focus of development in China and in the world.
Recycled fiber varieties: Limited

**Natural fiber:** Cotton, wool, silk, flax

**Chemical Fiber**

- **Recycled fiber**
  - Recycled protein fiber, Chitosan fiber, Alginate fiber
  - Recycled cellulose fiber (viscose, Tencel, Modal, Cupрамmouium)
  - Cellulose ester fiber (cellulose acetate fiber, carbamate fiber)

- **Synthetic fiber**
  - Polyester fiber, PA fiber, PU fiber
  - Organic high-performance fiber: Aramid fiber, PPS, Polyimide, Polyformaldehyde, PBO, etc.
  - Inorganic high-performance fiber: SiC, BN, metal, glass, Basalt, oxide, etc.

- **Heterochain fiber**

- **Carbon chain fiber**
  - PAN fiber
  - PVA fiber
  - Vinyl chloride fiber
  - Polyolefin fiber (PE, PP)
  - PTFE fiber
  - Carbon fiber

- **Circular hybrid recycled fiber**
Chemical fiber in quantity: Polyester dominating

- In 1978, China’s chemical fiber production was at 285 kt, only taking up 3% of the total in the world;
- In 2017, the world production was at 72 million tons, while China’s arrived at 49.195 million tons, nearly 70%.

China: World leading chemical fiber producer and consumer

Polyester dominating

49.195 million tons
69.4% worldwide
Recycling rate: Low

Waste textile reserves in China exceed 200 million tons

Recycling rate of waste textiles worldwide

<table>
<thead>
<tr>
<th>Country</th>
<th>Recycling Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Japan</td>
<td>84%</td>
</tr>
<tr>
<td>EU</td>
<td>49%</td>
</tr>
<tr>
<td>USA</td>
<td>29%</td>
</tr>
<tr>
<td>China</td>
<td>&lt;10%</td>
</tr>
</tbody>
</table>

ECE calculates:
Life cycle for fashion textiles in Europe: 2.5 years
China: 4-5 years; Annual volume 50 million tons;
Reserves over 200 million tons; Annual waste textile volume overall 20 million tons
Hereinto, apparel 45%, home textiles 27% and industrial textiles 28%

Key: Idea and policy
Core: Technology, industrialization, marketization

Polyester recycling is key for circular development of textile industry
Recycling and environmental protection: Difficult in quantization

Towards waste textiles: Simple disposal, huge pollution, wasting of resources

Most buried or burned as garbage, which pollutes environment and waste resources. According to statistics, the direct loss caused by environmental pollution has taken up 15% of China’s GDP, with immeasurable harm of microplastics, which seriously affects sustainable development.

- Carbon emission from burning 3.2t/t
- Landfill occupies 3m²/t
- Microplastics harm marine organism after entry into sea

Many poison contents, polluting air
Duration for degradation >50 years
Duration for degradation >450 years
Recycling and environmental protection: Serious sea pollution

Waste chemical fiber is also a main source for microplastics pollution

- In 2015 UNEA, microplastics pollution is listed in the second largest scientific issue in environmental and ecological scientific research field, known as major global environmental issues parallel to global climate change and ozone depletion.

- Synthetic fiber waste will generate a lot of primary microplastics, so it is known as the top pollution source, with proportion of 34.8%. Currently, there exists at least 5.25 trillion plastic microchips in the ocean, which can be hardly degraded and very easy to adsorb poison materials. They have spread worldwide, with the detection even in the Antarctica and 4,500-meter deep sea. Besides, microplastics are found in 90% of fish, 83% of tap water and salt. Thus, it is estimated that each person will intake around 5,800 microplastics every year, indicating huge hazard.

- If no control is launched, the plastic content in the sea will exceed the gross of fish by 2050.
Circular economy of chemical fiber industry

Based on 3R (reducing, reusing, recycling) principle, change the linear growth of chemical fiber economy that relies on resource consumption into the pattern that relies on resource recycling.

According the calculation of CNTAC, if all the textile wastes can be fully recycled, every year we will:

- Save 24 million tons of crude oil
- Save nearly 1/3 cotton planted area
- Reduce 80 million tons of carbon dioxide emission

Circular economy of chemical fiber industry is imperative
Carbon emission reduction is not only the major power responsibility, but also a new market.

Carbon trading: $10-20/ton

19th CPC National Congress
China will continue to fulfill Paris Agreement firmly and promises that by 2030, carbon emission will reduce by 60-65% from 2005, and non-fossil energy consumption takes up around 20% of primary energy consumption, with forest growing stock increasing 4.5 billion steres from 2005.

To realize Net Zero Emission by 2050

High-efficient & low-consumption recycling
Currently, the circular economy of chemical fiber industry in developed countries has advanced from policy support and encouragement to a new stage of self-development of major representative enterprises.

<table>
<thead>
<tr>
<th>Country</th>
<th>Supportive policies and regulations</th>
</tr>
</thead>
</table>
| US      | • Formulate circular economic policies from 1970s  
          • Formulate special projects to increase recycling proportion of municipal solid wastes  
          • Promote the elimination of non-tariff barrier for recycled products in the WTO  
          • Stipulate higher prices of 10% than regular textile products for those with 'recycled' tag |
| UK      | • Take the lead in formulating sustainable development strategy in 1994  
          • Formulate *Chemicals Strategy* in 1999, and establish the UK Chemicals Stakeholder Forum in 2000  
          • Make assessment for the life cycle of 2 million tons of garments, as well as 1.16 million tons of textile wastes in 2017, which is the first time for the UK government to support the special project of textile recycling |
| Japan   | • *Waste Disposal Law* in 1971  
          • *Environmental Basic Law* in 1994  
          • *Green Purchase Law* in 2000  
          • *Basic Law for Establishing Recycle-based Society* in 2001 |
## Recycling system—International technology and industry integration

Highly integrate recycled chemical fiber enterprises and logistics system

<table>
<thead>
<tr>
<th></th>
<th>Representative</th>
<th>Feature</th>
<th>Effect</th>
</tr>
</thead>
<tbody>
<tr>
<td>US</td>
<td><img src="image" alt="Evergreen Enterprises, Inc." /></td>
<td><img src="image" alt="Waste Carpet" /></td>
<td>Direct processing of waste carpets based on established classification system, with annual consumption of PP carpets at 80-100 million pounds</td>
</tr>
<tr>
<td>UK</td>
<td><img src="image" alt="nathanswastewater" /></td>
<td><img src="image" alt="Textile Recycling" /></td>
<td>Establish over 3,000 textile banks, and recycling rate of waste textiles reaches 16%</td>
</tr>
<tr>
<td>Japan</td>
<td><img src="image" alt="Teijin" /></td>
<td><img src="image" alt="Recycling Circle" /></td>
<td>Already realize fiber-to-fiber circulation, and to extend to the whole polyester chain including polyester bottle and film</td>
</tr>
</tbody>
</table>
Recycling system—Main body of domestic policies to be practically implemented

In May 2015, the State Council issued Made in China 2015, putting forward to develop circular economy, enhance recycling rate of resources, establish green manufacturing system and go ahead with ecological civilization. By 2020, actively practice low-carbon, circulation and intensification to promote the resource use efficiency of manufacturing industry; establish the recycling logistics chain for waste textiles, boost the establishment of recycled fiber symbol and certificate system, and enhance the market recognition of recycled fiber-based products. Production of recycled fiber from waste textiles to rank the first worldwide, resource utilization rate of waste textiles to rise to 12% (total recycling volume to reach 5 million tons/year), and higher value utilization rate to reach 30%.

By 2025, boost the standardization and scale development of resource recycling industry. And resource utilization rate of waste textiles to rise to 20% (total recycling volume to reach 10 million tons/year), and higher value utilization rate to reach 50%.

In Mar 2016, the 13th Five-Year Plan for Economic and Social Development was issued. It puts forward that China’s development in the coming five years must stick to the basic state policy of saving resources and protecting environment, and insist on sustainable development. Carry out guiding plan for circular development, to promote the circular linkage of production and living systems and accelerate the resource utilization of wastes. Put into practice the extended producer responsibility system. Complete the recycling network for renewable resources, to strengthen its linkage with household garbage sorting and recycling.

In Jul 2016, the Ministry of Industry and Information Technology issued Green Development Plan for Industry (2016-2020), which puts forward to accelerate the high-efficient utilization of renewable resources and regulated development of the industry. Centering on major renewable resources including ferrous wastes, waste paper, waste rubber, waste plastics, waste textiles and waste power battery, accelerate the promotion and application of advanced and appropriate recycling technology and equipment. Establish a batch of industrial clusters of renewable resources, to promote the cross-regional cooperative utilization of renewable resources and build regional renewable resource recycling system.
Recycling system—Main body of domestic policies to be practically implemented

In Sep 2016, MIIT issued Development Plan for Textile Industry (2016-2020), which clearly puts forward to establish collecting and recycling system of waste textiles, and standardize the mechanism of collecting, sorting and grading of waste textiles, as well as the activity process of zero discharge of used clothing. Formulate R&D and promotion roadmap for key generic technology of energy saving and emission reduction during the 13th Five-Year Plan period, and set up related database, to strengthen the standard management of printing & dyeing, viscose and recycled fiber industries.

In Dec 2016, MIIT and NDRC issued Guiding Opinions on Development during the 13th Five-Year Plan Period for Chemical Fiber Industry, which puts forward to establish and develop the resource collecting and gradient recycling system for waste textiles and post-consumer bottles. Boost the establishment of certification system for green fibers including bio-based chemical fiber and recycled fiber. Set up green development fund with chemical fiber enterprises and associations as the main body, to encourage and guide green consumption and realize green transformation.

In Jan 2017, NDRC issued Guidance Catalogue for Product and Service of Strategic Emerging Industry, which classifies harmless recycling of waste textiles into the strategic emerging industry of energy-saving & environmental-protection resource recycling.

In Jan 2017, the State Council issued Comprehensive Work Plan for Energy Saving and Emission Reduction during the 13th Five-Year Plan Period, which puts forward specific projects like circulation retrofit for industry park, establishment of resource recycling demonstration base, Internet Plus resource recycling and promotion of recycled products and re-manufactured products, and establishes 100 resource recycling demonstration bases. Till 2020, the volume of recycled resources replacing original resources will reach 1.3 billion tons, and the output value of resource recycling industry will get to 3 trillion yuan.
On 17 Jul 2017, China appealed to WTO to put forward the ban on the import of 24 kinds of solid wastes by end 2017, including PET scraps and post-consumer PET bottles (bales).

Requirement for high quality

Environmental protection of resources

Open-loop recycling

Waste from open-loop recycling

Waste from separation recycling

Ban on solid waste imports

High quality recycling

Complete Green
Requirement for high quality

Product and market

- Serious homogenization among recycled polyester fibers

Ecological safety
  - High quality
  - High value

Recycling
Requirement for high quality: Industry upgrade

Recycled polyester fiber capacity statistics in 2016

- In early stage, due to low requirement for environmental protection, many small-sized plants were started up, resulting in scattered capacity distribution.
- However, under strict environmental regulation now, enterprises that fail to completely treat three wastes will hardly live, and it is inevitable for outdated capacities to be phased out.
From Jul 2016 till now, environmental protection policies have been strengthening continuously, with the measures including environmental protection inspection and green tax as the focus. In 2018, China is still carrying out strict environmental protection policies, and has formed a stringent system of institutionalized governance, which means strict supervision on environmental protection has become a new normal.
### High-quality development: Cleaner production (recycled polyester fiber)

#### Technology and equipment (weight 0.25)

<table>
<thead>
<tr>
<th>序号</th>
<th>项目</th>
<th>单位</th>
<th>权重值</th>
<th>I级</th>
<th>II级</th>
<th>III级</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>整瓶/毛瓶片—净片</td>
<td>—</td>
<td>0.10</td>
<td>具有自动进料；金属、颜色、材质等自动分选功能；清洗水在线逆向套用；实施DCS控制的连续生产线</td>
<td>具有自动进料；金属、颜色、材质等分选功能；清洗水在线逆向套用；实施PLC分散控制的连续生产线</td>
<td>具有自动进料；金属、材质、颜色等分选功能的生产线</td>
</tr>
<tr>
<td></td>
<td>切片、泡料</td>
<td>—</td>
<td>0.10</td>
<td>利用化学法或熔体均质技术生产的再生聚酯（PET）</td>
<td>具有粉碎、清洗、自动输送、自动进料、摩擦成粒、冷却的生产线</td>
<td>具有粉碎、摩擦成粒、冷却的生产线</td>
</tr>
<tr>
<td></td>
<td>长丝、短纤维</td>
<td>—</td>
<td>0.20</td>
<td>具有原料自动配料及输送、连续干燥、在线自动清洗的过滤、熔体均质、自动打包和DCS与IPC相结合控制的纺丝生产线</td>
<td>具有连续干燥、连续生产过滤切换装置、熔体均质、自动打包和DCS与PLC相结合控制的纺丝生产线</td>
<td>具有连续干燥或间歇干燥、连续生产过滤切换装置、PLC控制的纺丝生产线</td>
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<tr>
<td>2</td>
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<td>≥60000</td>
<td>≥50000*</td>
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<tr>
<td></td>
<td>毛瓶片—净片</td>
<td>t/a</td>
<td>0.10</td>
<td>≥100000</td>
<td>≥60000</td>
<td>≥50000*</td>
</tr>
<tr>
<td></td>
<td>泡料</td>
<td>t/a</td>
<td>0.10</td>
<td>≥20000</td>
<td>≥15000</td>
<td>≥10000*</td>
</tr>
<tr>
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<td>0.10</td>
<td>≥30000</td>
<td>≥15000</td>
<td>≥10000*</td>
</tr>
<tr>
<td></td>
<td>长丝</td>
<td>t/a</td>
<td>0.10</td>
<td>≥100000</td>
<td>≥50000</td>
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<td>短纤维</td>
<td>t/a</td>
<td>0.10</td>
<td>≥80000</td>
<td>≥40000</td>
<td>≥30000*</td>
</tr>
</tbody>
</table>

- High degree of equipment automation and digitization will be translated into high process continuity and capacity.
High-quality development: Cleaner production (recycled polyester fiber)

Resource and energy consumption (weight 0.3)

<table>
<thead>
<tr>
<th>序号</th>
<th>项目</th>
<th>单位</th>
<th>权重</th>
<th>基准值</th>
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<tr>
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<td>Kgce/t</td>
<td>≤40’</td>
<td>≤45</td>
</tr>
<tr>
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<td>毛瓶片-净片</td>
<td>Kgce/t</td>
<td>≤30’</td>
<td>≤35</td>
</tr>
<tr>
<td></td>
<td>棉料</td>
<td>Kgce/t</td>
<td>≤25’</td>
<td>≤30</td>
</tr>
<tr>
<td></td>
<td>切片</td>
<td>Kgce/t</td>
<td>≤75’</td>
<td>≤80</td>
</tr>
<tr>
<td></td>
<td>长丝</td>
<td>166.7dtex POY</td>
<td>Kgce/t</td>
<td>≤160’</td>
</tr>
<tr>
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<td>166.7dtex FDY</td>
<td>Kgce/t</td>
<td>≤215’</td>
<td>≤230</td>
</tr>
<tr>
<td></td>
<td>三维中空</td>
<td>Kgce/t</td>
<td>≤165’</td>
<td>≤200</td>
</tr>
<tr>
<td></td>
<td>二维中空</td>
<td>Kgce/t</td>
<td>≤165’</td>
<td>≤200</td>
</tr>
<tr>
<td></td>
<td>棉型</td>
<td>Kgce/t</td>
<td>≤155’</td>
<td>≤180</td>
</tr>
<tr>
<td></td>
<td>毛型</td>
<td>Kgce/t</td>
<td>≤155’</td>
<td>≤175</td>
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<tr>
<td>2</td>
<td>整瓶-净片</td>
<td>t/t</td>
<td>0.3</td>
<td>≤1.0’</td>
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<tr>
<td></td>
<td>毛瓶片-净片</td>
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<td>0.3</td>
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<td>棉料</td>
<td>t/t</td>
<td>0.3</td>
<td>≤0.02’</td>
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<td>t/t</td>
<td>0.3</td>
<td>≤0.22’</td>
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<tr>
<td></td>
<td>长丝</td>
<td>t/t</td>
<td>0.3</td>
<td>≤1.65’</td>
</tr>
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<td>短纤维</td>
<td>t/t</td>
<td>0.3</td>
<td>≤2.5’</td>
</tr>
<tr>
<td>3</td>
<td>整瓶-净片</td>
<td>t/t</td>
<td>0.3</td>
<td>≤1150</td>
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<tr>
<td></td>
<td>毛瓶片-净片</td>
<td>t/t</td>
<td>0.3</td>
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<td></td>
<td>棉料</td>
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<td>0.3</td>
<td>≤1000</td>
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<tr>
<td></td>
<td>切片</td>
<td>t/t</td>
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<tr>
<td></td>
<td>166.7dtex POY</td>
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<tr>
<td></td>
<td>166.7dtex FDY</td>
<td>t/t</td>
<td>0.3</td>
<td>≤1035’</td>
</tr>
<tr>
<td></td>
<td>三维中空</td>
<td>t/t</td>
<td>0.3</td>
<td>≤1020’</td>
</tr>
<tr>
<td></td>
<td>二维中空</td>
<td>t/t</td>
<td>0.3</td>
<td>≤1020’</td>
</tr>
<tr>
<td></td>
<td>棉型</td>
<td>t/t</td>
<td>0.3</td>
<td>≤1020’</td>
</tr>
<tr>
<td></td>
<td>毛型</td>
<td>t/t</td>
<td>0.3</td>
<td>≤1020’</td>
</tr>
</tbody>
</table>

- Highest weight of resource consumption means efficiency improvement is crucial.
High-quality development: Cleaner production (recycled polyester fiber)

Resource comprehensive utilization (weight 0.1)

<table>
<thead>
<tr>
<th>序号</th>
<th>项目</th>
<th>权重</th>
<th>基准值</th>
<th>I级</th>
<th>II级</th>
<th>III级</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>※工业用水重复利用率</td>
<td>0.5</td>
<td>97.0%</td>
<td>≥96.0%</td>
<td>95.0%</td>
<td>86.0%</td>
</tr>
<tr>
<td>2</td>
<td>废丝、废料综合利用率</td>
<td>0.3</td>
<td>98.0%</td>
<td>96.0%</td>
<td>95.0%</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>危险固废处置率</td>
<td>0.2</td>
<td>100%</td>
<td>100%</td>
<td>100%</td>
<td></td>
</tr>
</tbody>
</table>

Generation of pollutants (weight 0.2)

<table>
<thead>
<tr>
<th>序号</th>
<th>项目</th>
<th>单</th>
<th>权重</th>
<th>基准值</th>
<th>I级</th>
<th>II级</th>
<th>III级</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>单位产品废水产生量</td>
<td>t/t</td>
<td>0.06</td>
<td>≤10.0°</td>
<td>≤11.0</td>
<td>≤13.0</td>
<td></td>
</tr>
<tr>
<td></td>
<td>毛瓶片净片</td>
<td>t/t</td>
<td>0.06</td>
<td>≤8.0°</td>
<td>≤9.0</td>
<td>≤10.0</td>
<td></td>
</tr>
<tr>
<td></td>
<td>泡料</td>
<td>t/t</td>
<td>0.06</td>
<td>≤0.5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>切片</td>
<td>t/t</td>
<td>0.06</td>
<td>≤0.5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>长丝</td>
<td>t/t</td>
<td>0.06</td>
<td>≤1.2°</td>
<td>≤1.4</td>
<td>≤1.7</td>
<td></td>
</tr>
<tr>
<td></td>
<td>短纤</td>
<td>t/t</td>
<td>0.06</td>
<td>≤1.2°</td>
<td>≤1.5</td>
<td>≤1.8</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>单位产品COD_{cr}产生量</td>
<td>kg/t</td>
<td>0.06</td>
<td>≤22.0°</td>
<td>≤24.0</td>
<td>≤26.0</td>
<td></td>
</tr>
<tr>
<td></td>
<td>毛瓶片净片</td>
<td>kg/t</td>
<td>0.06</td>
<td>≤22.0°</td>
<td>≤24.0</td>
<td>≤26.0</td>
<td></td>
</tr>
<tr>
<td></td>
<td>切片</td>
<td>kg/t</td>
<td>0.06</td>
<td>≤0.05</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>泡料</td>
<td>kg/t</td>
<td>0.06</td>
<td>≤0.05</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>长丝</td>
<td>kg/t</td>
<td>0.06</td>
<td>≤7.2°</td>
<td>≤8.0</td>
<td>≤8.4</td>
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</tr>
<tr>
<td></td>
<td>短纤</td>
<td>kg/t</td>
<td>0.06</td>
<td>≤10.2°</td>
<td>≤12.2</td>
<td>≤14.7</td>
<td></td>
</tr>
</tbody>
</table>

- Collection and treatment of three wastes should be performed in the whole process
- High requirement in water reuse rate
# High-quality development: Cleaner production (recycled polyester fiber)

## Cleaner production management (weight 0.15)

<table>
<thead>
<tr>
<th>序号</th>
<th>项目</th>
<th>权重</th>
<th>I级</th>
<th>II级</th>
<th>III级</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>产业性质符合性</td>
<td>0.1</td>
<td>符合国家和地方政府相关产业政策，未使用国家明令禁止或淘汰的生产工艺和装备</td>
<td>企业污染物排放总量及能源消耗总量满足国家和地方政府关于环保、能评审批的总量控制要求或其他相关规定</td>
<td>建有专门负责清洁生产的领导机构，各成员单位及主管人员职责分工明确；有健全的清洁生产管理制度和考核办法，有执行情况检查记录；制定企业清洁生产规划及年度计划，确定目标、指标。</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>建有专门负责清洁生产的领导机构，各成员单位及主管人员职责分工明确</td>
<td>建有专门负责清洁生产的领导机构，各成员单位及主管人员职责分工明确；有健全的清洁生产管理制度和考核办法，有执行情况检查记录；制定企业清洁生产规划及年度计划，确定目标、指标。</td>
<td>建有专门负责清洁生产的领导机构，各成员单位及主管人员职责分工明确；有健全的清洁生产管理制度和考核办法，有执行情况检查记录；制定企业清洁生产规划及年度计划，确定目标、指标。</td>
</tr>
<tr>
<td></td>
<td>清洁生产组织机构</td>
<td>0.05</td>
<td>建有专门负责清洁生产的领导机构，各成员单位及主管人员职责分工明确；有健全的清洁生产管理制度和考核办法，有执行情况检查记录；制定企业清洁生产规划及年度计划，确定目标、指标。</td>
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</tr>
<tr>
<td>2</td>
<td>清洁生产审核管理机构</td>
<td>0.1</td>
<td>建有专门负责清洁生产的领导机构，各成员单位及主管人员职责分工明确；有健全的清洁生产管理制度和考核办法，有执行情况检查记录；制定企业清洁生产规划及年度计划，确定目标、指标。</td>
<td>建有专门负责清洁生产的领导机构，各成员单位及主管人员职责分工明确；有健全的清洁生产管理制度和考核办法，有执行情况检查记录；制定企业清洁生产规划及年度计划，确定目标、指标。</td>
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</tr>
<tr>
<td></td>
<td>清洁生产审核管理机构及规划</td>
<td>0.1</td>
<td>建有专门负责清洁生产的领导机构，各成员单位及主管人员职责分工明确；有健全的清洁生产管理制度和考核办法，有执行情况检查记录；制定企业清洁生产规划及年度计划，确定目标、指标。</td>
<td>建有专门负责清洁生产的领导机构，各成员单位及主管人员职责分工明确；有健全的清洁生产管理制度和考核办法，有执行情况检查记录；制定企业清洁生产规划及年度计划，确定目标、指标。</td>
<td>建有专门负责清洁生产的领导机构，各成员单位及主管人员职责分工明确；有健全的清洁生产管理制度和考核办法，有执行情况检查记录；制定企业清洁生产规划及年度计划，确定目标、指标。</td>
</tr>
<tr>
<td>3</td>
<td>计量器具配备</td>
<td>0.05</td>
<td>符合国家标准 GB17167-2008《用能单位能源计量器具配备和管理通则》三级计量要求</td>
<td>二级计量要求</td>
<td>二级计量要求</td>
</tr>
<tr>
<td></td>
<td>清洁生产审核</td>
<td>0.1</td>
<td>按政府部门要求每三年开展一次清洁生产审核活动</td>
<td>按政府部门要求每三年开展一次清洁生产审核活动，中、高耗能企业实施率≥80%或单个项目投资额超过 100 万以上，设定目标完成率 100%</td>
<td>按政府部门要求每三年开展一次清洁生产审核活动，中、高耗能企业实施率≥80%或单个项目投资额超过 100 万以上，设定目标完成率 100%</td>
</tr>
<tr>
<td></td>
<td>定期开展清洁生产内</td>
<td>0.05</td>
<td>按政府部门要求每三年开展一次清洁生产审核活动</td>
<td>按政府部门要求每三年开展一次清洁生产审核活动，中、高耗能企业实施率≥80%或单个项目投资额超过 100 万以上，设定目标完成率 100%</td>
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</tr>
<tr>
<td></td>
<td>部审核</td>
<td></td>
<td>按政府部门要求每三年开展一次清洁生产审核活动，中、高耗能企业实施率≥80%或单个项目投资额超过 100 万以上，设定目标完成率 100%</td>
<td>按政府部门要求每三年开展一次清洁生产审核活动，中、高耗能企业实施率≥80%或单个项目投资额超过 100 万以上，设定目标完成率 100%</td>
<td>按政府部门要求每三年开展一次清洁生产审核活动，中、高耗能企业实施率≥80%或单个项目投资额超过 100 万以上，设定目标完成率 100%</td>
</tr>
<tr>
<td></td>
<td>定期开展清洁生产</td>
<td>0.05</td>
<td>制定清洁生产年度工作计划，对计划提出的目标、指标、清洁生产方案及执行过程进行检查。设定目标完成率≥80%；一年一次</td>
<td>制定清洁生产规划，每 2 年一次，对企业清洁生产规划的执行情况及目标完成情况进行检查。设定目标完成率≥80%；一年一次</td>
<td>不做要求</td>
</tr>
</tbody>
</table>
High-quality development: Cleaner production (recycled polyester fiber)

Cleaner production management (weight 0.15)

<table>
<thead>
<tr>
<th>序号</th>
<th>项目</th>
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<th>Ⅱ级</th>
<th>Ⅲ级</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>节能管理</td>
<td>0.05</td>
<td>建立健全环境管理体系，建立有 GB/T24001 环境管理体系，并取得认证，能有效运行；全部完成年度环境目标、指标和环境管理方案，达到持续改进的要求；环境管理手册、程序文件及作业文件齐备、有效。</td>
<td>建立有 GB/T24001 环境管理体系，并能有效运行；完成年度环境目标、指标和环境管理方案≥80%，并达到环境持续改进的要求；环境管理手册、程序文件及作业文件齐备、有效。</td>
<td>建立有 GB/T24001 环境管理体系，并能有效运行；完成年度环境目标、指标和环境管理方案≥60%，并达到环境持续改进的要求；环境管理手册、程序文件及作业文件齐备、有效。</td>
</tr>
<tr>
<td></td>
<td>建立健全能源管理体系</td>
<td>0.05</td>
<td>建立有 GB/T 23331-2012 能源管理体系，并取得认证，能有效运行；全部完成年度能源目标、指标和能源管理方案，并达到能源持续改进的要求；能源管理手册、程序文件及作业文件齐备、有效。</td>
<td>建立有 GB/T 23331-2012 能源管理体系，能有效运行；完成年度能源目标、指标和能源管理方案≥80%，并达到能源持续改进的要求；能源管理手册、程序文件及作业文件齐备、有效。</td>
<td>建立有 GB/T 23331-2012 能源管理体系，能初步开展及运行。</td>
</tr>
<tr>
<td></td>
<td>开展节能活动</td>
<td>0.05</td>
<td>按国家规定要求，组织开展节能评估与能源审计工作，认真整改节能审计发现的问题。</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>节能目标</td>
<td>0.05</td>
<td>国家及地方下达的节能目标完成率 90%以上，地区节能目标考核优秀。</td>
<td>国家及地方下达的节能目标完成率 80%以上，地区节能目标考核良好以上。</td>
<td>国家及地方下达的节能目标完成率 50%以上，地区节能目标考核合格以上。</td>
</tr>
</tbody>
</table>

- In general, high efficiency and continuity of production, the maximum resource utilization and multi-site collection & concentrated treatment of three wastes will be key to industry development.
Connotation of high-quality development (recycled polyester fiber)
Recycling technologies of waste textiles

- Post-consumer bottles
  - Physical melting
  - Physical melting
  - Physical chemistry

- Wastes from spinning and polymerizing
  - Physical opening
  - Physical opening
  - Physical opening
  - Physical melting
  - Physical melting
  - Physical melting
  - Physical chemistry
  - Physical chemistry
  - Physical chemistry
  - Chemical methods

- Clothes scraps
  - Physical opening
  - Physical opening
  - Physical opening
  - Physical melting
  - Physical melting
  - Physical melting
  - Physical chemistry
  - Physical chemistry
  - Physical chemistry
  - Chemical methods

- Textile wastes
  - Physical opening
  - Physical opening
  - Physical opening
  - Physical melting
  - Physical melting
  - Physical melting
  - Physical chemistry
  - Physical chemistry
  - Physical chemistry
  - Chemical methods
Bottleneck in resource management of PET recycling

Mixed polymers: PU, PE, PP, PVC, cotton …

Dyestuffs: Disperse dye, pigment …

1. Mixed components are multiple and complex and thus resource management is difficult. Pre-processing adds pressure to environmental protection.
Bottleneck in spinning technologies of PET recycling

2. Melt-spun yarn is recycled directly and thus is non-circular due to big downgrading.

Technology route:

PET wastes → Pre-processing → melting → filtering → spinning

(Proportion > 95%)

Low product performance and high quality fluctuation
Poor ecological security, low-end application

“bottle→fiber”

Downgraded recycling

“fiber→Low-end filling materials”

Non-circular
Bottleneck in separating technologies of PET recycling

3. “Depolymerization-purification-polymerization” is partial recycling

Technology route:

PET wastes → Pre-processing → Depolymerization to monomer → Monomer separation → Monomer purification → Polymerization → Spinning

Dyestuffs, mixed polymers, etc.

Unable to reuse, heavy pollution

Long process, high cost, difficult to promote
Based on the full life cycle layout of polyester textiles

Integration of “classifying, blending, controlling, customizing, high-value preparing and cleaning” this is China's solution to the development of recycled polyester industry considering both cost and quality
Technological advances in PET recycling industry

1. Classification: Resource management of PET wastes and standard classification

- Connecting the upstream and constructing base for sorting and collecting textile wastes and producing pellets.
- Closed continuous hydrothermal synergistic granulation from waste textiles, better quality of 50% compared with like products, no dust
- Post-consumer bottle: Automatic near-infrared positive + cleaning water + treatment and reuse of waste water, water consumption 1 t/t
- Establish systematic system of feedstock classification to ensure quality

Establish a classification and evaluation system

- From textiles: Classified according to color
  Code: F-3PU-B-SIII
  Textile Color Spinning grade Mixed components and content

- From bottles: Classified according to viscosity code: B-750 -G- FI
  Bottle Color Spinning grade Viscosity

Wastes

Industrial feedstock
2. Blending: Targeted blending of standardized feedstock

- Establish multi-level automatic silos, select different types of raw materials for blending in recycling according to demand
- Give full play to characteristics of all kinds of popcorn and make the best use of them

![Image of blending process]

- Whiteness control
- Chroma control
- Multi color matching of popcorn
  - black
  - brown
Technological advances in PET recycling industry

3. Controlling: Trinity control technology of melt quality

- Pellet/Sheet
- Transportation of mixed materials
- Drying
- Filtering of non-melt materials
- Tempering, VOC removal
- Tuning
- Tempering
- Homogenizing
- Spinning

Create trinity control technology of melt quality, and ensure the quality of recycled fiber to be the same as the virgin one.
Technological advances in PET recycling industry

4. Specialized customizing: Specialized customization applied in various fields

- **PET wastes**
  - In-situ utilization of hybrid components
  - Popcorn, flake color matching
  - Stabilization of hybrid system

- **Specialized customization**
  - Online functional modification
  - Online color modification

- **Professional application**
  - Color fiber

- **PET wastes**

- **Fabrics**
  - Fabric: FZ/T73024-2014, etc.
  - Home textile interior: GB/T11746-2008, etc.
  - Geotextile: GB/T17638-1998, etc.
  - Car textile: MS341-18 B, etc.
  - Shoe fabric: GB/T 19976-2005, etc.

- Make full use of waste materials, dyeing materials and hybrid polymers, better color difference and color fastness compared with virgin ones
- Fiber free of dyeing which is successfully applied in five areas and fully meets professional requirements
5. High-value preparing: High-value preparation of recycled composite fiber

- PET waste textile recycled melt (recycled PET core)
- Synthetic new-style low melt point copolymerization (intensive processing adaptive cortex)
- High pressure high shear composite spinning
- Low temperature and fine neck drafting

Recycled composite fiber

High-end interior

High-end mattress

High-end underwear

✔ Development of preparation technology for recycled composite fiber, level product performance and quality the same as virgin ones
Technological advances in PET recycling industry

6. “Cleaning”: Multi-site full-process collection and treatment of three wastes, standard discharge

- Anaerobic and aerobic combined biological treatment of wastewater
- Microbial treatment of exhaust gas
- Treatment and reuse of waste water
- Devolatilization Viscosity-increasing collection device of exhaust gas
1. Deepen system design
2. Improve the construction level of recycling logistics system

◆ Target Building

To establish a list of waste textile logistics technology and equipment procurement, under the coordination of the national government, coupled with the joint force from local government and professional institution. To develop waste textile recycling logistics industry chain of complete system, with full functions, and under orderly management and operation, in the form of special recycling fee (2-5 yuan/kg), via a combination of point-to-point and point-to-face. To gradually promote the construction of intelligent recycling boxes, professional logistics vehicles, and distribution management stations, based on the construction of the internet plus modern recycling logistics information platform. To build a 200-kilometer recycling economy circle around cities and achieve full coverage of the recycling logistics network system.
3. Strengthen the layout of basic research

Key research

Influencing mechanism of impurities in waste polyester fiber products on polyester recycling

Impurity components: Disperse dyes (azo type, anthraquinone type, heterocyclic type), auxiliaries, catalysts, etc.
Mixed polymer: PP, PA, PU

Quantitative correlation: Mechanism of mixed melt action, mechanism of alcoholysis regenerative polymerization, and mechanism of morphological action of blended phase.

Micro-depolymerization and quality control mechanism of impure polyester

Optimization design: Molecular weight and dynamic viscosity correlation, and devolatilization kinetics

Process Control: Melt hydrolysis kinetics, and viscosity-increasing kinetics

Alcoholysis and repolymerization mechanism of impure Polyester

Optimization design: Purification and decolorization mechanism, regenerative polymerization mechanism, and functional copolymerization modification mechanism

Process Control: Regeneration polymerization kinetics, and regeneration copolymerization kinetics
3. Strengthen the layout of basic research

Key research
● Regulation mechanism of products with properties of recycled polyester fiber in spinning process

Optimization design: Impure melt rheology, crystallization performance analysis and melt flow simulation calculation

Process control: Full Process Phenomenological Dynamics Model

● Efficient identification technology for the main components of waste fiber products

Optimization design: Analysis of factors affecting spectral acquisition, and optimization of recognition algorithm

Process control: Establishment of near-infrared spectrum library of waste textiles and rapid identification model

● Identification and safety evaluation of recycled polyester fiber

Optimization design: Analysis of influencing factors of chromatographic analysis and the simulation of processing and use environment

Process control: Efficient chemical pattern recognition and kinetics of toxic substance migration
4. Establish a green evaluation and management system for the entire life cycle

- The “green” characteristic of the entire life cycle of synthetic fiber products is the key to avoid pollution
Develop a green evaluation system for recycled fiber systems

- **Green ending**
  - Easy to circulate and recycle
  - Easy to degrade and return to nature

- **Green raw material**
  - Renewable resources
  - Bio-based resources
  - Biodegradable raw materials

- **Green production and processing**
  - High efficiency and low consumption of the process
  - Water recycling
  - Auxiliary materials are environmentally friendly and non-toxic
  - Zero emissions of three wastes during the production

- **Green product**
  - Homogeneous & heterogeneous
  - High quality and low release
  - Safe and non-toxic
  - Easy full recycling and traceable design
  - Low emission during use
Deepen the application and function evaluation system of recycled products
Deepen the application and function evaluation system of recycled products

- **Ecological assessment of products**
  - Homogeneous and traceable throughout the process
  - Connection with recycling technology
  - VOC, heavy metals, toxic and hazardous substances

- **Environmental assessment of product use and maintenance**
  - Research and development of collecting, filtering and detecting equipment of microfiber

<table>
<thead>
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<th>Product Class</th>
<th>4.0–7.5</th>
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<th>4.0–9.0</th>
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<th>Pb</th>
<th>Cd</th>
<th>Zn</th>
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<tr>
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<td>Zn</td>
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<td>Zn</td>
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</tbody>
</table>

*Heavy metals in digested sewage*
As the temperature of sea water is low, and the number of specific microorganisms is small, the natural marine degradation takes several times longer than land’s. Many plastic items may take hundreds of years to degrade.

http://advances.sciencemag.org/
5. Optimize the technical system of waste textile recycling

Treatment of waste textiles

- 90% subject to direct landfill
- Incineration energy utilization

- reclamation

Physical opening method
- Physical melting method
- Physical-chemical method
- Chemical method

Application fields
- Clothing fabric, luggage, blanket, waterproof rolling material, composite board
- Clothing fabrics, car interiors, home textiles, geotextiles
- Car textiles, needled geotextiles, fabrics, home textile interiors, shoe fabrics
- Clothing fabrics, bedding, curtains, etc.

From easy to difficult, and from simple to complex, to achieve the unity of resources, environmental protection, quality and professional application
Advance the upgrade of recycled fiber processing technology:

To reduce pollutant emission and increase product added value by upgrading general fiber regeneration technology

- **Clean-up and emission reduction of the whole process**
  - Creation and development of new technology for emission reduction
  - The whole process of three wastes collection, and waste water recycling
  - Dope dyeing and non-water medium dyeing...

- **Efficient flexibility and professionalization**
  - Efficiency increased by automation
  - Digital and intelligent upgrade
  - Flexible customization upgrade

---

**Advancing the upgrade of recycled fiber processing technology:**

Reduce pollutant emission and increase product added value by upgrading the general fiber regeneration technology through:

- **Clean-up and emission reduction of the whole process**
  - Creation and development of new technology for emission reduction
  - The entire process of waste collection and waste water recycling
  - Dope dyeing and non-water medium dyeing...

- **Efficient flexibility and professionalization**
  - Efficiency improvement through automation
  - Digital and intelligent upgrade
  - Flexible customization upgrade
6. Expand varieties of recycled chemical fiber

**Natural fiber:** cotton, wool, silk, flax

**Chemical fibers**

- **Recycled fibers**
  - Recycled protein fiber, chitosan, seaweed fiber
  - Recycled cellulose fiber (viscose, Tencel, Modal, cuprammonia)
  - Cellulose ester fiber (acetate fiber, carbamate fiber)

- **Synthetic fibers**
  - Heterochain fibers
  - Polyester fiber, polyamide fiber, Polyurethane fiber
  - Organic high-performance fiber: Aramid fiber, PPS, Polyimide, POM, PBO, etc.
  - Inorganic high-performance fiber: SiC, BN, metal, glass, basalt, oxide, etc

- **Carbon chain fibers**
  - Polyacrylonitrile fiber
  - Polyvinyl alcohol fiber
  - Vinyl chloride fiber
  - Polyolefin fiber (PE, PP)
  - Fluorofibre (PTFE)
  - Carbon fiber

- **Circular hybrid recycled fibers**
6. Promote the industrialization of green fiber raw material recycling technology:

Expand the regeneration of natural and bio-based fibers and reduce carbon emissions.
6: Promote the industrialization of green fiber raw material recycling technology:

**Expand renewability of bio-based synthetic fibers, biological raw materials and products**

- **Starch**
  - **C6, C5 syrup**
    - **Cellulase**
      - **Straw pretreatment**
    - **Polyols**: glycol, propylene glycol, butylene glycol
    - **Polyacid**: butanedioic acid, furan dicarboxylic acid
    - **Lactic acid**
    - **Ethanol-ethylene**
  - **PHBV**
  - **Ethanol-ethylene**
  - **Cellulase**
  - **C6, C5 syrup**

- **PLA**
- **PTT, PDT, PBT**
- **PBS, PBST, PBAT**
- **PEF**
- **PHBV**
7. Strengthen publicity and application promotion

- International mutual recognition of green fiber standard certification
- China Fibers Fashion Trends released for 7 consecutive years

The theme of “Origin and Vitality" in 2017/2018 session is divided into two chapters, namely, “Endearing fibers • Cozy and amiable" and “Vibrant fibers • Green pioneer“. 
7. Strengthen publicity and application promotion

The export is linked with the domestic market, seeing the gradient utilization of clothing, home textiles, automobile interior, shoes, waterproof rolling material, composite sheet, energy utilization, such as thermoplastic composite turnover box.
8. Focus on new green fiber products:

Solve the pollution caused by the large-scale use of disposable textiles for health care and other textiles

- Degradable to the level of small molecules in seawater within a short time and release non-toxic substances
- After alloying, good physical performance and processing properties are obtained to meet the application requirements

Biodegradable polyester (PBS/PBAT, PHA/PLA, alloy)
9. Recommendations on recycling system development policies

◆ 1. Strengthen overall design and promote inclusive development

1) To establish an organization to promote the upgrading of the recycling and circulating logistics system of chemical fiber and textile.
2) To set up a collaborative working mechanism for chemical fiber and textile recycling and circulation across regions and across industries.
3) To optimize the application environment of the recycling and circulating logistics system of chemical fiber and textile.
4) Pilot construction of textile recycling logistics system
5) To give full play to the municipal recycling system, sanitation company, neighborhood committee and other institutions to open up various recycling channels.

◆ 2. Strengthen industry norms and promote industrial upgrading

1) To strengthen the guiding role of the industry and control the market access.
2) To concentrate on strengthening the superior production capacity and supporting the backbone enterprises
3) To resort to national and local industrial layout, taxation, investment and other policy adjustment measures
4) To reinforce the guiding role of financial policies on scientific and technological innovation of chemical fiber textiles recycling and circulation.
5) To establish the industry risk early warning and dynamic regulation mechanism
9. Policy recommendations on recycling system development

- **3. Combine production, university, research and application, integrate innovative resources and promote technological innovation**
  1) To establish key special projects to promote the recycling and circulating technology of chemical fiber and textile
  2) To increase the support for cooperation of production, university, research and application in the field of waste textile recycling
  3) To promote the research and application of key applicable technologies for the commonality of chemical fiber and textile recycling and circulation

- **4. Deepen publicity and promotion, and enhance brand building**
  1) To popularize education of waste sorting as well as recycling and circulation
  2) To strengthen the construction of chemical fiber recycling and circulating certification system and strengthen international exchanges and cooperation
  3) To strengthen scientific guidance and publicity, increase government procurement and professional customization support, and encourage consumption

- **5. Strengthen base construction and cultivate professional talents**
  1) To build a global leading talent and innovation team for the recycling and circulation of chemical fiber and textile
  2) To gather high-level professionals in chemical fiber and textile recycling and circulation across the field
  3) The university and enterprise jointly carry out customized training for technical talents of chemical fiber and textile recycling and circulation
  4) To cultivate graduate students with professional degree in the field of chemical fiber and textile recycling and circulation, by crossing and integration among the multiple subjects.
Thanks!

Circular recycling,
Long way to go
supporting the circular economy of Polyesters with smart Recycling solutions
Nothing is for sure. Change is the only thing that is the absolute.

John Feldmann
Landfill...
WHY IS THERE PLASTIC IN THE OCEAN?

HOW IS IT GETTING INTO THE RIVERS AND SEAS?

2 BILLION PEOPLE WORLDWIDE
Do NOT have access to solid waste collection — United Nations

These people are left to rely on dumpsites, which are often located near oceans or waterways.

When plastic is littered on land or overflows from bins or dumpsites, it can end up in rivers and streams, which can carry it into the ocean.

WHERE DOES IT COME FROM?

Of the plastic that comes from land:

Approximately 80% comes from land-based sources

80%

US & EUROPE

2%

ASIA

82%

16%

REST OF THE WORLD

www.marinelitterthefacts.com
Plastic waste inputs from land into the ocean in 2010

The 192 countries with a coast bordering Atlantic, Pacific, and Indian oceans, Mediterranean and Black seas produced a total of 2.5 billion metric tons of solid waste. Of that, 275 million metric tons was plastic, and an estimated 8 million metric tons of mismanaged plastic waste entered the ocean in 2010.

Mitigation options:
- Reduce plastic in waste stream
- Improve solid waste management infrastructure
- Increase capture

*Plastics Europe, "Plastics—the Facts 2012" (2010 data)
**Cesar et al., 2014, Edens et al., 2014
There is a need for STRICTER environmental LAWS.
Europe
- Waste Framework Directive
- Landfill Directive
- Packaging & Packaging Waste Directive
- WEEE & ELV Directive

China
- Changes in the waste business
- Higher standards for resins
- Cost efficient production
- Wendt Group Loses Patents

America
- Know how exchange with Plastic Recyclers Europe
- Design guidelines
More globally traded

Secondary Plastics

Global demand for plastic scrap increases from 49 MT in 2015 to **85 MT by 2020**.

Source: ISWA 2014
More globally traded Secondary Plastics recycling volume increases Post Consumer
More globally traded Secondary Plastics

Where are the new Applications?

Re-pellets
BRANDS are DRIVERS for recycling. ... and more
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<td>Nike</td>
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<td>43,000</td>
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<td>Adidas</td>
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<td>100,500</td>
<td>160,800</td>
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<td>Pepsico</td>
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<td>50,000</td>
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<td><strong>10,911,266.055</strong></td>
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</table>
• Many suppliers with different quality / quantities on the market
• Available resin quality fluctuates
• Demand for worldwide supply
INPUT

OUTPUT = RAW MATERIAL

Quality level
1
2
3
EREMA Group

A very comprehensive portfolio of plastic recycling solutions.
EREMA Group

- Turnover EREMA Group: **155 mio. Euro** (fiscal year 2017/18)
- More than **500 employees** worldwide
- Approx. 250 **EREMA systems** a year
- More than **5,000 EREMA systems** in use around the globe
- Produce approx. **14 million tons of top quality plastic pellets** every year
EREMA is a global player

With more than 50 national representatives in all 5 continents and our subsidiaries in Austria, the USA, Russia and China, **EREMA is always close to you.** Around the globe.
Plastic Recycling Systems
for a broad range of applications

In-house & Industrial  Post Consumer  Bottle  Fibre, Nonwoven, Special Materials
                      Food Contact Approved  Tape, Textile  Automotive, WPC, Compounding, Bioplastics
EREMA® Products. Overview.

- **High tech plastic recycling**
  - INTAREMA® T, TE

- **High performance degassing**
  - INTAREMA® TVEplus®

- **Go the gentle way**
  - INTAREMA® RegrindPro®

- **Edge Trim Recycling**
  - INTAREMA® K

- **Food contact approved**
  - VACUREMA®

- **Hight Capacity-Melt Filtration**
  - SW RTF®

- **Hight Capacity-Melt Filtration**
  - Laserfilter

- **Pelletising Solutions**
  - HG D

- **Pelletising Solutions**
  - ASP-CIC

- **Recycling & Compounding**
  - COREMA®

For minor contaminants.
EREMA SW Direct Flow
VACUREMA®
One system, three application fields.

Bottle-to-Bottle
rPET pellets, extremely clean with IV like virgin material

Pelletising
rPET pellets with proven recycling technology

Inline Applications
VACUREMA® Inline Sheet
VACUREMA® Inline Strapping
VACUREMA® Inline Fibre
VACUREMA® Inline Preform
History of VACUREMA® Technology

- First VACUREMA delivered in 1996
- First NOL from FDA obtained in 1999
- VACUREMA Advanced developed in year 2001
- **VACUREMA Prime** developed in the year 2006
- Various country approvals, FDA NOLs, positive efsa opinions and brand owner approvals granted
- VACUREMA Technology is used for different applications (Bottle to bottle, sheet, strapping, fiber etc.)
- Since then >200 VACUREMA systems sold/delivered
What’s going on worldwide with PET bottle collection?

Source: PCI, 2016
...which end up where to?

11.2 million tonnes
Collection

2.1 million tonnes
Process Loss

9.1 million tonnes
RPET Flake Available

RPET Flake Supply

- Fibre
  - 66%
- Food Contact Bottles
  - 10%
- Non Food Contact Bottles
  - 3%
- Sheet
  - 12%
- Strapping
  - 3%
- Other
  - 6%

Source: PCI, 2016
More than 200 VACUREMA® systems have been installed worldwide. VACUREMA® is the most proven technology in the production of direct food contact grade rPET.
All VACUREMA® systems in total process more than 1.37 million tonnes of PET to make rPET every day. The majority of them produce rPET for direct food contact.
In which end applications VACUREMA is in?

207 VACUREMA® systems have been installed worldwide. VACUREMA® is the most proven technology in the production of direct food contact grade rPET.
Examples of what products are made out of VACUREMA pellet
Realized projects in China since 1996

- Fiber to Fiber
- Bottle to Sheet
- Bottle to Bottle
- EREMA delivered 2 VACUREMA lines alone in Q1/2018 ➔ increasing awareness and interest
EREMA advantage that makes the difference:
closed complete system

The right system.
We make sports accessible for the many
我们的宗旨

让最广泛的大众
同怀运动愿望，共享运动欢益
1976 The first Decathlon store
Michel Leclercq invented a new self-service sports retailing concept.

1986 Production and globalization
‘Decathlon Production’ was born. Its purpose is to design and manufacture sports goods besides sell products. The first international production office was established in Asia in 1988.

1997 Decathlon's first own brands
Decathlon created its first owned 'Passion' brands: Tribord for water sports and Quechua for mountain sports.

By December, 2017
A whole industry chain network of companies dedicated to mass sports market, covering design, R&D, production, brand, logistics and retail of sport products. It has recruited more than 85,000 teammates from 93 different countries.
Purpose & Values

Our Purpose
We make Sports accessible for the many

Our Fields
Decathlon is a generated group with developing, design, brand, retail, logistics and production departments which possesses a whole industrial chain in sport products

Our Values
Vitality Responsibility

Innovation is the gene of Decathlon

Decathlon’s innovation belongs to the public which is user-oriented. It provides more sports enthusiasts with best-value and affordable solutions!
40 PAYS AVEC MAGASINS 迪卡侬商店已在40个国家

2018 即将开店

Senegal, South Korea, Chile, Canada, Sri Lanka, RD Congo, Austria, Lithuania, Kenya
Innovation: the gene of Decathlon

Quechua
2” easy tent

TRIBORD
Easy Breath

ARTENGO
Rollnet

1. Needs and Dreams
   ‘a tent which can be pitched itself’

2. Process of thinking
   product managers, designers and engineers discuss possibility of its realization

3. Testing
   simulation test in the laboratory

4. Industrialization
   mass production

5. Logistics
   products are shipped to the world through the logistic network

6. Retail
   store sales and available in store for users
Decathlon Greater China History

1989
Decathlon entered Hongkong China, developing production and export business

1994
Decathlon entered Guangzhou, opening production office

1998
Decathlon opened the first factory store in Xinzhuang, Shanghai

2003
Asian headquarter moved from HongKong to Shanghai

2003
The first Decathlon concept store opened in China(Taiwan included).

2017
Decathlon has 267 stores in China(Taiwan included) with more than 17,000 teammates by December 31st, 2017.

November, 2003, Huamu, Shanghai
The e-commerce business started in 2010 and boasted a fast development. It has serviced the users around 400 cities.
Retail Development in Greater China

Decathlon has 267 stores in nearly 100 cities by December 31st., 2017.
The Decathlon Foundation was founded in July, 2005 in Lille, France. It exists to help people who are willing to but cannot do sports because of difficulties realize their sports dreams. The Foundation makes sports happiness accessible to all through the involvement of our teammates.

In addition, it help to solve people’s problems basically and fundamentally through social integration, education and employment. We hope that what we do can bring positive changes to their lives. By the end of 2017, the Foundation has supported more than 340 programs in more than 26 countries, covering more than 240,000 beneficiaries. With 18 programs, 43 volunteers, beneficiaries over 1300, Decathlon Foundation is well operating In China.
Problematic:

Less resources  More quantities

=> How to match “For the many” (mass-market) and Sustainability?

In China, we address this question with our strong ambition:

Everything Goes Green!

(all in action-mode for Green)

except our logo
1ST AMBITION: AT DECATHLON CHINA, WE ARE ALL LIVING THE SD PROJECT

1.1 We diffuse SD mindset to all

Project 1. One communication channel & active collaboration
We share to all WHY to do it, and share success!

By March 2019:
- SD Sport Experience
- Website & SD report in Chinese language
- WeSustain
- China Portal
- Eco-label test

We follow: Teammates survey "I am living the SD project in Decathlon China"
2ND AMBITION: WE MATCH “GREEN” AND “FOR THE MANY” FOR A CHINA UNIQUE BUSINESS MODEL

2.1 We build an eco-designed offer in China

**Project 3. Promote eco-offer**
*Eco-conception inspires the rest of Decathlon*

**Key Result March 2019:**

- Every Sport can extract its CO2!
- Devpt in China: 3 green products 4R

We follow: The CO2 footprint of China offer
2.2 We build an Ethical and Environment-friendly supplier panel

Project 5. Environmental management
We measure CO2 to support smart actions.

Key Result March 2019:
“Resource Advisor” platform is used at China partners to input data, measure CO2 by activity, define priorities.

2ND AMBITION:
WE MATCH “GREEN” AND “FOR THE MANY” FOR A CHINA UNIQUE BUSINESS MODEL
2ND AMBITION: WE MATCH “GREEN” AND “FOR THE MANY” FOR A CHINA UNIQUE BUSINESS MODEL

2.2 We build an Ethical and Environment-friendly supplier panel

Project 6. Happy team players
We increase the social positive impact on employees over our supply chain

Key Result March 2019:
1. Partner Team Mates Barometer result %
2. decrease the human turnover

Ex: Based on employees’ feedback, two key suppliers (Arcana, Tengfei) take concrete actions: sport & leisure facilities, refurbishment of dormitories & canteen
2ND AMBITION: WE MATCH “GREEN” AND “FOR THE MANY” FOR A CHINA UNIQUE BUSINESS MODEL

2.3 We deliver a Green @Store experience

Project 7. Green building
We decrease the CO2 impact of stores.

Key Result March 2019:

100% LED tubes

“Resource Advisor” installed in all stores

one site with solar panel

We follow: CO2/sqm for stores in China
2ND AMBITION: WE MATCH “GREEN” AND “FOR THE MANY” FOR A CHINA UNIQUE BUSINESS MODEL

2.3 We deliver a Green @Store experience

Project 8. Green service
We share the concept of Sustainability to the many @Stores

Key Result March 2019:

- 2018: 85% of returned repairable products are repaired
- Collection boxes:
  - plastic bottles in Beijing, Shanghai, Shenzhen
  - hangers
  - cotton in 2018

Decathlon Sustainability screen @ 4 stores
Play Green start from yarn

- Boost Eco–friendly components

- Provide energy cost saving solution from yarn
Boost Eco-friendly components

Target: Use 100% Sustainable Cotton > BCI +Rec +Organic
Product’s share in the global CO2 DK impacts

Textile Process CO2 Emission: 66% of Production
Synthetic Yarn raw material CO2 Emission: 17%
(13% of synthetic yarn sharing)
100% Sustainable Polyester (PES)

For a sustainable business in French stores

Decision in 2017 for application in 2021
Boost Eco-friendly components

China Yarn

Recycle

PET Bottle → Flake → PET Chips → Spinning → Clothing

Breaking the recycling process into pieces, get rid of the zipper, button and other accessories.

Chemical Breakdown

Pulverization

Spinning & Processing

Recycle larval polyester products.
DECATHLON GLOBAL NEEDS OF SYNTHETIC YARN
67,000 tons 2017

SUSTAINABLE YARNS
7,700 tons (11%)

2018 Piloting VS 2017 +25%
Thank you!
“Innovative solutions for recycling of PET bottles and PET thermoforms”

Yu Zheng

Assistant to Sales Department
AGENDA:

Fact & figures
Applications
PET recycling – Market & products
PET thermoforms recycling
FACTS & FIGURES
A 4° GENERATION FAMILY COMPANY

1922
Company PREVIERO was founded in Como
Activity in wood machine manufacturing

1950
Company SOREMA was founded in partnership with PREVIERO
First washing plant manufactured in 1975

1974
Starting production of plastics machineries

1993
Merging of the two companies for synergies and ownership

2005
4th generation entering the company

2015
New business unit in management service
PRODUCTION SITES AND ACTIVITY

Nr. 85 employees

Nr. 2 production sites with 11,000 m² of covered working area

1st DISTRICT in plastic machinery manufacturing

Sales, installation and service world wide

Facility in Anzano del Parco

Facility in Alzate Brianza

WASHING LINE

TURN KEY SYSTEMS
SALE SHARES

- **Previero**: 20%
- **Sorema**: 80%

**SOREMA activity**
- **Film line**: 25%
- **Pulper waste and special projects**: 10%
- [category name]: 0%
- [percentage]: 0%
PROJECTS

- More than 120 wash lines supplied in last 10 years
- More than 2,000,000 tons per year of post consumer plastic material recycled by our customers
- Largest market share in bottles to packaging recycling line
- Plants in operation since more than 20 years
GLOBAL TECHNICAL SOLUTIONS FOR RECYCLING

- Research / Analysis of process conditions
- Engineering and technical assistance
- Design and manufacture
- Partnership approach
- Technical solutions
- Pre-assembling
- Onsite installation (turnkey or supervisor)
- After sales and production support
- Management service

Customized engineering
Modular approach
Water and Energy optimization
APPLICATIONS
APPLICATIONS

BOTTLES RECYCLING PLANT

PET BOTTLES

HDPE BOTTLES & CONTAINERS
APPLICATIONS

BOTTLES RECYCLING PLANT

THERMOFORMS
RECYCLING PHASE AND END PRODUCTS

- **POST CONSUMER PET BOTTLES**
- **WASHED FLAKES**

**DIRECT APPLICATIONS FROM FLAKES**

**FOOD GRADE FLAKES AND PELLETS**

**Washing**

- **FILM**
- **WOVEN / N.W.**
- **STRAPPING**
- **FIBER**

**THERMOFORMS**

**B to B**
Each module is a “Subsystem” with net upstream and downstream interface

✓ Project customization
✓ Upgrade of Sorema unit
✓ Retrofitting of wash line from third parties
PACKAGE INTEGRATION

Third party package can be integrated in the system in downstream applications or complementary functions

- Complete turn key system
- Integration of packages procured by Customer
- Cost optimisation with “no risk guarantee” at interface
OPTIMIZATION OF WATER CONSUMPTION

- **Material Flow**
  - SOREMA MODULE 1
  - SOREMA MODULE 2
  - SOREMA MODULE 3
  - LAST MODULE

- **Counter Flow**
  - Counter Flow between SOREMA MODULE 1 and SOREMA MODULE 2
  - Counter Flow between SOREMA MODULE 2 and SOREMA MODULE 3
  - Counter Flow between SOREMA MODULE 3 and LAST MODULE

- **WATER FILTRATION**
  - After each module

- **WATER TREATMENT**
  - At the end of the process

- **Water/Solid Discharge**

- **FRESH WATER**
  - Source of fresh water
WATER FLOW - SOREMA GENERAL CONCEPT

START-UP AND SUPPLY OF FRESH INDUSTRIAL WATER ONLY TO RINSING MODULE

MATERIAL

PREWASHING

WATER FILTRATION

GRINDING

WATER FILTRATION

HOT WASHING

ULTRA FILTRATION

RINSING

WATER FILTRATION

SINK + FLOAT

WATER FILTRATION

RINSING

WATER FILTRATION

CHEMICAL/PHYSICAL TREATMENT

BIOLOGICAL TREATMENT

TO DISCHARGE

MATERIAL
PLANT SUPERVISOR

- Set process parameter
- Control status of equipment and instruments
- Register data of process set-up and consumption
PET / PP RECYCLING PROCESS

BLOCK DIAGRAM

FEEDING SECTION → DRY SORTING → METAL SEPARATION → HOT PREWASHING → BOTTLE SORTING → WET GRINDING

WASTE

WATER ULTRA-FILTRATION

BUFFER STORAGE SILO → INTENSIVE WASH → SINK/FLOAT SEPARATION

HDPE DRYING AND PACKING

FINES DRYING AND PACKING

FINAL RINSE

DRYING

IN-LINE WEIGHING

BLENDING

WATER FILTRATION

WATER ULTRA-FILTRATION

ELUTRIATION → SAMPLING DEVICE → FLAKES SORTING → SECOND GRINDING → SAMPLING DEVICE → ANALYSIS SILO → BIG BAG FILLING STATION

HDPE DRYING AND PACKING

FINES DRYING AND PACKING

DRYING

IN-LINE WEIGHING

BLENDING

WATER FILTRATION

WATER ULTRA-FILTRATION

WASTE
SOREMA RECYCLING PLANT

- Great flexibility in the plant solutions
- Possibility of recycling various types of plastic material
- Technological development aimed at reducing energy consumption and water
- Growing number of applications of recycled plastic
FILM RECYCLING PLANT

OTHER APPLICATIONS

POST CONSUMER FILM

POST COMMERCIAL FILM

AGRICULTURAL FILM
PET RECYCLING
Market and products
3 STRATEGIC POINTS

- Correct estimation of price and volume of the “procurable” feedstock
- Evaluation of quality and PET content
- Define capacity and leave provision for vertical or horizontal integration
TIPICAL NON CONTENT PET

SOURCE OF PET BOTTLES

- Return fee/ Deposit
- Selective collection - PET bottles
- Selective collection – all plastics
- Landfill Extraction / Materials recovery facilities

AVERAGE NON PET CONTENT (%)

- (30-40%)
- (22-28%)
- (18-20%)
- (16-18%)
MARTKET AND PRODUCT

CONTAMINATIONS

- Labels
- Solid + liquid content
- Metal
- Caps
- PVC
- Wrong PET
- HDPE
- Wrong color
MARKET AND PRODUCT

PET - collection, sorting, recycling

Kurbside / Drop Off Collection

Mixed Bottles

PET

Clear, light blue

Mechanical Recycling

Bottles, Film

Mixed colours

Mechanical Recycling

Fibres, Strapping, Black Films

Energy recovery

Chemical Recycling
MASS BALANCE FOR SELECTIVE COLLECTION

75% PET bottles recycling yield

25% NON PET MATERIAL consisting of

- 0,5 - 1% magnetic and non magnetic metals (RECOVERY)
- 0,5 % metal wire (RECOVERY)
- 1 – 3 % PET fines (BY PRODUCT)
- 5 % caps (BY PRODUCT)
- 2 – 5 % non PET container/product + wrong PET bottles (RE-SORTING)
- 9 – 12 % waste from recycling process (WASTE)
## MARKET AND PRODUCT

### END PRODUCTS

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Unit</th>
<th>Ref. Value (B2B)</th>
<th>Ref. value (fiber) (fiber)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Granulometry</td>
<td>% mm</td>
<td>95% in the range 5-8 mm</td>
<td></td>
</tr>
<tr>
<td>Fines</td>
<td>% mm</td>
<td>1% less than 1 mm</td>
<td></td>
</tr>
<tr>
<td>Intrinsic viscosity</td>
<td>g/dl</td>
<td>0.72 - 0.80 (same as in input bottles) bottles</td>
<td></td>
</tr>
<tr>
<td>Basicity</td>
<td>pH</td>
<td>7</td>
<td>≤ 10</td>
</tr>
<tr>
<td>Residual humidity</td>
<td>% weight</td>
<td>0.6 - 0.7</td>
<td>0.6 - 0.8</td>
</tr>
<tr>
<td>Residual glue/hot melt</td>
<td>ppm</td>
<td>0-10</td>
<td>0-30</td>
</tr>
<tr>
<td>Polyolefines</td>
<td>ppm</td>
<td>0-10</td>
<td>0-50</td>
</tr>
<tr>
<td>Residual paper</td>
<td>ppm</td>
<td>0-10</td>
<td>0-10</td>
</tr>
<tr>
<td>Metals</td>
<td>ppm</td>
<td>0-10</td>
<td>0-10</td>
</tr>
<tr>
<td>PVC content</td>
<td>ppm</td>
<td>&gt;10 ppm*</td>
<td>0 - 60</td>
</tr>
<tr>
<td>Colour selection</td>
<td>ppm</td>
<td>According to specification</td>
<td></td>
</tr>
</tbody>
</table>

* PVC content lower than 10ppm requires proper bottles detectors and flakes detectors.
MARKET AND PRODUCT

R-PET FLAKES PRICE COMPOSITION

RAW MATERIAL
PET CONTENT IN BALED MATERIAL

OPERATING COST
1. ENERGY
2. CHEMICALS
3. WATER
4. CONSUMABLES
5. PERSONNEL
6. SPARES

OPTIMISATION AREA

CAPITAL COST
6. BUILDING
7. PLANT
8. INSTALLATION AND UTILITIES
9. FINANCIAL

OPTIMISATION AREA
PET Thermoforms Recycling
RECYCLING IMPACT

**APET MONOLAYER**
- Difference in IV versus PET bottle
- LOW impact on color properties
- Impact on size distribution
- Applications in “Thermoforms to Packagings”

**APET + MULTILAYER**
- High impact on color properties
- Compatibility of barrier polymers with PET
- Application in colored sheet or fiber (in progress), profiles, compounding
CRYSTALLINITY IMPACT

Thermoform 100% PET with rigid lid
Mostly made with 100% RPET

- Amorphous PET
- Medium draw
- Low draw
PROCESS

- Typical IV measured on Bottles flakes: 0.70 – 0.72
- IV measured on Thermoforms (ave): 0.60 – 0.64 (higher IV range)
Bale opening of compacted 100% thermoforms:

Unpackaged thermoforms

Bale of 100% thermoforms
Additional concern:
- Expanded PET multilayer tray
- Non floating lids
- Labels
- Organic

Pressure sensitive labels

Direct print
Multilayer/Complex
Pad
CONTAMINATIONS

Additional concern:
- Expanded PET multilayer tray
- Non floating lids
- Labels
- Organic

25 Kg/ 1 M ton of plastics

100 Kg/ 1 M ton of plastics
MASS BALANCE

MATERIAL

PRESORTED TRAY
(mix mono + multilayer)

Surface contamination
5 – 10 %

PET trays washed
60 – 70 %

Floating material
20 – 25 %
SOREMA TRIAL: industrial trial

Mass balance of washing cycle – PET thermoforms (100%)

Loss considered > 1mm

<table>
<thead>
<tr>
<th>Process</th>
<th>Quantity (Kg)</th>
<th>Ratio (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>STARTING MASS Grinding</td>
<td>779</td>
<td>100</td>
</tr>
<tr>
<td>Waste from sampling</td>
<td>1</td>
<td>0.1</td>
</tr>
<tr>
<td>Sample of grinded material</td>
<td>1</td>
<td>0.1</td>
</tr>
<tr>
<td>Lost as fines</td>
<td>42</td>
<td>5.4</td>
</tr>
<tr>
<td>STARTING MASS washing cycle</td>
<td>735</td>
<td>94.4</td>
</tr>
<tr>
<td>Light fraction from aerodynamic separation</td>
<td>56</td>
<td>7.2</td>
</tr>
<tr>
<td>Waste from washing water screening (paper and mud)</td>
<td>103</td>
<td>13.2</td>
</tr>
<tr>
<td>Floating waste</td>
<td>162</td>
<td>20.8</td>
</tr>
<tr>
<td>FINAL CLEANED</td>
<td>414</td>
<td>53.2</td>
</tr>
</tbody>
</table>

Overview of the ground material

Overview on the washed material
IMPACT ON COLOR

Difference of color after oven test between APET monolayer thermoforms and multilayer

→ Limit of use in blend with PET Flakes without color impact
**IMPACT ON COLOR**

<table>
<thead>
<tr>
<th>Material (%)</th>
<th>Good quality bale of PET trays</th>
<th>Medium quality bale of PET/multilayer trays</th>
</tr>
</thead>
<tbody>
<tr>
<td>PET Tray clear</td>
<td>97</td>
<td>89</td>
</tr>
<tr>
<td>PET bottle</td>
<td>&lt;1</td>
<td>6</td>
</tr>
<tr>
<td><strong>Contamination (ppm)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PVC</td>
<td>0,5-1%</td>
<td>1-1,5%</td>
</tr>
<tr>
<td>Polypropylene</td>
<td><strong>732</strong></td>
<td><strong>6000</strong></td>
</tr>
<tr>
<td>Polystirene</td>
<td><strong>341</strong></td>
<td><strong>4000</strong></td>
</tr>
<tr>
<td>Metals</td>
<td>63</td>
<td>3000</td>
</tr>
<tr>
<td>High density Polyethylene</td>
<td>10</td>
<td><strong>18000</strong></td>
</tr>
<tr>
<td>PET trays with metal gasket</td>
<td><strong>707</strong></td>
<td>nd</td>
</tr>
<tr>
<td>Colored PET trays</td>
<td><strong>390</strong></td>
<td>nd</td>
</tr>
<tr>
<td>Polyolefin films and labels</td>
<td><strong>332</strong></td>
<td><strong>10000</strong></td>
</tr>
<tr>
<td>Fruit and vegetables residue</td>
<td>273</td>
<td>nd</td>
</tr>
<tr>
<td>Expanded PE shok absorber</td>
<td>146</td>
<td>nd</td>
</tr>
<tr>
<td>Paper</td>
<td>98</td>
<td>nd</td>
</tr>
<tr>
<td>Contaminated trays</td>
<td>88</td>
<td>nd</td>
</tr>
<tr>
<td>Multilayers film PE/PA</td>
<td>59</td>
<td>nd</td>
</tr>
<tr>
<td>Citrus fruit mesh bag</td>
<td>39</td>
<td>nd</td>
</tr>
<tr>
<td>Polycarbonate</td>
<td>nd</td>
<td>728</td>
</tr>
<tr>
<td>Other mixed contaminants</td>
<td>nd</td>
<td><strong>4000</strong></td>
</tr>
</tbody>
</table>

*Oven Test 1 vs. Oven Test 2*
FINES WASHING

INPUT MATERIAL
FINES WASHING

OUTPUT MATERIAL - PELLETS
FINES WASHING

SAMPLES OF PRODUCTS
THANK YOU FOR YOUR ATTENTION
Polyester Masterbatches Boost Green Development of Recycled Polyester Industry

Poly Plastic Masterbatch (SuZhou) Co., Ltd.

Xie Wei, Technical Engineer

Sep 2018    Shaoxing
Contents

• About us
• What is masterbatch?
• Production and test
• Products
• Qualification
• Perspective
About us
Poly Plastic Masterbatch (SuZhou) Co., Ltd., formerly the Suzhou Poly Plastic Material, is a leading polyester fiber masterbatch producer in China. We supply a full range of masterbatches, such as color masterbatches to be applied in polyester and polyamide fiber production, and functional masterbatches. For years, production and capacity of us had ranked high in the Top 10 domestic fiber masterbatch producers in China Color Masterbatch Association’s statics. In 2017, PPM had sold more than 34kt masterbatch, with sales value totaling 580 million yuan.
What is Masterbatch??
Polyester color masterbatch is a mid product between polyester resin and its downstream products. Resembling resin in appearance, color masterbatch is a semi-finished polyester product produced from a blending of resin, dispersers and pigment, without being diluted into a final density or processing into a final form. As a semi-finished product, masterbatch significantly facilitates processing of plastics and chemical fibers.
Why use color masterbatch

- **Cleaner production**: Color masterbatch help avoiding dust and effluent from downstream processing. Color masterbatch also simplify process itself. By applying dope dying technology based on color masterbatch, spinning mills can directly spin colored yarn, and the dyeing and finishing process, which consume much energy and cause considerable emission, are thus saved.
Why use color masterbatch

- Masterbatch can be produced from recycled materials: Waste apparel and post-consumer bottle are grinded into popcorons and flakes, which, instead of virgin polyester chip, can be used to produce masterbatch to be spun into polyester fiber.
Production and test of color masterbatch applied in polyester fiber manufacture
Production of polyester color masterbatch

Traditional process: long process, high costs, frequent complaint

Sample from customers → PPM makes proof → Confirmation from customers → Place the order → PPM produces

Remake proof upon customer’s feedback

PPM atlas: efficient, low-cost and reliable quality

PPM atlas → Confirmation from customers → Place the order → PPM produces

PPM already has more than two thousand samples of colored yarn in store. Customers may view the atlas and confirm directly on their customer application, thus save the process of proof making and confirmation. Fixed recipes ensures reliable product quality. Our atlas can meet requirement from more than 90% customers.
Polyester color masterbatch production

Carrier+toner → High-speed mixture → Input → Twin screw extruding

Pelletizing → Cooling in water channel → Sieving → Packaging
Index of polyester color masterbatch test

1）MFR
2）Filtering quality
3）Rheological property
4）Intrinsic viscosity
Index of polyester color masterbatch test

5) Partical size of pigment and functional powder
6) Color fastness to light
7) Color blending, and spinning color of finished masterbatch
Products
Recycled black masterbatch

Recycled polyester masterbatch and PSF, DTY spun from it

We sold 25kt black masterbatch in 2016, and 27kt in 2017.
Recycled full-dull masterbatch

Recycled full-dull polyester masterbatch and PSF, DTY spun from it
Recycled color masterbatch of high color fastness

- Light fastness: grade 6 (ISO105-B02:2014)
- Washing fastness (ISO105-C06:2010), Fastness to saliva (GB/T 18886-2002), Fastness to perspiration (SO105-E04:2013), Heat and dry fastness (SO105-P01:1993): grade 4-5
- Dry friction fastness (SO105-X12:2016) ≥grade 4
Recycled color masterbatch of high color fastness

Recycled grey color masterbatch and DTY spun from it

AATCC16.3-2014 using water cooled xenon arc lamp
Rated at grade 4 after hours
(Rate rank from grade 1-5, with grade 5 the highest rank)
Recycled noctilucent masterbatch

Mechanism

Absorb

Light-storing tombarthite

Day

Night

Application

Light-storing tombarthite

Emit

Recycled noctilucent masterbatch

Recycled noctilucent DTY sample
Recycled photochromic color masterbatch

R-PET photochromic masterbatch

R-PET photochromic POY sample

Before

After shone

Mechanism

\[ \text{Compound A} \xrightarrow{hv} \text{Compound B} \xleftarrow{hv'} \]

molecular structure or electronic energy level change
Far IR Masterbatch

Far IR masterbatch and fiber

CAS 115-2005 Healthcare textile
0.88 Normal emittance > the required 0.8
TiO2 modified bamboo charcoal masterbatch

JIS L 1902: 2015 quantitative test (Anti-bacteria)
Staphylococcus aureus: Bacteriostasis rate > 99%
CAS 115-2005 Healthcare textile
0.88 Normal emittance > the required 0.8
Colored R-PET flame-retard masterbatch and fiber

GB/T 5454-1997 LOI test
Vertical, lateral  LOI=30%
GB/T14644-1993 angle 45, burning rate test
None of all the five objects were lighted --Grade A
R-PET anti-bacteria masterbatch

R-PET anti-bacteria masterbatch and fiber

GB/T 20944.2-2007 Absorption test
Colibacillus Bacteriostasis rate > 99.99%
Candida albicans Bacteriostasis rate > 99.99%
Qualification
Honors

Certificate of High-tech Enterprise of Jiangsu Province

Certificate of Tech-oriented SME of Jiangsu Province

Enterprise of Chemical Fiber Application Innovation

National R&D Center of Functional Fiber Masterbatch

Enterprise Technology Center of Suzhou City

Functional Masterbatch Engineering Technology Research Center of Suzhou City
We highly value intellectual property. We have 18 cases of China Patent applying and 6 cases of licensing. With certifications from SGS and INTERTEK, we provide masterbatch products of ensured quality and environmental safety. What’s more, we have taken part in drawing up Technology Standard of Green Fiber Evaluation, Standard of Green Purchasing of Recycled Polyester Fiber Industry, and Flame-retarding R-PET Staple Fiber.
Perspective
In recent years, while the country is attaching more importance to recycling industry, more restrictions and standards have been issued by China’s authority to rule the industry. As waste PET recycling is essential to recycling economy, it is foreseeable that improvement in waste collection and processing will benefit polyester recycling.

Application of recycled polyester color masterbatch and functional masterbatch creates considerable margin for R-PET fiber industry. We are presently developing some functional products of chain extension, brightening, spinning assistant, etc., in the hope that our efforts will propel development of the recycling industry.

Polyester color masterbatch saves processing costs rising from printing and dyeing, while reduces pollution, and it will be a matter of course for recycling enterprises to adopt color masterbatch. With environmental ruling raising more awareness of environment protection, dope-dyeing with color masterbatch as the representative will greet their golden days!
Thank you!
Dr. Thiele Polyester Technology

Background and Business Activities

Issue 04-2018
Short Biography Dr. rer. nat. Ulrich K. Thiele, born 31.05.1944 in Dresden, Study Chemistry, PhD Polymer Chemistry Technical University Dresden, married, 2 Children, Citizen of Bruchköbel, Germany

1970 – 1972 Chemiefaserwerk (Textile Polyester Producer) Guben:
~ Application Technology Center Polyester and Polyamide Fibers
~ Head of Patent- and Scientific Information Department

1972 – 1982 Chemiefaserwerk Rudolstadt-Schwarza:
~ Technologist Spunbond and PA6 Recycling Plant
~ Head Polyester Technology Dpt. and Development – Film-PET Pellets

1982 - 1986
~ Plant Manager Film Polyester Production and PA6 Filament Recycling
~ Polyester R&D, Cooperation with PET-Film Producer of former Soviet Union
~ Development of PET Pellets for Ultra Thin BOPET-film for Capacitors
~ Development of PET Resins for BOPET Video and Audio film
~ Development of Polyester for X-Ray Film
~ Recycling process Development and Production of PA6 Filament /Compounding

1986 Karl Fischer Westberlin
~ Urea/ Phenol/ Formaldehyde Glue Plants, Development and Start Up Manager
1987 – 1999 Zimmer AG Frankfurt a. Main:
~Product Manager Polyester (4 years)
~Head of Polymer Research and Development (8 years)

Important Fields of Scientifically and Technically Activities during this Period:
- Film PET Production, Additive Preparation, BOPET Process Development
- Film PET Resin Plant Design, Film-PET recipe development
- Bottle PET Resin Recipes and Process, PTA and DMT based
- PET Recycling Processes, Partial Glycolysis, Melt Poly and R-PET SSP
- Bottle PET Resin Plant Design Optimization
- Bottle PET Resin Performance Additives, FHU, Toner
- SSP Processes and Technology Development
- SSP of high IV PET for Industrial Yarn and Tire Cord
- Base Development High IV Self-cleaning Reactor for Direct Spinning Cord (HVSR)
- Several Antimony Free Polycondensation Catalysts based on Ti, Al and Si
- Base Development Direct Preforming
- 5000 m/min POY Spinning Applying Polymer Additives
- Continuous PBT and PTT Process Based on PTA
- PCT Process based on PTA
- Total EG Recycling in Bottle PET and Textile PET Process
- Co-polyesters, Polyester Resin Recipes
- Base Development of PEN Process
- High Performance Polyamide 6
- TiO2 Masterbatch
- FDA approvals

As founder I was active in nearly all fields of the polyester industry for more than 30 years like PET production, PET R&D of polyester, polyamide, engineering, processing, recycling and application.

Publishing Activities:

~ 62 patents in the field of polyester and polyamide:
   Patent list on request via ESPACENET.com research

~ Various papers to international conferences and publications
   (see [www.polyester-technology.com](http://www.polyester-technology.com))

~ Book: „Polyester Producing Plants“, Verlag Moderne Industrie, 1996,
  ISBN 3-478-93148-7

~ Book “Polyester Bottle Resins, Production, Processing, Properties and Recycling”
  PETplanet Publisher GmbH, 2007 Heidelberg, Germany, ISBN: 978-3-9807497-4-9,
Selected Examples of current Consulting Activities of DPTP

Asset benchmarking (processes, patents and industrial plants)


Selected Examples of Research and Development Support in Process Chemistry , Technology and PET Recycling

Active developments in the fields of PET process optimization, PET-masterbatch and new Ti-based PET catalysts, bottle PET, film PET, textile PET, PET-spinning additives, technical yarn and PET recycling (examples)

Example customer contracts: Companies like M&G, YUHUA-PET, UIF, TEXFINA, PODDAR PIGMENT, WELSPUN, RELIANCE, PEARL-ENGINEERING, EPC, STPC, BRUECKNER,

Single development project with companies like BERSTORFF, TWD, SABIC, DEGUSSA-AEROSIL, DEGUSSA-RÖHM (now EVONIK), SIOEN

POY and DTY from PET recycling with TEXFINA

Start up support for EPC polyester plant revamping of SABIC
Selected Examples of Consulting Activities of DPTP (cont.)

Management Consulting and Coaching, Seminars

Consulting of top management and technical staff seminars

→ Some example customers like OERLIKON-BARMAG/NEUMAG, AUTONEUM, LIST, 4p, M&G GROUP, BRUECKNER GROUP, EVONIK, DOW, PIC-IRAN, FREUDENBERG, BERSTORFF, SABIC, TREVIA, ADVANSA, TWD, ERA GMBH, STPC-IRAN, GEHRSON & LERMAN Consulting, CRISTAL GLOBAL, GORE


→ As examples customers like UAB “NEO GROUP” (LIT), Johns & Day (USA, Eastman Wellman case), M&G Group, AIRLIQUIDE-LURGI (GER),

Support in Polyester Chemistry and Technology

→ The application of different newly developed equipment or additives required support and expertise for the introduction to PET-applications and PET-market → customer contracts with companies like for instance SUKANO Products, PODDAR PIGMENTS

→ Support in polymer recycling, process and equipment development and engineering: BRUECKNER GROUP, BO-Film technology , KURZ GmbH, LINDNER GmbH, GNEUSS KUNSTSTOFFTECHNIK GmbH, TECHNIP.
Conference Organization

Organization of POYESTER RECYCLING FORUM – PRF in Europe and Americas in cooperation with GNEUSS (www.Gneuss.com)
Recycling conferences in China in cooperation with CCFEI (www.ccfei.net)

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<td>Sao Paulo „Polyester talk and PRF“</td>
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<td>September 2018</td>
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Total number of customers since 1999: 130
Currently active projects/customers: 3

BACKGROUND
More information about contact addresses and cooperation under

http://www.polyester-technology.com

contact: drthiele@polyester-technology.com
Circular Economy of PET Waste by Loop Recycling – Dream, Fiction or Realty?
Dr. Ulrich K. Thiele – Polyester Technology Service, Bruchkoebel, Germany

14th China International Recycled Polyester Forum
Sept. 12 - 14, 2018
Shaoxing City, China
Outline

1. New chemical recycling processes under development
   1.1 PET waste hydrolysis by concentrated acetic acid under pressure
   1.2 “CreaSolve” process developed by Fraunhofer in 2005
   1.3 LOOP INDUSTRIES: Alkaline hydrolysis of PET waste by
   1.4 Gr3n / DEMETO: Alkaline hydrolysis of PET waste applying microwave reactor
   1.5 IONIQA and ACENTURE: Ionic liquids as PET waste decomposition catalyst

2. Which way leads to plants on the industrial scale?
   2.1 What shall be the final product quality of recycle PTA, MEG, IPA?
   2.2 What shall be the input quality of PET waste?
   2.3 What is in terms of feasibility and economy the minimum plant capacity of such a chemical recycling project?
   2.4 Are there existing chemical PET recycling processes on an industrial scale available?
   2.5 What to do with the occurring non-PET-waste?

3. CONCLUSIONS
1. **New chemical recycling processes under development**

During the past 20 years the polyester recycling industry grew up to a multimillion tons business and the above-average growth is continuing even today.

According recent publications (e.g.: https://assocham.org/upload/event/recent/event_1276/MR_RK_GERA_RIL.pdf) the amount of recycling PET in 2017 was about 10 Mio t/a.

Most of this R-PET is generated by mechanical recycling processes where mainly PET bottles are collected, intensively sorted, cleaned, grindes, directly converted to polyester intermediates or re-pelletized.

A comparable little portion of PET bottle waste only (<< 5 %) is converted by means of chemical recycling back to the polyester raw materials PTA (Purified Terephthalic Acid) and MEG (Mono Ethylene Glycol).

The patent literature is containing a large number of patents dealing with the chemical PET-recycling mainly based on hydrolysis to produce PTA, glycolysis to produce BEHT or methanolysis to produce DMT.

There have been numerous attempts to establish chemical recycling processes on industry-scale with the target to produce PTA or BEHT and MEG from polyester waste during the past 10 years.

Some of those recent developments are described in the following.
1.1 PET waste hydrolysis by concentrated acetic acid under pressure

Hussain Al Ghatta of former M&G group developed a process, where PET waste is hydrolyzed by concentrated acetic acid under pressure to generate PTA and MEG.

The advantage of this process is the fact that the resulting terephthalic acid is solved in acetic acid which is diluted with water the medium of further purification and trans-crystallization.

Unfortunately the process did not exceed the pilot level. Details see US2002077500 (A1) — 2002-06-20 “Recovery of dicarboxylic aromatic acids from polyester-resin contained in articles for recycling” to find under
1.2 “CreaSolve” process developed by Fraunhofer in 2005

In 2005 Fraunhofer developed the “CreaSolve” process.

Key step of this technology is using a blend of selective solvents to resolve the PET waste, removal of impurities by filtration, precipitation by a non-solvent and separation of the purified polyester.

The invention relates to a method for recycling polyesters or polyester mixtures from polyester-containing waste.

According to said method, the polyester or polyester mixture is dissolved in a solvent, whereupon free-flowing particles thereof are precipitated with the aid of a precipitating agent.

The precipitating agent is selected in such a way that the precipitating agent and the solvent can later be separated in a simple manner.


This process did not left the pilot stage till now for polyester recycling.
1.3 LOOP INDUSTRIES: Solvent supported alkaline hydrolysis of PET waste

The Canadian company Loop Industries published recently on its website (http://www.loopindustries.com/en/) a new PET recycling process based on solvent supported alkaline hydrolysis of PET waste.

At the same time it became public that Loop Industries is investigating this process together with Danone and Coca Cola (https://resource-recycling.com/plastics/2018/01/24/danone-coca-cola-proclaim-recycling-goals/). Basis of this process is most likely the invention USP 9,550,713 of Hatem Essaddam.

Key idea of the process is the treatment of PET flakes with a solvent mixture of methanol and dichloromethane in presence of equimolar amounts of potassium hydroxide.

To get finally the acids separated from the glycols the mother liquor is treated with equimolar amounts of sulfuric acid to precipitate the acids.

At the end there are left substantial amounts of potassium sulfate, insoluble impurities with adhering solvents, a blend of terephthalic acid and isophthalic acid and finally the solvent containing MEG, DEG and may be CHDM.

Finally the solvents methanol and dichloromethane must be completely removed from the insoluble waste like caps and labels and purified quantitatively by distillation or other means.

Recent internal information indicates that the process has been modified from hydrolysis to methanolysis and that the produced DMT is at site directly converted back to PET – which is currently the only reasonable solution for chemical PET recycling.
1.4 Gr3n / DEMETO: Alkaline hydrolysis of PET waste applying microwave reactor

The company Gr3n published under the name DEMETO a new European project focusing on the chemical recycling of colored PET bottles. ([https://www.recyclinginternational.com/recycling-news/10902/plastic-and-rubber/europe/chemical-based-technology-has-big-impact-pet-recycling](https://www.recyclinginternational.com/recycling-news/10902/plastic-and-rubber/europe/chemical-based-technology-has-big-impact-pet-recycling))


Key of this process is a microwave reactor where the hydrolysis of polyester waste intermingled with MEG and water takes place in presence of alkaline like sodiumhydroxide (NaOH) or potassiumhydroxide (KOH) to generate terephthalic acid alkaline salt and glycols.

After removal of insoluble waste by filtration the generated terephthalic acid is precipitated by neutralization under addition of hydrochloric acid (HCl).

The neutralization products sodiumchloride (NaCl) or potassiumchloride (KCl) are subsequent converted to NaOH or KOH applying chloralkali electrolysis.
The recovered chlorine (Cl2) and hydrogen (H2) gases are reacted to HCl which is reused in the process. In this way the hydrolysis agents NaOH or KOH are circulating as process aids.

The process patent WO2013014650 does not discover how the commonly present co-monomers like IPA, DEG or CHDM are separated from each other and purified to get the PTA and MEG (and off course the separated co-monomers) in a quality of common commercial industry standard.

Especially the use of HCl put some question marks because the finished PTA, IPA, MEG and DEG must be completely free of chlorine ions.

Over all the process is seemingly technically complicated especially the inclusion of chlorine recovery by chloric-alkali-hydrolysis.
1.5 IONIQQA and ACENTURE: Ionic liquids as PET waste decomposition catalyst

The companies Ioniqa and Acenture (http://www.ioniqa.com/news/) advertised in 2016 their new polyester recycling process by the following words: “Ioniqa invented a Magnetic Smart Process to recycle all kinds of colored PET polyester waste into ‘virgin quality’ raw materials, competing with oil-base PET in both quality and costs.....In the last weeks (October 2016) the recycling process was scaled up successfully to a volume of 1,000 liters. This brings the world closer to an economical viable solution for tens of millions of tons of PET Polyester waste, currently down cycled, dumped or incinerated.”

Looking at the patent publications of Ioniqa (https://worldwide.espacenet.com/searchResults?submitted=true&locale=en_EP&DB=EPODOC&ST=advanced&TI=&AB=&PN=&AP=&PR=&PD=&PA=ioniqa&IN=&CPC=&IC=&Submit=Search ) the key idea of Ioniqa’s recycling process is the application of a new generation of ionic liquids as decomposition catalyst, where the magnetic properties of the catalyst enabling the removal of the catalyst by means of magnetic fields.

In this way the catalyst is repeatedly usable in the decomposition reaction. Especially the US patent 2018037710 (A1) —2018-020 describes the theoretical background of the hydrolysis process catalyzed by ionic liquids.

Technical details about basic questions like how to separate the commonly in bottle PET present co-monomers or how to remove the adhering ionic catalyst from the solid waste filtrates are not the subject of the publication.

So far a short summary about some recently published activities and projects to establish circular economy approach of PET waste by chemical loop recycling.
2. Which way leads to PET recycling plants on the industrial scale?

Looking at these new processes and considering a production of market conform PTA, MEG and PET-resins on an industrial scale there are some questions in the air. The most obvious are:

2.1 What shall be the final product quality of PTA, MEG, IPA?

2.2 What shall be the input quality of PET waste?

2.3 What is in terms of feasibility and economy the minimum plant capacity of such a chemical recycling project?

2.4 Are there existing chemical PET recycling processes on an industrial scale available?

2.5 What to do with the occurring non-PET-waste?
2.1 What shall be the final product quality of recycle PTA, MEG, IPA?

Everyone will of course answer “PTA, MEG and IPA shall be produced in fiber or bottle grade quality” meaning that these PET raw materials are useful as “drop-in” replacements for the usual market commodity qualities.

This question is not as simple as it seems because it took the polyester industry during its development phase in the last century decades of time and lots of money to establish raw material qualities which are self-evident for us today. And to the important issue “QUALITY” comes immediately the demand for “QUALITY CONSISTENCY”.

Polyester continuous production plant capacities are within a range of 500 – 1500 t/d today. Lines of smaller capacities are shut down step by step.

As consequence quality consistency of PTA is crucial to run plants of such capacity stable and successful.


The next slide is showing a typical quality specification of PTA.
PTA quality specification from SIBUR (see google: SIBUR+ terephthalic acid + specifications, 4. answer)

<table>
<thead>
<tr>
<th>Quality characteristics</th>
<th>Specification</th>
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<tbody>
<tr>
<td>1 Appearance</td>
<td>White crystalline powder</td>
</tr>
<tr>
<td>2 Color, Hazen unit</td>
<td>10 Max</td>
</tr>
<tr>
<td>3 Color index b</td>
<td>2.5 Max</td>
</tr>
<tr>
<td>4 Acid number, mg KOH/g of product</td>
<td>from 673 to 677 inclusive</td>
</tr>
<tr>
<td>5 4-Carboxybenzaldehyde content, µg/g</td>
<td>25 Max</td>
</tr>
<tr>
<td>6 para-Toluic acid content, µg/g</td>
<td>150 Max</td>
</tr>
<tr>
<td>7 Benzoic acid content, µg/g</td>
<td>100 Max</td>
</tr>
<tr>
<td>8 Water content, %</td>
<td>0.2 Max</td>
</tr>
<tr>
<td>9 Ash content, µg/g</td>
<td>10 Max</td>
</tr>
<tr>
<td>10 Metals content*, µg/g</td>
<td>- Fe, Mo, Cr, Ni, Mn, Co, Ti 3 Max</td>
</tr>
<tr>
<td></td>
<td>- Mg, Ca, Na, K, Al 10 Max</td>
</tr>
<tr>
<td>11 Iron content, µg/g</td>
<td>2 Max</td>
</tr>
<tr>
<td>12 Particle size distribution, %</td>
<td>- under 40 µm 30 Max</td>
</tr>
<tr>
<td></td>
<td>- over 250 µm 18 Max</td>
</tr>
</tbody>
</table>

* At the customer's request.
2.1 What shall be the final product quality of recycle PTA, MEG, IPA?

It is striking that there is no or minor information about commonplaces like grain size and grain size distribution, flow-ability or shelf live in big bags over years.

The right grain size of PTA which is within a range of 40 and 240 µm and an average of 150 – 170 µm is one basic property responsible for reactivity, flow-ability and together with moisture of less than 0.1% the guarantee of flow-ability in silos and pneumatic conveying systems as well as shelf live in big bags over years.

Information about particle size and reactivity see also under http://www.micromeritics.com/Repository/Files/appnote130.pdf.

The process to achieve this quality feature is for instance the recrystallization of crude TA under pressure in water or diluted acetic acid, the centrifugation and subsequent drying. Because of the high corrosive internal environment of recrystallization and drying this equipment is made of titanium or titanium lined stainless steel.

The same simple question is seemingly how to separate TA from IPA. But also for this operation recrystallization in diluted acetic acid or organic solvents is required.

Such chemical base operations are in terms of process economy and profitability for any investor meaningful only at capacities commonly used in basic material chemistry.
Using the PTA quality specification of slide 20 as example and looking at the limitation of metal content which is for Mg, Ca, Na, K, and Al together < 10 ppm it becomes obvious that recycling processes which are using large quantities of alkaline like NaOH or KOH as hydrolysis aid will need high sophisticated purification and recrystallization technology to achieve metal contents < 10ppm.

One way out avoiding high expenses for purification and finishing of PTA, IPA and MEG is described for example by an EU invention (EP2838941 A1) where PET waste glycolysis is done by MEG, fine filtration of the solved PET waste and direct reuse of the glycolate blend as 20 - 100 % raw material replacement of a running PET filament plant.

Similar approaches are also described in the Chinese patent literature (.CN103146151A or CN202482242U) where the recovered PET building blocks MEG and TA are directly converted to PET using up to 100% recycled raw materials.
2.2 What shall be the input quality of PET waste?

Looking at PET bottle waste which is the most common input material for polyester recycling there is a broad variety of qualities in the market.

One can find in the market all kind of input material from baled bottles of > 80 < 95% PET or PET flakes up to 99,9% purity with variation in color and transparency. Key question is now which level of waste purity is feasible for the chemical recycling process?

It becomes obvious immediately that waste streams of high impurity levels only like unsorted household packaging waste, presorted polyester textiles or polyester-cotton blend textiles which otherwise are used as fuel of waste incineration power plants are useful in terms of economy and CO2 footprint.

As soon as waste of purity levels > 80% PET is used for chemical recycling this input is competing with mechanical recycling where a large number of well-established, optimized and low cost processes are available.

Looking at CO2 footprint of PET chemical recycling most of time it is forgotten that the produced r-PTA, r-IPA and r-MEG are to convert to polyester again with its known conversion cost (energy, investment, labor).

With simple words chemical recycling to produce PTA, IPA and MEG must use crude waste instead of crude oil.
2.3 What is in terms of feasibility and economy the minimum plant capacity of such a chemical recycling project?

This is the most crucial question. Looking at current plant capacities to produce PTA and MEG we are within a capacity range of 0.6 – 1.2 Mio t/a or 1.6 – 3.3 kt/d which is in terms of recycling beyond all conceivable capacity.

Let us make very simple example sketch to produce PTA and MEG of bottle or fiber grade market quality and assuming a PET waste input of 200 t/d and purity of 70% PET. Provided the PET fraction could be converted with 90% yield to crude PTA and 90% yield to MEG final products are estimated as following:

Example: input waste should contain 70% PET
The containing 140 t PET of 200 t waste are theoretically converted to 119.8 TA + 44.6 t MEG
Rectification and recrystallization losses are estimated to 10%
Resulting products from 200 t waste are 107.8 t PTA and 40.2 t MEG
Resulting non-PET waste is 60 t + 16.4 t production waste are in total 76.4 t waste

This example project would produce ~ 110 t PTA, 40 t MEG and 76 t non-PET wastes per day. The equipment to produce these amounts of PTA and MEG is regarding its capacity in the size of a small pilot facility and fare away from common polyester raw material production capacities in economical size. The simple conclusion is – regardless of any imponderables – the production of market conform PTA and MEG from PET waste based on a green field investment is not representable at all in terms of the economy and feasibility within an input capacity range of 50 – 200 t/d.

Common production capacity of PTA from PX is 1.2 Mio t/a. “Small” plants are of a capacity of 600.000 t/a. Old fashioned PTA plants are in a capacity range of 200.000 – 400.000 t/a. Another interesting figure: downsizing capacity from 100 to 50% requires still 70% of the investment!
2.4 Are there existing chemical PET recycling processes on an industrial scale available?

It is surprising that ever new processes of chemical recycling are invented, although there are a number of well-functioning and industrially proven recycling processes on an industrial scale available.

➔ Teijin Eco-Circle Process

Teijin is playing a pioneering role in Chemical Polyester Recycling (CPR). The company builds on the experience of methanolysis of polyester waste, as it has been operated by polyester manufacturers for many years.

Together with Teijin's existing equipment for the production of DMT and PTA, a robust process for the chemical recycling of polyester waste has been developed during the last 15 years.

The initial production of PET resin for bottle making (B2B) was changed several years ago for profitability reasons to the manufacture of all types of textile fibers and filaments.

Teijin now works with more than 150 apparel and sportswear manufacturers worldwide to develop and manufacture products made from recyclable materials, as well as to collect and recycle these products at the end of their useful lives. See also: http://www.polyester-technology.com/fileadmin/media/literature/82-Thiele_Chemical_Polyester_Recycling_II_Teijin.pdf.pdf.

Based on Teijin license the company Zhejiang Jiaren New Materials Co., Ltd. is operating a chemical recycling plant of 70 t/d capacity and a plant of 440t/d is under erection.
Polygenta ReNew process

“Polygenta's proprietary, commercially proven technology ReNEW™ that produces polyester filament yarn from post-consumer waste PET bottles, is executed at 10.000 tons per annum recycling facility in Nashik, India.

The ReNEW process is a trailblazer technology given its ability to recycle dirty clear and colored PET bottles in a cost effective manner as well as significantly reducing the use of virgin petrochemical feedstock and delivering superior quality products” (see also: http://www.polygenta.com/Our_Breakthrough_process.html).

The basic principle of the ReNew process is the washing of the PET bottle flakes with glycol, glycolysis of the flakes, and fine filtration of the glycolysate, removal of the excess glycol and polycondensation of the glycolysis product thus obtained.

The father of this process, Simon West, started the development in the 1990's and the company Polygenta completed the technical process development in the years 2010 to 2013.

Today, POY filaments are produced by direct spinning from 100% recycled material.
Aquafil Engineering
The process approach of Aquafil is similar the ReNew process of Polygenta and based on mild glycolysis, purification of the glycolysate and direct repolycondensation by a polyester polycondensation plant.

Chinese approaches
Substantial industry development and R&D work towards of new PCR-technologies are done in China.

Major target is the development of recycling processes using polyester textiles as input material. Preferred processes are methanolysis and glycolysis combined with the direct consumption of the recycled materials in running polyester production lines.

Latest news about these processes we will learn during our conference topic: Company tour to Jiaren.

2.5 What to do with the occurring non-PET-waste?

Looking at a chemical PET recycling plant with an assumed capacity of 400 t/d r-PET and an input purity of 70% there are occurring 170 t non-PET wastes daily.

This means besides the chemical recycling plant a waste treatment plant of this capacity is required.

In this context, the construction of a waste incineration plant would be sensible, with the majority of the heat produced being used for the poyes recycling plant.
3. CONCLUSIONS

# As a summary it is becoming obvious, that the main problem is not the lack of a chemical recycling processes but the solution of logistical, capacitive and financial issues of a large-scale plant for PET recycling.

# To simplify process chemistry and purification of the monomers the polymer destruction should refrain as much as possible from the use of catalysts, additives, solvents and process aids like KOH, NaOH, HCl or H2SO4 and prefer heat and pressure as well as process friendly chemicals like water, methanol or glycol. All what is added must be removed up to a purity > 99,99% !

# There are several industry proven chemical recycling processes for licensing available in the market.

# In view of the useful capacity of a recycling plant and its complexity, only the cooperation of major polyester manufacturers, such as Indorama or Reliance with major consumers such as Coca Cola, Nestle, Danone, Lidl or P & G to make a successful entry into the chemical recycling of polyester.

# Most promising solution of chemical PET recycling are those processes where the generated raw materials DMT/PTA and glycol are subsequently and at site used to produce virgin polyester.
Thank you for your kind attention!
LIFE CYCLE ASSESSMENT——QUANTIFY PRODUCT ENVIRONMENTAL VALUE

Presented by Intertek Green Initiatives

Intertek天祥集团绿色环境部
AGENDA 内容

1. Background 背景
2. Life Cycle Assessment 生命周期评价
3. Action in Textile Industry 纺织行业行动
4. Intertek Solution 解决方案
01

BACKGROUND

背景
1. 1 Environmental Impacts 环境影响

- **Environmental Impacts**
  - Pollution
  - Waste
  - Hazardous Material & Waste Management
  - Using the wrong energy & Global warming
1.2 Circular economy & recycling 循环经济、脱钩、资源再生

1.3 PET Recycling PET的加工使用和回收

02
LIFE CYCLE ASSESSMENT
生命周期评估LCA
Environmental Impact of Life Cycle 生命周期过程中的环境影响

2.1 Life Cycle Assessment 生命周期评估 LCA简介

- Raw material grow/extract
- Input
- Resource consumption (such as water)
- Energy consumption, chemicals

- Weaving/knitting and dyeing
- Tailing and sewing
- Finishing and packaging

Quantitative estimation of environmental impact
CO2 Footprint
Energy consumption
Water consumption
Eutrophication (N, P,..)
Toxic to human body
Acidification (NOX, SOX, NH3..)
...

Burying, burning, recycling
Washing, drying, ironing
Logistic
2.2 Life Cycle Assessment Method

List construction

Importing raw materials

Proceeding

Logistic

Use and maintenance

Waste

Data collection

Resource

Raw material

Energy

Output

Emission into air

Emission into water

Discharge into soil

Solid wastes

List

Midpoint environmental impact

Draining resource

Energy consumption

Toxic to human body

CO2 footprint

Acidification

Eutrophication

Ozone destruction

Ecosystem quality

Resource consumption

Environmental impact

LCI

LCIA

Standardization

Characterization index

Standardization = Characteristic value / Fiducial value

Composite value = Standardization x Weight index

Characterization = \( \Sigma ( \text{Substance} \times \text{Characterization index}) \)

e.g. GWP = CO2 x 1 + CH4 x 25 + CFC x 7100 + ……

(kg CO2 eq.)

Draining resource

Energy consumption

Toxic to human body

CO2 footprint

Acidification

Eutrophication

Ozone destruction

Ecosystem quality

Standardization & Weight index

Data collection

Resource

Raw material

Energy

Output

Emission into air

Emission into water

Discharge into soil

Solid wastes

List

Midpoint environmental impact

Draining resource

Energy consumption

Toxic to human body

CO2 footprint

Acidification

Eutrophication

Ozone destruction

Ecosystem quality

Standardization & Weight index
2.3 Life Cycle Assessment Function 生命周期评估 LCA作用

- **Analyze** the environmental impacts of your products 分析产品的环境影响
- **Reduce** the environmental impacts 减小环境影响
- **Communicate** the impacts to consumers 传递信息给消费者

- Product environmental impacts full report 产品环境影响的全套分析报告
- ISO 14040:44 certification (through Peer Review) ISO14040:44认证（通过同业对比）
- PAS 2050 certification + Carbon Trust reduction label PAS 2050证书和Carbon Trust的碳标签

The Full LCA enables a communication on the environmental impacts of your products. 全套LCA分析实现信息传递
ACTION IN TEXTILE INDUSTRY

纺织行业先驱行动
3.1 More and more buy-in 越来越多的品牌加入...

This hip L.A.-based fashion company repurposes vintage clothing, rescues deadstock fabric from fashion houses that over-ordered and also simply uses eco-friendly fabrics to create sexy, sophisticated styles — they even make wedding dresses. The brand has recently launched an app that lets you know just how much water and energy you'll be saving by buying their goods — making your glam purchase a feel-good one, too. And it gets even better: Reformation is sustainable in their own business operations, too — whether using recycled paper to non-toxic cleaning supplies to energy-efficient lighting, there can be little doubt that Reformation is committed to sustainability from top to bottom.
3.1 More and more buy-in 越来越多的品牌加入...

Emma Watson’s Met Gala Dress Was Made Of Recycled Plastic Bottles Because She’s Awesome

Gorgeous for good.

Emma Watson stepped at the Met gala Monday night in New York City where the theme was "Manus x Machina: Fashion in an Age of Technology" because, obviously.

The star posted her thanks on Facebook along with a description of the clothing’s purpose with the hashtag #10Years, writing:

Thank you Calvin Klein & Eco Age for collaborating with me and creating the most amazing gown. I am proud to say it is truly sustainable and represents a connection between myself and all the people in the supply chain who played a role in creating it. The body of the gown is crafted from three different fabrics, all woven from yarns made from recycled plastic bottles (1). Plastic is one of the biggest pollutants on the panel. Being able to repurpose this waste and incorporate it into my gown for the Met Gala proves the power that creativity, technology and fashion can have by working together.

Quoted from (http://www.nydailynews.com/life-style/fashion/emma-watson-met-gala-gown-made-recycled-plastic-article-1.2623120)
3.2 European Methods 欧盟统一方法学（环境足迹：评估，比较和标识）

The development of the PEF and OEF methods

DG Environment has worked together with the European Commission’s Joint Research Centre (JRC IES) and other European Commission services towards the development of a harmonised methodology for the calculation of the environmental footprint of products and organisations (including carbon).

Existing methods and initiatives were taken into account:

- For the product angle, the International Reference Life Cycle Data System (ILCD) Handbook as well as other existing methodological standards and guidance documents (ISO 14040-44, PAS 2050, EP 330, WRI/WBCSD GHG protocol, Sustainability Consortium, ISO 14025, Ecological Footprint, etc).
- For the organisation angle, the Reference Life Cycle Data System Handbook (ILCD Handbook), as well as other existing methodological standards and guidance documents (Global Reporting Initiative, WRI GHG Protocol, CDP Water Footprint, ISO 140064, DEFRA guidance on GHG reporting, ADEME Bilan Carbone, etc).

The final methods, called Product Environmental Footprint (PEF) and Organisation Environmental Footprint (OEF), were published as an Annex to the Commission Recommendation on the use of common methods to measure and communicate the life cycle environmental performance of products and organisations. The two methods are tightly interlinked and will have many elements in common.
3.3 ECO Design 生态设计

材料可持续发展指数
The Material Sustainability Index (MSI)

产品设计工具
The Product Tools

Designers and developers use the Higg Index’s Product Tools to design the best products from an environmental standpoint. These tools help measure product environmental performance at different stages within the product-development cycle, from initial prototype to sourcing raw materials to final design. By giving designers the information they need to make better choices at every stage of development, and by providing inspiration on how to improve their designs, the Product Tools have significant impact in improving the entire industry. Put simply, the choices made by designers and developers drive the actions and choices of manufacturing partners.

http://apparelcoalition.org/
3.4 Supply Chain Management 供应链管理

Environmental Module

The Facility Environment Module is appropriate for any tier of manufacturing in the apparel, textiles, and footwear industry. It measures:

- Environmental Management systems
- Energy use and greenhouse gas emissions
- Water use
- Wastewater/effluent
- Emissions to Air (if applicable)
- Waste management
- Chemical use and management

Social and Labor Module

The Facility Social and Labor Module (still in Beta testing phase) is appropriate for any tier of manufacturing. It measures facility-level social impacts and the efficacy of social management programs. Specifically it assesses:

- Facility workforce standards and those of value chain partners
- External engagement on social-labor issues with other facilities or organizations
- Community engagement

http://apparelcoalition.org/
3. 5 Environmental performance comparison and Label

- A rated footwear products have among the best environmental score of the selected pilot sample.
- B rated footwear products have a better than average environmental score of the selected pilot sample.
- C rated footwear products have an average environmental score of the selected pilot sample.
- D rated footwear products have a poorer than average environmental score of the selected pilot sample.
- E rated footwear products have among the poorest environmental score of the selected pilot sample.

http://apparelcoalition.org/
### 4.1 Intertek Solution 解决方案

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<td>- 环保产品声明</td>
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<td>- 产品LCA用户界面（即时LCA）</td>
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4.2 The development of Global Recycled Standard (GRS V4) 标准发展
Intertek award GRS V4 to Zhejiang Grerial Environment Protecting Co., Ltd.

2018年7月Intertek天祥集团绿色环境服务部（以下简称Intertek）为浙江绿环环保股份有限公司颁发了GRS V4（Global recycled standard全球再生标准认证，第四版）证书。

GRS标准是对再生产品的一套全面评估标准，包含对产品中再生成分的确定、再生材料在供应链的追溯性、再生产品生产过程的质量控制、企业的社会责任、环境管理和化学品禁用等都做出了明确的规定。满足上述条件的同时，产品的再生成分超过了20%的企业，可以申请GRS认证。而如果需要使用GRS标识悬挂在产品上以示环保以及消费者交流产品的环境价值，则需要产品的再生成分不低于50%。

为了避免重复性评估带给企业不必要的成本，该标准还在每个模块设定了等级标准，如在社会责任模块，如果企业已经顺利通过了SA8000或BSCI的评估，则在申请认证时可以递交有效期内的相关证明，进行部分或全部评估豁免。

另外，GRS认证强调追溯性以及供应链成分分配原则。顺利通过认证的企业，在进行交易时，可向认证机构申请交易证书用以提供给下游客户，方便下游客户申请认证或是直接使用标识与消费者交流。“
4.4 Intertek GRS V4 Certificate

Certificate of Compliance

Intertek declares that the products of the categories as mentioned below (and further specified in the annex) comply with this standard:

- Product and use of material
- Recycled content

Certification body: Intertek

Certificate Number: GRS0000000000

Certification Body: Intertek

Global Recycled Standard 4.0 (GRS 4.0)

Certificate of Compliance, page 1/2
4.5 Intertek LCA of Product Carbon Footprint 产品碳足迹/LCA

- At Product and supply chain level在产品和供应链层面上
  - Life Cycle Inventory (LCI) through TGI assessment通过TGI评估建立生命周期目录
  - Capacity Building services to help them collect the right information footprint能力建设服务帮助收集正确的碳足迹信息
  - Full LCA expertise to run LCA on products 全套LCA专家服务开展对产品的LCA分析服务
  - Simplified LCA approach to assess the environmental footprint of a product simply at low cost 简化LCA分析方法（费用较低）可对产品的环境足迹进行评估
  - IT Interface (Instant LCA) for clients who wish to work on their product Eco-Design 为愿意进行产品生态设计的客户提供用户界面（Instant LCA）
  - IT Software (Range LCA) for clients who want to run their LCA internally为愿意进行LCA分析的客户提供IT软件服务（RangeLCA）
  - IT Software (E-balance) for clients in E&E sector 提供机电产品LCA应用思路
  - ISO 14040/44 certification for those who wishes to communicate 提供ISO14040/44认证服务，帮助企业与外界的信息沟通
  - Support to PAS 2050 certification for those who wishes to use the Carbon Trust Reduction Label 为愿意使用Carbon Trust碳标签的客户提供PAS2050认证协助
  - Peer Review for those who wishes to have their own LCA reviewed externally 为愿意将LCA结果被外部评估的企业提供同业对比服务
4.6 Intertek LCA履历

- A renowned third party service provider worldwide, originated from the outstanding ETL established by Thomas Edision a century ago. (世界知名的第三方服务机构，其电子电器服务起源于由托马斯.爱迪生成立的电器实验室)
- A pioneer in LCA simplified methodologies (Intertek是LCA简化方法学的先驱)
  - FCD / ANIA (Carrefour, Danone, Etc.)
  - AFISE (Henkel, Procter & Gamble, Unilever etc.)
  - ADEME / WWF (our partners)
- Active member of WG on Carbon/Environmental Labelling (Intertek积极参加碳标签/环境标签等相关标准的制定)
  - ADEME / AFNOR
  - ISO 14067 TC active member (代表法国环保署参与ISO14067标准的制定)
  - Carbon Trust Partner
- A global verification network and supply chain expertise (Intertek拥有全球验证网络和供应链服务专长)
- A EU Center of Expertise with RDC Environment (和RDC合作，是欧洲的专业技能中心)
- A team of GHG/Carbon Footprint expert in Asia (在亚洲拥有碳足迹核算专家团队)
- Accredited for the PAS2050 standard (获得PAS2050标准授权)
Global ATIC Business with over 42,000 Employees

- Global Market Leader in TIC
- Global Market Leader in Assurance
- 3,000 auditors
- 100,000 audits
- 1,000+ laboratories and offices
- 100+ countries
- 100,000 audits
INTERTEK CHINA 中国概况

10,000+ People 员工

100+ Laboratories and offices 实验室和分支机构

40+ Cities 城市

First foreign company in the industry to enter Mainland China in 1989
第一家进入中国的国际第三方质量与安全机构
WE ENABLE BUSINESS SUSTAINABILITY!
Product Marketing
Differentiated Goods
13-14 Sep 2018
The purpose of business is to create customers. The business enterprise has two basic functions: Marketing and innovation. Marketing and innovation produce results; all the rest are costs.
What is 
product 
marketing
Start with the status quo of customers, their needs and the values.

Create and produce what customers need. Only in this way can a true marketing be realized.

Introduce products required by customers and supporting after-sale services into the market.
Aim of marketing: To make selling superfluous

Difference between marketing and selling:

Selling means producers sell goods to customers who are thought to need these goods. Marketing is market-oriented and aimed at meeting customer needs, and introduce goods together with services into the market.
The change from selling to marketing is not only a technological change, but also a transformation of business thinking.

Master of Management Peter Drucker says: The consumerism makes it clear that correct guiding principle of enterprise management should be changed "from selling to marketing", the more the better.
What is differentiated goods
Functional and high-value-added products

Products with multi varieties and multi specs

Differentiated goods
Product differentiation means the same kind of products from different enterprises in the same industry are not able to replace each other completely owing to the difference on their quality, performance, selling service and information providing. In another word, the product of one enterprise is able to differentiate itself from those from other enterprises in the same industry based on its unique characters. Usually this kind of product is called differentiated product, while those without such features are called non-differentiated products.
The core of differentiation: start from a "Special" one. No matter what kind of enterprise, it must turn to be a "Special" one if it wants to enter into one market while not following the crowd. Only in this way can this enterprise truly get into a higher-level competitive field.

Effective differentiation: Enterprises need to truly recognize their own advantages and disadvantages as well as the status quo and the chances so that they can have a good understanding of the consumption motivation and habit of consumers.
How to do a good job in developing differentiated goods?
Enterprises take the route of product differentiation. It means operators must directly take a leading role in developing new products and new markets.

All sections of enterprises from selling, producing to purchasing must serve the effective production of differentiated goods.

When the route for production differentiation is determined, enterprises must push the development without distraction and persistently.

Enterprise management level needs to have marketing philosophy, innovative thinking and the capability to have an insight into market development and consumer demand.
Anshun Fiber

How we do this?

BORETECH GROUP

Resources and Technology Integrator of Recycled Polyester Industrial Chain
COMPANY PROFILE

- 100% owned by Taiwanese Investors

- 260 employees

- Products range from 1.5D to 25D

- Annual capacity 26,000 MT

- Focus on technical textile industry, especially in Nonwovens and Hygienic field.
Zhejiang Anshun Pettechs Fibre Co., Ltd.

Fiber Solutions

Adjustment on business strategies in previous years

2007
Put efforts on lifting up the proportion for the sales of high-value-added products. Shift gradually from stuffing market to non-woven fabric-based medium to high-end market.

2009
Set up customers' need-oriented marketing idea and run along a route of making differentiated, customized and specialized products so as to make profits by seeking an improvement on the values of products.

2012
Put forward the "Big Quality" route and choose "big companies and big brand businesses" as our target customers.

2016
Build up a test line for composite spinning, and put forward a market layout with needle punching and stitch knitting industries taking the leading role and hygienic material and wool spinning markets taking the supplementary role, so as to form up a fighter-shaped comprehensive market capacity.
Supporting measures for the implementation of business strategies

**Product code management**
 Arrange production based on "Enterprise standard" and "Special standard" and implement production code management during the whole course (Order-production-storage-sales).

**Marketing strategy**
 Set up market-oriented and customer-centered marketing strategy, and the business mode changes from sales promotion to marketing.

**Product route**
 Establish a route of making multi-variety, high-quality, specialized and customized products.

**Product certification**
 - INTERTEK Environmental Friendly Material Certification in 2010
 - INTERTECK Bio-textile Certification in 2011
 - OEKO-TEX Confidence in Textiles Certification in 2012
 - ZDHC-approved pilot company in 2016
 - (GRS) Global Environmental Friendly Material Certification in 2017
Supporting measures for the implementation of business strategies

The route of customized products

1. Supply chain control
   - Carry out supply chain control from 2012
   - Set out ecological requirement for chemical projects
   - Set out ecological standard for chemical purchase
   - Set out ecological quality standard for chemical fiber products
     - Set out ecological inspection procedure for raw materials and auxiliary materials
     - Set out ecological inspection procedure for products
     - Carry out list management for chemicals

2. Improve R&D ability
   - Set up R&D department to continuously improve the quality of existing products and develop new products, and has the capability to help downstream customers research and develop new products.

3. Adjust the processes of fiber production in line with different products or according to the requirements of customers.
Supporting measures for the implementation of business strategies

Promote the environmental friendly concept of recycling sources when selling products, and fulfill the responsibility of protecting environment during the course of production.

It's the core idea for the route of differentiated, specialized and customized products.

Do a good job in supply chain control, the inspection of hazardous substances and the ecological certification of products. Take an active part in the pilot work organized by ZDHC Programme.
Main uses of our products in 2017

- 车饰 Automotive
- 服饰 Garment
- 其他 Others

What others??

家纺, 滤材, 毛毯, 建材, 运动器材等
Home textiles, Filter materials, Blankets, Construction, Sports.

- 靴材 Shoe materials
- 卫材 Hygienic materials
- 其他 Others 10.9%
- 车饰 Automotive 38.3%
- 靴材 Shoe materials 14.2%
- 卫材 Hygienic 29.2%
- 服饰 Garment 7.4%
China and Foreign Market

60%

中国市场
China Market

40%

国外市场
Foreign Market
Fiber for automotive decorations: low VOC, low smell
Fiber for shoe materials: No or low content of antimony metal

- Designed for Needle-punched non-woven fabrics
- Designed for Stitch Bonded nonwovens fabrics
- High Tear Strength
- Recycled & Eco Control the heavy Metal (NPEO,OPEO,SB)
Fiber for filter materials: pass FDA test

- Dust Filter
- Liquid Filter
- Air Filter
- FDA 食品级检测
- Our fiber can pass FDA test.

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<th>Test Requested</th>
<th>Conclusion</th>
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<tr>
<td>FDA 21 CFR 177.1630-Chloroform-soluble extractives</td>
<td>PASS</td>
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Fiber for spinning: Plump appearance for spun yarn

- Triangle
- OB Free
- Bosilun
- Imitation Wool
- PA6 / PET
- Flame retardent PA6/PET
Flame retardant fiber: High flame retardancy and low smoking thickness

- Virgin Permanent
- Recycled Permanent
- Non-permanent FR
- Colored FR Fiber
- Low Smoking FR
- Flame retardent PA6/PET
Bico fiber: with different functions

- 复合纤维 Bico fiber
  - 皮芯结构 Sheath-core
  - 聚乙烯/聚酯 PE/PET
  - 聚乙烯/聚丙烯 PE/PP
  - 尼龙6/聚酯 PA6/PET
  - 阻燃复合纤维 FR Bico fiber
Fiber for hygienic materials: Fluffy and soft

- **Hydrophilic Nonwoven Layer**
- **Acquisition Distribution Layer**
- **SAP 芯体**
- **Water Repellent Nonwoven Layer**
- **Breathable Back Sheet**

Diaper structure
We have set up enterprise strategy planning, market positioning and product route.

We have established production and business concepts learnt as "Market-oriented and with customer needs as the goal".

We have confirmed the profit-making mode of "Lifting up added value of our products".

The most important thing is we have developed common products into differentiated products and improved our profitability.

Recycled fiber spun products: We have made what virgin fiber spinning enterprises are unwilling to produce while recycled fiber spinning enterprises are unable to manufacture.

We have laid emphasis on the construction of business team and advocated the construction of learning enterprises, so as to train managers and market personnel by ourselves.

Key factors for the achievements gained by Anshun at present
Bico Fiber

Anshun will set up the third bico fiber production in Sep. 2018, with capacity at 18,000 tons. Mainly produces bico fiber from 1.5D-2D in dust-free plant, which apply to Hygienic industry.

2018年10月，安顺的第三条生产线（复合纺）将投入生产，规划产能18000吨/年，生产1.5D-2D双组份复合纤维，配套无尘车间，主要用于卫生材料领域。
Thank You
INDIAN TEXTILE SCENARIO

AND

ESTER’S PRODUCTS FOR RPET

SPEAKER:

MR. SANJAY T. KULKARNI

ESTER INDUSTRIES LIMITED, INDIA
Sanjay T Kulkarni is a Chemical Engineer with 40 years experience in manufacture, Projects, Quality Assurance, Marketing, R & D & business Development of Nylon-6 & Polyesters. With experience & expertise in entire range of Polyesters viz PET, PBT, PEN, PTT and allied co-polymers, he has been main inventor in 45 patent applications filed globally. He has worked in partnership with many reputed global companies to develop customized products.

He also has worked in RPET field in developing many grades based on PCRPET for applications in textiles, packaging & Engineering applications.

Currently working in Ester Industries Ltd in Specialty Polymer Division as Business Head.
Who We Are

- Incorporated in 1985
- A multi-business manufacturing company, supplying products and services to customers in over 75 countries.
- Manufacturing premises: Khatima, Uttarakhand, India
- Headquarters: Gurgaon, Haryana, India
- Listed in India on Stock exchanges – BSE and NSE
- Certifications
  - ISO14001:2015 (Environment)
  - ISO 9001:2015 (Quality)
  - OHSAS 18001:2007 (Health & Safety)
- All Ester’s products & processes are patented/patent pending
GREEN INITIATIVES: Lower C-Footprint

BIO-BASED Fuel Consumption
(No fossil fuel is used in manufacturing on products. We save about 110 to 140 kg fossil fuel per ton of polyester manufactured)

RENEWABLE ENERGY
(All electricity used is generated in hydral power plant)

BIO-BASED Raw Material
(Can Supply Polymers based on Bio MEG)

RECYCLING
(Can offer all polyesters based on RPET)

Customer Satisfaction: through Innovation, Development & Partnership
• There are 35 companies manufacturing rPSF in India (approximately 1770 tons per day)
• rPSF is produced as Semidull, black, dope dyed color fibers, hollow fibers, coarser denier fibers, trilobal fiber, hydro management fibers etc.
SPINNING CAPACITY - INDIA

Extruder Spinning Capacity (TPD)

- Install capacity
- Running Capacity

1944
2160

Direct Spinning Capacity (Tons)

- Install capacity
- Running Capacity

15800
17410

Customer Satisfaction: through Innovation, Development & Partnership
SPINNING CAPACITY BREAKUP - INDIA

Extruder Spinning Install Capacity Breakup (TPD)
- 640: POY/DTY
- 1520: FDY

Direct Spinning Install Capacity Breakup (Tons)
- 2550: POY/DTY
- 3650: FDY
- 2900: PSF
- 8310: Chips
Fiber Industry in India is expected to grow at 14% CAGR for the next 5 years and is likely to increase to 15% in the following years.

Source: www.textileexcellence.com
NATURAL FIBRES – PRODUCTION & SHORTCOMINGS

❖ PRODUCTION
  ✓ Resource Intensive - Requires Land, Water
  ✓ Expensive Production Cost
  ✓ High use of Pesticides, Insecticides
  ✓ Prone to crop failure, animal losses

❖ SHORTCOMINGS
  ✓ Difficult to Dye
  ✓ Susceptible to Stains
  ✓ High Maintenance
  ✓ Susceptible to Insect Infestation
SUSTAINABILITY

❖ DEFINITION
Avoidance of the depletion of natural resources in order to maintain an ecological balance.

❖ MAINTENANCE
✓ Avoid accumulation of discarded waste
✓ Avoid dumping waste on land & sea
✓ Follow the 5R’s – Refuse, Reduce, Reuse, Repurpose, Recycle
India has about 3,500 plastic recycling units under organized sector, and over 4,000 under unorganized. Put together, they are estimated to recycle about 3.6 million MT of plastics every year.
Drivers, Restraints, and Challenges

Bans on import of bottle scrap and growing demand for recycled PET for polyester yarn production pose a significant challenge for sufficient availability of raw material for rPET flakes.

**Drivers**
- The Indian retail market is expected to grow at 12% per annum
- 77% of PET bottles consumed in India is recycled, there is scope of further improvement in bottle collection
- Increasing preference for recyclable packaging materials likely to increase demand for recycled PET
- Improvement in technology can lead to growth of rPET industry

**Challenges**
- Ban on use of plastic containers / PET bottles / flakes.
- Undue or hasty decision in banning rPET
- Cleanliness of PET bottle.
- Availability of clean flakes
- States banning PET containers < 300 ml
- Higher cost of rPET

**Preference for recyclable packaging / reduced use of virgin products**

**Growth of Retail Sector - > Packaging Industry**
PET Flakes market is projected to register a CAGR of about 13.5% from 2014 through 2020, exceeding projected CAGR of 11.9% for virgin PET (bottle grade) resins demand during the same period.
Difference in price of virgin and rPET is gradually decreasing, this shows there is more demand of rPET.
Advantages of Ester’s Masterbatch in rPET

- Manufacture value added product with rPET
- Improve dye bath exhaustion
- Enable reduction in dyeing cost
- Enable blending polyester with natural fibers
- Flexibility in Inventory Management
- Add comfort to Polyester
- Improve Softness & Moisture Absorption
ESPET MB-10 : Improves Softness and Moisture Absorption

ESPET MB-06 R4 : Imparts Cationic Dyeability

ESPET MB-07 R8 : Imparts Easy/Deep Dyeability by Disperse Dyes

ESPET MB FR-10 : Imparts Flame Retardancy

ESPET MB-90 : Imparts Abrasion Resistance

ESPET MB-100 : Imparts Soft Feel and Abrasion Resistance

Ester has developed many other products for textile industry (For Nylons & pp ), carpet industry (For PET/RPET, PP & Nylons ) & packaging Industry .
ESPET MB-10

MASTER BATCH TO IMPROVE SOFTNESS AND MOISTURE ABSORPTION OF PET/RPET

APPLICATION:
- Master batch to improve moisture absorption
- Recommended dosing: 10% for improving moisture absorption up to 2 ~ 3%.

SALIENT FEATURES:
- Allows dyeing of Fabric/Yarn at 90 – 95°C at atmospheric pressure.
- Dye bath exhaustion (> 95%)
- Reduction in effluent treatment costs (thus is environment friendly)
- Imparts Soft feel
- Accelerates dyeing process
- Enables printability
APPLICATION:

- ESPET MB-06 is a Master Batch to impart cationic dyeability in PET/RPET for PSF/ PFY/BCF applications.
- Dosage can be varied based on required depth of the shade.
SALIENT FEATURES:

- Product supplied in crystalline form
- Enables deeper and darker dyeing
- Excellent filterability and processability
- Can be blended in bright, semi-dull and full dull PET
- Enables flexible dosage based on dyeing depth required
- Enables efficient inventory management
- **Environment Friendly:** Complete dye bath exhaustion (>90% against traditional process wherein 60-70% exhaustion occurs) with cationic Dyes
- **Cost effective and less time consuming process:** Dyeing time reduced by 40% and better dye exhaustion leads to reduced ETP cost
ESPET MB-07 R8

MASTER BATCH TO IMPART EASY/DEEP DYEABILITY IN PET/RPET BY DISPERSE DYES

APPLICATION:
- Master batch to impart easy dyeability in PET/RPET
- Enables Differential Dyeing
- Low DPF yarns

Customer Satisfaction: through Innovation, Development & Partnership
ESPET MB-07 R8

MASTER BATCH TO IMPART EASY/DEEP DYEABILITY IN PET/RPET BY DISPERSE DYES

SALIENT FEATURES:

- Dyeing at 95°C at atmospheric pressure
- Dyeing time reduced by 40%
- Enables darker dyeing
- Superior dye bath exhaustion at > 90%
- Reduction in effluent treatment costs
- Dosing flexibility
  - Can be blended at dryer inlet
  - Can be dosed at extruder inlet
  - Dried and molten MB-07 can be injected in polymer melt line
- Imparts soft feel
ESPET MB FR-10

MASTER BATCH FOR MANUFACTURING FLAME RETARDENT PET

APPLICATION:

- **FR yarns/Fibers based on P based Reactive additive**
- The P additive is incorporated as a part of the PET chain
- Can be dosed with RPET/ PET
- Imparts permanent FR Properties with good processability

SALIENT FEATURES:

- Supplied in crystallized form with 40000 ppm P
- P-content and I.V. can be customized as per the requirement
ESPET T-90

MASTER BATCH FOR ABRASION RESISTANCE

SALIENT FEATURES:

- Master batch to improve abrasion resistance
- Can be blended 10% in PET/RPET to achieve 300% abrasion resistance over standard PET
- Flexibility in Dosage
- Supplied in crystalline form
- Can be dried like normal PET in dehumidified dryers
MASTER BATCH TO IMPART SOFT FEEL AND ABRASION RESISTANCE IN POLYESTER

SALIENT FEATURES:

- Improves moisture absorption & soft feel
- Improves scratch/abrasion resistance
- Can be blended between 10 and 15% to achieve 250% abrasion resistance with desired comfort level
- Improves Easy dyeability using Disperse Dyes at 95°C, Atmospheric pressure
- Dye bath exhaustion > 95% 
- Reduction in effluent treatment cost (Environmental friendly)

Customer Satisfaction: through Innovation, Development & Partnership
AMERICHEM(SUZHOU) CO LTD is marketing our Products in China & Asia.
450 ZHONG NAN STREET,
SUZHOU IND PARK, SUZHOU JIANGSU- 215123
CHINA

For any query you may contact:

* Mr Sanjay T Kulkarni (Business Head-Specialty Polymers) : <Sanjay.Kulkarni@Ester.in>
Ester Industries Ltd

* Mr. Stanley Teoh (M.D.) Americhem : <STeoh@americhem.com>

* Mr Frank Li (Commercial Manager) Americhem : Fli@Americhem.com
Thank you!

We look forward to building enduring partnerships with you

Please Visit us at www.esterindustries.com
Hubei Weisuyuan Renewable Resources Co., Ltd.

Your Professional Supplier of Recycled PET Raw Materials

September 13th, 2018, Shaoxin, China.
Invested and established according to the national “Guiding Opinions on Accelerating the Development of Renewable Resources Industry”, Hubei Weisuyuan Renewable Resources Co., Ltd. is a technological and environmental-friendly joint-stock burgeoning enterprise. It is an enterprise pertains to national "Double Hundred Project" of comprehensive utilization of resources. Each year, 40 billion waste bottles are recycled, which can save 1.2 million tons of oil, and reduce emissions of carbon dioxide and sewage by 1.6 million tons and 0.9 million tons respectively.

The company introduces German technology and apply the most advanced technology and equipment in the country. With a total investment of 200 million yuan, the first-phase project covers an area of 160 mus and its investment is 100 million yuan. It has been completed and put into operation in March 2018. The company plans to achieve an annual output of 100,000 tons of bottle flakes within 3 years!
Enterprise Environment
Thanks to Secretary General Lin Shidong of China Chemical Fibers Association for guiding and caring the work of our company!

Thanks to Hangzhou Jinfuchun Industrial Co., Ltd. for the continuous support to and trust in our products!
Industry Background

1. National supervision of environmental protection;
2. The integration of the two networks of private recycling and environmental sanitation system;
3. Prohibition on the import of foreign garbage.

The above comprehensive factors have led to the shortage of raw materials in the domestic PET recycling industry as well as the quality decline of reclaimed raw material.

At present, CCFA is pushing for the import license of foreign hot-washed bottle flakes, and at the same time adjusting the relevant acceptance standard of hot-washed flake to fill the raw material gap in the domestic chemical fiber industry.
Hope and Opportunities

1. Standardization of the circular economy;
2. Market demand;

The policy is favorable, to improve the production capacity and profitability of enterprises with normalized production, and to avoid disorderly competition in the market.

There is still a big gap between the utilization rate of recycled polyester fiber in China and that in developed countries in Europe.
1. Under the influence of multiple factors at home and abroad, downstream customers meet with the shortage and quality decline of raw materials;
2. Hubei Weisuyuan will continue to actively undertake the responsibility of environmental-friendly recycling. At the same time, we will provide high quality and stable raw materials for our downstream customers with professional technology and first-class management.
3. We will actively provide our after-sales service and live up to the mission of the industry and the expectations of our customers.

Duty and Mission
Thanks

Hubei Weisuyuan Renewable Resources Co., Ltd.

Contact: Chen Shengguang  Tel: 13997566719
Status Quo and Future Development of Recycled PFY

Cen Kechao

Cixi City Xinxian Chemical Fiber Co., Ltd.
current situation
POY capacity

<table>
<thead>
<tr>
<th></th>
<th>Oil-based POY</th>
<th>Recycled POY</th>
</tr>
</thead>
<tbody>
<tr>
<td>Capacity</td>
<td>33,580</td>
<td>1,160</td>
</tr>
</tbody>
</table>

- Oil-based POY: 97%
- Recycled POY: 3%
POY annual production

- Oil-based POY: 98%
- Recycled POY: 2%

<table>
<thead>
<tr>
<th></th>
<th>Oil-based POY</th>
<th>Recycled POY</th>
</tr>
</thead>
<tbody>
<tr>
<td>Production (kt)</td>
<td>26,300</td>
<td>450</td>
</tr>
<tr>
<td>Capacity (kt/yr)</td>
<td>33,580</td>
<td>1,160</td>
</tr>
<tr>
<td>Operating rate</td>
<td>78%</td>
<td>39%</td>
</tr>
</tbody>
</table>

Data in 2017
**Physical method**
- Low cost
- Fast and low energy consumption
- Quality largely affected by flake
- Quality improvement requires upstream coordination.

**Chemical method**
- Stable quality
- Low requirement for feedstock
- High cost
- High energy consumption and slow process
How heavy is a 500ML mineral water bottle?

A 500ML mineral water bottle is about 25 grams!

10 mineral water bottles = 1 T-shirt
Cost control

Old equipment
Lacking cash flow margins, enterprises fail to upgrade equipments and in turn fail to improve products quality.

Reduce equipment investment

Reduce the staff

Lacking workers and administrative staff leads to difficulty in meticulous management.

Extensive management
02
FUTURE
Conventional product

Reduce feedstock cost
Using cheaper recycled materials to partially replace bottle flakes.

Improve profits
After several years of industry reshuffle, the cash flow has been improved.

Raise industry barrier
Professional production and continuous improvement of supporting facilities

Upgrade industry agglomeration
The Matthew effect is more and more obvious in the industry, and the factory with low efficiency is further withdrawing from the market.
Superior product

**Mature technology**
Domestic R-PET makers have more experience in improving quality

**Fierce competition**
In the future, new capacity and potential entrants will continue to increase, leading to fierce competition

**Large-scale market**
More intentions to increase production of recycled products

**Reduced profits**
High profit margins can not last for a long time, and future competition will continue to erode profits.
XINGKE CHEMICAL FIBER
Cixi Xingke Chemical Fiber was founded in 2000. It is a technological innovation-based enterprise specializing in the production and sale of recycled polyester filament yarn with various specifications. The company is located in the east coast of Cixi. The total investment is 250 million yuan and the company covers an area of 110 mus, with a total construction area of 80,000 square meters. The company’s POY capacity stands at 130kt/yr. The company recycles 4 billions beverage bottles annually to make textile products based on the concept of resource regeneration and environmental protection. Currently, Xingke is one of companies with largest production of recycled POY in the world and at the same time has a wealth of experience in recycled POY business.
CERTIFICATE OF COMPLIANCE COPY
(Scope Certificate)

CERTIFICATE No: CU849408GRS-01.2017
REGISTRATION No: CU 849408

Control Union Certifications declares that

Cixi City Xingke Chemical Fiber Co., Ltd.
North Yan Hai Road, Cidong Industrial Zone, Cixi City
Ningbo
Zhejiang CHINA

has been inspected and assessed according to the
Global Recycled Standard (GRS)
Version 3.0

and that products of the categories as mentioned below (and further specified in the annex) comply with this standard:

Yarns

Processing steps / activities carried out under responsibility of the above mentioned company (by the operations as detailed in the annex) for certified products

Exporting, Importing, Processing (DTV), Processing (POY), Trading

This certificate is Valid until: 08 November 2018

Place and date of issue: Shanghai, 16 November 2017

Stamp of the issuing body

Standard's Logo

Name of authorised person
### POY annual production

<table>
<thead>
<tr>
<th></th>
<th>Recycled POY</th>
<th>Xingke’s POY</th>
</tr>
</thead>
<tbody>
<tr>
<td>Production (kt)</td>
<td>450</td>
<td>100</td>
</tr>
</tbody>
</table>

- **Other recycled POY**: 78%
- **Xingke’s POY**: 22%
Existing equipment

- 400 winding heads: Daily output at 450 tons
- 8 washing lines: Daily cleaning capacity can reach 800 tons.
- 11 texturing machines: DTY daily output at 15-35 tons
Independent of the original factory management, annual output of 10,000 tons of recycled POY, mainly white, and part of the colored filament, and annual output of 2,000 tons of recycled FDY.

Plan to add six new texturing machines to process POY.

50kt/yr high-end recycled POY unit and texturing machines are both advanced equipments.
Initially completed goals
Medium-to-low-end recycled PFY

Middle target
Medium-to-high-end recycled PFY

Ultimate target
Top brand of recycled PFY
Phone: 13805815989    E-mail: cenkechao@126.com

THANK YOU
Analysis on 2018 recycled chemical fiber market in China

CCFEI    Cao Wenting
01

Macroeconomic overview in 2018
Crude oil market trend

Oil prices started to rebound in mid-2017 as interest rates rose in the US and Saudi Arabia broke off relations with Qatar.

In 2018, the prices fell back despite ongoing geopolitical crisis. The number of oil drilling rigs in the US increased, and crude oil yields also rose, with signs of higher oil production in Saudi Arabia and Russia. All these raised major concerns.
<table>
<thead>
<tr>
<th>Date</th>
<th>Measures</th>
</tr>
</thead>
<tbody>
<tr>
<td>9 March</td>
<td>Trump signed tariff agreement to levy 25% and 10% tariffs on steel and aluminum respectively.</td>
</tr>
<tr>
<td>22 March</td>
<td>The White House announced to levy additional tariffs on Chinese products worth 50 billion dollars.</td>
</tr>
<tr>
<td>23 March</td>
<td>Chinese Department of Commerce planned to levy additional tariffs on US products worth 3 billion dollars.</td>
</tr>
<tr>
<td>2 April</td>
<td>China levied additional tariffs on 128 items imported from the US.</td>
</tr>
<tr>
<td>4 April</td>
<td>The US levied 25% additional tariff on Chinese products worth 50 billion dollars under 301 investigation.</td>
</tr>
<tr>
<td>4 April</td>
<td>China decided to levy 25% additional tariff on 106 items from the US including beans and automobiles.</td>
</tr>
<tr>
<td>5 April</td>
<td>Trump considered levying additional tariffs on Chinese products worth 100 billion dollars.</td>
</tr>
<tr>
<td>17 May</td>
<td>Chinese delegation led by Liu He paid a visit to the US.</td>
</tr>
<tr>
<td>19 May</td>
<td>The US and China made joint announcement to strengthen trade cooperation in multiple areas.</td>
</tr>
<tr>
<td>29 May</td>
<td>the US mentioned levying additional tariffs on Chinese products worth 50 billion dollars again.</td>
</tr>
<tr>
<td>2 June</td>
<td>US delegation led by Head of Department of Commerce paid a visit to China.</td>
</tr>
<tr>
<td>15 June</td>
<td>The US issued the tariff list of products worth 50 billion dollars.</td>
</tr>
<tr>
<td>16 June</td>
<td>China decided to levy 25% additional tariff on US products worth 50 billion dollars.</td>
</tr>
<tr>
<td>6 July</td>
<td>The US levied 25% tariffs on first batch of 818 kinds of Chinese products worth 34 billion dollars, while China also enforced formally the additional tariffs on some US-origin products.</td>
</tr>
<tr>
<td>11 July</td>
<td>The US announced to levy 10% additional tariffs on Chinese products worth 200 billion dollars.</td>
</tr>
<tr>
<td>3 August</td>
<td>China Department of Commerce announced to levy 5%-25% additional tariffs on US products worth 60 billion dollars</td>
</tr>
<tr>
<td>23 August</td>
<td>The US enforced formally the 25% additional tariffs on China-origin goods worth 16 billion dollars.</td>
</tr>
</tbody>
</table>
Environmental inspection as a new normal

Ministry of Ecology and Environment officially went into operation, marking the normalization of environmental inspection that started in 2017.

01. Environmental Protection Tax Law and Water Pollution Prevention and Control Law were implemented from 1 January, 2018.

02. From 11 June to 24 June, the first round of intensive supervision was carried out in the Beijing-Tianjin-Hebei region, including Beijing, Tianjin, 26 cities and 334 counties/districts.

03. Measures for Pollutant Discharge Permitting Administration (Trial) was enacted.

04. The environmental protection department in Jiaxing City started 2018 "Zero 2" special law enforcement action for environmental protection. Yangtze River Economic Belt: comprehensively cracking down “river pollution”.

05. First shot of national environmental remediation in printing and dying sector has been fired in Shaoxing Paojiang Economic and Technological Development Zone.
On May 14, 2018, the General Administration of Customs issued internal documents which allowed companies to import high-quality cleaned PET flakes as ordinary commodities.

On August 10, 2017, the five departments adjusted and revised the current Catalogue of Prohibited Imports of Solid Waste, the Catalogue of Solid Wastes that Can Be Used as Raw Materials under Restricted Import and the Catalogue of Solid Wastes that Can Be Used as Raw Materials under Non-restricted Import.

In early 2018, rumor came that we were going to import cleaned flakes.

In January to December 2017, China imported 2166.9kt of waste PET scraps, down by 365.7kt from 2532.6kt in January to December in 2016. In 2018, China imported 82kt PET chip (HS Code 39076990), and import volume of PET chip (HS Code 39076910) increased by 59kt on year.

On July 16, 2018, the revised industrial standards for recycled PET flakes were submitted to the Science and Technology Development Department of CNTAC.

This year, the bottleneck troubling recycled fiber industry is still the sources of bottle flakes, which accelerated capacity elimination in recycled fiber sector.
Price trend of recycled PET raw materials and products
Price trend of bottle flake and recycled fiber
Bottle flake cash flow

- Clear flakes to spin virgin-like R-PSF
- Clear flakes to spin 3-D-crimped R-PSF
- Clear flakes to spin R-PFY

Cash flow and Cost are represented in the graphs.
Recycled PET cash flow in 2018

- Virgin-like R-PSF
- Recycled POY
- 3-D-crimped R-PSF
Price spread

The price spread between SD chip and clear flakes to spin virgin-like R-PSF dropped from 2,500 yuan/ton to 700 yuan/ton in 2017 and rose to 3,450 yuan/ton at the end of August this year.

The price spread between virgin-like R-PSF and PSF dropped from 2,000 yuan/ton to 500 yuan/ton in 2017 and rose above 1,500 yuan/ton at the end of August this year.
The price spread between SD chip and clear flakes to spin R-PFY dropped from 2,800 yuan/ton to 450 yuan/ton in 2017 and rose to 2,450 yuan/ton at the end of August this year.

The price spread between polyester POY and R-POY dropped from 2,800 yuan/ton to 450 yuan/ton in 2017 and rose to 1,250 yuan/ton at the end of August this year.
The price spread between SD chip and clear flakes to spin 3-D-crimped R-PSF dropped from 3,250 yuan/ton to 850 yuan/ton in 2017 and rose to 3,150 yuan/ton at the end of August this year.

The price spread between 3-D-crimped PSF and 3-D-crimped R-PSF dropped from 3,200 yuan/ton to 1,100 yuan/ton in 2017 and rose to 2,000 yuan/ton at the end of August this year.
Run rate and Inventory

Inventory in 2018

Run rate and Sale/production ratio

Jan Feb Mar Apr May Jun Jul Aug

0% 20% 40% 60% 80% 100% 120%
Import and export of R-PSF

Import (kt)

Export (kt)

RMB exchange rate
After 2005, business cost surged and profits declined, resulting in a slowdown in investment growth. In 2009, however, profits increased in recycled fiber sector amid economic recovery, and investment heated up. In 2010-2017, producers were less keen to invest again amid fierce competition, and capacity growth rate dropped due to entrance threshold in the industry.
Recycled PET market outlook
Market Outlook

Price spread remains unchanged between virgin and recycled products

More interaction with brands; new standards for import may change fundamental structure

Favorable PET feedstock fundamental

R-PET fiber still in capacity elimination cycle

Industrial structure upgrade

1. Recycled fiber capacity continued to be eliminated.
2. Capital continues to flow into bottle flake sector, with industrial monopoly already in existence.
Future focus

01 Sino-US trade friction
Focus should be on macro-economy amid friction, as well as changes of exchange rate, crude oil, and import and export.

02 Deeper supply-side reform
Focus should be on environmental inspection and market demand for products with high added value.

03 Industrial chain dynamics abroad
Focus should be on development of recycled polyester industrial chain abroad and international interaction.
Thank you
DAFA CULTURE AND HEALTH

NINGBO DAFA CHEMICAL FIBER CO., LTD
Established in 1995, Ningbo DAFA is a private company mainly produce regenerated polyester staple fiber by using recycled PET bottle flakes.

We have achieved the certification of ISO9001, ISO14001 and OHSMS18001 international management system from 2003.
We have paid more attention to Science and Technology Innovation. We have applied for 306 items of patent, 261 items of which have achieved the nation patent. We have undertook 5 projects of National Torch Plan, 3 projects of National key new products and 1 project of the country's 13th five-year major science and technology. (As of Dec. 2017)
ABOUT US

We mainly produce regenerated polyester staple fiber with an output capacity of 2 billion, they are good to be used for non-woven, toys, pillows, quilts, bedding, cushions, car interior industries, etc.

DAFA products are in a leading position among global market no matter in output, quality variety and brand economic indicators, etc.
**VISION:** DAFA generalizes the philosophy of “Earn money as well as keeping a health body”. Make employees feel the most happiness not only in material life, spirits but also in health, and employee satisfaction has reached over 98%. We would like to make a progress to society by using the resource to produce high quality and environment protection products.

**AIM:**
1. To be a Century-Old Enterprise.
2. Standing a leading position in world industry
3. To be a global health character enterprise
ENTERPRISE CULTURE

1. EVERYBODY DEVELOPMENT CULTURE
2. CONSCIENCE CULTURE
3. HEALTH CULTURE
Enterprise development

Staff development

Partner Development

Society Development

Nation Development

DAFA PHILOSOPHY

NINGBO DAFA CHEMICAL FIBER CO., LTD.
Enterprise needs to make money.

Treat staff with better salary, welfare and health comparing with the same industries.

Pay tax to the nation as much as possible.

Make annual charitable donation over 3 million, which is unshakable.

AFA like win-win cooperation, and we care about partners’ benefit and not bullying partners.
We obey not only laws but also conscience. Law is the bottom line but has loopholes, and conscience has no loopholes.
HEALTH CULTURE

✓ Earn money as well as keeping a health body.
✓ Join in DAFA, live more than 10 years.
✓ To be a person, the most important is to “live in a healthy and happy life”, all the human activities are for health and happy in a direct and indirect ways.
1 System of employees physical examination has been last for 13 years.

Cost Standard:
- Workers ¥ 400/time per year (Including Pre-job physical and on-job physical)
- Administration and Canteen staff and workers, grassroots cadres who works over 10 years ¥ 1000/time per year.
- Factory director, minister and deputy general manager ¥ 1000/two time per year (i.e. ¥ 4000 per year).

The examination result will be imported to the health management system for dynamic state management.
2 Health Reward
Health reward is included 15 indicators, including 10 physical examinations (40 points), BMI measurement (20 points), health study (10 points), mental health (10 points), exercise (10 points) and personal hygiene (10 points). These indicators will be examined, the full marks is 100. The employees will be regarded ¥500. The premise is that you have to sign a promise to quit smoking, otherwise you will not get any reward even get full scores in all indicators.
ENTERPRISE HEALTH MEASURES

3. Each employee will be given a box of yogurt which is the best in local market (or equivalent raw walnuts, organic dates, etc.) every month.

4. Each employee will be given an electric toothbrush with a value of over ¥400.

5. Hold a health lecture each month. Also spread healthy education through a variety of form, such as the "DAFA NEWS PAPER" column, health publicity column, SMS tips, health public platform WeChat.
Special position in production line
In strict accordance with the labor protection requirements, each employee is provided with labor insurance supplies, and good health management: with regular environmental testing, regular job rotation and health physical examination every year.

High temperature production area
Increase workshop ventilation facilities, set up operation observation room, equipped with air conditioning to improve the working environment.
Issued health pamphlets of self-compiled by DAFA four times, with a total copies of more than 10,000. Bought 12,500 copies of Nutrition Revolution and 12,000 copies of Don't get Sick to all the employees and some related persons. Subscribe the Life and Health with a copy of 106 to all the departments.
Regularly (weekly) calls out doctors and experts to DAFA for free diagnosis and on-site prescription. Each department take turns to DAFA (internal medicine, surgery, gynecology, orthopedics, acupuncture and massage, etc.)

Set up health consultation room and help employees to solve some difficult disambiguation, measure height, weight, blood pressure and so on.
11 Forest Office

Place over 10 green plants in each office and 2 air purifiers, one for internal circulation and the other for outside circulation to ensure office can get enough sufficient oxygen. When the outdoor PM2.5 is above 500, the indoor temperature remains below 20. The general manager's office has installed a artificial waterfalls, with more than 1,500 negative oxygen ions per cubic centimeter, and the air quality reaches the international quality standard.
The administrative canteen staff controls the cooking oil, salt consumption per capita, and issue a statistics report each month.

The canteen is not allowed to fry, pickle, smoke, roast, finish, mildew food during cooking. Advocate grains, brown rice in diet, refuse MSG.
The canteen water is filtered with the secondary level standard, and the electrical conductivity is tested by special staff regularly every Monday morning to ensure that the electrical conductivity of the water used for food is below 5uS (the electrical conductivity of the water supplied by the municipal government is around 500uS, and the national standard is below 1000uS).

The administrative canteen vegetables are supplied by two farms, all with olive oil, camellia oil, sea salt. We advocate for public chopsticks, spoons, distribution meal.
Establish a health team headed by the general manager.

- Set up Enterprise council for the promotion of health, family planning association and new citizens branch;
- Set up health commissioner;
- Hired an experience director whose major is in health chief physician over 30 years and China health management division as our health consultant (total four);
- Hired a Dr. who studied in the United States (the author of Nutrition Revolution, Not Sick of Dietary Daily Life and so on) lectures and guide the keeping in good health, global purchasing health food.
Equipped over 20 varieties of sports equipments with a total of over 60 pieces, of which there are 10 tennis tables. Every year we held a sports meeting and a fitness test match. The administrative employees need to leave 15 minutes free time in the afternoon and afternoon for exercise.
In order to reduce the radiation from mobile phone, over 1,000 DAFA employees are provided with free China Telecom phones instead of China mobile phones and pay free phone bills for employees for 2 years. Guarantee everyone could use the low-radiation mobile phone.
Every administrator staff, middle and top managers are provided with a pedometer, massage comb, mobile phone radiation protection stick. Besides, the top managers will also be provided with foot massage device and electric heat foot bath basins.
**Equipped with various testing instruments**

- **Air:** Air PM2.5 and PM10, negative oxygen ion, formaldehyde, comprehensive volatiles of oxygen, chlorine, air rate;

- **Body Health:** Including muscle rate, blood pressure, heart rate, height, weight, BMI;

- **Diet:** Conductivity, pesticide residues;

- **Others:** Electromagnetic radiation and so on.
All the employees’ dormitories are equipped with double hollow glass windows (for sound insulation and thermal insulation) and dark double-layer curtain cloth, in order to improve the employees' sleeping feeling. All the offices are equipped with double windows, and the general manager's office is equipped with 4 windows.
Start from April 2015, the company spreads health education to guide employees to lose weight by ways of comprehensive intervention of diet structure and lifestyle. After one month’ training, comparing with previous years, the 51 employees lost a total of 258.8 kg, and most of the physical examination indicators go towards normalization.
Since July 2016, the new activity of "Bring Health Knowledge in Workshop" has been carried out, Health commissioner will share health information with workers about 5-10 minutes for interactive communication during pre-work and after-work meetings. By June 2017, the mini health meeting has held over 300 times.
Establish "Healthy China" fitness club, with table tennis, basketball, football, badminton, table tennis, running, fitness. And more than 100 employees have joined in. Invest special funds to combine employees' interests with health exercises together.
In DAFA factory, the small garden is fully filled with fitness equipments. Company vision, health slogan and health knowledge can be seen everywhere in the factory. The word "health" covers every corner of DAFA factory.
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26 Set up contraceptive dispensation and health promotion station inside the employees’ dormitory building, spread the coverage and availability of contraceptives so that to enhance the health and safety awareness of floating population.
ENTERPRISE HEALTH MEASURES

Establish "Health Science Base for DAFA Health", design health exhibition hall. Establish "The Station Agent "library and a "Health Cabin", supply employees with health concepts knowledge, and enable them to pay more attention to health during their busy work.
（一）大家发文化

（1）公司发：开办公司一定要赚钱；
（2）员工发：每位员工到了公司后要比去别的公司待遇好（含工资、福利、健康、环境、关怀等），让全体员工物质、精神、健康等全面幸福；
（3）国家发：要尽可能地多交税；
（4）社会发：多做慈善，搞好环保，为社会进步作出贡献；
（5）合作伙伴发：与公司做生意的各方都要合情合理地赚钱。
（二）良心文化

既要讲法规，更要讲良心。法规是底线，有漏洞，良心无漏洞。良心是心理健康的基础。
(三) 健康文化
既要赚钱，
更要赚健康。融入大发，多活
10年。
Establish "Health Science Base for DAFA Health", design health exhibition hall. Establish "The Station Agent "library and a "Health Cabin", supply employees with health concepts knowledge, and enable them to pay more attention to health during their busy work.
ENTERPRISE HEALTH MEASURES

Ningbo DaFa Chemical Fiber Co., Ltd.
Establish "Health Science Base for DAFA Health", design health exhibition hall. Establish "The Station Agent "library and a "Health Cabin", supply employees with health concepts knowledge, and enable them to pay more attention to health during their busy work.
急性出血性结膜炎俗称红眼病，起病急骤，眼刺激症状重，结膜高度充血，本病传染性强，发病率高，传播很快，发病集中，自然病程短，目前尚无特殊有效疗法。

患者是本病的主要传染源，其眼部分泌物及眼液均含有病毒。发病后2周内传染性最强。该病潜伏期一般为12-48小时，最长可达6天。该病主要是通过接触被患者眼部分泌物污染的手、物品或水等而发病。患者病愈后，可以再次感染而发病。

对有“红眼病”症状的，要及时就医，同时要自觉自我主动隔离，积极治疗患者，与患者有密切接触关系者也应与患者及时隔离、预防。患者所用手巾、手帕、脸盆、眼镜等物品须经常消毒，并与健康人分开。少儿、老人抵抗力弱，尽量少去人多处，并经常保持手、眼卫生，不与患者共睡。一旦与病人或其接触过的物品接触后须立即洗手消毒以防交叉感染。在“红眼病”多发区，下水前后可以预防性地滴一些抗菌、抗病毒眼药水。

NINGBO DAFA CHEMICAL FIBER CO.,LTD.
Establish "Health Science Base for DAFA Health", design health exhibition hall. Establish "The Station Agent "library and a "Health Cabin", supply employees with health concepts knowledge, and enable them to pay more attention to health during their busy work.
六、杜绝浪费，兴新食尚

珍惜食物，按需备餐，提倡分餐不浪费。

选择新鲜卫生的食物和适宜的烹调方式。

食物制备生熟分开、熟食二次加热要热透。

学会阅读食品标签，合理选择食品。

多回家吃饭，享受食物和亲情。

传承优良文化，兴饮食文明新风。
Establish "Health Science Base for DAFA Health", design health exhibition hall. Establish "The Station Agent "library and a "Health Cabin “ and supply employees with health concepts knowledge, and enable them to pay more attention to health during their busy work.
Establish "Health Science Base for DAFA Health", design health exhibition hall. Establish "the Station Agent "library and a "Health Cabin", supply employees with health concepts knowledge, and enable them to pay more attention to health during their busy work.
选择天然、新鲜（当地当季）的食品；不食糖，避吃面，少吃米，多吃根类，吃海鲜、肉类和蛋类；烹调顺序为：生、蒸、煮、炒、烤、炸，尽量生食；吃七分饱，不喝饮料、多喝水。
戒烟戒酒，避免化学毒素，远离电磁辐射；早睡早起，充足睡眠，常晒太阳，少用灯光；适时多开窗，少用药。
ENTERPRISE HEALTH MEASURES

适度运动
彻底打破久坐，经常快走，偶尔快跑，常做力量训练。
及时释放压力，顺应

NINGBO DAF A CHEMICAL FIBER CO., LTD.
ENTERPRISE HEALTH MEASURES

及时释放压力，顺应自然变化，淡泊名利，与人为善，多做善事。

NINGBO DAFA CHEMICAL FIBER CO., LTD.
Establish "Health Science Base for DAFA Health", design health exhibition hall. Establish "The Station Agent" library and a "Health Cabin", supply employees with health concepts knowledge, and enable them to pay more attention to health during their busy work.
ENTERPRISE HEALTH MEASURES

火災隱患的重大危險性

1. 火災給人人類帶來文明進步、光明和溫暖，但是，失去控制的火災，往往給人類造成災難。火災不僅損害財產，造成社會秩序的混亂，還直接威脅到人類的生存，給人們的心靈造成深重的傷害。每年火災造成直接財產損失數十億元，尤其是造成幾十人、上百人死亡的特大火災火災時有發生。火災的頻繁發生，火災是當今世界上多發性災害中最常見的事故之一，也是時時刻刻威脅人類的一種災害。

2. 火災的自救方法

1. 當火災發生時，首先確保自身安全，控制火勢擴大。
2. 用濕毛巾捂住口鼻，快速進入安全區域。
3. 撒離時，注意遵循逃生口號，不擠不細。
4. 留意身體的狀況，如感到疲勞、呼吸困難等，及時尋求幫助。
5. 根據火災現場的環境，選擇正確的逃生路線。
6. 如火勢无法控制，可利用滅火器進行滅火。

7. 逃生10策

1. 平時要制定各種不同方向的逃生路線。
2. 躲避火源不要走陽台、床頭、大廳內。
3. 火勢不大要當即立即用最佳的方法逃生，選擇安靜的出口，不得盲目跳出。
4. 不要留念財物，盡快逃生火場，記住，已逃生的不要反顧。
5. 在火災中要避免逃生，要盡量在屋頂。
6. 如身上着火，不要奔跑，要就地打滾，壓滅身上火。
7. 不要奔賞逃生，可用液體或潤滑液進行冷靜。
8. 在火災現場中，要設置在門前和窗戶上，順勢滑下。
9. 費用的火災火災，火向室外打開火。
10. 逃生時請順防火門逃生，如果逃到室內，關閉門窗，堆在窗戶，用衣物或門板上水。
27 Establish "Health Science Base for DAFA Health", design health exhibition hall. Establish "The Station Agent library and a "Health Cabin", supply employees with health concepts knowledge, and enable them to pay more attention to health during their busy work.
生命在于运动
适量运动是天下最好的补品和良药
It is not hard to be health and just remember six words: "Awareness, Approach, Persistence".

Awareness means you want to be health from your heart, it is not about talking health but smoking at same time. If you have consciousness, you will find a way to be health. With methods and stick to them and you will be health.
In recent years, DAFA has spent about 7 million RMB on enterprise health annually. In addition, another 3 million RMB is spent on charity each year. We get much award while spending money.
Employees’ Health Awareness Enhanced

The health awareness among over 1,000 employees has been generally improved, which also have an affection on their families. Various unhealthy lifestyles have also been improved.
Employee’s Quit Smoking Rate Has Increased

The non-smoking rate has been increased from 35% before the health award set up (in 2011) to currently 97.8%, and the remaining 2.2% of smokers have also been decreased from the previous average of more than one pack per person per day below five. Each year, the company will reduce consume 200,000 packs of cigarettes, save more than 2 million RMB spent on cigarettes, which also reduce the harm of second-hand smoking, unsanitary environment and fire risk caused by smoking.
3 Employees’ Turnover Rates has Decreased

Health is the most important project among employees, which make them feel comfortable to work in the company. The annual turnover rate of employees has decreased from 20% of six years ago to below 10% in 2016. The core employees like this culture and no one left the company, and has achieved "healthy retention"
Employees High Satisfaction

When employees are health in body and work in a pleasant mood and feel the great concern from company, so the employees’ satisfaction is over 95%. In return, they will work more hard and devote themselves to company’s technology and management innovation.
The Enterprise Develops Steadily and Healthily

At present, the company in the global counterparts in the competitiveness of the top. For eight years, the company did not stop production every Spring Festival, but also in the continuous expansion of production, in the global industry is rare.
The Enterprise Develops Healthily and Sustainably.

We have achieved good profits so that we can invest some of the profit for health and charity project, and this way bring more profit to company, which makes a virtuous circulation. The company has been rewarded as "National Enterprise Health Management Model" by media. About 90% workers think working in DAFA can live more than 10 years, at least 5 years.
CREATE NEW HEALTH PROJECT

1. Create more than 2 new health projects every year, with an invest of more than 500,000 RMB.

2. By the end of 2018, the company smoking rates will be "zero".

3. To be a global health enterprise.
It is just a start to create DAFA health enterprise. Implementing the health strategy and enable Chinese people to living an extra ten years is our ultimate goal. Through "China Health Management Promoting Enterprise Alliance", we have provided suggestions on "safeguard national health into basic national policy", "Preventive Treatment of Disease " & "Control Smoking " &" Renew Daylight Saving Time " and so on. And we have been in collaboration with the national committee of the newspaper four times in the Chinese people's political consultative conference hall invitation CPPCC member more than 50 people and medical experts, media and other hundreds of passengers on the above issues for discussion. Above topics as a joint proposal of more than 10 CPPCC members at the National People's Congress in 2015, 2016 and 2017, and which has achieved good results.
THANK YOU!

NINGBO DAFA CHEMICAL FIBER CO., LTD
Lean Production of Recycled Polyester Staple Fiber

Fan Lubin, General Manager
Henan Shunxiang Chemical Fiber Co., Ltd.
13 Sep, 2018
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II. Supply chain & Value stream

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I. Lean Production
• International Motor Vehicle Program (IMVP)
• The Machine That Changed the world (1990)
• Lean Thinking (1995)
• Minimized input to acquire maximum output
Evolvement of modern manufacture models

- End of 19th, in France: Panhand-Levassor
- Mid in the 18th
- Quantity production: Ford, 1920
- TPS
- Lean thinking: Lean Production
- 1940S
- 1990S
# Three production models

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<th>Item</th>
<th>Manual Production</th>
<th>Quantity Production</th>
<th>Lean Production</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Product feature</strong></td>
<td>Completely customized</td>
<td>Standardized, with narrow range of product variety</td>
<td>Varied products in series</td>
</tr>
<tr>
<td><strong>Equipment and installation</strong></td>
<td>Flexible and economical</td>
<td>Specialized, efficient and expensive</td>
<td>High flexibility and efficiency</td>
</tr>
<tr>
<td><strong>Division and content of labor</strong></td>
<td>Rough, plenty</td>
<td>Sophisticated, simple and repeating</td>
<td>Rough, multi-skilled, plenty</td>
</tr>
<tr>
<td><strong>Requirement on workers</strong></td>
<td>Know how to design and make; Adequate operation skill</td>
<td>No special skill needed</td>
<td>Multi-skilled</td>
</tr>
<tr>
<td><strong>Inventory level</strong></td>
<td>High</td>
<td>High</td>
<td>Low</td>
</tr>
<tr>
<td><strong>Production cost</strong></td>
<td>High</td>
<td>Low</td>
<td>Lower</td>
</tr>
<tr>
<td><strong>Product quality</strong></td>
<td>Low</td>
<td>High</td>
<td>Higher</td>
</tr>
</tbody>
</table>
Lower costs, higher quality, shorter cycle
LEAN Production System

Kai

及时生产 Takt Time
单件流 1 Piece Flow
拉动生产 Pull Production

异常响应 Abnormality Response
人机分离 Autonomation
流程稳定 Process Stability

VS M 价值流

均衡生产 Production Smoothing

5S, TPM, 可视化管理, 标准化作业 5S, TPM, Visual Management, Standard Operation
Monopoly
Price = Cost + Profit

Traditional model
Profit = Price - Cost

Market-oriented model
Cost = Price - Profit
Company’s competitiveness

- Quality: Best
- Delivery: Flexible
- Cost: Lowest
- Safety: Highest
- Morale: Enterprising

Excellent performance
Added values for what customers would pay

5% Value-adding
Modification to material’s size, form, construction and function to meet customer’s demand

60% Necessary
Indispensable for added value, though do not directly create value

35% Unnecessary
Wasting resources without creating any value
Defects 01
Overproduction 02
Transportation 03
Motion 04
Waiting 05
Inventory 06
Over-processing 07
Management 08
Core Concept

To completely eliminate waste
Enterprises keep optimizing process, eliminating waste and minimizing resource consumption, thus to achieve lean production, which led to high efficiency.
Persistent pursuing of **PICQMDS**

1. **Products** • Multi-varietal mixed flow production
2. **Inventory** • Inventory reduction
3. **Cost** • Comprehensive cost control
4. **Quality** • High quality
5. **Maintenance** • Increasing operating rate
6. **Delivery** • Rapid response, short delivery period
7. **Safety** • Safety first
Benefit of Lean Production

Successful practices during more than half a century proved:

- Production efficiency up by 30% - 100%
- Quality improved by 50%
- Production cycle shortened by 30% - 90%
- Employee proficiency up by 100%
- Inventory 30% - 90% lower
- Operation cost 5%-20% lower
- Higher operation efficiency of system
II. Supply Chain & Value Stream
Four stages and seven concepts of supply chain

- Raw material suppliers
  - Physical capital
  - Information
  - Working capital

- Customer-centric
  - Focusing on core business, outsourcing other businesses

- Cooperation between enterprises
  - Design, practice, modification and improvement of workflow

- Optimize supply chain operation with information system
  - Shorter production/replenishing cycle
  - Minimum costs in each stage

- Buyers
Value stream of Shunxiang’s chemical fiber production
Why VSM

10,000 m high: Observation of the entire company, possibly outside the company boundaries

10,000米高空: 观察整个公司包含公司的周边界限

1,000 m high: Observation of a business process

1,000米高空: 观察业务流程

100 m high: Observation of individual subprocesses

100米高空: 观察个体的子流程
You vision is your world
Where enterprises’ money go?

Few enterprise would consider their amount of fund as adequate. Where all the funds of the supply chain go? They are turned to receivables and inventory.

It’s common with bankrupt companies: Huge account receivable and inventory.
Dangers of large account receivable

- High interest
- Occupying working capital, increasing opportunity cost
- Inflated profits
- Burden on capital turnover
- Danger of bad debt
- Extra expense occurring from audit, debt dealing and lawsuit, etc.
Cash Sale, Cash Purchasing
Danger of high inventory

- High interest
- Occupying plant space
- Extra management expense
- Transportation and logistics costs
- Reworking costs
- Quality problems
- Making other plant problems less outstanding
Integrating Supply Chain to Minimize Transportation, Shorten Cycle and Reduce Inventory
II. About us
Introduction

I. Capacity
Shunxiang Chemical Fiber operates two R-PSF lines in Guangshan County of Henan Province, with capacity at 50kt/yr in total, mainly down-like and 3-D-hollow R-PSF. We also have three bottle grinding and washing lines of 80kt/yr capacity in total, as well as two processing lines of 40kt/yr capacity.

II. Demand
Each year our demand for bottle bales and cold washed flakes is 80kt/yr and 40kt/yr respectively.

III. Contact
Mou Jian: 86-15837676919  Xue Kezhun: 86-15565526189
Thank you!