

The Construction Research on Rapid-Response Eco-Supply Chain of the Textile Industry Based on the Circular Economy

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Abstract—China is a power country in the textile production and trading. But comprehensive perspective on the development of China's textile industry, we find that it is not free from extensive growth mode, and is still an industry with more serious environmental pollution in our country. As to some problems which existed in the rapid development of China's textile industry, this paper put forward the basic concept of the Rapid-Response Eco-Supply Chain of the textile industry according to the basic theory and operation principle of the circular economy, and analyzed that's very important to construct the Rapid-Response Circular Supply Chain for sustainable development of China's textile industry and overcoming the "green" trade barriers. Finally, the main content of the construction research is elaborated.

Keywords- ecological economy; circular economy; textile industry; supply chain; Circular supply chain

I. INTRODUCTION

Textile industry is one of China's traditional pillar industries. Since reform and opening up, China's productive forces of science and technology have made great achievements in the textile industry, but the long-term accumulated structural contradictions have become increasingly prominent. At present, China's textile processing enterprises are basically labor-intensive enterprises, with characteristics of low-tech, wastewater pollution, poor ability to innovation product and to respond rapidly to the global market. Therefore, taking the market as the guidance, taking the information management as the method, taking the theory of circular economy as the foundation, it is very urgent to construct the Rapid-Response Circular Supply Chain of the textile industry.

II. ANALYZING THE DEVELOPMENT STATUS OF THE TEXTILE INDUSTRY

A. Development status

Since the 21st century, Chinese textile industry has developed rapidly, and has formed gradually perfect industry system, ranging from the upstream textile fiber material processing to the manufacture of garment, home textiles and industrial textiles. The production continues to grow quickly, exports enhance largely, and the structural adjustment of the industry makes progress, and it has made a great contribution

for employment and farmers. In 2007, the textile industry achieves the industrial added value of 812.6 billion Yuan, accounting for 6.9% of the total industrial added value and 3.3% of China's GDP. China shared about 30% of the total textile and garment trade volume in the international market. Especially, the international market share has ranked the world's top for more than ten years continuously. The industry absorbed more than 20 million employees, and 80% of them were rural population. The use of raw materials, e.g. cotton, hemp, silk and natural fiber, also benefits more than 100 million local peasants. China has become the world's largest producer and exporter of textiles and apparel.

Nonetheless, from 2006 to 2008 October, the growth rate of Chinese textile and garment export has decreased significantly. The rate is 25.08% in 2006, 18.77% in 2007, but it dropped to 5.89% in 2008 October, and compared with the same time last year recedes 13.84 percentage points, which is the lowest in the recent 6 years. The slowdown of the textile and garment export has a serious impact on our country's textile industry, such as, the market imbalance between supply and demand, business difficulties, increased losses, and the declining employment population, so, at present, our country's textile industry falls into the difficult position which we have not seen in so many years. The capacity and level of production and processing of China's textile industry is seriously incompatible with its position in the international industrial chain, it is being from the rapid development period since accession to the WTO into the period of upgrade and adjustment, and the period is obvious painful.

B. Existent Problems

The slowdown of China's textile and garment export is directly linked to the global financial crisis, but also is related with technology trade barriers such as environmental protection. With the international Eco-Tex standards have been released, the technology trade barriers on environmental protection will become one of the chief obstacles to China's textile and garment export.

On the one hand, Chinese textile industry is a pillar industry in the national economy; on the other hand, there are also many resources and environmental problems during the development of Chinese textile industry. There are mainly points as the following.

(1) A low utilization rate of materials, lead to the shortages of raw materials is intensifying. According to

related information: the consumption of China's synthetic fiber, cotton, textile raw materials were 10~20 times, 40~80 times than in developed countries, respectively, 4.4 times and 2.2 times than in India, which led to a relative shortage of fiber resources frequently in China, though China is rich in natural fiber resources, has fruitful chemical fiber resources, and shares about 20% of cotton production of the world.

(2) Output of high energy consumption, inefficient use of energy conversion. Energy consumption per unit of China's textile industry is 40% higher than the international advanced level. Furthermore, in the textile industry, the energy consumption of printing and dyeing industry is highest.

(3) Water consumption is relatively high, especially in printing and dyeing industry. In the textile industry, the total water consumption is 2.81 billion cubic meters during the processing of textile, garment and partial chemical fiber, but the total water consumption is 6.4 billion cubic meters in the printing and dyeing industry.

(4) A large quantity of wastewater discharge and a lower level of wastewater reuse technique. The average recycling rate of wastewater is 80% in textile, garment industry, but 10% in printing and dyeing industry.

(5) A lower level of "green structure" in the textile industrial, insufficient investment in environmental protection, the ratio and the level of green products is low compared with foreign countries.

III. CIRCULAR ECONOMY

National Development and Reform Commission held the forum on circular economy twice in 2006, Environmental and Resources Protection Committee of the NPC Standing Committee has made "Circular Economy Promotion Law" included in the legislative program. The so-called circular economy, in essence, is a kind of ecological economy; it requires the use of ecological rule rather than the mechanical theory of law to guide the human society and economic activities. The traditional economy is a kind "resource - product-waste-pollution emissions" one-way flow of linear open-loop economy, characterized by high exploitation, low use, and high emissions. In this economy, there is extensive and one-time use of resources, and to achieve economic growth in number through turning the resources into waste constantly. On the contrary, circular economy advocated harmony with the environment is a model of economic development, is a kind "resources - products - renewable resources - products" circular flow of closed-loop economy, characterized by low exploitation, high-use, low-emissions. All the material and energy should be obtained reasonable and sustainable use in this ongoing economic cycle, and it is necessary to reduce the impact on the natural environment caused by the economic activities to the extent as small as possible.

Circular economy has three major operation principles, including the principles of reduce, reuse, recycle. Reduction principle belongs to the source control method, targets to reduce the consumption of raw materials and energy, and to realize source reduction of the resources and pollutant discharge. Reuse principle belongs to the process control

method, which is aimed at improving the utilization of product and resources, requires the packing container can be reused with the initial form. Recycling principle is the terminal control method, which requires that waste generated in the process of production and consumption should be re-become a renewable resource through the means of "converting into resources". Circular economy can be divided into three consecutive stages: the production stage, the consumption phase and re-manufacturing stage of waste materials; to develop circular economy, there are three kind of technologies need to be resolved: the cleaner production technology of the production stage, terminal treatment technology and remanufacturing technology of waste materials.

IV. THE TEXTILE INDUSTRY CIRCULAR SUPPLY CHAIN WITH FAST RESPONSE

As to above problems which exist in the development of China's textile industry, this paper put forward the basic concept of the Rapid-Response Circular Supply Chain of the textile industry, according to the basic theory and operation principle of the circular economy.

The Rapid-Response Supply Chain of the textile industry based on circular economy requires taking social and ecological benefits into consideration when considering economic benefits, taking into account the entire product life cycle, from raw materials, through manufacture to the product, throughout its use, and from disposal through recycling to create new raw material. Thus, the Rapid-Response Circular Supply Chain of the textile industry is a kind of network around the core enterprise, which is constituted by the fiber raw materials manufacturers, enterprises of spinning (silk reeling, synthetic), weaving, printing and dyeing, final product manufacturing, and enterprises of transportation, distributor and service department, consumer, recovery processing, which targets to make textiles bring the least negative impact on the environment, the highest resources and energy efficiency during the entire life cycle from raw materials, processing, packaging, warehousing, transportation, reuse to disposal. Figure 1 is a simple model of the Rapid-Response Circular Supply Chain of the textile industry.

According to the characteristics of the textile industry, the circular supply chain of the textile industry mainly focuses on two aspects of "high use" and "low-emission". From the beginning to the source control, using the ecological environment-friendly raw materials, dyes, additives, which is degradable, renewable under natural conditions, thus reducing environmental pollution. During the design process, it should be taken into account that the energy consumption in the production and use of these products, and the way of abandoning or disposing waste, try to reduce environmental pollution and minimize the energy consumption as much as possible. The processing technique of less energy and resource consumption should be used, and cleaner production should be widely applied. Do our utmost to reusing or recycling the waste water, waste generated in the course of processing, as well as textile waste.

The core enterprise of the Rapid-Response Circular Supply Chain of the textile industry is usually an end-product manufacturing enterprise. The starting node of the Circular Supply Chain is raw material suppliers, and the Circular Supply Chain doesn't possibly have the end node in the entire supply chain. After the recovery processing, if the textile waste can be reused as fiber material or semi-finished products, then the supply chain is a cycle network; if can be used as raw materials producing other products, then the recovery processing node is the starting node of another supply chain; if needs waste disposal such as burning, then the recovery processing node is the end node of the supply chain. Every enterprise of the Supply chain is focused on financial, technology, and energy to consolidate its core competencies and improve its production and business separately. The core enterprise coordinates and controls the entire supply chain to become seamless integration through assessing, evaluating, supervising production process and ecological products of each node enterprise, optimizes resources, energy efficiency, environmental benefits, economic benefits.

V. THE IMPORTANCE OF CONSTRUCTING THE RAPID-RESPONSE CIRCULAR SUPPLY CHAIN IN THE TEXTILE INDUSTRY

As the Rapid-Response Circular Supply Chain of the textile industry integrates various hot issues such as supply chain management, ecological environment, cleaner production, and the rapid response and so on, it can generate multiple benefits such as lower costs, more resources efficient, environmental protection, rapid response to market, so it is important for sustainable development of Chinese textile industry.

A. *Help to reduce the environmental pollution, improve the efficiency of resource and energy*

The Rapid-Response Circular Supply Chain of the textile industry requires to considering the environmental protection and conservation of the raw materials and the auxiliary raw materials in the source node of the supply chain, emphasizes to adopt clean production technologies in the process of production and waste disposal technology at the end. So it is an effective management model for China's textile industry to reduce resource consumption, reduce pollution and achieve sustainable development.

B. *Help to optimize the allocation of global textile resources*

In order to make textiles remain environmentally friendly and high efficient in its entire life cycle, which means that the entire production chain must ensure be ecological from the beginning of the raw materials. The Rapid-Response Circular Supply Chain of the textile industry can integrate these competitive enterprises have come to the fore in various nodes to building a strategic alliance. Each enterprise of the supply chain commit to their core competencies on green production. Through information technology, closer cooperation among enterprises makes the alliance running

efficiently and smoothly, so as to ensure the realization of the true eco-textiles.

C. *Help the textile industry to respond quickly to market demand.*

The Rapid-Response Circular Supply Chain of the textile industry requires node-enterprises to adopt advanced production methods, such as LP (Lean Production) and Agile Manufacturing, to improve production flexibility, to remove all of the non-value intermediate links, to promote the coordinated production and delivery on time between the upstream and downstream enterprises, to arrange the inventory reasonably, so as to achieve the seamless connection among enterprises in the supply chain. Thereby, it is possible to shorten the product development cycle and production cycle, and accelerate new products to market.

D. *Help to improve the overall competitiveness of the textile industry, and promote industrial upgrading*

Competition in the 21st century is no longer a firm versus a firm or a product versus a product but rather a supply chain versus a supply chain. Guided by the principles of powerful alliances, with the best integration of the global textile resources, information technology as a support and the cycle of economic theory as a guide, building the Rapid-Response Circular supply chain will help improve the overall competitiveness of the textile industry, transform the economic growth from extensive mode to intensive mode rely on advanced science technology, and promote industrial upgrading.

VI. THE MAIN CONTENT OF THE CONSTRUCTION RESEARCH ON RAPID-RESPONSE CIRCULAR SUPPLY CHAIN OF THE TEXTILE INDUSTRY

A. *According to the characteristics of the textile industry, establish the evaluation system of supply chain based on the theory of circular economy*

From the actual condition of Chinese textile industry, based on the theory of circular economic, establishing a scientific, reasonable, and feasible evaluation index system is not only the prerequisite for choosing supply chain strategic partners, but also the basic requirements to construct the rapid-response circular supply chain of the textile industry. Not only should the evaluation system consider evaluation indexes of traditional supply chain, but also include some green indicators such as energy efficiency, water consumption, recycling rate of wastewater, clean production, energy consumption, product recovery efficiency, the ratio of eco-textile materials, and negative impact on the environment as well as cost of environmental management.

B. *The evaluation and selection of strategic partners in the Rapid-Response Circular Supply Chain of the textile industry*

According to the evaluation index system which has been established, to choose strategic partner by adopting the appropriate evaluation method, then to integrate these

competitive enterprises into a strategic alliance and optimize global textile resources, which can ensure the textile industry supply chain and each node enterprises are ecological.

C. The construction of the rapid-response circular supply chain of the textile industry

On basis of the principles of powerful alliances, the textile end-products manufacturing enterprise is usually the core of the textile supply chain, which optimize the global textile resources, upward to integrate some partners such as raw materials suppliers, spinning companies, weaving, printing and dyeing factories, and downward to integrate enterprises such as transport, distribution, service sector, consumers, recycling center, and waste recycling enterprise, consequently to form a closed-loop system and constitute the entire circular supply chain of the textile industry.

D. The optimization of the rapid-response circular supply chain of the textile industry

In order to improve operation performance of the supply chain, to adapt to market changes, and to enhance overall competitiveness of the textile industry, it is necessary for the textile supply chine to coordinating and optimizing. A more refined, agile and flexible market competitive advantage can be obtained through the coordination of the supply chain.

E. The development of the management decision support system of the textile circular supply chain

A variety of decision-making and optimization methods will be adopted in the process of the design and optimization of the textile circular supply chain, furthermore, most of these methods are rather complicated, but also a great amount of calculation. Therefore, a decision support system needs to be developed which could help decision-makers to complete the design and optimization of supply chain.

VII. CONCLUSIONS

In view of existing situating of Chinese textile industry, this paper put forward the basic concept of the Rapid-Response Circular Supply Chain of the textile industry, and elaborates the main contents of the research on constructing the supply chain. At present, China's textile industry is undergoing a painful adjustment. Guided by the market, based on the theory of circular economy, information management as a means, it is very important to construct the Rapid-Response Circular Supply Chain for the sustainable development of China's textile industry and overcoming the "green" trade barriers.

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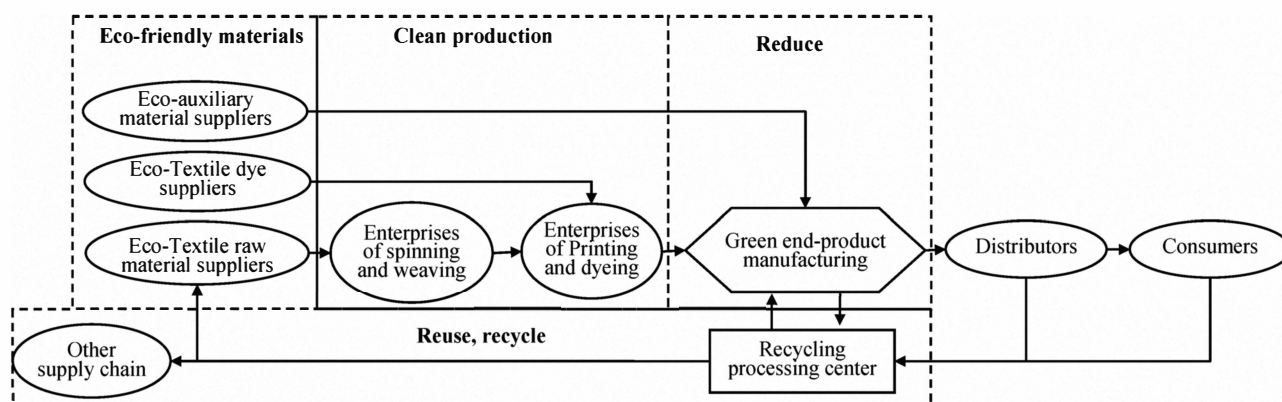


Figure 1. A simple model of the Rapid-Response Circular Supply Chain of the textile industry.