The present situation of the old shoes recycling and the existing old shoes treatment method

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Abstract. With the industrial production of shoes and the continuous improvement of production technology, the total production of shoes has been increasing, a wide range, the existing categories including sneakers, leather shoes, plastic shoes, work shoes and all kinds of woven sandals, the material of shoes is increasing, at present old shoes are still landfill and incineration as the main treatment methods, many foreign countries or companies have established their own old shoes recycling system, through the old shoes recycling status analysis, summed up the existing old shoes treatment methods for reference.

1. Introduction
Shoes as a necessity of human life, since ancient times not only to provide a great convenience for mankind, but also stimulate people’s need on higher quality and more kinds of pursuit and exploration. With the progress of science and technology, the shoe industry has undergone great changes in the past 50 years, shoe types and materials are increasing, in the past decade, the footwear industry has entered a rapid development stage, due to labor costs and material costs increased year by year, the footwear industry more focused on improving the production process of material utilization rate and operator's efficiency; At the same time because consumers are increasingly concerned about the safety of footwear and other performance, the footwear industry in the production process also began to reduce or even avoid the use of toxic, harmful substances; With the rapid changes in market and consumer buying orientation, the effective use of shoes is relatively short, and is shrinking.

At present, the annual production volume of global footwear exceeds 20 billion pairs, with the rapid development of the social economy, this number is still increasing annually, however, the loss of the use of shoes (the end of life cycle), and not timely recycling, most of which were sent to landfills or abandoned in the natural environment, resulting in a large number of waste production, It has caused great waste of resources and great pollution to the natural environment.
In this paper, the old shoes recycling as the reference point, the status of the old shoes and the treatment of old shoes are analyzed in detail, through the analysis of the data and the way summarized, for the old shoes recycling and use of reference.

2. China's footwear annual production volume, types and production materials

2.1. China's annual production of footwear
China is a big country of footwear production and export, according to Statistics, 1995, China's footwear production reached more than 4 billion pairs, 2003 to 2005 China's footwear annual production capacity of 8.5 billion pairs, exports reached 6.9 billion pairs, 2013, China's footwear production reached 14.2 billion pairs, export total breakthrough billion mark, reached 10.6 billion pairs, China's footwear industry in recent years, the growth rate has fallen, but the total annual production and export total, still ranked first in the world. China's large population base, the same is the world's highest consumption of footwear countries, now our annual footwear products consumption more than 2.2 billion pairs. With the increasing production technology and people's higher quality of life requirements, footwear production should not only shift to high production efficiency, but also to the high comfort, diversification style.

Footwear products due to less recycling, incineration and landfill treatment more, therefore, the total reserves of footwear are growing by the number of annual production, shoe storage years can often reach decades, even if the removal of the burning part, total reserves of footwear can still reach hundreds of billions, so huge reserves did not create a complete old shoes recycling system, It is not only polluting the environment, but also a great waste of limited resources.

2.2. Footwear category and production
Footwear production categories including sneakers, leather shoes, plastic shoes, work shoes and a variety of woven sandals, a wide variety, at the same time because of people's use and the user's comfort and satisfaction with the shoe caused by the difference in the footwear production material complexity, shoe soles for example, At present, the global footwear industry sole material market has more than 5 million tons, the soles of materials mainly include polyvinyl chloride (PVC), polyethylene (PE), thermoplastic polyurethane (TPU), etc[1]. The proportions of various materials are shown in Figure 1.

![Figure 1. Market share of sole materia](image)

The footwear product material has the very good reuse superiority obviously, such as footwear products in the rubber material, can be processed into plastic rubber asphalt paving road, improve the road noise reduction performance, make the road thinner[2], or used in rubber concrete, reduce the slump of concrete mixture, enhance concrete frost resistance under the double action of erosion and freeze-thaw, or the construction of the ash bucket and ash bucket, etc[3-5]. Polyvinyl chloride (PVC) is
used to make various pipes or fittings, lining of various storage tanks and construction materials or electrical equipment. However, the material complexity of footwear products will inevitably lead to the recovery of footwear materials separation difficulties increase, resulting in increased recovery costs, enterprises can not profit, seriously inhibit the enterprise recycling of old shoes enthusiasm.

3. Old shoes existing treatment mode

3.1. Old shoes traditional treatment method
Because of the huge reserves, the old shoes there is no more mature technology or system to support, resulting in the old shoes recycling costs remain high, which makes old shoes recycling more difficult, so at present all over the world are still landfill and incineration, which is also the advantages of traditional processing methods, that is, convenient and quick, A lot of discarded old shoes can be handled with less labor.

In the city individual family, the shoe are discarded after they are used, generally will not store the old shoes, causes the old shoes cannot unify the recovery. Rural areas can collect a certain number of old shoes, but these old shoes not only because of the excessive storage time caused by the old, and often because of the farm run led to the dilapidated, these old shoes are usually the farmers unified incineration or landfill, so there are few old shoes that really get recycled.

Footwear production tends to meet a variety of performance requirements, the use of a variety of materials for production, combustion of these materials released a large number of benzene, chlorine toxic gas, not only cause a great environmental pollution, but also pose a great threat to the person, if they are buried, they will not be corrupted for decades. After soaked in the rain, the old shoes will produce poisonous substances, polluting the soil and water. Sole rubber and PVC materials include a variety of additives, such as anti-aging agent, curing agent, plasticizer, anti-Coke agent, viscosity-enhancing agent, including vulcanizing agent, coloring agent, mold inhibitor additive components contain heavy metals such as chromium, lead, septum, titanium and other elements, these heavy metal pollutants in the incineration process can not be destroyed, in the process of incineration will occur migration and transformation, and finally almost the same number of discharged into the environment, and ultimately through the air and other channels for the human body to eat and harm. The heavy metals ingested by organisms from the environment can be enriched by the bio-amplification of the food chain, which leads to the formation of pathological changes in certain organs and tissues, causing serious harm to human beings caused by carcinogenic malformations[6-8].

Burning and burying old shoes not only wastes a lot of reusable resources, and the formation of the material pollution of the environment, but also poses a great threat to the human body, so the recycling of old shoes have a high economic value, not only energy saving and emission reduction, but also for the human body damage than incineration or landfill, has been reduced to the extreme. However, the old shoes recycling system is not complete, all aspects of policy, subsidies have not been announced, the old shoes recycling has a long way to go.

3.2. The present situation of recycling and utilization of old shoes
The recycling of old shoes has high economic value, and people have made many attempts to recycle the old shoes. Old shoes recycling mainly to the individual family footwear reuse and the overall recycling of footwear companies mainly, individual family footwear reuse of the old shoes of the individual flower pots, old shoes DIY, the old shoes reassembly and old shoes art, etc[9-11]. The overall recovery of footwear companies is mainly in the form of innovative use of available materials[12-17].

Individual family footwear reuse can be used to grow more meat plants, wall-shaped pots, such as the use of old shoes through simple changes to form a concise art, not only gave life more fun, but also reuse the so-called waste. First with an awl in the bottom of the shoe pierced hole, in order to be able to water when the excess moisture can flow from the hole, to prevent the root of the plant for a long time to soak up and rot away, the insole removed, with a layer of small stones in the bottom of the shoes thin ground layer, the rich and moist nutrients added to the shoes, Then transplant the prepared
plants to the past or directly plant seeds, convenient and efficient, to treasure, add green in the home at the same time, reduce the flower pots and other unnecessary expenses. The re-creation of this individual family is worth learning.

Nike is the leader in the recycling of old shoes in many footwear companies, and in 1993, sports footwear giant Nike launched the "Old Shoes Reuse" program, with Nike statistics showing that it has recycled more than 21 million pairs of trainers worldwide by the end of 2008. Today, Nike is able to recycle about 2 million pairs of worn-out sneakers every year in the United States. Their recycling approach is to decompose shoes into three parts, namely rubber outsole, foam midsole and fiber uppers, which are then crushed, separated and purified for different purposes. The outsole of the shoe can be made into a plastic runway, a playground, and the floor of a bubble can be made into outdoor basketball and tennis courts; Nike's recycling program can recycle most brands of sneakers, but for sandals, slippers, boots and other kinds of shoes can not be seen, footwear companies to reclaim the limitations of old shoes, that is, recycling equipment is single-minded, can not adapt to the full range of old shoes recycling, crushed materials used single, only sports venues and other facilities.

Adidas has also launched old shoes for new services, while using marine waste 3D to print concept shoes, made from ocean plastic to the upper and sole layer, the soles of the mezzanine to recyclable polyester and barbed wire material, made of 3D printing. China's Li-ning company based on discarded tires, to recover the waste tires made of sole, uppers also use environmentally friendly materials, the design of the concept of recycling shoes green in black won the "design Oscar" reputation of the German if design awards.

Germany's old shoes recycling industry is thriving, with a local company called the Hanover Old Shoes Recycling company, dedicated to the old shoes recycling program, where they set up more than 11,000 old shoes recycling stations in Germany, and since the start of the old shoes Recycling program in 1990, The perfect old shoes recycling facility allows them to recycle old shoes to 5000 tonnes a year, and half of the recycled shoes are sold back to some poor countries at low prices. Perfect recycling system, complete sales channels and mature processing technology has led to the development of individual enterprises, the benefits are very considerable.

2013, the world's first old shoes dismantling and useful materials comprehensive recovery system, developed by the Center for Innovation Manufacturing and Architecture Research (IMCRC), Loughborough University, UK, was successfully tested. The system separates leather, plastic foam and rubber into pellets, which are used to pave the rubber surfaces of sports fields and can even be used again to produce new shoes. Their recycling process is: first by hand, the shoes into large categories, such as sports shoes, and then the shoes on the buttonhole and other metal recovery, and then use the machine to cut the shoes into fine particles, these particles will automatically be divided into 4 kinds of waste streams, such as leather, foam, rubber and other materials., the system first use granulating machine to make shoes 3~4 mm of debris, Then, the low cost airflow separation technique is used to separate different materials according to size and weight.

At home, there are fewer examples of similar recycling. Fujian Quanzhou Tri-Tatsu Plastic Co., Ltd. engaged in waste recycling, the company uses specialized technology and technical equipment for waste recycling, through professional technology to decompose, foaming, can be recycled to produce better quality of foam products. Companies from the surrounding enterprises and Guangdong and other land recycling 40,000 tons of discarded scraps, processing into new shoes. The recycling of old shoes has not set off a wave in China, China's old shoes recycling in all aspects of policy guidelines are pending, the EU has on the management of waste, developed the EN 12940-2004 standard “Footwear production waste classification and management”, France on the recycling of waste to develop the"on the new textile and apparel products , footwear and household linen waste recycling and Disposal Act”, the draft decree establishes an organizational procedure for the textile waste Extension producer Responsibility scheme, which shows that China has not paid much attention to the old shoes and other wastes, meanwhile, the infrastructure of the old shoes needs to be built urgently, and the technology for recycling the materials should be further studied.
4. Improve the recycling efficiency of old shoes in China

The severe market pressure and the distinctive social form force the shoe industry to come up with the old shoes recycling method, technology, establish its own recycling system.

Old shoes Recycling, first of all need in the public thought to build up old shoes can reclaim and reclaim a certain income ideology, to ensure that there are shoes can be recycled, now ordinary people for the old shoes recycling understanding is not enough, generally think that shoes wear old, wear out will not be anyone need, the old shoes though small, But such a huge amount of old shoes storage can create billions of dollars in economic value, for environmental protection is beyond measure, so, first of all to let people realize that the old shoes still have the value of recycling, like paper, steel recycling, which requires government policies to encourage or restrain, enterprises and the media to promote and guide. The government's flexible strategy is to enable people to follow policies, also to ensure that there is no pollution of old shoes and other problems, the problem of the old shoes need to detect and then effectively to deal with, to avoid the production of products to pollute the environment, poses a threat to personal health, enterprises and the media need to integrate policy, To guide people on how to store and recycle old shoes, China's old shoes recovery methods are mainly relying on small vendors to recover, fixed-point centralized recovery, and so on, which requires enterprises through their own flexible strategies to encourage consumers to send old shoes back to the recovery point, such as to give people the appropriate economic incentives, the formation of trading chain, etc.

Perfect recycling infrastructure and labor force to ensure that old shoes can be recycled into the enterprise, the enterprise relies on infrastructure to collect the old shoes stored in the household, the sufficient labor to ensure that old shoes can be recovered in time, and then sorting, disinfection, or crushing, or re-sale, Infrastructure construction requires not only the capital investment of enterprises, reasonable facilities allocation, but also the support of government policies to ensure that enterprises can actively work. Enterprises consciously take responsibility to build their own old shoes recycling technology, external construction of their own old shoes sales channels or the use of old shoes products, to ensure that the recycled shoes can be effectively processed, or sales, or crushing separation.

The old shoes type is many, the material is complex, therefore the processing difficulty is very big, the enterprise may first aim at some kind of old shoes, develops a set of pertinence strong technical system, then from easy to difficult, one by one breakthrough. A steady stream of capital investment is the technology can be successfully developed and mature, and innovation and upgrade the strong guarantee, the use of new technologies can make the cost of reducing, but the development of new technologies need a strong financial support, for the recovery of such small profits of the industry, old shoes recycling must form a complete industrial chain, reasonable adjustment within the enterprise and the open channels of operation and the government's financial subsidy are all available and absent.

Old shoes recycling same as old paper, scrap steel products, waste electrical products, the use of sophisticated operating experience, all the old shoes recycling system for the construction of a reference, China's old shoes recycling backward European developed countries 20 years, but China's huge population of the formation of the old shoes recycling market is near zero, So the development of the recovery of old shoes in China has been eager to sprout.

5. Conclusion

The recycling of old shoes has great benefits, old shoes are recycled and reused for other products, such as rubber particles used in road laying, improve road noise reduction, anti-skid and other performance, in line with today's policy background of energy conservation and emission reduction, reflect on the domestic recycling of old shoes, the recycling of old shoes is a long way to go, not only need government policy support. The construction of a variety of infrastructure, but also to the old shoes recycling enterprises to subsidize, to promote the productivity of enterprises, or to urge footwear production companies to form their own product recycling industry chain, the company's own products have developed technology, it is easier to deal with their own products, such as Nike's "Old Shoes Reuse" program, domestic and foreign old shoes , scrap recycling, have made good profits, enterprises
have money to earn, people have work to be busy, which all prove that the recycling of old shoes is feasible and must be done.

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