

Review of Waste Tire Reuse& Recycling in China

—current situation, problems and countermeasures¹

WANG Hui-zhi²

XU He³

XUAN Xue-jian²

Abstract: This article first expounds the current situation on waste tire generation and recycling in China. Then it analyses the existing problems and causes in the industry of waste tire recycling. Finally, it proposes countermeasures and suggestion on promoting a healthy waste tire industry. These strategies include accelerating the speed of drawing up regulations on waste tire reuse and recycling management, completing encourage policies and mechanism of waste tire resource recycling industry, developing adequately the influence of China Rubber Industry Association (CRIA) and China Tire Retreading And Utilization Association (CTRA), and etc.. China has an abundant resource of waste tires and recycling potential. And it will be of great significance to mitigating the scarcity of rubber resource, improving ecological environment, developing circular economy and building resource-efficient society in China if we can reuse and recycle waste tires properly and form a healthy waste tire industry.

Key words: waste tires; circular economy; ecological environment; reuse& recycling

1. INTRODUCTION

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² Research Center for Strategic Environmental Assessment, Nankai University, China

College of Environmental Science & Engineering, Nankai University, 300071, P.R.China

³ Vice director, Professor, Research Center for Strategic Environmental Assessment, Nankai University, China

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Along with the rapid development of the world automobiles possession, the problem of environment pollution and resource squandering aroused by waste tires has become more and more serious and obvious. According to the statistics from the World Health Organization (WHO), the number of worldwide waste tire storage has reached 3 billion and it is increasing rapidly every year. Recycling waste tires as resource recovery macromolecular materials has drawn worldwide attention. In recent two years, China has become the biggest rubber consumer and rubber import country. It generates as many as 100 million waste tires while the recycling rate is only about 10%, which is far lower than developed countries. Waste tire recycling can not only mitigate the problem of rubber resource scarcity of China and save large amount of money for economic construction, but also can reduce the “black pollution” and become the breakthrough point of circular economy development, which is very significant for us to develop the circular economy and establish an economical society.

2. RESULTS AND DISCUSSION

2.1 The current situation of waste tire generation and recycling in China

Along with the increasing living standard, the rapid development of automobile industry and increasing vehicle possession in China, it brings two serious problems:

One is rubber resource scarcity. From 2002 to 2004, the volume of rubber consuming in China stayed at the top of the world each year. In 2004, the number of rubber consuming reached 4.2 million tons, 70% of which was used for tire producing. Since China lacks rubber resource, raw rubber depends mainly on import to meet the national command for economic development. The import volume of raw rubber of China in 2004 is 2,370,000 tons, which consists 60% of the total consuming volume. This high rate is extremely detrimental to a country's economy and society safety as regards an important strategy resource.

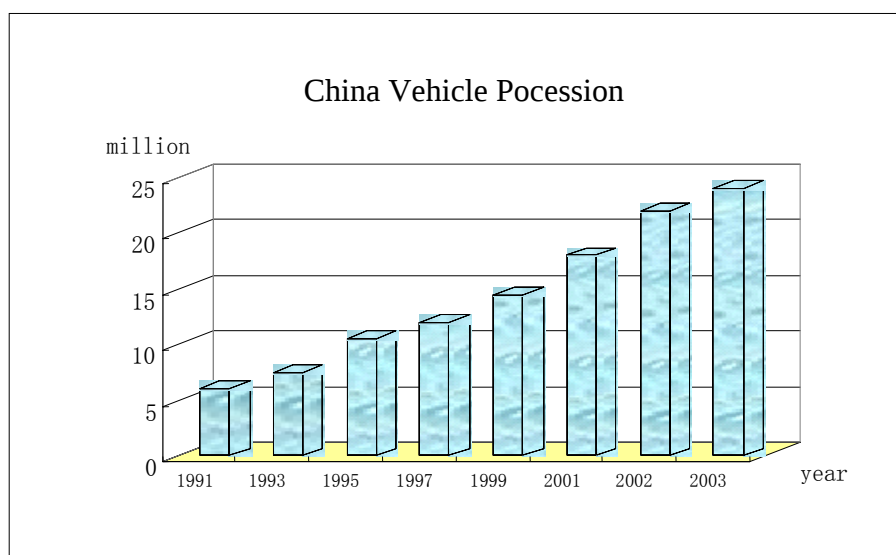


Figure 1

The other is the problem of large amount of waste tire generation. The number of tire producing in China exceeded 239 million in 2004, which was the second biggest of the world. Meanwhile, it

generated more than 112 million waste tires and this number increased by two digital places each year. According to related estimation, automobile possession of China will reach as many as 70 million in 2010 and the tire production will exceed 300 million, which will generate more than 200 million waste tires weighed 5.2 million tons. China will become the biggest tire producing and waste tire generating country in the world.

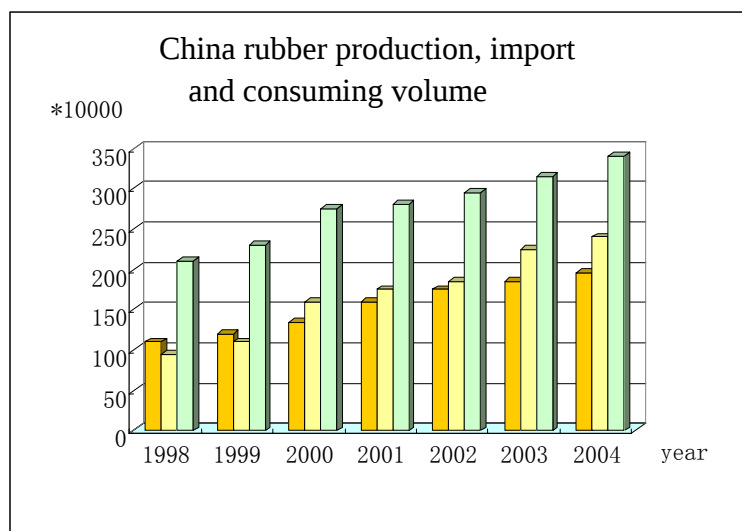


Figure 2

Waste tires generally called “black pollution” belong to non-fusible macromolecule elastic materials, which are resistant to heat, organism and mechanism and are hard to decompose. If piled up in the open air over a long period of time, they will not only take up a lot of land space but also become a breeding space for mosquitoes that carrying disease and will easy to catch fire through accident. On the contrary, waste tires regarded as a renewable resource are called “black gold mineral”. One used tire can equal 2-3 tires after retreading for many times. And tire retreading consumes only 15%-30% of the raw materials to produce a new tire of the same standard, while the price is 20%-50% of a new tire. 22%-24% of a waste tire is nylon and other synthetic fiber that can be manufactured into plastic products. 16%-24% of it is steel wire which can be raw materials for springs of good quality. And 58%-60% of it is rubber mixture that can be used to produce rubber powder and reprocessed glue, whose products and extend products can be used widely in civil economy industry such as rubber, chemical engineering, transportation and urban construction, and it has become an important second resource. Therefore, it is an urgent problem for China to solve how to utilize the waste tires adequately, to save rubber resource and to prevent environment pollution.

China has the following ways in waste tire resource comprehensive utilization presently.

The first is wasting tires original shape transformation. Through binding, trimming, cutting and etc, waste tires can be used on docks or pilings as boat bumpers, dike protections, floating lighthouses, highway retaining walls, way marks, seawater breeding reefs, amusement apparatus and etc. Original shape transformation is a valuable recycling method, but it can only consume as little as 1% of the waste tires. Thus, it can be used just as an auxiliary way.

The second is decomposing scrap tires through pyrolysis. We can extract gas of high heat value, oil with plenty aromatic hydrocarbon, carbon black, steel and etc. from it, but this method needs complicated technology, costs a lot, causes second pollution easily and the quality of substances recycled in this way is low and unstable. So it has not been popularized domestically.

The third is retreading used tires. The term tire retreading indicates a technological procedure, in

which tires are partially repaired, manufactured, re-pasted tire surface glue and are vulcanized to regain their use value. Tires of automobiles when using are generally destroyed by damaging the surface. So tire retreading is one of the main ways of recycling used tires. If used and maintained properly, one tire can be retreaded many times and its life will be prolonged for at least 1-2 times. After each time of retreading, a tire can regain a use life-span that equals 60%-90% of a new one and its average mileage can cover 50000 to 70000 kilometers. Tire retreading not only prolongs automobile tire use life and promotes reducing used tires, but also reduces environment pollution. It is an important industry of circular economy. Now there are about 500 tires retreading enterprises in China, 90% of which are medium-sized or small-sized. Their annual retreading capacity is 15 million and retreading proportion is about 4% of new tire products.

The fourth one is using scrap tires to produce reprocessed rubber. To produce reprocessed rubber, waste tires should first be grind into rubber particles, and then add water and other chemicals into it. After that, put more pressure and heat to make them “anti-harden”. At last, make them return to their original status through mechanical compress. Reprocessed rubber production that has been eliminated from rubber utilization by developed countries has many disadvantages, such as low profits, high work intensity, long producing procedures, resource consuming, and serious environmental pollution. Due to historical reasons, reprocessed rubber production is still the main way of waste tire recycling in China. The number of annual products has exceeded 1 million tons in China. And the country is worthy of the title “Reprocessed rubber Kingdom”.

The last one is using scrap tires to produce vulcanized rubber powder. To produce vulcanized rubber powder, waste tires should be grinded into well dispersed rubber particle, from which metal and textile substances have been moved out. Vulcanized rubber powder is light, dry, and has a good superficial measure. Compared with traditional reprocessed rubber, rubber powder producing does not cause second pollution and its utilization rate is 100%. It can extend to be a new type of product which has high accessory value and can be recycled. For example, rubber products and water-proof materials; rubber-plastic crosstie instead of cement and timber crosstie; rubber reformed pitch instead of SBS synthetic rubber, which has the advantages of reducing noise and cost, as well as lengthening road use life. Thus, this is a recycling way of integrating environment protection and resources renew and reuse. It is also the best way of utilization to develop circular economy. Rubber powder industry has just started in China. There are only tens of manufactures which produce less than 50000 tons annually. It has not formed a burgeoning industry yet.

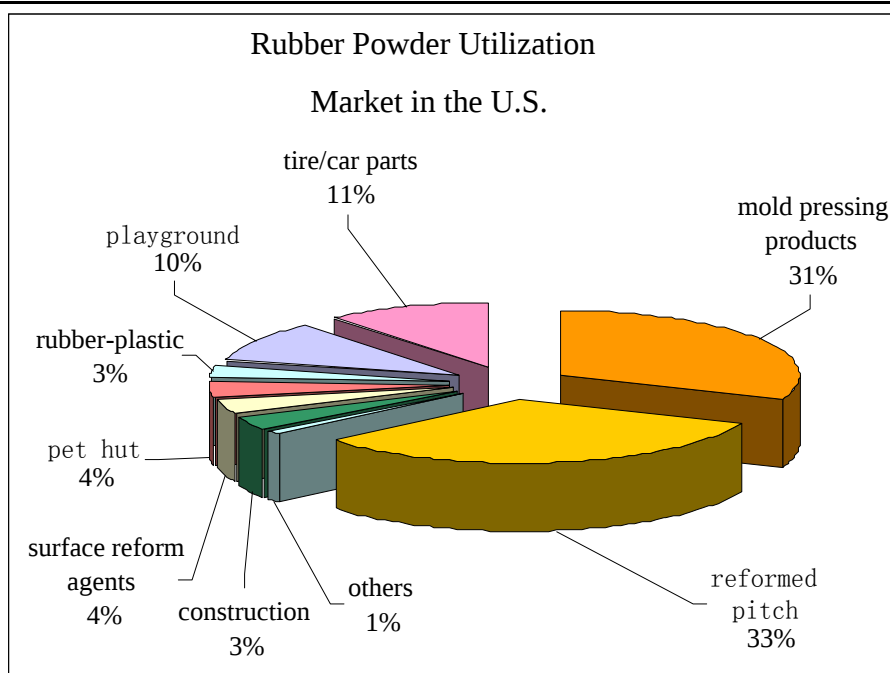


Figure 3

2.2 Challenges to waste tire industry of China

Waste tire industry has made great contribution to our economy construction since 1949, when China became independent. Especially since the Reform and Open policy in 1978, waste tire industry of China has been developing quickly and has formed a series of enterprises of certain producing scale and level, which has acquired notable social and economy benefit. However, there are still many problems that cannot be neglected when developing. It is focused on the following four aspects:

2.2.1 Low rate of used tire retreading

Tire retreading has the most value in tire reuse and recycling. But its industry is developing slowly in China now. And there is a big gap in tire retreading between China and developed countries. For example in 2004, the rate of used tire retreading in China is 20:1, while 10:1 or 9:1 in developed countries. Seen from the tire types, China mostly retreads tires of heavy duty trucks and passenger transport buses, while it does not retread tires of saloons. But in European Union, the rate of saloon tire retreading has reached 28.8%. In China, the retreading rate of giant tires used in large-sized mine and water conservancy project does not reach 20%, while less than 10% in aerospace industry. But in America, the retreading rate of these types of tires has come to more than 80%. At present, there are three main factors that constrict tire retreading industry development of China. The first is generally low quality of domestic tires and limited number of used tires that can benefit from retreading. The second is that car owners lack the awareness of tire maintenance, and they drive overloaded and severely, which worn the tires' surface too badly to retread them. The third one is that China lacks the method and standard on selection before retreading and test after retreading. Moreover, the whole society lacks recognition of the value of tire retreading, which makes its market hard to develop and expand.

2.2.2 Limited ways of using scrap tires

At present, the main way of recycling scrap tires in China is to produce reprocessed rubber. It is mostly

related with the situation of oblique intersecting tire producing. According to the different structure, tires can be divided into oblique intersecting tires and meridian tires. Compared with oblique ones, meridian tires have a more complicated structure and components, and are more difficult to recycle and dispose. They are used mostly in producing low rank fuels, which causes obvious environmental problems. As the rate of meridian tires in China is low, tire enterprises mainly produce oblique intersecting tires. And this determines the large developing scope for reprocessed rubber industry that uses oblique intersecting tires as its main stuff. On the other hand, the industry of fine rubber powder that is considered internationally has no second pollution developed inadequately. Problems exist as tough technology and weak market. Rubber powder manufacture technology of China, no matter normal or low temperature method, has reached the leading level of the world. And the equipments basically meet the development demand of rubber powder industry, while the price is only 1/3 to 1/4 of imported ones of the same type. But due to restriction by policies, taxes, national standard, and scrap tire resource, domestic rubber powder enterprises cannot expand and even being idling or half-idling; The application of pitch reformed by rubber powder is difficult to expand in China as it lacks local and national standard.

2.2.3 Has not set up a freely flowing waste tire reuse& recycling system

Overall, waste tire reuse& recycling system in China is not standardized and lacks a specific method to control waste tires from generating, receiving, to disposing. The reuse& recycling net made up mainly by individuals cannot adapt to current demand for waste tire utilization. Reuse& recycling points have not been put into urban infrastructure design, which leads to inadequate management on sanitation, environment, and safety of them; most of the waste tire buyers are farmers who come into cities for work. And they do not get training on basic reuse& recycling techniques; Due to profit motivation, recycled waste tires cannot use in the way that conforms to circular economy. Such as illegal scrap tire purchase for oil refining, which wastes the rubber resource and pollutes the environment severely.

2.4 Undeveloped management, legislation, and supporting policies

China has not formed systems of routines, legislations, policies, and social mechanism to encourage renewing and recycling waste tire resource. Although the methods and technologies we are using in recycling does not fallen behind, the undeveloped management, legislations and policies have seriously hampered the development of waste tire industry, which also formed the main inferiority to developed countries.

For management, many developed countries have set up waste tire management organizations, such as “scrap tire management committee” in the US, and “Scrap tire recycling management association” and “scrap tire bureau” in Canada. China has neither such managing departments nor set up formal systems of waste tire reuse& recycling. Due to blind and disorder competitions among enterprises, and substandard market management, products of good quality and enterprises with advanced technologies cannot gain deserved support.

For legislation, developed countries have established a series of relatively perfect law and policy systems. Such as *Resource and Recycling Law* and *Tire Reuse and Recycling Law* in US, *Waste and Resource Recycling Law* in France, *Law for Circular Economy* in Germany, *Resource Saving and Reuse Promotion Law* in Korea, *Basic Promoting Law for Circular Society* in Japan, and etc. These laws have some important points in them: According to the principle of “who pollute, who clean”, waste tire disposing tax should be levied on tire consumers. Special funds for collecting and recycling separated waste tire should be set up in the society; waste tires should be sent as product resources to manufacturers who will get disposal subsidies from the special funds; low tax rate should be implemented on waste tire recycling enterprises to encourage folk investment; using renewed products should be encouraged and even compelled to be popularized. For example, provision 1038 in *Comprehensive Land Transportation Economy Law* of the U.S. says: Road construction that is invested or supported by the government should use pitch reformed by rubber powder made from waste tires, so that scrap tire integrated utilization can be promoted. China has no such specific legislation on waste tire

reuse& recycling so far, neither does any specific measures to embody the principle “who pollute, who clean” in waste tire reuse& recycling.

After the implement of supporting policies in the U.S., the recycling rate increased obviously from 24% in 1990 to 78% in 2001.

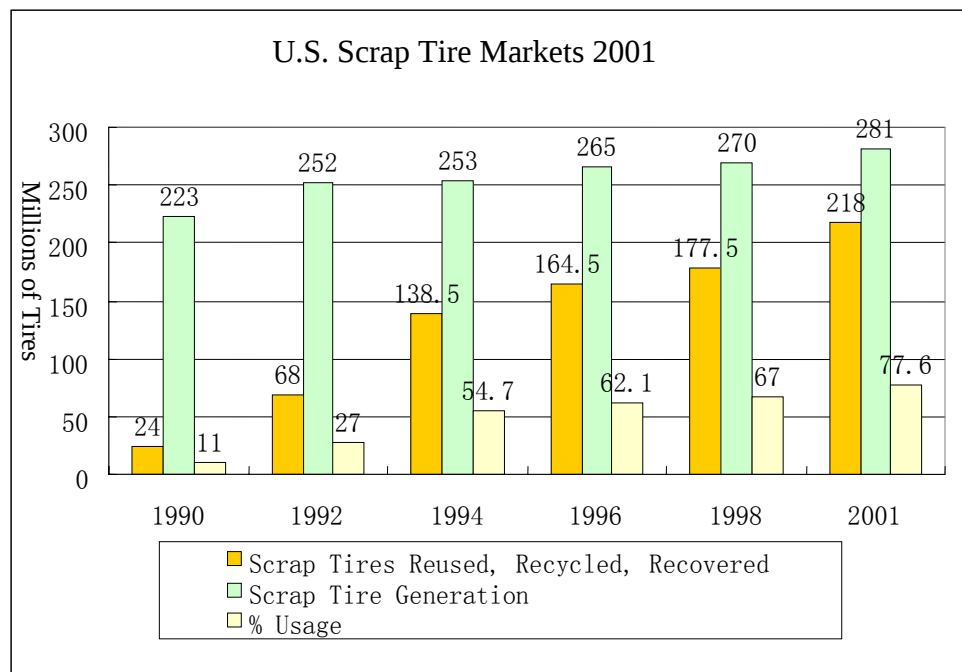


Figure 4

For policies, there are no specific industrial policies on waste tire reuse& recycling industry in China. Even the business of using scrap tires to produce rubber powder, which is internationally agreed on resource recovery and not harmful, has not been brought into the industry catalogue of the government. It makes foreign traders and folk investors face policy barrier. Waste tires overseas are mostly utilized for free. And enterprises can enjoy the tax-free policy and get subsidies from the government. While in China on the other hand, these kinds of enterprises are not free of tax and even have to pay more tax than other manufacture businesses; there is no subsidy and the price of waste tires is very high. As waste tires are purchased from the non-government, producers cannot get the receipt of value added tax to compensate for income tax, which actually causes double tax impose. It makes the subtle profit business become a loss and difficult to exist, not to speak of development. The unequal treatment in policy is very detrimental to the development of waste tire reuse& recycling business of China.

3. COUNTERMEASURES AND SUGGESTIONS ON WASTE TIRE REUSE& RECYCLING INDUSTRY OF CHINA

The industry of waste tire reuse& recycling is represented for waste tire “reduce, reuse, recycling, harmless, and resource recovery”, which has become the new growing point of the national economy. It conforms to market benefit, social employment, resource recycling and environment protection, and has been listed in the field of circular economy development. It is a new opportunity and the most urgent thing is how to establish an operating system and development mode of waste tire reuse& recycling,

which are suitable for China. The following passage will propose some countermeasures and suggestions on it.

One of the measures is that we can accelerate to draw up legislations on waste tire reuse& recycling management, to manage according to the law, to standardize the business development.

The nation should set up and perfect regulations and detailed rules on waste tire reuse& recycling as soon as possible. It should also manifest the responsibility and obligations of the producers and users. And waste tire integrated utilization should be oriented scientifically; set up complete waste tire reuse& recycling channels and methods on disposal tax imposing, registration, payment, use and management; regulate the industry management and adjustment, supervision, design, preferential policies, scrap rubber utilizing technology study and exploration, second pollution disposal, products and raw material standard, recycling, statistics gathering, announcement, reward and punishment, and implement authentication system to waste tire utilizing enterprises. It is said that China is actively drawing up *Regulation on Waste Tire Reuse& Recycling Management*. The National Quality Supervision Check and Quarantine Bureau has drawn up *The Announcement on Recording, Checking and Supervising Imported Old Tires for Retreading*, and it will be declared and implemented within this year. Hopefully these two documents can come out quickly and gradually put waste tire recycling into a legal managing system.

The second measure is to perfect encouraging systems and policies on waste tire reuse& recycling business.

First, a system of waste tire reuse& recycling tax and compensation should be set up as soon as possible. According to the principle “people who pollute pay for the tax, and who utilize make a compensation” in *Decisions on Certain Environmental Problems* drawn up by the State Council of China, the system of waste tire reuse& recycling tax and compensation should be established, and tire consumers should have the responsibility to pay for disposal tax. In addition, the benefits of tire producers, consumers and disposers should be adjusted. Firstly, Get pollution disposal tax from tire producers and import traders during the process of selling. And use the money mainly in compensating waste tire recycling transportation cost and policy subsidies for collecting and distributing centers and disposal enterprises; secondly, levy the tax by the national tax authority from tire producers in selling and importing process when collecting value added tax. List the tax into the national finance budget to unify management and implement different compensation system; thirdly, make it transparent in collecting and using waste tire disposal tax. Despite the audit authorities, it should also be supervised by the public, and announcements on the use of the fund should be given to public regularly.

Second, China should give support on tax levy, credit and investment. The nation should implement preferential tax on waste tire disposers to reduce their burden; increase investment on the technology exploration for waste tire utilization by all means. It should also give financial support on technology exploration for waste tire integrated utilization and model projects with high new technology industrialization; put waste tires into the national compulsory recycling catalogue. Another thing we can do is to implement the system of “change the old for new ones” and set up waste tire collecting and distributing centers across the country to take charge of local waste tire collection, classification, early manufacture and reuse.

In addition, the nation should conduct by policies on the waste tire resource recovery way to be most scientific and have most supplementary value. For example, rubber powder industry is the trend of waste tire integrated utilization. It has just started in China, while manufacture technologies has reached the top level of the world. The key point is application and popularization. So the nation should coordinate applications in rubber industry, construction material business, roads, public places and etc. The government should give policy support to rubber powder manufacturers and applied enterprises, set up national and local standards, and give them advantages on taxation.

Another measure is that we should develop adequately the influence of China Rubber Industry Association (CRIA) and China Tire Retreading And Utilization Association (CTRA), and make further propagation.

It will become a bridge and link between the government and enterprises. We should reinforce

investigation and researches and set up an information system and data pool of waste tire reuse& recycling. Try to do well on the work of gathering basic statistics, and collect, arrange, and release information in time on domestic and overseas waste tire reuse& recycling. Give deciding advices according to different periods of waste tire utilization; Combine producing, learning and researching together to organize studying projects on significant trend of scrap tire recycling; accelerate to cultivate workers of different level in the field of waste tires; summarize advanced experience in producing, operating and management, and popularize and exchange it among waste tire enterprises. On the other hand, improve the social awareness on waste tire reuse& recycling through propagation by the associations. Promote waste tire reuse& recycling industry to develop in a healthy, stable, and orderly way.

In sum, waste tire reuse& recycling industry has high economic and environmental benefits and it is a very important part of circular economy development of China. China has a great potential in waste tire reuse& recycling and a brilliant prospect. It needs supports from the government, the society and many other aspects to promote waste tire reuse& recycling industry to develop healthily, which is of great significance to realizing sustainable development.

REFERENCES

- Current Situation And Countermeasures In Development Of Waste Tire Reuse& Recycling Business Of China, <http://www.crra.com.cn/zslt-ltdc.htm>, 17th October 2002.
- LI Ru-lin. (June 2005). *To Establish Scientific Point Of View On Development To Promote The Business Develop Healthily*. Proc. of The National Waste Tire Rubber Powder Applied Technology, Tianjin, China.
- LI Xiao-ming. (2003). *Waste Tires: Black Golden Mine. Investment In China*, (12), 46-48.
- Yan LI, ZHANG Yong & ZHANG Yin-xi. (2003). Current Research Situation On Scrap Rubber Utilizing Domestically And Abroad. *Synthetic Rubber Industry*, China, 26 (1), 59-61.
- LU Yong-qi. Current Situation And Development In Scrap Rubber Utilization Industry Of China. *Rubber In China*, 20 (12), 4-7.
- LU Yong-qi. (2005). A Profile Of Scrap Rubber Resource Utilization Abroad, *Renewable Resource Research*, (1), 16-19.
- CHENG Yuan. (June 2005). *Develop Up And Down For A New Prospect Of Tire Recycling*. Proc. of The National Waste Tire Rubber Powder Applied Technology, Tianjin, China.
- Waste Tire Reuse & Recycling Will Gain Policy Support.
<http://www.cnpowder.com.cn/news/view.php?id=4056>, 8th November 2004.
- JIANG Zhi-yun. (June 2005). Make Effort To Improve Scrap Tire Rubber Powder Applied Technology And Promote The Development Of Waste Tire Enterprises. *Proc. of The National Waste Tire Rubber Powder Applied Technology*, Tianjin, China.
- JIANG Zhi-yun. (2005). The Current Situation And Prospect Of Waste Tire Reuse& Recycling In China. *Tire Resource Integrated Utilization In China*, 6 (6), 6-8.