

The Use of Recyclable Rubber Materials in Children's Recreation Facilities

Bo Gao^{1*}

¹ Binhai College of Nankai University, Tianjin 300270, China

*Corresponding author. Email: 15327529@qq.com

ABSTRACT

Recreation facility is a key point to children's approach to the society in their early life. Through both information and field research, the demands of children and parents for recreation facilities have been learned about. In order to create a safe environment for children's entertainment, based on properties and usage of recyclable rubber materials, as well as the summarization of different physiological activities at different ages, this paper designs the recreation facilities in urban parks.

Keywords: recreation facility, rubber material, recreation safety

1. INTRODUCTION

Among China's population of 1.396 billion, 21% are children.^[1] With the beginning of the two-child policy, this percentage will increase. Education on children will determine the future of the whole nation. With the improving economy, Chinese people now enjoy better living conditions, and families spend more and more on children. Recreation facilities play an important role on children's life, because they not only develop children's body and intelligence, but also cultivate sense of community and responsibility. Recently, although some new features have been developed on Chinese recreation facilities, they are still behind those in other countries for their identical appearances without outstanding features, poor variety in materials, and poor functions. There is also no targeted design for different ages. Meanwhile, the city is growing rapidly, and more and more land are occupied for constructions with less land are for recreations and parks. As a result, there are fewer recreation facilities for children, and many children don't have place to play. Most recreation facilities are now placed indoors, which has reduced children's incentive to play outdoors and resulted in less communication with others. Some health problems are also likely to appear such as obesity and shortsightedness. People now care more on the environment. Most recreation facilities use plastic and steel materials. Such materials cost much, and may hurt children. What's more, they are hard to be recycled.

Proper materials will be fit for the recreation facilities, and also guarantee the safety while playing on them. Parents will also trust well-designed facilities. The use of well-chosen materials can promote the development of recreation facilities. Children can cultivate environmental awareness, which will promote sustainable development.

2. PROPERTIES OF RECYCLABLE RUBBER MATERIALS

Rubber is an elastic polymer material with the ability to undergo reversible deformation. Waste rubber is hard to degrade under natural conditions as it is water-insoluble and poorly soluble in organic solvents, which is known as "the black pollution". Waste rubber is also elastic, insulated and water resistant. China is one of the biggest countries in automobiles as well as rubber consuming. Around 45% of the total rubber consumption depends on import.^[2] By 2007, there are over 170 million waste tires across the country, which means many rubber materials like tires have been wasted. Under the background of sustainable development, how to make use of those waste rubber and how to deal with those black rubbish are of practical significance. If the waste rubber could be recycled and reused, it will create value again. For example, waste tires can be retreaded, or turned into artificial fish reef or cushioning materials. Physical or chemical methods are also available to process waste rubber into powder or particles. The reason why rubber is used in recreation facilities is that it is elastic so it provides a cushioning effect on whatever falls

on it, which is not available for other material commonly used in facilities such as plastics, wood and steel.

3. CHARACTERISTICS OF CHILDREN, AND MATERIALS OF RECREATION FACILITIES

From birth to adolescence, children’s body and mind change a lot, so does their requirement for recreation. So it’s important to learn about children’s physical and psychological characteristics.

Currently most recreation facilities in China can be categorized as “swing type” (mainly using rope, metal, plastic and wood as material), “climbing type” (mainly using wood, metal and plastic, or just taking advantage of the ground), “rotation type” (mainly using metal and plastic), “slide type” (mainly using plastic and metal), “crawling type” (mainly using cement, plastic, metal and wood), “balancing type” (mainly using metal, plastic and wood) and “bouncing type” (mainly using materials with high ductility such as rope and inflatable plastic). Most of them are made of similar materials. Indoor recreation facilities are the production of those outdoors, with some spongy pads or Styrofoam as cushioning. Most indoor playgrounds have entrance fee. About properties of the materials, different physical property, and different usage of the same facility both may have influence on safety. The safety of materials is also important for the overall safety. Those aged materials may also affect the safety. The materials of recreation facilities are much different from those of toys. They have huge influence on children’s entertainment activities. Currently there are both natural and synthetic materials for recreation facilities. Natural materials include wood, sand and water, while synthetic materials include plastic, steel and concrete. Wooden materials are not toxic and easy to be acquired. They can be assembled into different shapes, but costs much in maintenance, and produces lots of waste during the manufacturing process. What’s more, a coat of paint has to be given as waterproof and antiseptic. Plastic is a kind of chemical material, which is easy in manufacturing process and rich in color, but is likely to be damaged and hard to replace. The plastic may release some toxic gases if the temperature is too high. Steel is a solid and durable material, and can be easily assembled into different shapes. However, its high hardness may cause injury on children.

The material used in facilities is the basis that constitutes its shape and does not depend on human consciousness for existence. Every material has its characteristic. Its beauty is mainly expressed by the color, luster, texture, appearance and the combination of varied materials. Children are relatively lacking in self-protection. [3]They may roll or crawl everywhere, or even lick the facility. It is especially important to be able to be exposed to the sun for a long time, and to maintain a non-toxic and environmentally friendly elastic material after seasonal changes, wear and poke. Therefore, designers should pay attention to the different safety features brought by the different materials used in the facility. The plastic material has good high elasticity, viscoelasticity, insulation, cushioning and shock absorption, and has a good protection effect on children's activities, so it is suitable to be used on recreation facilities. However, plastic material costs much. Rubber is a widely used material in life. It is widely used in transportation, industry, agriculture, forestry, water conservancy, military solidification, civil engineering, electrical communication, medical and health, commodity storage, cultural and sports goods, education, and daily necessities. It is safe to use rubber materials for recreation facilities. Different rubber types have different effects, and different facilities can be made using different rubber types for children to play. At the same time, various colors can be added during the reprocessing of the rubber to attract children's attention and active participation in the activity.

At present, many cases around the world show that the materials are mostly taken locally, and rarely use cement and plastic materials, which greatly protect the environment and ensure that the entire facility materials can be recycled. Meanwhile, most of the ground is paved with elastic properties or sand, dirt and grass ground materials to protect children's safety. In addition, most facilities have a slope to reduce the hard damage when they fall.

4. DESIGN OF CHILDREN'S RECREATION FACILITIES USING RECYCLABLE RUBBER MATERIALS

When children perform a variety of recreational activities, parents sometimes cannot keep a close eye on

Table 1. The children’s physical and psychological characteristics

	Font	Spacing	Numbering
Psychological characteristics	12- Infant period, when they first develop the sense of self and passively receive information. The language skill has yet completed, and	The consciousness begins to awake, and the concept of gender has been developed. They can distinguish the things around them through the environment	The different characteristic between different genders appears. They are moving closer to the society, and are conscious about their initial entry into the society. The negative mentality may

	they can only imitate others to express themselves		arise. They don't like being controlled, but enjoy activities in groups. They also begin to care about their behaviour and social status.
Physical characteristic	Just walking and running with guidance of parents. They cannot play complicated games by themselves.	They are already able to think independently, and to do exercises by themselves like running and jumping. But they still need to be cared by parents.	The brain and body continue to grow. They can do things by themselves and think logically. Basically they can take part in intellectual activities.
Recreation characteristics	They are curious about the world. They experience the world mainly through what the body feels. For example, they learn about something that can be directly touched like sand and water. This process requires the guidance of parents.	The sense of independence develops gradually, and the body continues to grow. They have the sense of community, and their activities become more vigorous. They start to challenge something higher like slide, swing and climbing, which still needs parental guidance.	The body grows rapidly and they can think independently. They prefer to play together with friends. Meanwhile, the negative mentality results in the reluctance to parents' guidance and the refusal to play with smaller kids.

them. The primary purpose of the project is to reassure parents that their kids are safe on recreation facilities instead of being nervous, and to provide all-dimensional protection from various sites and facilities, not only the protection measures of the flat areas but also those of the climbing areas, minimizing the possible risk and thus protecting children's recreation safety.

The project is designed to be located in an urban park near residential areas and schools, and to provide all leisure activities for the surrounding residents and school students.^[4] The functions are clearly defined, including basketball courts, climbing area, maze, plant area, children's activity area and splash fountain.



Fig.1 The aerial view of children's play area

Recyclable rubber material is largely used in the project. The combination of hard materials (wood and steel) and rubber materials protects children's safety during play. Taking into account the needs of children in the play area, the all-round protection of children's play safety is thus provided. The ground is generally flat, and

soft rubber mats are placed to prevent children of younger age from falling and being injured during walking, thereby protecting children's walking safety.



Fig.2 The aerial view of children's play area

In the free play area, the swing seat is made of soft rubber material, such as used tires or used car inner tubes. The swings are painted more colorful, and a protective net is added to make it suitable for children of all ages. Rubber pads are placed at the corners of the maze to prevent children from injuries due to carelessness or blind spots. In the building block area, the special compression of the rubber material will produce deformation, and the micro-deformation will be used to make the building blocks stronger and more stable, not only to exercise the child's mind, but also to exercise the child's upper limb strength.

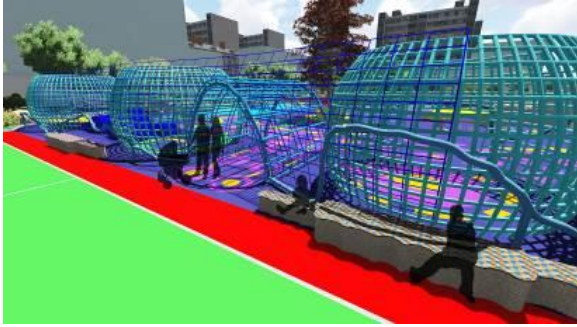


Fig.3 Large climbing facility area

In the large facility area, the ground is elasticized, such as adding a net in the play area, or placing elastic rubber balls, which not only guarantees the safety, but also increases the fun of activities and greatly improves the enthusiasm of children to play. Elastic nets are added around facilities. Together with the rubber protective layer around the fence, they prevent children from improper activities and accidental fall or bruise.



Fig.4 Plant area

In the plant area, used tires are recycled. Waste rubber materials are transformed into flower pots. Taking advantage of the elastic property of rubber, part of the flower pot can be separated from the whole, and the separated part forms a spoon shape, which can be used to water the plants. In this way, the integrity of the tool and the aesthetics of the facility are guaranteed. The ground of the splash fountain is made of rubber with non-slip particles. The ground of the splash fountain is made of rubber with non-slip particles. Reasonable drilling on the ground not only prevents slipping, but also drains the water on the outside ground, ensuring the safety of children and parents.

5. CONCLUSION

Children's play facilities should be designed from a safety point of view, taking full advantage of the properties of rubber and combining it with hard materials.^[5] The three-dimensional protection ensures children's play safety in all aspects, and makes the whole children's play area full of vitality instead of a pile of cold steel, so that children would really love playing there and playing safely, and will promote children's psychological and physiological growth in playing.

REFERENCES

- [1] Enzhi Liu, *Solid Waste Treatment and Utilization*, Dalian University of Technology Press, Shandong, (2004)
- [2] Shuang Wu, *Research on Space Safety of Children's Outdoor Activities*, Nanjing Agricultural University, Nanjing, (2005)
- [3] Na Li, *Children's Behavioral Psychology and Children's Park Design*, Changsha Hunan University, (2008)
- [4] Chun Yang, *Discussion on Product Safety Design from Form Treatment*, (2008)
- [5] Courage, Catherine, Baxter, Kathy. *Understanding Your Users*. Morgan Kaufmann, (2004)