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Research on Green Rubber Concrete Construction Technology based on Fractal Dimension Theory

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Abstract. Rubber concrete not only can make extensive use of waste rubber, but also with excellent performance. Based on the literatures at home and abroad, this paper summarizes the research progress of the working performance, mechanical properties and durability of rubber concrete, and provides reference for the further research and application of rubber concrete.

Introduction

Waste rubber is not easy to natural degradation, landfill will pollute the soil, incineration will produce a large number of toxic and harmful gases to cause air pollution, and not effective disposal is also a great waste of resources, it is necessary to waste utilization of waste materials , Make it waste into treasure. Cement concrete is the largest amount and the most widely used civil engineering materials, but its high brittleness, low strain capacity has seriously restricted its application in some specific areas. Rubber concrete is a kind of ordinary concrete with ordinary concrete as the base material, in which it is uniformly mixed with a certain amount of rubber particles or rubber powder. Typically, the rubber particles are mixed with concrete in an equal volume to replace the aggregate, and the rubber powder is incorporated into the concrete in a manner that is mixed with the mass percentage of the cement. As the rubber density is lighter, stirring and molding process prone to float in the uneven distribution of concrete, so the preparation of rubber concrete than ordinary concrete process complex. At home and abroad, a lot of research has been done on rubber concrete. The results show that rubber powder can not only make use of waste rubber in cement concrete, but also has high quality, toughness, good impact resistance and good durability. And so on, especially in the impact resistance and durability have higher requirements of the road works in a better application prospects.

The mechanical properties of rubber concrete

The strength of rubber concrete generally shows a tendency to decrease with the increase of rubber content. In view of the effect of rubber particle size on the strength of concrete, the results of different scholars have different results. The reason why rubber powder will reduce the strength of concrete is mainly due to rubber is organic materials, and inorganic materials as a combination of cement is poor, in the rubber powder and cement interface easily formed a weak link. The higher strength is the prerequisite for the cement concrete as the structural material. When the rubber powder is mixed into the concrete, it will reduce its strength, which seriously restricts its application. Therefore, it is necessary to take measures to improve the strength of the rubber concrete. The existing measures are mainly to pretreat the rubber particles, by removing the rubber particles on the surface impurities, reduce the rubber is not conducive to the cement bonded zinc stearate content, change the hydrophilicity of rubber particles to improve the strength of rubber concrete pretreatment The method usually includes washing, carbon tetrachloride treatment, NaOH solution treatment, coupling agent treatment and latex treatment. The results show that these pretreatment methods can improve the strength of rubber concrete in different degrees.

Ordinary cement concrete is brittle material, the impact resistance is poor, under the impact of the load easily damaged. As the rubber has a toughness, it is incorporated into the cement concrete can significantly improve the impact resistance of concrete, making the "brittle concrete" into

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"tough concrete". Eldin and Senouci studied the failure mode of rubber concrete, and found that the destruction of rubber concrete is different from the brittle failure of ordinary concrete and ductile failure. Khatib and Bayomy also show that the failure mode of rubber concrete changes with the increase of rubber content, and even when the rubber content is 60%, the concrete exhibits elastic deformation characteristics. Tantala et al. studied the effect of rubber and rubber particle size on the toughness of concrete with different content (equivalent volume substitution coarse aggregate). The results show that 10% rubber concrete is better than 5% rubber concrete The impact resistance and toughening effect of rubber granules concrete is better than that of fine rubber particles. Shen Weiguo et al. showed that the impact toughness index of concrete mixed with 18% coarse rubber particles and concrete containing 14% fine rubber particles increased by 5.1% and 9.7%, respectively, compared with the reference concrete. Zhao Zhiyuan et al. showed that the amount of impact resistance of rubber concrete was increased by 6. 2 times compared with that of the reference concrete with 25% rubber particles.

Savas et al. studied the effect of different rubber contents on the frost resistance of concrete. The results show that the rubber content has a significant effect on the durability of concrete, and the durability of cement concrete can be improved when the content is 10% and 15% The content of 20% and 30% of the cement concrete durability can not meet the requirements. Paine KA et al. have shown that rubber powder can introduce stable and uniform bubbles in concrete, and the frost resistance of rubber concrete is better than that of ordinary concrete, which is equivalent to the frost resistance of blending agent concrete. They also incorporate rubber particles with particle sizes ranging from 0.5 to 1.5, 2 to 8, 5 to 25 mm, and found that the performance of rubber concrete under freeze-thaw cycles was better than that of ordinary concrete. Zhang Yamei et al. found that the rubber particle size and content of the concrete would affect the frost resistance of concrete. The coarse rubber particles with particle size of 3 ~ 4 mm could not significantly improve the frost resistance of concrete, Rubber powder in the appropriate dosage can improve the frost resistance of concrete. They also further studied the frost resistance of rubber concrete in water and NaCl solution media. The results show that the rubber powder improves the frost resistance of concrete in water and NaCl solution at appropriate dosage. Li Guangyu et al. showed that the frost resistance of rubber concrete increased with the increase of rubber powder content under the small content of rubber powder (15%), the particle size of rubber powder decreased, and the quality loss of concrete The smaller. Wang Tao, etc. that 80 mesh rubber powder can play the role of air-entraining agent, so increase the concrete content and the characteristics of rubber powder itself can improve the frost resistance of concrete, rubber powder content of 90 kg / m3 In the range, the frost resistance of rubber concrete increases with the increase of rubber powder content.

Water infiltration into the concrete is the premise of steel corrosion, freezing and thawing damage and alkali aggregate reaction, and water is also the carrier of the erosion medium into the concrete, so the impermeability of concrete is of great significance to its durability. Chen Bo et al. studied the effect of rubber powder and rubber particles on the impermeability of concrete. The results show that the impermeability of rubber concrete increases with the increase of rubber powder or rubber particles, The optimum dosage is 10%. Hu Peng et al. studied the impermeability of rubber concrete under different rubber content and water-cement ratio. The results show that the impermeability of rubber concrete is best when the rubber content is 50 kg / m3, and the rubber impermeability With the water-cement ratio increases and decreases. Fan Lulu et al. also showed that the permeability of rubber concrete increased first and then decreased with the increase of rubber content. The effect of different particle size rubber on the impermeability of concrete was different. The blocking effect of the internal pores is better than that of the smaller particle size rubber. Yang Biao et al study shows that the larger the rubber particles, the less the impermeability, rubber particle size in the range of 8 to 28 mesh, with the rubber particle size increases the better impermeability of concrete. Tian Yanfeng et al. It showed that the rubber content in the range of 125 L (equivalent volume of aggregate) can improve the impermeability of concrete, different particle size rubber to improve the effect of concrete is not the same, the smaller the rubber particle size, rubber The better impermeability of concrete. As the rubber powder is mixed with concrete to fill the internal pores, and the smaller the particle size is, the better the capillary porosity of rubber concrete is, so the impermeability is better.

Application of Rubber Concrete in Engineering

The uniform distribution of the rubber particles inside the concrete causes the interior of the concrete to form a uniform elastic support system so that when the rubber is subjected to different external effects, the rubber particles can be deformed to absorb energy and at the same time to prevent the extension of the cracks And development, which effectively hinders the segregation of aggregate to ensure the density of concrete, toughness and impact resistance, for concrete, whether the cracks do not depend entirely on the tensile strength of concrete, but to see the deformation resistance of concrete, That is, ultimate tensile strain. For the ordinary concrete with the level of improvement, the ultimate tensile strain decreases. According to the United States in Huaxi Dashi concrete experimental study shows that, ordinary concrete ultimate tensile strain is generally 1 × 10-4, fast loading, the value dropped to 0.8 × 10-4, slow loading can be increased to 1.6 × 10-4. For the ultimate tensile strain of rubber concrete is the ultimate tensile strain of ordinary concrete 2 times, if the maintenance in the construction and the creep can fully develop, then the ultimate tensile strain can be increased to (3 ~ 4) × 10-4 , Compared with the ordinary concrete, the increased strain value converted into the temperature equivalent of 15 ℃ ~ 25 ℃ temperature difference.

For some super long or large area of the ground, because the ground is very strong constraints on concrete, and concrete is generally not very thick, which for the control of the cracks to bring a certain degree of difficulty. In general, in order to avoid visible cracks, often at intervals to leave a stretch joints, this is not only the use of concrete and durability of the adverse effects, but also on the progress of the construction impact. The use of rubber concrete if designed properly, and in the construction can adhere to: "excellent construction, reasonable conservation" principle, cancel the reserved expansion joints is not impossible. In the United States, rubber concrete in a number of pavement engineering has been widely used for the control of concrete cracks to achieve significant results. But in the country, rubber concrete is still a research and development of materials, its large area of application potential.

For the continuous wall, because of its use of the reasons, it does not bear a lot of load, so when designing the continuous wall is mainly to control the continuous wall of the cracks. For concrete, the effect of temperature is part of the concrete shrinkage itself also has a very important role in the generation of cracks, in which the impact of cross-section dimensions on the shrinkage can be used to reflect the reciprocal of the hydraulic radius of the cross- The ratio of the circumference L (the side length of the contact with the atmosphere) to the area F surrounded by the periphery. For example, a cross-section of 20cm × 20cm prism, the hydraulic radius of the reciprocal: r = L / F = 0.2cm-1; and the same area of the thin plate, take 2cm thick, 200cm wide, the hydraulic radius of the reciprocal: r = L / F = 1.01 cm-1, so that the shrinkage of the sheet is much larger than that of the same area of the prism. And continuous wall is precisely this is not conducive to the contraction of the components, for the continuous wall on the ground, the demolition of the continuous wall exposed to the air, not only to withstand the daily temperature difference, but also to withstand the huge seasonal temperature difference, for the general not allowed to stay There is a continuous wall with expansion joints, the control of cracks is a big problem. To similar projects, for example, if the use of rubber concrete pouring, and then reasonable configuration of steel, not only to crack the means of simplification, but also reduce the cost of a lot.

Because of its low elastic modulus, the rigidity is lower than that of the ordinary concrete, so the application in the structure is limited. According to the experimental study of the bending of the rubber concrete beam, the deflection of the concrete is large, More ductile than the general concrete, but its application in the structure to be further studied. However, for some practical projects, such as local prestressing engineering, due to the needs of the design, the need for a part of the structure made of prestressed structure, and other parts made of non-prestressed structure, in the prestressed structure and non-pre-stressed The stress structure must be set at the boundary of the post-pouring belt, on the one hand is the need for prestressing tension, more importantly, because the prestressed structure in the tensile after the axial compression deformation, this part of the deformation will be prestressed and non- The prestressed concrete at the junction of the crack, serious will affect the use of the building. As the prestressed structure under the action of axial prestressing will produce creep, and creep growth will lead to increased axial compression deformation, so that after pouring pouring problem is very critical. Pouring too early, due to the growth of creep will make the junction of the concrete cracking; pouring too late, affecting the progress of the project. And for the post-pouring is generally set in the smaller force, and its width will not be too large. Therefore, with a certain strength and ultimate tensile strain of rubber aggregate concrete can be short and short, to play its due role. On the one hand neither bear the structural load, but also with the prestressed structure with the coordination of deformation, and not appear obvious cracks. Of course, there are many factors that affect the cracks in concrete, but to improve the ultimate tensile strain of concrete itself, to reduce their own shrinkage is the most fundamental way to solve such problems.

Conclusion

In this paper, a series of experiments and existing experience, pointed out that rubber concrete is not only environmentally friendly, light weight, with the basic properties of ordinary concrete, and its elastic modulus is small, ductility, hardening shrinkage, with strong deformation capacity, Compared with the former Soviet Union or the existing domestic rubber concrete, its low price, with a good price. The existing work results and theoretical discussion show that: rubber aggregate concrete can be widely used in general engineering prospects.

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