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ОБСУЖДЕНИЕ О ЭКОЛОГИЗАЦИИ ТРАНСПОРТНЫХ ДОРОГ С ИСПОЛЬЗОВАНИЕМ НЕМЕТАЛЛИЧЕСКОГО ВОЛОКОННОГО АСФАЛЬТОБЕТОНА

DISCUSSION ON GREENING TRANSPORTATION ROADS BY USING NON-METALLIC FIBER ASPHALT CONCRETE

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Асфальтовое покрытие широко применяется в дорожном строительстве, однако для производства традиционного асфальтобетона требуется большое количество высококачественных минеральных веществ, асфальта и топлива. Поэтому зеленая трансформация традиционного асфальтобетона стала главным приоритетом. В целях содействия устойчивому развитию асфальтового покрытия и социальной энергетики, окружающей среды и экологии, в этой статье улучшается асфальтобетон путем добавления зеленых неметаллических волокон, а также обсуждается экологическое, высокопроизводительное и функциональное развитие дорожного асфальтобетона. автомобильные перевозки, зеленый цвет.

Asphalt pavement has been widely used in road engineering, but the production of traditional asphalt concrete requires a large amount of high-quality minerals, asphalt and fuel. Therefore, the green transformation of traditional asphalt concrete has become a top priority. In order to promote the sustainable development of asphalt pavement and social energy, environment and ecology, this paper improves asphalt concrete by adding green non-metallic fibers, and discusses the ecological, high-performance and functional development of road asphalt concrete.

Ключевые слова: *неметаллическая фибра, асфальтобетон.*

Keywords: *non-metallic fiber, asphalt concrete, road transportation, green.*

INTRODUCTION

Asphalt pavement has the advantages of low fuel consumption, low noise, good skid resistance, and low vehicle damage. It has been widely used in road projects. As we all know, the production of asphalt concrete not only consumes a large amount of high-quality stone and petroleum asphalt, but also consumes a large amount of diesel, heavy oil and other fuels. Certain harmful gases are also released during the high-temperature production and construction process. With the increase in environmental protection efforts, a large number of stone mines have been closed; the price of petroleum asphalt remains high, and the cost of road construction is getting higher and higher; the mileage and density of roads increase, and the environmental pollution caused is becoming more and more serious. Therefore, this article focuses on the addition of non-metallic fibers to asphalt concrete to change the existing asphalt concrete technology, extend the service life of roads, and improve the efficiency of road transportation to meet the application performance of green technology in today's society.

GREENING TRANSPORTATION ROADS

From early natural asphalt to industrial coal tar asphalt, and then to the application of modern asphalt mixtures and modifiers, asphalt pavement has undergone great development. However, with the increase in traffic volume, heavy loads, extreme weather and other factors, asphalt pavements have experienced problems such as rutting and cracking, shortening their service life, and reducing the overall performance and quality of the pavement [1]. In the 1960 s, fiber began to be used in pavements. People found that the addition of fiber can significantly improve the high temperature performance and low temperature crack resistance of the pavement. At the same time, it has obvious advantages in preventing the generation and expansion of pavement reflective cracks. Therefore, fiber was listed as an important material for improving concrete performance at that time [2].

In order to meet these challenges and improve the service life and performance of asphalt pavements, researchers have conducted extensive research. These efforts focus on the study of various regeneration agents and modifiers. Among them, fiber is a high-strength, durable and lightweight reinforcing material. It is well known that the addition of fiber can significantly improve the performance of asphalt pavements and ultimately extend their service life [3].

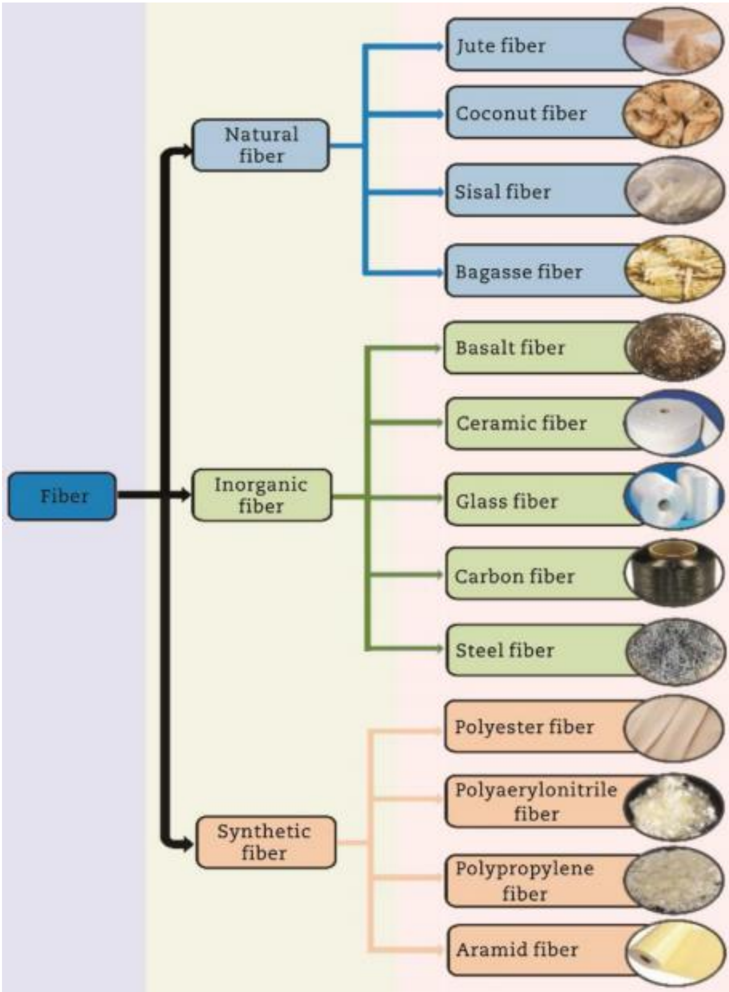

Figure 1 – Classification of non-metallic fibers

The performance of fiber-reinforced asphalt and asphalt products can be divided into natural fiber, inorganic fiber and synthetic fiber according to the fiber source. The research of AlHamaydeh M, et al. [4] showed that different types of fibers exhibit different effects in asphalt applications; The mechanical properties of non-metallic fibers are shown in tabl. 1. Through toughness tests, dynamic shear rheometer (DSR), bending beam rheometer (BBR) and multi-stress creep and recovery (MSCR) tests, it was found that adding 2 % reed stalk fiber can improve the viscosity and deformation resistance of asphalt, but has little effect on low temperature performance and fatigue resistance [5].

Table 1 – Mechanical properties of natural fibers (Dittenber and Gangarao, 2012; Kabiret al., 2012).

Fiber type	Density (g/m3)	Tensile strength (MPa)	Young's modulus (GPa)	Specific modulus (GPa/g/cm3)	Elongation at break (%)
Jute	1,3–1,4	393–773	13–26,5	10–18,3	1,16–1.5
Flax	1,5	345–1000	27,6	18,4	2,7–3,2
Hemp	1,14	690	30–60	26,3–52,6	1,6
Coir	1,2–1,5	95–230	3–6	4	15–51
Reed	1,5–1,6	287–800	6–13	6	3–10
Sisal	1,45	468–640	9,4–22	6,4–15,2	3–7

In the practical application of road materials, the key point of the modification method of natural fibers is that researchers need to solve the compatibility problem between natural fibers and asphalt, the dispersibility and durability of natural fibers in road materials, physical or chemical modification methods, The natural fiber structure is shown in fig. 2.

First, various methods are used to reduce the hydrophilicity of the fiber and improve the interface bonding between the fiber and the substrate, including mercerization, acetylation, silanization, etc. In order to improve the dispersibility, on the one hand, it is necessary to ensure that the fiber in the matrix is added to the fiber and fully stirred to ensure uniform dispersion. On the other hand, the surface modification can be used to weaken the hydrogen bonds between adjacent hydroxyl groups, thereby improving the dispersibility. The groups on the surface of the fiber promote the formation of hydrogen bonds between the fiber and the substrate. In order to delay the degradation of natural fibers in an alkaline environment, plant fibers need to be treated.

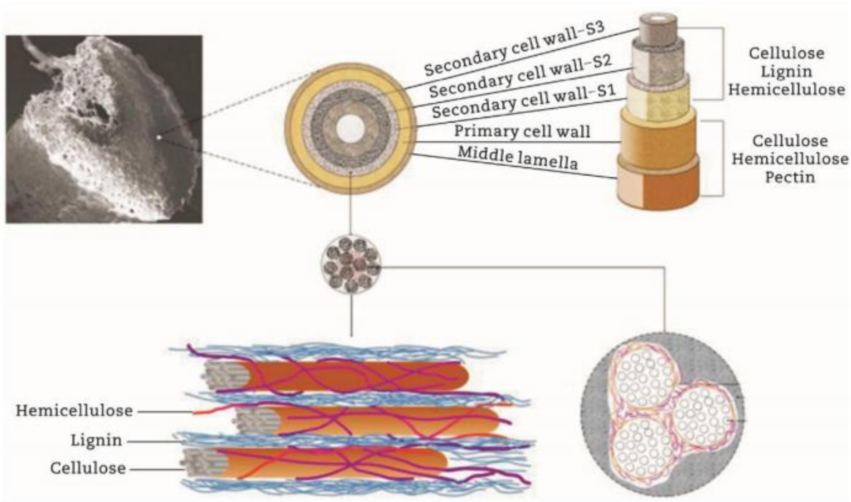

Figure 2 – The natural fiber structure

Zhao et al. wrapped the surface of sisal fibers with graphite oxide (GO)-based films to improve the selective permeability of GO films, which can prevent harmful ions from entering the fiber. It can effectively improve the alkaline degradation of sisal fibers. In addition, when natural plant fibers are added to asphalt, they will also gather together, and this phenomenon will become more obvious as the dosage increases. For example, when the content of bamboo fiber in asphalt binder exceeds 3 %, the reinforcement effect of composite modulus will be significantly reduced. The lignin fiber flocculated by reed fiber has less dispersion and is more likely to entangle into a ball and bind asphalt concrete than short fiber. They may have an impact on the fiber-modified road material.

CONCLUSION

People are bound to accelerate the greening process of road asphalt concrete, attach importance to the organic combination of material design and structural design with the design concept of the whole life cycle, increase the resource utilization of various inferior and low-grade raw materials in asphalt concrete, and strengthen the research and development and application of its special functions while improving the practical functions of asphalt pavement. Attention should be paid to energy conservation and emission reduction in the production and construction process to promote the development and application of green asphalt concrete and achieve sustainable development of the road industry.

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