Research on Performance and Application of Fiber Asphalt Concrete Based on Pavement Engineering

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Abstract: With the rapid development of China's economy, the whole transportation industry is also facing enormous challenges, mainly the problem of pavement diseases is more serious, so adding fibers to improve the road performance of asphalt mixtures. The paper aims to provide a useful reference for the research of fiber asphalt concrete, to explore the performance of fiber asphalt concrete, and to analyze the advantages of pavement asphalt concrete application. Finally, the application of fiber asphalt concrete in pavement engineering is expounded.

1. Introduction

Since the reform and opening up, with the continuous development of the economy, China's infrastructure has ushered in the climax of construction. As an important part of the infrastructure, road and bridge engineering has also been greatly developed. However, due to various reasons, the road surface damage is very common, which not only causes huge waste, but also seriously affects people's safe travel, and should attract enough attention. In the process of practice, people encounter problems and constantly summarize experience to deal with them. Especially in recent years, various new technologies and new materials have been emerging, which provides more choices for engineers and technicians to solve such problems. Especially the combination of fiber and asphalt concrete greatly improves the quality of road surface, improves the life of road surface, and facilitates people's safe travel.

2. Performance of Fiber Asphalt Concrete

According to the author's many years of practical experience and referring to other materials, the main performances of fiber asphalt concrete are summarized as follows: First, to prevent cracking of asphalt concrete and effectively resist reflective cracking. When cracks occur in the mixture under external forces, uniformly dispersed fibers play a bridging role at the crack tip, thus effectively preventing the generation and development of cracks. At the same time, dislocation and slip will occur between granular materials under external force. When large slip is blocked, the uniaxial stress of the fibers can be transferred to other substrates, so that the stress distribution is more uniform. Secondly, improve the high temperature stability of asphalt concrete. The poor high temperature deformation ability of asphalt mixture is closely related to the rapid decline of the bond strength of asphalt, while the flow and concentration of asphalt in the structure will occur under the high temperature of traditional mixture, which further enhances the high temperature deformation performance of asphalt mixture. When the fiber is added, it can improve the viscosity and cohesion of asphalt at high temperature due to the adsorption of the fiber. At the same time, due to the cross-stiffening and bridging, the fluidity of asphalt is reduced, the lateral displacement and flow of aggregate are limited, and the stability and rutting resistance of asphalt concrete are improved. Third, improve the low temperature crack resistance of asphalt concrete. The asphalt pavement will crack when the temperature drops sharply or the weather is cold, because the pavement shrinks sharply and the stress relaxes. The pavement formed by fibre reinforced concrete has a large number of crisscross and evenly distributed fibre monofilaments, and it still has a good elongation at low temperature, so that the pavement mixture still maintains flexibility and strong tensile strength at low temperature. Thereby, the rapidly changing stress is effectively dispersed, the

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generation of the temperature-shrinkage crack is suppressed, and the development of the reflective crack is prevented. Fourth, the interface effect is significantly enhanced. Due to its large specific surface area, the fiber material adsorbs oil in the asphalt, which is equivalent to the relative increase of asphaltenes, so that the viscosity of the asphalt is increased and the adhesion is stronger. At the same time, the physical and chemical adsorption, diffusion and bonding between the asphalt and the fiber make the thickness of the structural asphalt film increase, so that the interface effect between the fiber asphalt phase and the mineral phase is enhanced, thereby effectively reducing the structure. Destroy the danger. Fifth, the water stability of fiber asphalt concrete. The addition of fibers has an improved effect on the water stability of the asphalt mixture, and the fiber has a relatively large improvement effect on the ordinary asphalt mixture. This is mainly because the fiber can adsorb part of the asphalt, thereby increasing the amount of asphalt and increasing the saturation of the asphalt. Moreover, the structural asphalt film adhered to the mineral material is thickened, the erosion damage effect of the water on the asphalt cement is reduced, the ability of the asphalt cement to resist the damage of the natural environment is enhanced, and the water resistance of the mixture is enhanced. Sixth, the mechanical properties of fiber asphalt concrete. When the reinforcing fibers are added to the asphalt mixture, the fracture stiffness modulus of the asphalt mixture also increases. However, the rate of failure stiffness increase is slower, indicating that the fiber reinforced asphalt mixture has greater deformation ability and is more suiTable for deformation of the bridge deck. In addition, the reinforcing effect of fiber on ordinary asphalt mixture is more obvious than that of modified asphalt mixture. This is mainly due to the strong cohesiveness of the modified asphalt itself, and the effect of the fiber cannot be fully reflected. After the fiber is added to the asphalt mixture, the pressure resistance performance is improved whether it is a common asphalt mixture or a modified asphalt mixture, but the improvement effect on the compression resistance of the ordinary asphalt mixture is more obvious. Although fiber asphalt concrete has very superior performance, it should be noted that the ratio of fiber strength to interfacial bond strength should be moderate in the application process, otherwise it will increase or not. If the fiber strength in the fiber asphalt mixture is too high and the bond strength with the matrix is not compatible, the fiber will be pulled out; the fiber strength is too low to enhance. Due to the different mineral grading, the performance difference of the fiber reinforced matrix is also large, and the choice of mineral material should be combined with the fiber type selection. Generally, in the fine mineral gradation, the effect of the fiber is obvious, but the gradation is too fine, and the overall strength of the matrix is low. How to coordinate this contradiction is crucial in design and fiber selection, and should be fully considered.

3. Analysis of Advantages of Fiber in Pavement Asphalt Concrete Application

3.1 Improvement of Fatigue Resistance of Asphalt Mixture by Fiber

The process of fatigue failure begins with the generation of tiny cracks in a certain part of the structure. The starting point of the crack is the fatigue source. For asphalt concrete structures, the presence of load, temperature and internal uneven joints is a major factor in crack generation. When the mixture is subjected to load, stress concentration occurs at the crack tip, and the crack propagates. When the crack size reaches a critical value, instability and expansion occur, and a large crack is generated until the fracture is broken. Secondly, the extraction of the fiber requires additional energy, and the redistribution of stress when creating a new surface also requires energy consumption, which has a toughening effect on the composite, thereby enhancing the fatigue resistance of the mixture (composite). In addition, due to the excellent wear resistance of the fibers, the matrix fibers can be combined into a protective layer coated with aggregates. At lower temperatures, the adhesive force of fiber toughened asphalt mortar to aggregate particles increases, which makes the whole body not easy to loosen. Cracked pavement will not be broken and lost due to the involvement of fibers, and will not appear large pits, which is of practical significance for driving safety and comfort, and easy to repair the pavement.

3.2 Function of Interface Structure between Fiber and Asphalt

Fibers generally have a considerable surface area, the surface area of each gram of fibers can reach several square meters or more. Fiber disperses into asphalt, and its huge surface area becomes an interface that can make asphalt wet. On this interface, fibers can adsorb a large amount of asphalt and form a new phase with a certain thickness, called interface layer. The structure and properties of the interface layer depend on the nature of the two phases of asphalt and fiber. The role of the interface layer is to connect the two phases and transfer and buffer the stress between the two phases, which is the key to affect the physical and mechanical properties of the entire fiber asphalt material. The interface layer between fiber and asphalt is a region with at least several molecular layers. Its properties depend on the molecular arrangement and chemical properties of the fibers and the molecular structure and chemical composition of the asphalt. Therefore, different fibers correspond to interfaces of different properties. Floor.

3.3 Function of Fiber Blocking Crack in Asphalt Mixture

The retarding effect of fibers on cracks in asphalt binder matrix greatly improves the self-healing ability of cracks in asphalt mixture, enhances elastic recovery and reduces the appearance of pavement cracks, thus delaying the aging and destruction of asphalt pavement. We have done three test sections of different modifiers on the road. After several years of alternating heat and cold load and load, the crack rate of fine-grained asphalt surface layer is 100%: the crack rate of double-layer SBS modified pavement structure 50% to 100%. The bottom layer is fiber modified, the surface layer is fiber and SBS comprehensively modified section; the crack rate is only 5%.

4. Application of Fiber Asphalt Concrete in Pavement Engineering

4.1 Adding fibers to asphalt concrete

In the construction of fiber mixture, it is generally necessary to manually add fibers to the hot storage port of the asphalt mixing station for more than 2 people. First, according to the amount of the mixing mixture, the amount of the actual fiber blended by each mixing mixture is accurately weighed from the large fiber and divided into small packets. After the mixing station is opened, the asphalt is not added and the wet mixing is not started. The weighed fiber is put into the mixing pot from the heat storage observation port. In addition, the warehouse door of the observation port of the hot bin should be closed before the start of wet mixing to ensure that the fibers are fully stirred with the dry mixing of aggregates, so as to prevent asphalt and fibers from overflowing from the observation port of the hot bin and agglomerating with asphalt because the fibers are not stirred evenly. At present, some manufacturers have developed automatic adding equipment, which can be automatically and accurately weighed and added after connecting it with the mixing plant.

4.2 Mixing of Asphalt Concrete Mixed with Fiber

The mixing process is mainly divided into dry mixing process and wet mixing process, in which the dry mixing process is to add fibers to the aggregate after full mixing, and the dry mixing time with the aggregate after adding fibers is about 10-15 seconds. The wet companion process is that the fiber is added to aggregate after dry mixing, that is, asphalt is added to wet mix, mixing time is to mix evenly, but it should not be too long. In order to fully mix the fiber with the mixture, the total mixing time of the mixture should be no less than 60 s.

4.3 Paving of asphalt mixture

Continuous and sTable paving is the most important measure to improve the smoothness of the road surface. The paving speed of the paver shall be adjusted according to the output of the mixer, the supporting condition of the construction machinery, the paving thickness and the paving width, and shall be adjusted according to 2~6m/min to make uninterrupted paving. The paving speed should not be increased arbitrarily and the equipment should be stopped at will. The mechanical operator should adopt a shifting system to avoid downtime due to personnel rest and eating during

construction. The thickness control during paving of the lower layer shall adopt the wire-guided elevation control method. The steel wire is twisted and its diameter is 6 mm. The tension of steel wire is greater than 800N, and a steel wire bracket is set up every 5 m. According to the specific conditions of the construction site, steel wire can be erected on the right side of the central partition belt and sled on the left side of the paved layer. Mobile automatic leveling datum device can be used to control paving thickness in middle and upper layers. Flattening boots should be installed on the longitudinal joints of the paving layer, which should be moved forward by the rear paver. It is suggested that the distance between the two pavers should not exceed 30 m.

4.4 Compaction Forming of Asphalt Mixture

Compaction of asphalt mixture is an important part of ensuring the quality of asphalt surface layer. Reasonable mechanical combination and rolling step should be selected according to the construction occasion and the type of mixture. In order to ensure compactness and smoothness, rolling should be carried out at higher temperature after paving as far as possible without slipping and cracking of the mixture. Equidistant operation of strict compaction requires that the compaction process be divided into three stages: initial compaction, re-compaction and final compaction. The purpose of initial compaction is to leveling and stabilizing the mixture, which is the basis of compaction. Therefore, attention should be paid to the smoothness of compaction. The purpose of repression is to make the mixture compact, sTable and shaped. The compactness of the mixture will depend on the process. The purpose of final pressing is to eliminate wheel tracks and eventually form a flat compacted surface. All of these must be strictly operating procedures and operational requirements.

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