

# Application of Modified Asphalt in Municipal Roads

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**Abstract:** The article expounds modified asphalt technology by introducing commonly used modifiers and fillers and analyzing the construction technology of modified asphalt. The use of modified asphalt in municipal roads provides new alternatives for asphalt pavement materials, but also solves the existing construction problems and reduces project costs. Therefore, the research and application of modified asphalt using new materials and new processes is a crucial aspect in road construction.

**Keywords:** Modified asphalt; Municipal road; Construction technology

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## 1. Introduction

As a non-renewable resource, asphalt is an important guarantee for the development of urban economy and the improvement of people's living standards. This is because asphalt is an important material for municipal road construction. With the development of society, traditional asphalt is no longer suffice, so there is need for modifications. Modified asphalt consists of modifiers and additives instead of asphalt alone, which can improve the stability of the road and prolong the service life. With the development of our country's economy, the number of national infrastructure construction and municipal road engineering projects is increasing, which puts forward higher requirements for road construction technology, construction management, and engineering quality. However, there are several prevalent issues with the current use of modified asphalt in our country: (i) Limited variety options and challenges in quality assurance. (ii) Outdated production technology and inadequate raw material supply. (iii) Low utilization of modified asphalt. Absence of systematic research on modified asphalt construction techniques and a standardized construction management system. In view of the problems above, combined with the research and analysis of new modified asphalt materials and case studies, a set of systemic application schemes for modified asphalt in municipal roads that are in line with our country's conditions have been proposed, and have been popularized and applied. There are mainly two types of modified asphalt: the first type is physically-modified asphalt and the other is chemically/biological-modified asphalt <sup>[1-6]</sup>.

## **2. Modified asphalt technology**

### **2.1. Basic properties of modified asphalt**

The composition of asphalt mainly includes colloid, asphaltenes, aromatics, ash, and volatile components. The properties of asphalt are greatly affected by temperature. When the temperature rises, the viscosity of asphalt will increase, and the color will change, thus losing its fluidity. When used at room temperature, if softener is added, the performance will be improved, but its basic properties will not change. Different types of high molecular compounds or natural polymers have different properties and advantages. Asphalt can be modified physically or chemically to improve road performance and service life. Different types of modifiers are often used to improve the performance of asphalt. Modified asphalt is commonly prepared by mixing two or more components according to a certain ratio. The performance of asphalt can be improved by adjusting the proportion of each component in the mixture according to the properties of the base asphalt. Modified asphalt has many advantages: improved road rutting resistance, improved high-temperature stability and low-temperature crack resistance, reduce water damage and reflection cracks, improved fatigue resistance, etc <sup>[7]</sup>.

#### **2.1.1. Physical properties of modified asphalt**

Modified asphalt refers to the addition of a certain amount of chemical or biological modifiers using suitable technology to improve the performance of asphalt. This includes improving its low temperature performance, high temperature performance, anti-aging ability, and the adhesion with aggregates, fillers, and other materials. Physical modification involves heating the asphalt in an enclosed environment). Heating asphalt will cause it to undergo physical changes and produce modifier substances, mainly physical modifications, including rubber, fiber, inorganic pigments, etc. There are many types of modified asphalt, which are mainly divided into two categories: one is to improve the properties of asphalt by introducing new components, the other way is by adding modified asphalt into traditional asphalt <sup>[8]</sup>.

#### **2.1.2. Chemical and biological modification**

The chemical modification method involves changing the molecular structure of asphalt by adding certain chemicals to improve its low-temperature performance and anti-aging performance. On the other hand, the biological modification method improving the ageing resistance of asphalt by adding various organisms. Both chemical and biological methods have their own characteristics, and the suitable type of modified asphalt should be selected based on the type of project. Chemical and biological modifications can be used alone or in combination. Chemical modification involves inducing chemical reactions in asphalt using chemical processes. On the other hand, biological modification utilizes organisms with specific activity or compounds that are easily decomposable to initiate chemical reactions within the asphalt.

#### **2.1.3. Technical advantages**

Currently, in China, modified asphalt is mainly used in municipal roads, with asphalt concrete pavement being the most used, accounting for more than 90%. Municipal roads require higher grades, higher standards and higher quality, and higher requirements for modified asphalt. Due to the high cost of new materials, technologies, and equipment, most roads still use ordinary asphalt. Therefore, popularizing and applying modified asphalt is of great significance to the development of municipal roads in China <sup>[1-6]</sup>. In the following sections, the characteristics of new materials technologies, and equipment and their application in our country's municipal roads are analyzed in detail, and relevant improvement suggestions are put forward.

## 2.2. Common modifiers and fillers

Modified asphalt is a new type of asphalt material with a wide range of applications. Our country has a long history of road construction. Traditional asphalt materials can no longer meet growing needs of road construction, and modified asphalt has become an inevitable choice. Modifiers and fillers are the most important raw materials in modified asphalt. With the development of economy and society and science and technology, the requirements for modifiers and fillers are also increasing. Modifiers offer significant potential and development prospects as they are substances used to treat asphalt materials, and different modifiers can enhance road performance, appearance, and durability. Mineral powder and fiber materials are among the most common and crucial modifiers. They are used to fill the matrix asphalt through dispersion, enhancing the performance of asphalt materials during road construction. Mineral powder is a natural substance consisting of calcium carbonate and silicon oxide. The mineral powder acts as a filler; mineral powder has good cohesiveness, high hardness, and good performance. Silica is a common inorganic filler that has good performance. Silica-modified asphalt can improve the mixing quality and performance of the mixture, which in turn improves the construction quality; at the same time, silica has good road performance and good durability to meet actual needs. Fiber is also a new type of additive. Adding fiber to asphalt can improve the technical indicators of asphalt materials such as hardness, wear resistance, and toughness. At the same time, fibers can reduce the aging of the bonding force between medium-base asphalt and aggregates and improve the quality of road construction<sup>[9]</sup>. These three commonly used fillers include have relatively large particle size and surface area, and light particles. These fillers can improve technical indicators and production efficiency, and the service life of roads. Through comparative analysis of various fillers, it is found that mineral powder has several advantages over other types of fillers: (1) low-cost, (2) improves the overall performance of asphalt materials, (3) good modification effect (mineral powder also shows good effect on the technical indicators when used together with other materials, but it is costly), (4) easily processed<sup>[10]</sup>. At present, this technology has been gradually promoted and applied with good results.

## 2.3. Analysis of aging resistance of new modified asphalt materials

Different road construction uses different materials. On road sections with heavy traffic volume, complex pavement structure, and prone to aging, modified asphalt materials are used. Its anti-aging properties are of great significance for improving the quality and service life of asphalt pavement. Various factors such as temperature and environmental conditions can lead to different types of damage to pavement, often irreversible. Some materials may meet road construction standards but fall short in terms of durability. In recent years, improved living conditions have resulted in increased road vehicle usage, which in turn has placed considerable stress on expressways. Overloading leads to more and more damage on the pavement. In addition to human factors, there are also natural factors. Ultraviolet rays and rain will cause certain stress and deformation of the road, resulting in a decrease in the strength of the structure, resulting in fatigue cracks. Styrene-butadiene-styrene (SBS) helps in improving the durability of asphalt<sup>[11]</sup>. The anti-seepage performance of asphalt concrete plays an important role in the stability of asphalt concrete pavement. Therefore, asphalt concrete must have strong corrosion resistance, especially in areas with a lot of rain. Adding SBS to conventional asphalt and properly adopting modified asphalt will have a greater effect on the anti-permeability of the road.

From a construction and operational perspective, we conducted an analysis of the workability of the new modified asphalt. Based on the performance study, we concluded that the new asphalt pavement is conducive to easy laying and compaction. The laying and compaction methods are critical aspects of engineering construction, and their quality significantly impacts the project's progress and surface smoothness. Therefore,

the workability of the modified asphalt will be directly related to whether the project can be successfully completed. In the current application of asphalt materials, there is no clear standard for its workability, and only the viscosity index of the material is used. The composition, aggregate, particle size, and compactness are important factors that determine the performance of modified asphalt. The ingredient ratios must be carefully adjusted to prevent challenges during rolling, which can result in issues like uneven mixing and hinder the project's progress to some extent.

### **3. Construction technology analysis of modified asphalt**

(1) Quality control of pavement base

Before the construction of the pavement base, the surface of the base should be cleaned comprehensively and thoroughly. After cleaning the surface, the sundries and accumulated water on the ground should be discarded, and a drainage system should be set up to facilitate smooth drainage.

(2) Application of asphalt pavement construction technology

Before adopting asphalt pavement construction technology, the relevant technical requirements should be mastered, and then the asphalt paving and rolling can be carried out according to the design plan. First, the mixture should be mixed evenly and transported to the pavement base for paving and rolling. Secondly, the mixture is poured into the mold according to the design plan. Then, the mixture is compacted through vibration or other compaction methods. Lastly, the surface of the asphalt pavement is swept clean, and some water is sprinkled onto the surface and swept again.

(3) Construction of anti-collision barriers

Concrete is used in building road guardrails to better prevent traffic accidents. The concrete and reinforced concrete are combined to form a composite structure, which allows the guardrails to have better impact resistance. This composite structure can provide a good traffic environment for pedestrians by reducing interference and damage caused by vehicles, and prevent traffic accidents. In order to ensure the safety of pedestrians, the use of anti-collision barriers for isolation during road construction can play a very good role in protection.

(4) Sidewalk slab pavement and quality control

Sidewalk slabs, which are essential parts of municipal roads, often face quality problems during construction. This is because materials like cement and sand are added to improve their performance. Some companies may even resort to excessive additives in the production process to gain more profit <sup>[4]</sup>. Hence, strict control over material composition and additive levels, along with adherence to the designated design plan for raw material allocation, is crucial to minimize quality issues during municipal road construction.

(5) Paving and rolling work

The asphalt mixture temperature increases rapidly during paving, necessitating the use of vertical rollers to prevent this rise. When the temperature increases, cooling measures should be applied, and conversely, heating measures are required when the temperature drops.

### **4. Conclusion**

The emergence of modified asphalt is inevitable and it has a wide range of applications. Therefore, it is necessary to do a good job in the research of modified asphalt and continuously improve the level of construction technology. Modifiers and fillers should be fully utilized to ensure that the quality of the mixture is

up to standard, while strengthening construction management and testing. It is necessary use modified asphalt and relevant technologies appropriately depending on the nature of the project. (1) Selection of modifier: suitable modifiers and fillers should be selected according to the needs of the project. For example, fiber can be added to the asphalt mixture to improve its performance. Besides, the mixture should also be prepared at a suitable temperature. (2) Controlling the construction process: The ratio of ingredients in the mixture should be determined according to the needs of the project. Besides, material testing and process management should also be strengthened. (3) Quality inspection: During asphalt mixture preparation, it is crucial to ensure that each step adheres to the design specifications and relevant standards. Rigorous quality inspections are essential to detect material issues promptly and address them to maintain construction quality.

## Disclosure statement

The author declares no conflict of interest.

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