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## Review on technical specifications of asphalt and modified asphalt at home and abroad

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**Abstract** This paper compares the technical specifications of asphalt and modified asphalt at home and abroad, in order to summarize the advantages and disadvantages of the technical specifications of asphalt and modified asphalt used at home and abroad.

**Keywords** asphalt, Modified asphalt, technical specifications

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### 1. Introduction

With the development of China's market economy, the total mileage of domestic roads has increased year by year. In the process of the development of China's and global road projects, how to increase the durability of asphalt pavement and prevent the early damage of asphalt pavement durability has become the direction of the industry. Especially in recent years, with the development of domestic transportation, the vehicle load borne by domestic roads has also increased, It also provides a further challenge to the durability of the asphalt surface. In recent years, with the continuous progress of highway technology in our country, the traffic load borne by our country's highways has gradually increased, which has further challenged the service life of asphalt pavement. However, in recent years, due to the continuous progress of China's highway transportation technology, the pavement structure of many high-grade highways and the types of mixed materials used are also constantly changing. In China, many regions have begun to take the initiative to improve the raw materials of asphalt pavement and its road structure. Generally, asphalt mixtures are composed of asphalt cementitious materials and mineral materials. However, due to its chemical characteristics, asphalt is often sensitive to high temperature and stress. Therefore, in order to prolong the service life of asphalt pavement as much as possible, it is particularly important to analyze the technical properties of asphalt.

### 2. Road petroleum asphalt

The function of asphalt material in asphalt mixture is to condense the granular material into a whole. Asphalt materials commonly used in China's expressway projects include petroleum asphalt, emulsified asphalt, modified asphalt, etc. as for the selection of asphalt materials, appropriate asphalt materials shall be selected according to the requirements of asphalt pavement pouring, site weather requirements, mixture gradation, etc. However, for high-grade highways with multiple surface layers, it is often based on the stress characteristics of the planned road [1]. For high-grade highways with multiple surface layers, different types of asphalt are usually



selected according to the stress characteristics of the planned pavement and road requirements. Generally, asphalt with high viscosity is usually selected for the upper surface layer, and asphalt with low viscosity is usually selected for the lower layer. However, if the asphalt grade used in construction is large or small but other indexes meet the requirements, generally speaking, asphalt with high consistency is often used for the upper layer, while asphalt with low consistency is often used for the lower layer. However, once the asphalt grade during construction is larger or smaller and all other technical indicators are qualified, the asphalt with different grades can be mixed and used on the premise of ensuring that all technical indicators are qualified. However, the mixing proportion must also be confirmed through test. The mixed asphalt must be mixed evenly and all technical indicators are qualified before it can be put into production [1]. The following is a comparison of road asphalt indicators between China and foreign countries.

### **2.1 Technical specification for road petroleum asphalt in China**

The technical indexes of petroleum asphalt for roads in China are generally as specified in Table 1. In the actual construction practice, the PI value of road asphalt, i.e. 60°C dynamic viscosity and 10°C ductility, can also be taken as the selective technical indexes after consulting the construction unit. As for asphalt pavement, when using asphalt, it is necessary to comprehensively consider the climate, traffic volume, mixture type and other aspects of the construction site, and investigate the service life of the local asphalt pavement, and select it after comparison and demonstration. In this part, China's specific provisions are as follows:

A. For high-grade highways with heavy load, high summer and long time; In mountainous and hilly areas where climbing is required; In places where great shear stress will occur, such as toll stations and parking lots, it is also necessary to use viscous asphalt. For places with small traffic flow and cold temperature, asphalt with high low temperature ductility and low viscosity should be selected. For places with large daily temperature difference, asphalt with large penetration can be selected; For places with large daily temperature difference, asphalt with large penetration can be selected;

B. If it is found in the actual construction process that the asphalt grade to be used is large or small but the other indexes are qualified, it can be mixed with various grades of asphalt on the premise of ensuring that the technical indexes meet the requirements. However, it must be emphasized that when mixing asphalt, the mixing degree must be uniform and all the technical indexes of the mixed asphalt must meet the requirements the regulations.

### **2.2 Technical standard for SHRP asphalt**

Compared with the technical standards of petroleum asphalt for roads in China, the performance of Superpave binder specification and the selection standard of binder according to the scope of use are also unique. The physical property characteristics of all kinds of bonding materials are the same. The difference between different bonding materials is mainly the difference in temperature. Under this characteristic, all conditions must be met [1, 2]. For example, the asphalt binding material with grade PG64-22 refers to the requirement that its physical properties can be maintained at high temperatures above 64°C and below - 22°C.

Due to the different classification methods of asphalt at home and abroad, the classification method of SHRP asphalt binder is mainly based on the type of high and low temperature, which also makes users need more information to select the most suitable binder for special use. The method of Superpave users selecting binder grade includes the following three categories:

A. By Region: the builder selects the grade of thermal binder to be used according to the climate of the construction site;

B. According to the road ambient temperature: according to the design road temperature determined by the designer;



C. Calculated temperature: after the designer confirms the design temperature, the designed temperature is converted into the design road temperature.

### 3. SBS modified asphalt

#### 3.1 Mechanism of SBS modified asphalt

Modified asphalt refers to the modified asphalt with better properties by adding modifier to the base asphalt. The basic preparation process is as follows: firstly, SBS modifier is added to the base asphalt; Then they are mechanically stirred. The basic preparation process is as follows: firstly, SBS modifier is added to the base asphalt; Then, the two are mechanically mixed. During this mechanical mixing process, SBS modifier will be mixed with the base asphalt to produce physical swelling effect, thus improving the quality of the base asphalt<sup>[3]</sup>. In this mixture of modified asphalt, the base asphalt is a small molecular compound, while the modifier is a high molecular compound. The relative atomic mass difference between the two is 100 times. In this case, as the molecular weight difference between the two is increasing, the swelling effect of the two must be more unstable through mechanical stirring. Therefore, the swelling effect caused by asphalt composition and mechanical mixing will be more unstable. It can be seen that the asphalt composition, SBS composition and SBS concentration will have an important impact on the characteristics of SBS modified asphalt. If the content of aromatic hydrocarbons is high and the content of asphaltene is low, it will help to further improve the dispersion of SBS modifier in the modified asphalt. Under the same SBS concentration, SBS modified asphalt containing 30wt% styrene also has good viscosity and toughness. Compared with the base asphalt, the performance of SBS modified asphalt has been greatly improved, and with the appearance of double bond in butadiene segment, SBS modified asphalt will have poor heat resistance, oxidation resistance and UV resistance, so SBS modified asphalt will have delamination after long-term storage.

#### 3.2 Comparative analysis of SBS modified asphalt index system at home and abroad

Due to the great difference in characteristics between modified asphalt and ordinary pavement petroleum asphalt, SBS modified asphalt is not directly used in the technical standards of ordinary pavement petroleum asphalt. In order to solve this problem, many developing countries have tried to explore new technical standards and technical indicators. So far, the three main technical standards of modified asphalt in the world are penetration system, viscosity system and PG system [4, 5].

##### 3.2.1 Penetration system

The penetration system takes the 25°C penetration line as the national standard. At present, the countries or regions adopting the system mainly include China and the European Union. Currently, the European modified asphalt regulatory standard is EN14023, which is generally divided into the following common test items (penetration, softening point, aging, etc.). Such test items are generally the main technical basis and industrial classification basis of modified asphalt<sup>[5, 6]</sup>. In addition, there are special technical indicators for modified asphalt, such as elastic recovery, brittle point, etc. at the same time, it also includes the segregation phenomenon that is easy to occur in the use environment and the newly added test items.

The reason is that China has not issued any technical standards on modified asphalt before, and the later technical standards on modified asphalt are mainly prepared by referring to the domestic and foreign construction experience. According to the laws of China, the modified asphalt is divided into three types, I, II and III, according to the different types of polymers, and the modified asphalt of grade I and III is divided into four levels, i.e., A, B, C and D, according to the different penetration degree. At the same time, the modified asphalt of grade II is divided into three levels, i.e., a, B and C, so as to meet the different application requirements of various regions. In the same type, different grades mainly reflect the differences in the base



asphalt grade and the modifier doping amount. In the same type, different grades mainly reflect the differences in the base asphalt grade and the modifier doping amount. From A to D, the penetration of the modified asphalt shows a downward trend, and the viscosity increases, but the low-temperature performance will decrease.

### 3.2.2 Viscosity system

The main technical index of the viscosity system is viscosity. Currently, the countries or regions using this technical index are mainly Australia and Japan.

Since 1970, viscosity has been used as the most important evaluation index of modified asphalt in Australia, and it has been modified for many times. The modified technical index can better meet the needs of engineering construction practice. Meanwhile, more extensive research has been carried out on the technical index of modified asphalt. However, as its index is still developing, it needs to consider the actual needs of the project more, so its technical index system is relatively simple. The main indexes to be investigated are 60 °C viscosity and penetration rate. Since the actual needs in the process need more consideration, the technical indexes are relatively simple. The key factors to be considered are 60 °C viscosity, penetration rate, flash point and aging.

Similar to Australia, Japan is also one of the countries with the largest number of modified asphalt used in road construction. In Japan's technical standards, modified type II products mainly include EVA modified asphalt and SBS modified asphalt.

### 3.2.3 PG classification

Because the penetration classification system or viscosity classification system both emphasize laboratory results, the numerical value of the two experimental results and the road are not very related to the road and actual engineering performance because the penetration classification system or viscosity classification system both emphasize laboratory results. Therefore, it may occur that the road penetration or viscosity test results can not meet the theoretical conditions but can meet the actual engineering conditions. However, according to the relevant provisions of the international standard system, such problems cannot be specified. In order to solve this problem, the United States has developed a PG classification system. The PG classification has fully considered the test environment of different temperatures, but according to the relevant requirements of the standard system, such phenomena cannot be explained. In order to solve this problem, the United States has developed a PG grading system. PG grading has the advantages of fully considering the test environment at different temperatures and taking various conditions into account. It can be used as the test object to simulate the short-term aging and long-term aging of asphalt produced by handling, construction, paving, rolling, use and other steps in construction.

## 4. Comparative analysis

Through the above comparison, it is not difficult to find that most of the technical standards of ordinary road petroleum asphalt or SBS modified asphalt are empirical standards. Such standards often lead to a large difference between the test results and the actual road use results, resulting in a low correlation between the two. It is difficult to effectively control the technical performance and service life of asphalt pavement, especially for the penetration system and viscosity system in SBS modified asphalt.

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