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The advance research of organic silane rubber asphalt stabilizer

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Abstract
The causes of rubber asphalt and rubber asphalt stabilizer are analyzed, and the compatibility between rubber asphalt is to determine the service life of rubber asphalt. and a detailed introduction of the research progress of several kinds of rubber asphalt stabilizer, finally the development of rubber asphalt stabilizer of future prospects. Organic silane coupling agent has many unique physical properties and chemical properties, these properties,

making it in all kinds of industry production, plays a very important role. Combining our country current road conditions, we concluded that the organic silane coupling agent as rubber asphalt stabilizing agent will be more has the prospects for development.
Keywords: STABILIZER, RUBBER ASPHALT, ORGANIC SILANE, STORAGE STABILITY

1. Introduction

At present , with the rapid development of the world, the car has the public life, however, it brings convenience to our lives, but also has brought great harm to our environment . According to the report, the whole world of junked tires has reached 120 million in 2005, about 3.4 million tons of recycling, not including 70%, and by 2010, the amount of waste tires around the world has reached 200 million, about 5.2 million tons. These waste tires, people are not properly utilized, not only cause a waste of resources, but also caused a series of serious environmental problems. The main component of tire rubber is a kind of high molecular organic compounds are excellent in quality, has strong stability, which makes rubber waste cannot break down, causing serious environmental problems, such as: polymer to decomposition, has certain toxicity, worsen natural environment, destruction of vegetation growth in the process; rubber packing, will release smoke and carbon monoxide, serious air pollution, in addition, a large number of waste rubber occupies lots of land, under the sun and rain, and will breed mosquitoes, spread diseases, causes fire. In order to solve this problem, a lot of people tries, then someone found, performance will be the addition of rubber asphalt can improve asphalt effectively, not only the prolong to use effect of asphalt, but also to ease a series of environmental problems caused by waste rubber, and rubber asphalt this product emerges the times require.

Rubber asphalt is the asphalt pavement, a new type of paving the road surface material of people and developed[1,2], at present on a global scale has been widely used. At present on a global scale has been widely used. In particular the waste rubber to break into fine powder, after a certain technical processing, added to asphalt to. In this system, part of the surface of powder particle cracking, absorption of light group of matrix asphalt, a direct improvement of matrix asphalt, on the other hand to rubber and asphalt composite effect. Among them, the main rubber powder and asphalt mixing is swelling reaction, is not simple physical filling, is not entirely of chemical reaction, but both the state of coexistence. And the crumb rubber content is usually large, swollen rubber powder volume reached binder 30%-40%, rubber powder particles are connected through a gel membrane, forming a large viscosity of semisolid continuous phase system[3].

Relatively ordinary asphalt, rubber asphalt performance is really improved a lot, but in the construction and road service life, there still exist many problems.

On the microcosmic aspect, relative molecular mass and structure of rubber and asphalt to decide they have incompatible in thermodynamics[4] Although before construction, often mixing, use blender to make both temporary but, due to the incompatibility, rubber asphalt system will with the passage of time, powder particle density increases gradually downward movement and delamination of the gravity and the thermal motion of molecules under the effect of the dispersion and segregation phenomenon appears, and when the rubber powder content is low, bitumen modification effect is not obvious, the high content of rubber powder modified asphalt viscosity, dispersion and the difficulty of the construction of large in asphalt[5]. Directly affect the various performance of rubber asphalt, rubber asphalt and difficulty makes construction and road usage life greatly decreased.

2. Classification of Asphalt Rubber Stabilizer

Since 1978 the United States of California Department of transportation first dry rubber asphalt pavement in the MeyersFlat SR50 after installation, we have become more perfect and the struggle for nearly forty years to make it. In this forty years, the research about this endless, have on rubber asphalt between was modified, with the emulsification of the treatment on the change of its properties, also by directly adding additives and their internal structure change but for now, many studies on this aspect, are committed to in the rubber powder on the role and influence factors of asphalt, rubber asphalt for the study of compatibility between the less and less. This paper mainly introduces the VESTENAMER (TOR), epoxy rubber asphalt and its mixture, as well as the influence of styrene tar on the performance of rubber asphalt.

2.1. Vestenamer

Germany Degussa company «VESTENAMER» octene copolymer rubber reaction agent (Tran8-Poly-octenamer Rubber (TOR) Reactive Modi- tier), is a kind of white particles, having a double bond structure

of the polymer, in response, double bond and asphalt in its quality and rubber sulfur of sulfur crosslinked network structure, form a macromolecular polymer, change the internal structure, so as to improve its performance[6]. Through a lot of experiments and engineering practice that, added to the rubber asphalt, anti rutting, anti cracking ability of asphalt rubber has been significantly improved, and, in the delivery process in the long time, no also segregation and dispersion phenomenon of asphalt rubber.

In this experiment, first of all to the processing of raw materials: the processing method of rubber asphalt is divided into dry and wet. Dry rubber powder in asphalt mixture is directly into the material mixing process[7,8,9]. The main process includes the following steps: the matrix asphalt heated to the specified temperature called the rubber powder amount, the rubber powder and TOR followed by slowly adding the matrix asphalt rubber, and mixing with the glass rod, after it will be put in the device and automatic temperature control, temperature control in a certain range, and continuously stirring in the heating in the process of. But the steps and dry wet roughly the same, just do not add TOR. After the preparation, and then a series of performance tests on it. Because the mechanism of rubber powder and TOR in the asphalt is very complex, there are significant differences between the properties of TOR rubber asphalt and the general nature of modified asphalt, asphalt index changes our current (penetration, ductility, softening point) performance is not suitable for the evaluation of TOR rubber asphalt. Learn from foreign experience, our country also carried out by viscosity index system as the core, and the penetration, softening point, ductility as an auxiliary index for export[10,11].The penetration, softening point, ductility, elastic recovery and Trypanosoma bruce (Block Field) rotary viscosity test. In the experiment, respectively, types of rubber powder, particle size, dosage, TOR dosage, stirring time system, preparation method using control variable method, obtain the optimal scheme. Through the experiment, we can get the following several conclusions: (1) containing rubber powder has better performance of natural rubber much some. (2) the more fine rubber powder, rubber asphalt viscosity produced more; but the cost of materials, construction workability and construction process control, should not be the pursuit of the use of powder processing rubber asphalt too fine. (3) with the increase of rubber powder content, the viscosity of the system began to soar. (4) in ensuring the processing time on certain, extending the processing time has little influence on the. (5) after the addition of TOR, which makes the system viscosity decreased.

However, for TOR, the price is too expensive, the current market price of up to 100 thousand /t, and the technology requirements is very high, which will be applied to actual production, not practical. Moreover, in the recovery degree of the effect on the temperature sensitivity, flexibility, is also not ideal.

2.2. The study of epoxy asphalt rubber

Epoxy resin is polymerized compound is not high with 2 or more epoxy groups, is a kind of adhesive materials. While in the epoxy rubber asphalt system, epoxy group in epoxy resin can form high molecular rubber network structure and mercaptan radical reaction in rubber, the advantages of both, the epoxy resin and rubber both in this regard, we through the Marshall experiment and rutting experiment, in the following several aspects to do an analysis of epoxy asphalt rubber.

In the production process, the epoxy resin is applied to the rubber modified asphalt, the asphalt rubber, due to differences, rubber powder and asphalt in the relative molecular mass and the chemical structure of the therefore, in this system, the interface between different components to interact. In the process of interaction, on the one hand, powder absorbing light oil in asphalt, to increase the proportion of matrix asphalt in asphalt, to promote the formation of sol gel of structure. On the other hand, is at a high temperature, so that the rubber desulfurization crack, which is evenly distributed in the asphalt, the formation of “island structure”, in order to improve the asphalt impact degree and plasticity[12]. And if rubber asphalt into epoxy resin, epoxy thiol reaction with rubber in the rubber, forming a network structure of polymer, and also part of asphalt rubber crosslinking, reinforcing system of epoxy resin, and part of the adsorption on the surface of rubber, the formation of epoxy rubber particles, enhance the “island” effect, the extension of the road the service life.

The epoxy resin was prepared by adding epoxy rubber asphalt, rubber asphalt in flexibility, corrosion resistance, water resistance and strength are improved obviously, which has good resistance to temperature cracking ability rubber asphalt mixture[13], both epoxy asphalt mixture rutting resistance of high temperature stability, excellent capability and anti water damage performance[14].

However, epoxy rubber asphalt also like TOR, one of the largest problems, is on the rubber asphalt system in each phase of the compatibility, not what positive meaning, that still will be bleeding, dispersion, segregation phenomenon, making the road us-

age period is greatly shortened, and the price, nor economic, this scheme is not ideal.

2.3. Of Styrene Butadiene Rubber Modified Asphalt

Styrene butadiene rubber synthesis technology originated in foreign countries, from twentieth Century to the late 50's, USA Philips company using lithium initiated anionic polymerization successfully developed SSBR. To the early 80 century, Britain's Duniop and Holland's Shell company through molecular design technology jointly developed a new low rolling resistance type SSB20 styrene butadiene rubber R products. This marks the SSBR production technology has entered a new stage. China SSBR development is late. So far, SSBR has been developed to the third generation, some developed countries have begun to study the fourth generation and the fifth generation SSBR.

Styrene butadiene rubber (SBR), normal temperature solid white or transparent liquid, has the micro fragrant, is one kind of performance is better than industrial linear alkylbenzene detergent products raw materials, monomer composition: 1,3- butadiene (CH2=CH-CH=CH2), styrene (C6H5-CH=CH2). However, although the styrene butadiene rubber asphalt compared with ordinary rubber asphalt has more performance, however, there are also many problems, such as: high temperature stability of modified asphalt rubber with the SBR is not very good, and need to be heated to high temperature in the process, so that between the two prone to separation, the actual application effect. It's these because of lack of styrene butadiene rubber asphalt into production limited great[15]. The styrene butadiene as modified by SBR is not obvious on the mechanical physical performance at high temperature asphalt, even if a large amount is so. In addition, the SBR modified asphalt to the construction from the processing needs high temperature storage, easy and phase separation occurs because of the bad compatibility, thus affecting its practical use. Requirement of road asphalt material technology in our country, not specified on the segregation test of SBR modified asphalt. The shortcomings of SBR makes the application of modified asphalt is greatly limited.

While the rest of rubber modified asphalt research, such as: Research on rubber asphalt stability of fiber, adding fiber, partly through "reinforced" fiber, makes the stability increase, however, the remaining part will agglomerate into a bundle, closely link effect of asphalt and aggregate, but reduce the stability[16]; another example: styrene tar into the rubber asphalt to, can make the system of softening point, ductility, penetration increased, however, with the increasing of aging time, the rubber particle system will be precipitated, and thus reduce the stability of the system. But for many of the problems faced by the stabilizer, organic silane coupling agent to give us a satisfactory reply.

3. Organic Silane Coupling Agent As The Application Of Rubber Asphalt Stabilizer

Silane coupling agent is a kind of organosilicon compounds in the molecule also contains two kinds of different chemical properties group, the classic product using formula YSiX3 said[17]. In the formula, Y is a non hydrolysable groups, including the alkenyl (mainly ethylene), and end with Cl, NH2, SH, epoxy, N3, (methyl) propylene acyloxy and isocyanate groups of the alkyl carbon functional groups, namely; X hydrolyzable groups, including Cl, OMe, OEt, OC2H4OCH3, OSiMe3, and OAc etc.. Because of the structure of organic silane molecules, so it also has combined with organic materials and inorganic materials group, which is widely used for surface treatment agent framework material; at the same time, can also be added to the adhesive, or directly added into polymer materials. Therefore, the coupling agent in the aspect of material modification has a very broad prospects, in recent years, the research is also in full swing. Comparison of organic silane coupling agent and the rest of the various types of stabilizing agent, modifier, additive, which has many unique places.

First of all, through the coupling effect of silane coupling agent, connect the rubber asphalt two different nature of the material is firm, makes the compatibility greatly improve system[18]. And through the softening point test, viscosity test, bending creep test at low temperature and the segregation of a series of experiments to evaluate the silane coupling agent for rubber asphalt high temperature performance, low temperature performance, softening point, ductility, storage stability, concluded that: (1) using high temperature performance of rubber powder pretreated by silane coupling agent can improve the rubber asphalt, and with the silane coupling agent dosage (O ~ 1.5%) increases, the high temperature performance of rubber asphalt gradually improve. (2) the low temperature performance of the silane coupling agent or not and its dosage size of rubber asphalt has no effect. (3) the temperature sensitivity by rubber powder pretreatment with silane coupling agent can be reduced by improving the rubber asphalt, the temperature sensing properties, and the storage stability of rubber asphalt has been significantly improved. (4) the high temperature performance of rubber asphalt, storage

stability and economy based on, recommendations for the best dose of silane coupling agent is about 1%. Compared with SBS modified asphalt, rubber asphalt adding silane coupling agent which has remarkable economic benefit.

At present the related research mainly factors on asphalt modification effect and influence in the rubber powder, processing conditions and powder type, particle size, amount and types on the effect of matrix asphalt on the performance of the modified asphalt and aging resistance, long term performance and so on, and the problem of compatibility of rubber powder and asphalt is seldom studied[19]. Therefore, using organic silane coupling agent instead of on the market at present, stabilizer, can make up the rubber asphalt in the compatibility of rubber asphalt modification of organic silane coupling agent with the limitations of the stabilizer, has a very broad prospects.

Organic silane coupling agent has many unique physical properties and chemical properties, these properties, making it in all kinds of industry production, plays a very important role. But, from the point of «molecular bridge» role in the improved electrical properties, mechanical properties, material, thermodynamic performance, also has an important significance. From the last century 40's, the study of organic silane coupling agent has already started, and with the rapid development of the social industry, the study of organic silane coupling agent has also become a hot research field in the modern.

4. The Prospect Of Organic Silane Coupling Agent

At present, many highway uses mostly is the asphalt road, there are a large number of waste tires produced in China each year, causing a great waste of resources, environmental pollution. And our country is the main use of asphalt pavement, it has weak winter summer bleeding, brittle cracking. This leads to the damage of the pavement is more serious. Although the service life of road has improved, but the use of life in optimistic. Doping of asphalt rubber will make its viscosity is very high, it will bring some difficulties to construction and secondly, stability of rubber asphalt storage is poor. These shortcomings make the pavement can be easily damaged, will cause some economic loss. In order to change this kind of disadvantage, in foreign countries are mainly used in the TOR to improve the. But the price is relatively expensive. But SBS, styrene butadiene rubber, styrene tar stabilizer and can't give the matrix asphalt provide excellent performance on security, therefore, at present no rubber asphalt stabilizer for high performance, high performance to price ratio on the market.

Organic silane as rubber asphalt stabilizer, part of gene activity in the use of rubber asphalt, introducing organosilanes with active group to improve its stability, and thus to reach the stable effect.Stabilizer using organic silane as rubber asphalt. Achieved through the synergistic effect of chemical modification technology and material structure. Organic silane are relative to the price of TOR is more affordable, more practical than SBS, styrene butadiene rubber, his development will be in China is a good news. He will solve the rest of the stabilizer can not solve the problem, and more affordable. Our country will promote the development of the road one step. At the same time, also to protect the environment, conserve resources role. Will have a beneficial effect on many of the developing countries.

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