Construction Technology of Waterborne Epoxy Emulsified Asphalt Mixture

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Abstract: With the development of all aspects of our society, environmental pollution is more and more serious, especially the air pollution, haze intensified, seriously affected people's normal life, but China's highway construction is still the focus of national infrastructure construction. Therefore, the traditional hot mix asphalt mixture of high energy consumption, high emissions shortcomings gradually emerged, becomes one of the factors that cannot be ignored air pollution. Compared with the hot mix asphalt mixture, cold asphalt mixture with low energy consumption, small emission, light pollution characteristics, is a relatively energy saving and environmental protection technology. This paper introduces a common cold mix - waterborne epoxy modified emulsified asphalt mixture construction process, for the future application of large area cold mix mixture to provide a reference.

Keywords: waterborne epoxy; construction technology; emulsified asphalt; mixture

1. Introduction

Waterborne epoxy modified emulsified asphalt mixture is a non-toxic, non-polluting materials, and has a high strength, high durability characteristics, is a high-performance pavement paving materials. With excellent performance at the same time, waterborne epoxy modified emulsified asphalt mixture construction conditions are more demanding.

The first is the weather requirements, is strictly prohibited in the rain construction.

Second, the water-based epoxy modified emulsified asphalt mixture of water and temperature requirements are more stringent. Experiments show that, in order to mix the mixture can be mixed, must be added in the modified emulsified asphalt water. At the same time, emulsified asphalt demulsification and epoxy cross-linking reaction is also related to the temperature, so pay close attention to the recent construction before the temperature.

Waterborne epoxy modified emulsified asphalt mixture is different from hot mix, the construction machinery must meet the requirements of cold mix material. Epoxy materials will be cured, with retention time, also known as the operable time, so in the construction, the construction time must be strictly controlled.

2. Pre-Construction Preparation

2.1. Selection of raw materials

Preparation of water-based epoxy modified emulsified asphalt should use anionic emulsified asphalt, the solid content cannot exceed 80%, the purpose is to prevent the mixture in the mixing process to produce the ball. In this paper, Shandong Dashan Road and Bridge Company production of solid content of 62.9% of the anionic emulsified asphalt.

Water-based epoxy materials are commercially available as water-based epoxy resin H203A (hereinafter referred to as A component) and epoxy resin curing agent H203B (hereinafter referred to as B component), the indicators shown in Table 1.

Table 1. Waterborne Epoxy Resin System H203A and H203B Indicators.

Component	*H203A*	*H203B*
Exterior	light-colored viscous liquid	light yellow viscous liquid
Solid content	95~98%	49~51%
PH	7~8	8~9

Aggregates must be made of hard, abrasion resistant, non-weathering, clean, good in particle shape, and have good adhesion properties with the binder or the same level of high quality stone. The results show that the coarse aggregate of limestone and basalt is used as anti-slip surface coarse aggregate, and it is beneficial to prolong the maintenance life of anti-skid surface anti-slip performance due to the existence of "polished self-compensation" function, so this text coarse aggregate using basalt, fine aggregate with limestone. The moisture content of the aggregate should not exceed 2%, otherwise the water contained in the aggregate should be subtracted when calculating the amount of water used. Aggregate use continuous grading, this paper uses the recommended AC-13 gradation.

2.2. Determine the amount of water used

The results show that the more water in the mixture, the more water-borne epoxy emulsified asphalt concrete pavement formation intensity is slower (as shown in Figure 1, the water consumption to A component of the multiple), but for the mixing of the mixture, Add an appropriate amount of water to the waterborne epoxy modified bitumen. In the preparation of water-based epoxy modified emulsified asphalt mixture, must be carried out indoor mixing test, by mixing the state of the mixture to determine the amount of water. When mixing, observe the surface of the mixture to mix, the mixture is no white flowers, water-based epoxy modified emulsified asphalt wrapped evenly, and small mixing pot without residual emulsion is appropriate, indoor test mixing effect such as Figure 2 shows. Mix the mixture should not be discarded should be observed in the closed state of the curing time. Taking into account the road construction process of air flow affect the evaporation rate of water, the actual water consumption should be more than indoor mixing test water increased by 5% to 15%. The amount of water used in this article is 1 times the amount of A component.

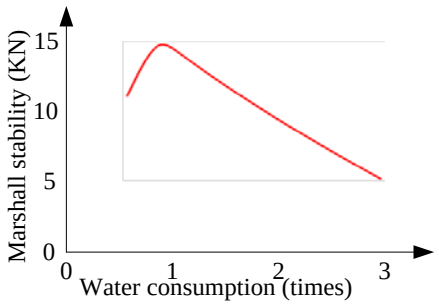

Figure 1. The relationship between water consumption and stability

Figure 2. The effect of indoor mixing test

2.3. Preparation of waterborne epoxy modified emulsified asphalt

Most of the waterborne epoxy materials are relatively viscous, are not easy to mix evenly, and the epoxy resin and the curing agent after the reaction is faster, so in the preparation of modified emulsified asphalt process, the raw material mixing sequence is very important. Waterborne epoxy modified emulsified asphalt unlike hot mix epoxy asphalt, it is necessary to strictly control the mixing sequence due to the need to add water during the preparation process (for specific reasons, as described below). The mixing order is as follows:

Water is mixed with the curing agent and stirred until homogeneous. There are two reasons for the mixing of the water and the curing agent: on the one hand, although the curing agent has a solids content of about 50% and contains about half of the water, the curing agent is still more viscous than the water-based epoxy, Followed by mixing with other materials evenly; the other hand, water-based epoxy resin mixed with water, although can stir evenly, but prone to air bubbles, and mixing time is relatively long. If the water-based epoxy resin is mixed with water and curing agent, it takes less time to stir until homogeneous.

Mixed with emulsified asphalt. The reason why the first mixed with the emulsified asphalt rather than with the epoxy resin is mixed with the curing agent with the water-based epoxy contact occurs when the cross-linking reaction will affect the mixing time (similar to the epoxy asphalt retention time). In the mixing process, should be extended stirring time or directional stirring, and pay attention to the curing agent sticky wall.

Mixed with waterborne epoxy. The above mixing time of about 2 minutes, stirring in the outdoor for 3 minutes, and the last mixing of the mixing time should be appropriate to the previous time to 1.5 to 2 times to ensure that the final mixing evenly.

After the preparation of water-based epoxy modified emulsified asphalt, the mixture should be mixed immediately. The interval between the two cannot exceed 5min.

2.4. Selection of construction machinery

Mixing equipment selection. In the actual construction process, if it is a small road or pavement repair construction, you can choose the cement mixing roller mixer; if it is a large area paved, you can choose the nearby mixing or other large mixing equipment mixing, However, in the choice of large-scale mixing equipment or mixing plant, you should choose a special cold mixing equipment.

The choice of transport vehicles. In the water-based epoxy modified emulsified asphalt concrete mixing station mixing, the transport vehicles to small vehicles,

each vehicle should not exceed five tons, in a certain range, the less the better car traffic. In addition, if the conditions are feasible, you can use cement concrete tanker transport, but need to slightly increase the amount of asphalt concrete outside the water.

Selection of rollers. In addition to the road repair can use a small roller, the actual construction will choose medium or heavy wheel roller, and otherwise it will lead to a serious shortage of road surface compaction. As the rubber roller in the rolling process will form a slight rut, to promote the water-based epoxy modified emulsified asphalt floating, so the use of rubber roller is strictly prohibited.

Selection of heating and maintenance equipment. In the selection of heating equipment, especially large heating equipment should choose uniform heating equipment. If the road heating is not uniform, likely to cause road scorching and heating depth is not enough.

3. Waterborne Epoxy Modified Emulsified asphalt Mixture Construction Technology

3.1. Pavement preparation before work

Choose the right weather: see the weather forecast in advance, try to choose the last week without rain date, at least pavement can not rain the day, and the temperature can not exceed 30℃.

Pavement pretreatment: treat the base surface of the asphalt pavement clean, remove the stones, scum, dust, oil or other impurities by sweeping or high pressure water washing or air compressor cleaning or other methods, spraying or applying sticky oil. The viscous oil is used in an amount of 0.4 to 1.2 kg / m2; one or more of the emulsified bitumen, the modified emulsified asphalt, the hot asphalt, the aqueous epoxy resin and the epoxy resin.

3.2. Mixing and transport of the mixture

When the aggregate and slag into the mixer after, in order to prevent the fine aggregate, mineral powder and modified emulsified asphalt mixed ball, should be the first dry mixing, dry mixing time to 1min ~ 3min is appropriate. When the modified emulsified asphalt, it should be divided into inputs, under normal circumstances, four inputs, so that the mixture can be more mixed, reducing the mixing time. The material selected in this paper is divided into four times, mixing time is 6 min, just mix well.

Cold material construction generally take on-site mixing, no transport process, but in the large amount of conditions, in order to improve efficiency can also choose a small distance from the concentration of mixing. If the use of cement concrete tanker transport, the water-based epoxy asphalt mixture transport process, should be in a closed state, and non-stop mixing, to prevent the material part of the curing too fast; if the use of commonly used mixture transport truck transport, the internal cannot brush oil , but should be pad to thicken the plastic film. The bottom of the vehicle cannot leak water, the surface of the vehicle covered with black plastic film, try to make it in a closed state, to prevent the surface in the transport process curing too fast. The transit time is controlled within 30 min.

3.3. Paving and rolling

Transport vehicles to the scene or after mixing the scene is completed, should be paving as soon as possible.

Waterborne epoxy modified emulsified asphalt concrete construction if the use of on-site mixing method, preventive maintenance must be carried out before rolling. Preventive conservation reasons are as follows: ① water-based epoxy modified emulsified asphalt mixture in the presence of a large number of free water, the water on the curing of epoxy resin and emulsified asphalt demulsification inhibitory effect is obvious. ② premature rolling, modified emulsified asphalt in the process of rolling water floating on the pulp.

At the same time, during the preventive maintenance process, the curing of the epoxy resin and the demulsification of the emulsified asphalt are faster than the lower surface due to the contact of the upper surface of the mixture with the air. Therefore, in the preventive maintenance, should be covered in the upper surface of the black plastic film. Preventive maintenance time + paving time is generally within 40min, the specific preventive curing time to the surface of the mixture should prevail. When the surface color of the concrete becomes dark and the depth of blacking exceeds 1/3 of the coarse aggregate particle size contained in the mineral material, the preventive maintenance is finished and the rolling is performed.

Water-based epoxy modified emulsified asphalt concrete rolling can only use steel wheel rolling, can not use rubber tire rolling. Roller using medium-sized roller or heavy-duty roller (≥ 6 tons), the general pressure of 5 to 8 times. Pavement in the rolling should pay attention to the following points: ① If the rolling process occurs when the sticker or asphalt floating can be divided into several times, generally divided into two, the middle interval of 10 minutes, so that can make the rapid evaporation of water due to rolling and is conducive to the formation of road surface strength. ② Rolling process can only use static pressure. Pavement in the rolling process, part of the water-based epoxy resin has been cured, so too much vibration will lead to road cracking. ③ The initial pressure + final pressure time cannot exceed 30 minutes.

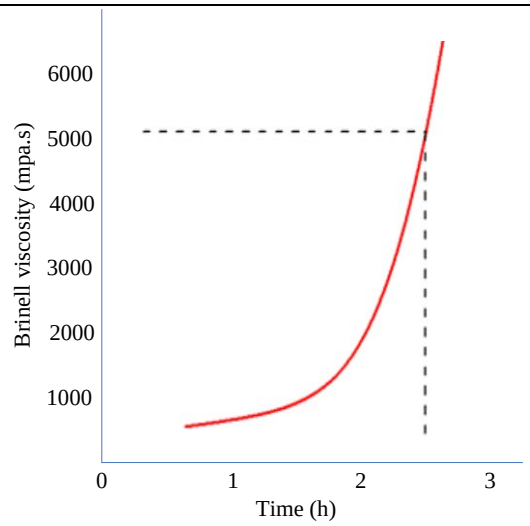

Figure 3. Waterborne epoxy viscosity's relationship with time

The Figure 3 shows that when the 2.5h, this paper selected the waterborne epoxy Brinell viscosity has reached 5000 mPa·s, have most of the curing reaction of epoxy resin, Continued construction can lead to road cracking. In accordance with the general experience of road construction, water-based epoxy modified emulsified asphalt mixture from the factory time to complete the rolling time cannot be more than 1.5h.

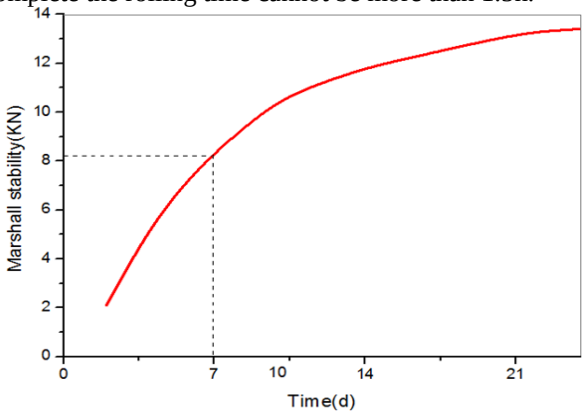

Figure 4. Waterborne epoxy viscosity's relationship with time

3.4. Road maintenance and open traffic

Water-based epoxy modified asphalt concrete pavement only after a certain period of time to maintain the maintenance of traffic, the specific time according to the experiment to determine. According to the natural conservation of this material Marshall specimen to form the strength of the law (shown in Figure 3), open traffic conditions is Marshall stability greater than 10MPa, so it must be at least conservation in the natural state for more than a week. Pavement maintenance should be noted that in the pavement paved within 3 days, encountered rain, the road must be covered, while extending the road maintenance time.

If you are eager to open the traffic, you can heat maintenance to shorten the time of closed traffic. Pavement heating maintenance generally use intermittent heating maintenance, which can effectively prevent the road scorched. Experiments show that in the case of intermittent heating 2h per day, the time of the water-based epoxy-modified emulsified asphalt to reach the open traffic intensity is about 4 days, much less than 7 days without heating, and the time is shortened by about half.

4. Construction Advices

In the waterborne epoxy modified emulsified asphalt concrete construction process, encountered many difficult to avoid the problem. This article gives the following suggestions based on these unavoidable questions:

Due to the high epoxy ratio of water-based epoxy modified emulsified asphalt concrete low temperature performance is insufficient, it is recommended that a high proportion for the southern region, especially in the open traffic or rainy areas.

Different manufacturers of the same water-based epoxy are not the same, different water-based epoxy should adjust the ratio. Similarly, the aggregate in different regions is not the same, before the construction should be re-measured in accordance with these control indicators.

The waterborne epoxy modified emulsified asphalt mixture mentioned in this paper is too large to be applied to the upper surface of the pavement and is suitable for the middle and lower layers.

The curing reaction of the epoxy material is irreversible. Before rolling, epoxy once the initial curing, should immediately discard the vehicle mixture discarded, so this paper recommended on-site mixing.

Water-based epoxy is different from hot mix epoxy asphalt mixture, due to the reasons for the material itself cannot be used for steel deck pavement, deck pavement should be carefully applied.

5. Conclusions

Based on the above analysis and suggestions of the construction process, the following conclusions are summarized:

The weather is an important factor affecting the construction of waterborne epoxy modified emulsified asphalt concrete. Pavement construction should use sunny days, and the temperature cannot exceed 30 ℃, during the conservation period cannot have rain, or to carry out appropriate rain cover, and maintenance extension.

Water can make the concrete mix more uniform, but excessive water will reduce the strength of asphalt concrete, so before the construction should be carried out indoor mixing test to determine the amount of water.

The water-based epoxy-modified emulsified asphalt is prepared in the order of mixing of the components and, after the preparation of the asphalt, the mixing of the mixture should be carried out immediately.

In the mixing process of the mixture, should first dry mix of aggregates and then adding modified emulsified asphalt. Water-based epoxy modified emulsified asphalt should be added in stages, which can effectively prevent the fine aggregate and emulsified asphalt ball.

In the transport of waterborne epoxy modified emulsified asphalt mixture process, try to keep the closed state, and the transport time should be controlled within 30min.

The field-adjusted modified asphalt concrete should be prevented from curing before rolling, which can prevent the slippage of the road surface and the propellant, while promoting the formation of road surface strength. With the mixture of state judgement in the process of the curing time, when the depth of the concrete surface color is black and black more than 1/3 of the coarse aggregate size, end of preventive maintenance.

Pavement compaction, medium or heavy rollers should be adopted, and the static pressure.

Open before transportation, drilling core sample should be made for the road. Marshall stability for core samples is greater than or equal to 10 MPa to open the traffic. If it is eager to open the traffic can be shortened by heat curing road closed transportation time.

According to the characteristics of the waterborne epoxy modified emulsified asphalt, this paper argues that it should not be used for the cold area. In addition, some other suggestions are put forward.

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