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Study on Improvement of Aging Performance for Gussasphalt Modified by Reclaiming Agent

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Abstract. Gussasphalt has been widely used in steel bridge deck and pavement in China, but it will lead to the pyrolysis aging of gussasphalt binder in the mixing process due to the high temperature and long time mixing. In this paper, the effect of ARA asphalt reclaiming agent on the main performance indexes of gussasphalt at five aging temperatures was studied. It was found that the indexes of penetration and ductility were greatly improved after the addition of the reclaiming agent, and the softening point was regularly reinforced. All the three indexes were improved to varying degrees, which indicates that ARA reclaiming agent had a significant effect on the performance recovery of the gussasphalt after superheat aging.

1. Introduction

With the improvement of bridge construction technology in China, the channel form design of crossing the river, sea and Yellow River has been developed from the 100-meter cable-stayed bridge in the 1990s to the single-span suspension bridge of double-tower at the kilometer level and even the multi-tower double-span suspension bridge (such as Taizhou bridge and Maanshan Yangtze river bridge) at more than two kilometers level. Meanwhile, the higher technical requirement is put forward for pavement layer to keep good compatibility with steel bridge deck with the continuous record of main span for steel box bridge [1]. Under this background, gussasphalt concrete paving materials are widely used for their excellent synergetic deformation ability, low temperature cracking resistance and water tightness [2].

However, during the process of molding and transportation, gussasphalt mixture needs to undergo superheat temperature from 220°C to 240°C and mixing in the special equipment named Cooker car for about 4~6 hours. The molding environment is more severer than the common polymer modified asphalt mixture for the 170°C to 185°C level of mixing temperature and seconds of mixing time. Such superheated temperature and long time molding conditions will lead to the pyrolysis aging of the gussasphalt [3].

In order to solve the problem that the performance decreases seriously of gussasphalt after superheat aging, this paper attempts to add reclaiming agent into the asphalt after superheat aging. The improvement of aging performance for gussasphalt was studied by a series test methods.

2. Study on the performance improvement of gussasphalt by reclaiming agent

2.1. Asphalt reclaiming agent

The commonly used asphalt reclaiming agents on the market are Ruth brand RF reclaiming agent from JSR Corporation of Japan, AE series asphalt reclaiming agent from USA, ERA-C series reclaiming agent from USA and ARA bituminous reclaiming agent, a new technology product of Jiangsu Academy



of Transportation Sciences in China [4]. ARA asphalt reclaiming agent is a viscous oily black liquid made from heavy petroleum distillates, aromatic petroleum solvents and modified by polymer. ARA asphalt recycling agent is mixed with asphalt recycling material in the process of hot recycling or hot mixing of asphalt pavement. It can supplement the aromatic and colloidal components lost by asphalt binder due to aging, restore the balance of chemical components of aging asphalt, and effectively improve the road performance of aging asphalt [5]. Therefore, ARA asphalt reclaiming agent was selected in this study, and its appearance is shown in figure 1.



Figure 1. ARA reclaiming agent

2.2. Study on property recovery of aged asphalt by reclaiming agent

In this study, aged TLA-70#matrix mixed asphalt and finished product of high-elastic gussasphalt were selected as the test samples, in which TLA:70# = 60:40 and 65:35. The recommended amount of ARA reclaiming agent is 6%~10% of the mass of asphalt. As the asphalt aging test in this study is short-term aging, the amount of ARA reclaiming agent is usually targeted at aged asphalt pavement, which belongs to long-term aging. Therefore, in order to avoid the situation that asphalt properties change too much due to the addition of too many reclaiming agent, it is suggested to select the lower limit of the dosage, namely 6% as the dosage of reclaiming agent in the aging and regeneration test of asphalt in the study.

The specific implementation plan is as follows:

- 1) Samples of high elastic gussasphalt and TLA asphalt with 60% and 65% amount were obtained.
- 2) Before the asphalt samples are taken from the aging plate, the mass of the empty sample dishes should be weighed. After the aging asphalt samples are collected, the quality of the sample dishes after the aging asphalt samples are collected should be weighed to calculate the mass of aging asphalt.
- 3) According to the mass of aging asphalt, the mass of reclaiming agent was calculated and added.
- 4) The asphalt sample was heated appropriately with the reclaiming agent, mixed evenly, and poured into the mold for testing.

The data of the three main indexes before and after the addition of the reclaiming agent in the high-elastic gussasphalt are shown from Figure 2 to Figure 4.

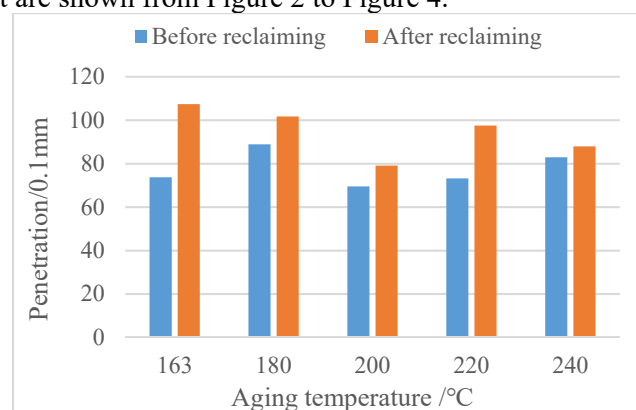


Figure 2. Penetration of gussasphalt before and after adding reclaiming agent

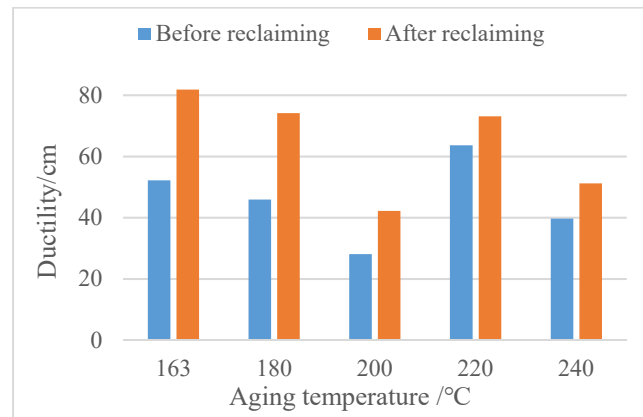


Figure 3. Ductility of gussasphalt before and after adding reclaiming agent

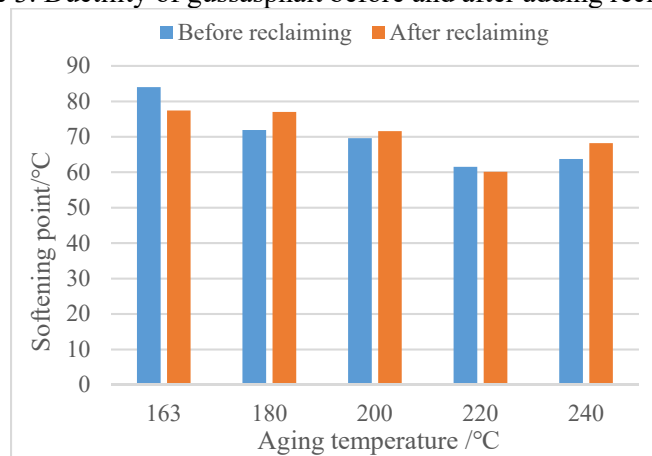


Figure 4. Softening points of gussasphalt before and after adding reclaiming agent

The data of the three indexes before and after adding reclaiming agent in TLA:70# = 65:35 mixed asphalt are shown from Figure 5 to Figure 7.

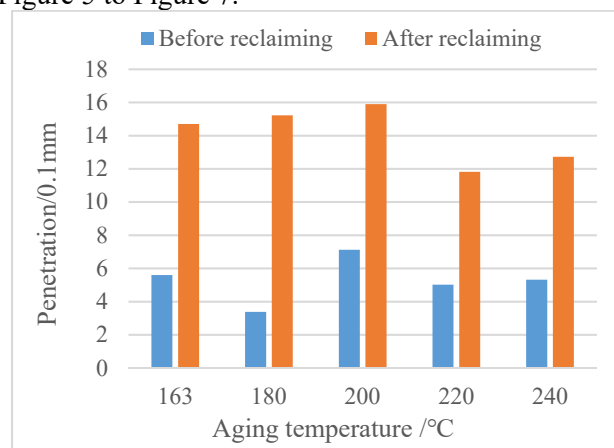


Figure 5. Penetration before and after adding reclaiming agent of mixed asphalt with 65% TLA

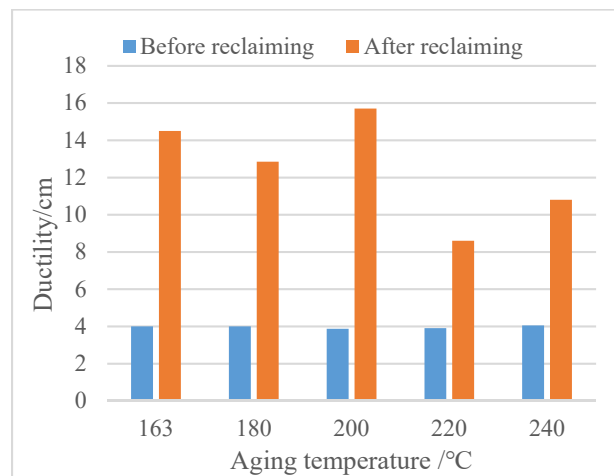


Figure 6. Ductility before and after adding reclaiming agent of mixed asphalt with 65% TLA

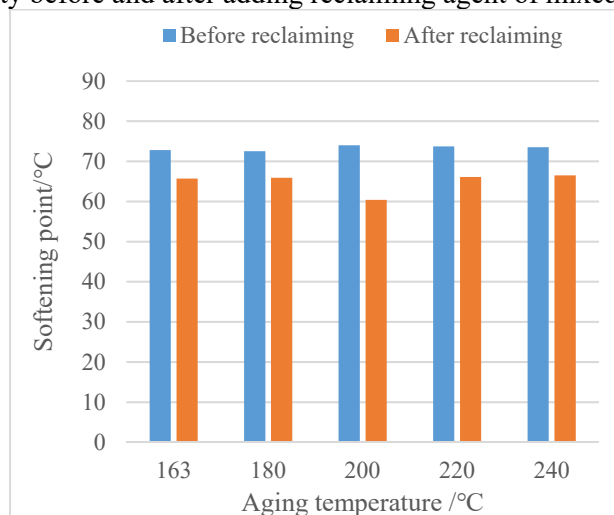


Figure 7. Softening points before and after adding reclaiming agent of mixed asphalt with 65% TLA

The data of the three indexes before and after adding reclaiming agent in TLA:70#=:60:40 mixed asphalt are shown from Figure 8 to Figure 10.

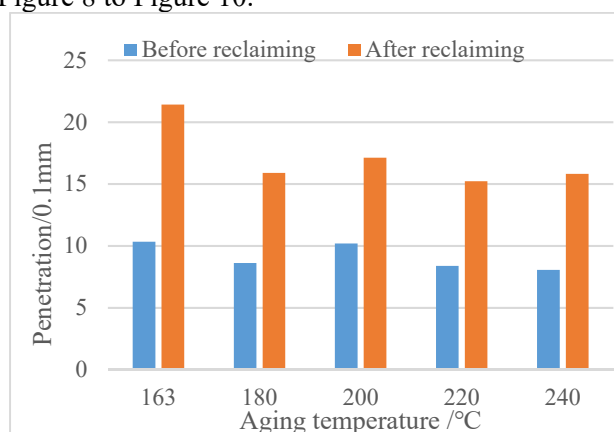


Figure 8. Penetration before and after adding reclaiming agent of mixed asphalt with 60% TLA

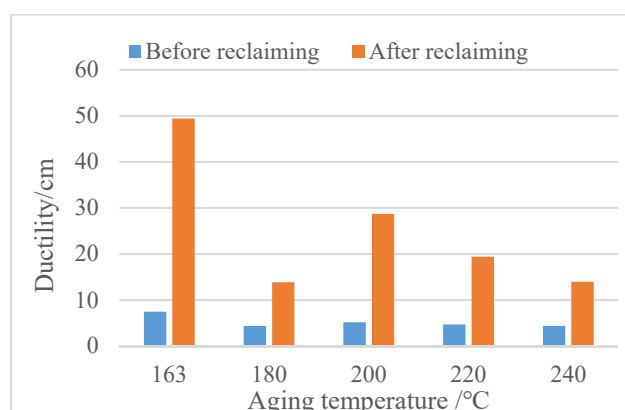


Figure 9. Ductility before and after adding reclaiming agent of mixed asphalt with 60% TLA

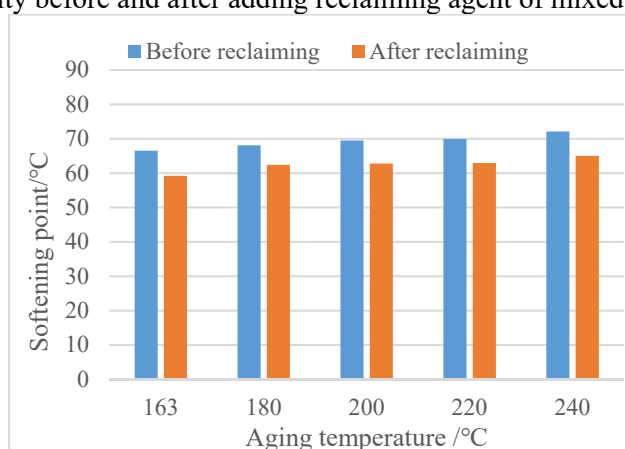


Figure 10. Softening points before and after adding reclaiming agent of mixed asphalt with 60% TLA

It can be observed from Figure 2 to Figure 10 that after adding reclaiming agent, the penetration, softening point and ductility indexes of the gussasphalt and the mixed asphalt obtained by TLA and 70# asphalt have all been improved to varying degrees. It indicates that ARA reclaiming agent has a significant effect on the performance recovery of aging asphalt.

The ductility and penetration of the high elastic gussasphalt have been greatly improved after the addition of reclaiming agent, but the change regularity of softening point is not strong, which may be related to the modifier inside the original asphalt. However, it can still be considered that the performance of the high-elastic gussasphalt after superheated aging can be improved by the reclaiming agent, so that the deterioration degree of performance caused by aging is greatly reduced. After the addition of reclaiming agent, the properties of the gussasphalt developed towards the direction before aging, and its road performance was restored to a certain extent.

As to the mixed asphalt with TLA ratio of 65% and 60%, the aging samples added with reclaiming agent showed the following behaviors: increased penetration, increased ductility, decreased softening point. Especially for penetration and ductility, the improvement is highly significant, more than double the data before aging. This indicates that ARA reclaiming agent has a significant recovery effect on the aged gussasphalt, which can effectively improve the temperature sensitivity of the mixed asphalt, strengthen the anti-fatigue cracking ability, and improve the plasticity of the mixed asphalt. In addition, it can be seen from the test results that whether the mixed asphalt with TLA ratio of 65% or 60% shows a trend of change with aging temperature, the three indexes are basically consistent with that before and after the addition of reagent, indicating that the properties of aged asphalt after using reclaiming agent are closely related to the properties of asphalt materials before adding reclaiming agent.

In addition, it can be seen from the data in the above figures that, after the addition of reclaiming agent, the performance of the three indexes of the high-elastic gussasphalt at partial aging

temperature recovered to the required range of road performance. The corresponding aging temperature is 180°C and 200°C. While performance of 65% TLA mixed asphalt also restore the road performance requirements. For mixed asphalt with 60% TLA content, the performance of the three indexes under five aging temperatures recovered to the required range of road performance.

According to the test results, the best proportion of the gussasphalt obtained by mixing 70# asphalt with TLA is TLA:70#=60:40. At this ratio, all the indexes of the mixed asphalt meet the expect design requirements, and after aging, ARA asphalt reclaiming agent with a mass ratio of 6% can restore the performance of aging asphalt to the pre-aging level and still meet the requirements of road performance specification.

3. Conclusion

In this study, aimed at the serious degradation of the performance of gussasphalt after aging, asphalt reclaiming agent was added into the asphalt after superheated aging, and the effect of reclaiming agent on the performance of asphalt after aging was tested and evaluated. The main conclusions are as follows:

- 1) ARA asphalt reclaiming agent with 6% content has a significant effect on the performance recovery of aged asphalt. For the finished high-elastic gussasphalt, the index of penetration and ductility can be greatly improved, and the softening point is strengthened regularly. As to TLA and 70# asphalt blending mix asphalt, penetration and softening point have more than doubled improvement, softening point decreased 6~10°C, the three main indexes have different degrees of improvement.
- 2) The optimal ratio of for the mixed asphalt is obtained by mixing TLA and 70# asphalt of TLA:70#=60:40. At this time, all indexes before aging meet the expected design requirements. For the aged asphalt, after adding ARA asphalt regenerating agent with a mass ratio of 6%, the performance for the five kinds of aging temperatures all meets the requirements.

Acknowledgements

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