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Article

The Effect of Silicone Resin on the Fuel Oil Corrosion Resistance of Asphalt Mixture

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Abstract: Fuel oil leaked onto asphalt pavement will damage the asphalt layer by dissolving the binder, softening the mixture and finally resulting in distress such as raveling and pitting. In the meantime, the skid resistance, high temperature stability and water stability deteriorate dramatically. Silicone resin is a fog sealing material for asphalt pavement. It forms a three-dimensional network structure with -Si-O- chains and therefore shows strong hydrophobicity and chemical stability. This paper looks into the effect of silicone resin on the fuel oil corrosion resistance of asphalt mixture. The contact angle, Cantabro test, water stability test, wheel tracking test and three-point bending test were used to investigate the road performance and the corrosion resistance under diesel and gasoline. It was found that, compared with diesel, the contact angle between gasoline and asphalt is smaller, indicating better compatibility. The gasoline corrosion decreases the properties of asphalt mixture more than that of diesel, which indicates that the compatibility is related to the corrosion effect. The results also show that silicone resin can effectively improve the adhesion, strength, water stability and high- and low-temperature performance of asphalt mixture before and after fuel oil erosion, and the improving effect on asphalt mixture after oil erosion is better.

Keywords: silicone resin; asphalt mixture; fuel oil corrosion; compatibility; adhesion performance; pavement properties

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1. Introduction

Asphalt concrete is the most popular paving material for highways which is formed by gluing together the designed graded aggregates with asphalt [1–3]. Asphalt is a complex polymer composite containing saturated phenols, aromatic phenols, colloid and asphaltene, which are produced from the residue after the distillation of petroleum [4–6]. Nowadays, diesel and gasoline are the main oil fuels for vehicles. As products of petroleum refining, they have similar chemical compositions to asphalt and show good compatibility [7–9]. Inevitably, oil leakage from vehicles happens in roadway traffic due to traffic accidents and vehicle faults, and the leaked oil wets the road surface, dissolves the asphalt, causes the asphalt binder to peel off and finally results in oil erosion damage on the asphalt concrete layer such as raveling. The fuel oil corrosion might cause pitting disease on asphalt pavement in a short time. In the meantime, the skid resistance, high temperature stability and water stability deteriorate dramatically, therefore threatening the road durability, driving comfort and safety [10–16]. Hence, it is of great significance to investigate and develop adaptable technology to improve the oil corrosion resistance of asphalt pavement.

Property tests have been used to investigate the oil erosion effect on the performance of asphalt mixture, such as the pull test, Cantabro test, Marshall test, freeze–thaw splitting test and rutting test [17–19]. Modified asphalt such as SBS and PE may have better diesel corrosion resistance than base asphalt due to the polymer network structure [20,21]. Xu et al. evaluated the diesel corrosion resistance of TLA modified asphalt using the Marshall stability test, freeze–thaw splitting test and rutting test, and found that the incorporation of TLA could improve the high temperature stability and water stability of asphalt mixture after oil etching [22]. It was also reported that the use of oil corrosion-resistant agents can significantly improve the high temperature performance and water stability of asphalt mixture suffered from gasoline corrosion [23]. Li et al. used scanning electron microscopy, infrared spectra (FTIR), the turbidity test and the pavement performance tests of asphalt mixture and found that oil corrosion-resistant agents can inhibit the loss of strongly polar aromatic compounds in asphalt under oil erosion to protect the asphalt membrane that coats aggregate and improves the pavement properties of asphalt mixture after diesel etching [24].

Preventive maintenance technologies can retard future deterioration, and maintain or improve the functional condition of the pavement at the beginning of road technical condition decay, including slurry seal, fog seal and micro-surfacing [25–27]. Chaturabong et al. found that sealing with chips and emulsified asphalt could be used to repair oil-corroded asphalt pavement [28]. Huang et al. studied the effects of modified emulsified asphalt fog seal and silicone fog seal on coal tar-corroded asphalt pavement, and found that silicone resin could delay the damaging process and reduce the rutting depth, and show better improvement in skid resistance [10]. Fog seal is the most convenient preventive maintenance form to construct and is fastest for resuming traffic, which could create a significant environmental and economic impact [29,30]. Silicone resin is an emerging fog sealing material with excellent hydrophobicity and permeability, which can quickly penetrate through the asphalt layer to form and prevent water erosion [31,32]. In addition, supported by -Si-O-Si- chains, silicone resin forms insoluble three-dimensional solid meshes after curing, which has remarkable chemical stability therefore can delay the damage of oil corrosion on asphalt pavement. Wu et al. studied the waterproof and oil resistance of asphalt mixture before and after spraying silicone resin and found that silicone resin could significantly improve the anti-rutting performance of asphalt mixture before and after oil corrosion [33].

Existing works have mainly focused on the moisture resistance of silicone resin as the fog sealing material, but very few studies have focused on its oil-corrosion resistance. Therefore, this research intends to use FTIR and X-ray fluorescence spectrometer (XRF) to analyze the chemical composition of asphalt. Contact angle (CA), Cantabro test, Marshall stability (MS), freeze–thaw splitting test (FTST), wheel tracking (WT) test and three-point bending (3PB) test were used to investigate the corrosion of diesel and gasoline on the asphalt mixture and the effect of silicone resin on the fuel oil corrosion resistance of asphalt mixture. The experimental design of this paper is presented in Figure 1.

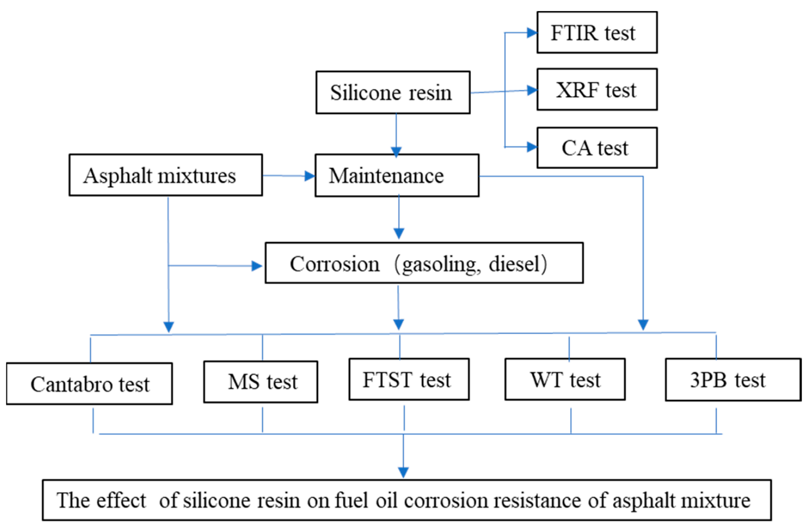

Figure 1. The experimental design of this study.

2. Materials and Methods

2.1. Materials

Silicone resin was provided by Hubei Huanyu Chemical Co., LTD (Tianmen, China). Silicone resin is a transparent liquid with a viscosity of 25.0 mPa.s at 25 °C which is produced by mixing Dimethyl-Diethoxy-silane (DMDES), Methyltrie-Thoxysilane (MTES) and tetraethoxysilane (TEOS) together with solvent, catalyst, etc. After being sprayed onto the asphalt pavement, silicone resin covers the asphalt concrete surface and forms a protective layer after the volatilization of the ethanol solvent.

For the asphalt corrosion test, $0^{\#}$ diesel and $92^{\#}$ gasoline were used as the fuel oils. The main components of $92^{\#}$ gasoline are C4~C10 alkanes, aromatics, alkenes and oxygen-containing compounds, while the main components of $0^{\#}$ diesel are C10~C22 alkanes and aromatics.

SBS modified asphalt I-D was provided by Hubei Guochuang Road Material Technology Co., LTD (Wuhan, China). The asphalt basic physical properties are shown in Table 1 which were tested according to JTG E20-2011 [34]. The aggregate used in this study is basalt collected at Jingshan, Hubei, China and the basic physical properties are shown in Table 2 which were tested according to JTG E42-2005 [35]. All technical properties of asphalt and aggregate meet the requirements of JTG F40-2004 [36].

Table 1. Basic physical properties of SBS modified asphalt I-D.

Properties	Unit	Tested Value	Criteria in China
Penetration (25 °C, 100 g, 5 s)	0.1 mm	56.7	40~60
Softening point	°C	76	≥60
Ductility (5 cm/min, 5 °C)	cm	59	≥20
Brookfield viscosity (135 °C)	Pa·s	2.7	≤3
Solubility	%	99.4	≥99.0

Table 2. Basic physical properties of basalt.

Properties	Unit	Test Value	Criteria in China
Apparent relative density	/	2.891	≥2.6
Water absorption ratio	%	0.745	≤2.0
Flat and elongated particle content	%	5.4	≤12
Los Angeles abrasion loss	%	15.7	≤28
Crushed stone value	%	13.7	≤26

2.2. Sample Preparation

2.2.1. Asphalt Mixture Design

AC-13 asphalt mixture is the most widely used mixture type for the asphalt surface layer. The grading curve of the AC-13 asphalt mixture design is shown in Figure 2. The optimal asphalt content is 4.5% and the void ratio is 4.2%.

2.2.2. Sample Preparation and Treatment

The silicone resin treated samples (SRTS) were prepared by spraying 400 mL/m^2 of silicone resin liquid on asphalt mixture samples and then curing under 25 °C for 5 h, following the same procedures reported by Cui et al. [32]. Asphalt mixture samples without silicone resin treatment were used as contrast samples (CS).

To simulate the fuel oil damaging process in the field, asphalt mixture samples were coated with 600 mL/m^2 fuel oil (diesel or gasoline) and then curing under 25 °C for 24 h. The diesel corrosion (DC) samples or gasoline corrosion (GC) samples were prepared. Asphalt mixture samples without fuel oil corrosion were used as reference samples (RS). Figure 3 shows the images of asphalt mixture samples before and after oil corrosion.

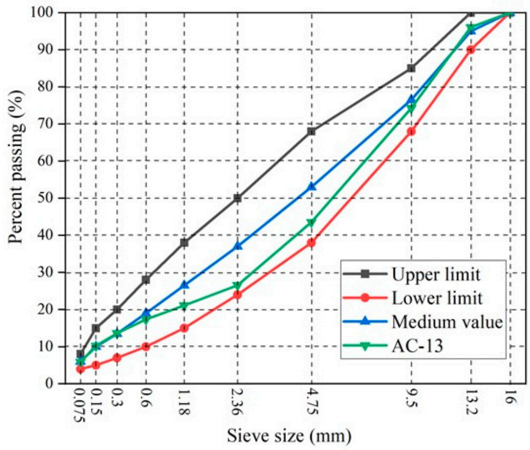

Figure 2. The grading curve of asphalt mixture.

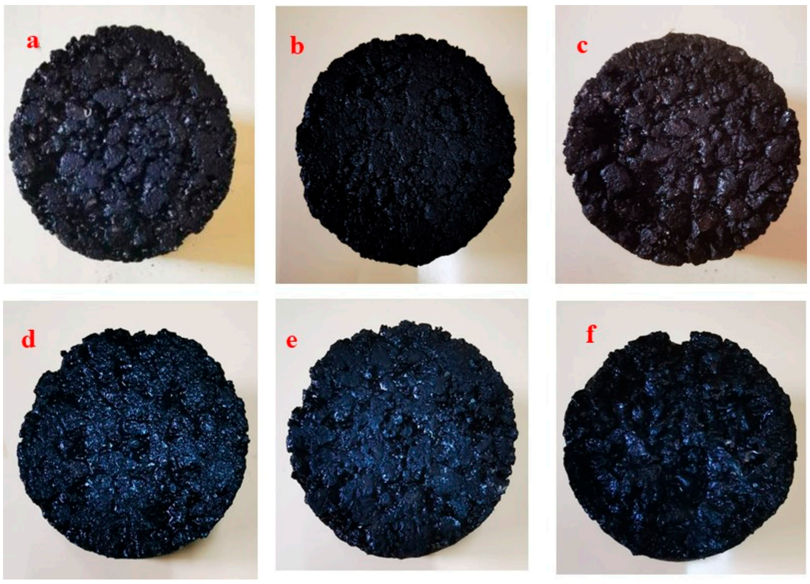

Figure 3. Images of asphalt mixture samples before and after oil corrosion (**a**) CS-RS, (**b**) CS-DC, (**c**) CS-GC; (**d**) SRTS-RS, (**e**) SRTS-DC, (**f**) SRTS-GC.

2.3. Experimental Testing

2.3.1. Chemical Composition of Silicone Resin

The molecular structure of silicone resin was analyzed by the Nexus intelligent Fourier transform infrared spectrometer manufactured by Thermo Nicolet. Axios XRF (PANalytical B.V, Almelo, The Netherlands) was used to characterize the chemical composition of silicone resin.

2.3.2. Contact Angle

The compatibility between liquid and solid surfaces can be evaluated by the contact angle which is shown in Figure 4. The larger the contact angle, the more the solid material is alienated from the liquid. The smaller the contact angle, the better the infiltration and the stronger the ability of the liquid to penetrate through the solid surface. When the contact angle between the liquid and solid material is greater than 90°, it is difficult for liquid to infiltrate into solid material. The contact angle was tested by CA-XP150 contact angle analyzer from Concorde Interface Science Co., LTD (Japan). By testing the contact angles between liquid silicone resin, water, gasoline, diesel and asphalt, the invasiveness and compatibility of silicone resin, water and fuel oil on asphalt were investigated. By analyzing the contact angles between water, gasoline, diesel and silicone solid, the waterproof and fuel oil resistance of silicone resin was studied.

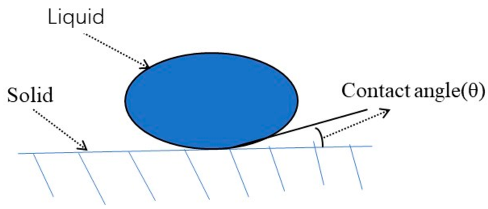

Figure 4. Contact angle test.

2.3.3. Cantabro Test

Through the water immersion and flying test on Marshall specimens before and after oil erosion, the quality of scattered materials of asphalt mixture specimens was tested after 300 rotations of impact in the Los Angeles testing machine, and the effects of silicone resin and oil erosion treatment on the bonding property and water stability of asphalt mixture were compared and analyzed. The immersion dispersion loss of asphalt mixture (ΔS) was calculated using Equation (1) according to the JTG E20-2011 [34].

$$\Delta S = (m_0 - m_1)/m_0 \times 100\% \quad (1)$$

where m_0 and m_1 are the mass of Marshall specimen before and after Cantabro test, g.

2.3.4. Water Stability

The Marshall stability test and freeze–thaw splitting test were used to characterize the effect of silicone resin on the water stability of asphalt mixture before and after oil etching. The Marshall stability test and freeze–thaw splitting test were carried out according to T0709 and T0729 in JTG E20-2011 [34]. Residual Marshall stability (RMS) and tensile strength ratio (TSR) of freeze-thaw splitting test were calculated according to Equations (2) and (3):

$$RMS = MS_1/MS_0 \times 100\% \quad (2)$$

$$TSR = ITS_2/ITS_1 \times 100\% \quad (3)$$

where MS_0 and MS_1 are Marshall stabilities before and after moisture damage, kN; ITS_1 and ITS_2 are indirect tensile strengths before and after freeze–thaw cycles, MPa, respectively.

2.3.5. High Temperature Performance

The influence of silicone resin and oil corrosion on the high temperature performance of asphalt mixture was characterized by the wheel tracking test, which was conducted according to T0719 in JTG E20-2011 [34]. The test temperature was 60 °C, the load was 0.7 MPa, and the rolling speed was 42 times/min. Dynamic stability is calculated according to Equation (4):

$$DS = (t_2 - t_1) \times 42/(d_2 - d_1) \quad (4)$$

where t_1 is 45 min, t_2 is 60 min; d_1 and d_2 are deflection at 45 or 60 min, mm.

2.3.6. Low-Temperature Performance

The influence of silicone resin and oil corrosion on the low-temperature performance of asphalt mixture was characterized by three-point bending test, which was conducted according to T0715 in JTG E20-2011 [34]. The test temperature was −10 °C, the loading rate was 50 mm/min and the size of the specimen was 250 mm × 30 mm × 35 mm. Failure flexural tensile strength (R_B) and strain (ε_B) are calculated according to Equations (5) and (6):

$$R_B = (3 \times L \times P_B)/(2 \times b \times h^2) \quad (5)$$

$$\varepsilon_B = (6 \times h \times d)/L^2 \quad (6)$$

where L is specimen span, mm; b is specimen width, mm; h is specimen height, mm; d is deflection, mm; P_B is peak load, N.

3. Results and Discussion

3.1. Chemical Composition of Silicone Resin

Figure 5 shows the infrared spectrum of cured silicone resin. The characteristic absorption peak at 3450 cm^{-1} shows the existence of -OH bond, the stretching vibration and bending vibration of -CH functional group form the absorption peak at 2969 cm^{-1} and 1279 cm^{-1}, respectively, and the stretching vibration peak at 1635 cm^{-1} is C=C, indicating that there is ethylene group in the main chain of silicone precuring material. The stretching vibration peak of the Si-O bond forms the largest absorption double peak at 1130 cm^{-1} and 1025 cm^{-1}.

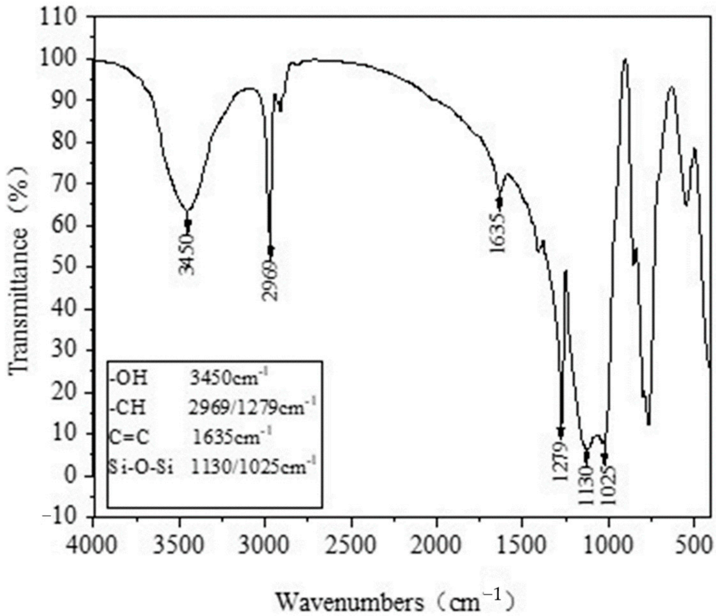

Figure 5. FTIR spectrogram of silicone resin.

The chemical composition of cured silicone resin obtained by XRF analysis is shown in Table 3. The content of SiO_2 is 99.49%, indicating that most of the silicone resin is composed of the Si-O functional group, which is the molecular backbone of silicone resin and has hydrophobicity and chemical stability. In addition, the silicone resin contains a very small amount of Ca, Fe, P, Al, S, Na, Cl, Mn and K heteroatoms ≤0.1%.

Table 3. Chemical composition of silicone resin.

Element	SiO_2	CaO	Fe_2O_3	P_2O_5	Al_2O_3	SO_3	Na_2O	Cl	MnO	K_2O	Loss
Content (%)	99.49	0.10	0.10	0.08	0.07	0.06	0.03	0.03	0.02	0.01	0.01

3.2. Infiltration Properties

Figure 6 shows the contact angles between liquid silicone resin, water, gasoline, diesel and asphalt. The contact angles between liquid silicone resin, water, gasoline, diesel and asphalt are all less than 90°, indicating that these liquids can infiltrate the asphalt surface and affect the performance of asphalt. Liquid silicone resin has the smallest contact angle with asphalt, and has excellent infiltration and permeability to asphalt. According to the study of Cui et al. [32], liquid silicone resin can penetrate the inside of the asphalt mixture to a certain depth, and form a protective film on the surface and inside of asphalt after curing, changing the pore structure of the asphalt mixture. The mean contact angle between water and asphalt is 86.4°, which is close to 90°. Asphalt has certain hydrophobicity. The mean contact angles of gasoline and diesel oil with asphalt are 27.4° and 30.3°, respectively, which are soluble in asphalt and easy to penetrate asphalt film to dissolve asphalt, and the infiltration solubility of gasoline is stronger.

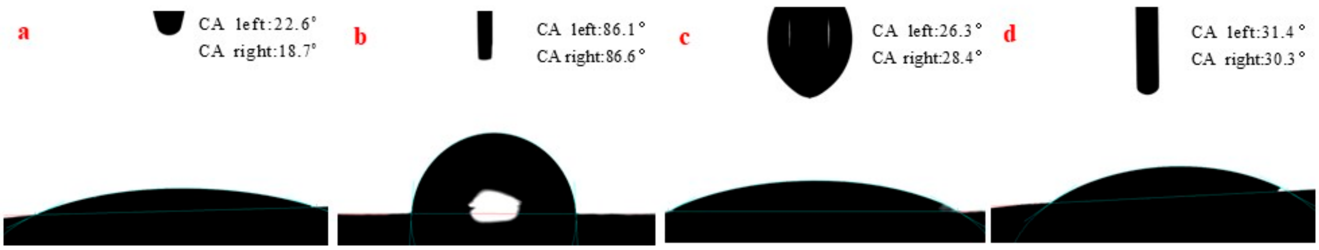

Figure 6. Contact angles between liquid silicone resin, water, gasoline and diesel and asphalt: (**a**) silicone, (**b**) water, (**c**) gasoline, (**d**) diesel.

The contact angles between silicone resin and water, gasoline and diesel oil after curing film formation are shown in Figure 7. The contact angle between the water and the cured silicone resin is 102.2°, much greater than 90°, so the silicone resin has good hydrophobicity and can enhance the water stability of the asphalt mixture. The mean contact angles between gasoline and diesel oil and cured silicone resin are 40.4° and 22.2°, respectively. All of them are soluble, and diesel has a strong solubility in the infiltration phase of cured silicone resin. However, because the three-dimensional network structure formed by the curing silicone resin has certain chemical stability, it can still play a role in resisting oil source corrosion in the asphalt mixture.

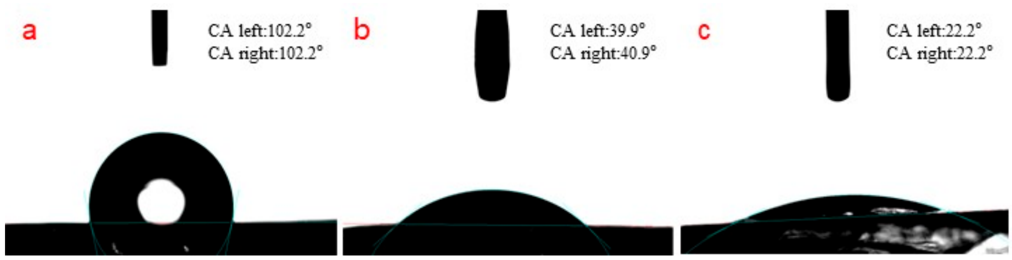

Figure 7. Contact angles between water, gasoline, and diesel and solid silicone: (**a**) water, (**b**) gasoline, (**c**) diesel.

The results of the contact angle test show that compared with diesel, gasoline has a smaller contact angle with asphalt, showing it to be more soluble in asphalt, and it is more corrosive to asphalt pavement. The contact angle between the cured silicone resin and water reaches 102.2°, which has excellent hydrophobic property and is conducive to improving the water damage resistance of asphalt pavement. However, the contact angle of cured silicone resin with gasoline and diesel oil is less than 90°, which may cause some phase miscibility. In addition, the solubility of diesel oil to cured silicone resin is stronger, so the resistance of silicone resin to diesel oil corrosion is weak.

3.3. Adhesive Properties

Figure 8 shows the immersion dispersion loss of asphalt mixture contrast sample and silicone resin treated sample before and after diesel and gasoline corrosion. A smaller ΔS generally indicates a better adhesive property for the asphalt mixture. The immersion dispersion loss of asphalt mixture was reduced by 1.4% by the silicone resin treatment, which indicated that the silicone resin could effectively enhance the adhesive property and water damage resistance of the asphalt mixture. The corrosion of diesel and gasoline increased the immersion dispersion loss of asphalt mixture by 5.0% and 7.1%, respectively.

Because diesel and gasoline oil can dissolve part of asphalt, the bond between aggregate and asphalt is reduced, so that the asphalt mixture is more prone to loss, and the water stability is further deteriorated. By silicone resin treatment, the immersion dispersion loss of diesel and gasoline corroded samples was reduced by 3.2% and 4.4%, respectively, indicating that solid silicone resin can largely improve the oil corrosion resistance of asphalt mixture. This is because the three-dimensional network structure formed by the curing silicone resin has strong chemical stability and is difficult to be dissolved and corroded by the oil source, so it can play the role of oil corrosion resistance. Moreover, the amplitude of the silicone resin to reduce the immersion dispersion loss of the specimen after oil corrosion is greater than that before oil corrosion, indicating that the silicone resin has a good effect on oil corrosion resistance.

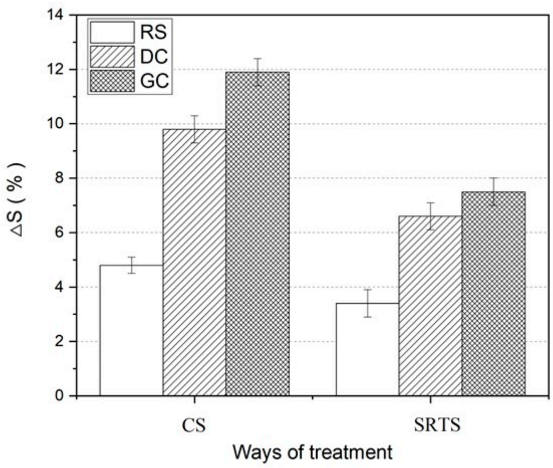

Figure 8. Cantabro test results.

3.4. Water Stability

The Marshall stability test and freeze–thaw splitting test results are shown in Figures 9 and 10. As shown in Figure 9, the Marshall stability of asphalt mixture decreases due to oil erosion, but it is still greater than the requirement of ≥8 kN proposed in JTG F40-2004. Silicone resin treatment can improve the Marshall stability and immersion Marshall stability of asphalt mixture before and after oil etching, and the effect of enhancing the immersion Marshall stability is greater, so as to improve the residual Marshall stability of asphalt mixture before and after oil etching. The Marshall stability reflects the strength of asphalt mixture, the residual Marshall stability reflects the water stability and the Marshall stability and the residual Marshall stability after oil erosion reflect the ability of asphalt mixture to resist oil erosion. Therefore, the Marshall test results show that oil corrosion reduces the strength and water stability of asphalt mixture, and silicone resin cannot only improve the strength of asphalt mixture, but also improve the water stability and oil corrosion resistance of asphalt mixture.

The freeze–thaw splitting strength ratio is also used to characterize the water stability of asphalt mixture. The freeze–thaw splitting strength test results of asphalt mixture are shown in Figure 10. As can be seen from Figure 10, oil erosion reduces the freeze–thaw splitting strength ratio of asphalt mixture, but it is still greater than the requirement of ≥80% in specification JTG F40-2004. By silicone resin treatment, the freeze–thaw splitting strength ratio of asphalt mixture before oil etching was increased by 1.1%, causing the results after diesel and gasoline corrosion to increase by 4.4% and 5.0%. The results of the freeze–thaw splitting test and Marshall stability test showed a similar trend, indicating that the cured silicone resin can effectively inhibit the water and oil etching of asphalt mixture, reduce the adhesion loss between asphalt slurry and aggregate, and has good waterproof and oil resistance properties.

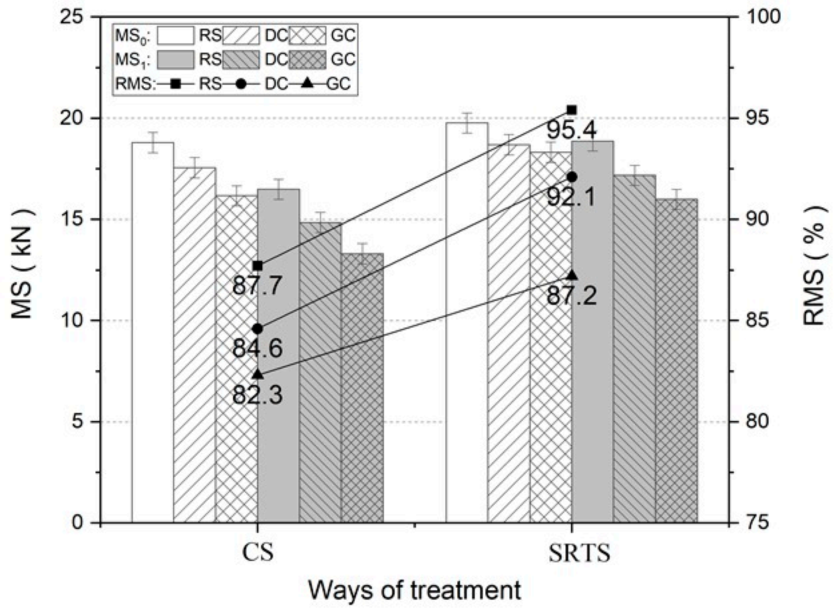

Figure 9. Marshall stability test results.

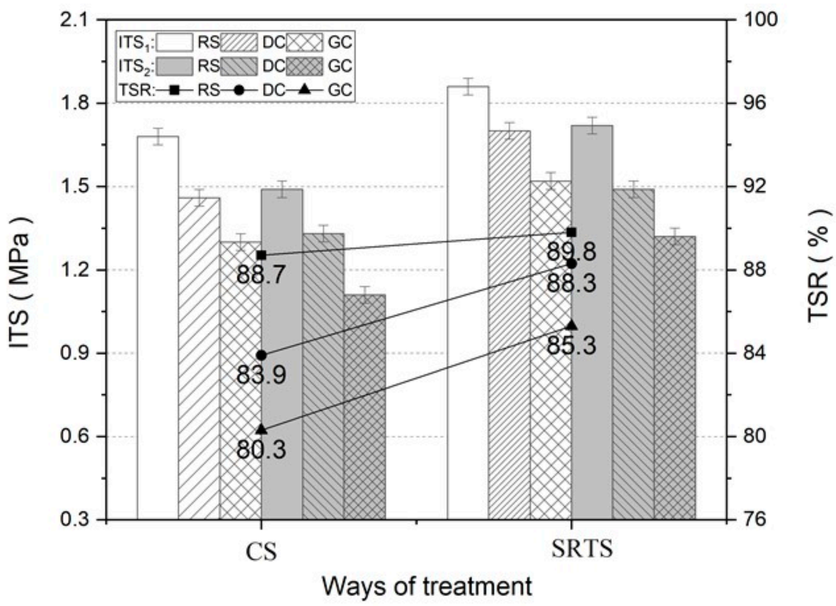

Figure 10. The freeze–thaw splitting test results.

3.5. High-Temperature Properties

Figure 11 shows the high temperature dynamic stability and rutting depth (RD) of asphalt mixture. A smaller RD or a larger DS generally indicates a better rutting resistance for the asphalt mixture. Silicone resin treatment can reduce the rutting depth of asphalt mixture by 10.0% and improve its rutting dynamic stability by 4.7%, and effectively improve the high temperature deformation resistance of asphalt mixture. This may be due to the enhanced shear deformation resistance of the cured silicone resin distributed in the asphalt mixture, thus improving its high temperature performance. It also showed that diesel and gasoline corrosion increase the rutting depth of asphalt mixture by 246.1% and 298.8%, respectively, while the dynamic stability decreases by 49.3% and 67.3%. The rutting resistance of asphalt mixture under gasoline corrosion decreases even more, which significantly increases the threat of high temperature rutting disease on asphalt pavement. After the treatment with silicone resin, the cured silicone resin can inhibit the corrosion of oil due to its better chemical stability, so as to improve the high temperature stability of the oil-etched asphalt mixture specimen. Compared with the contrast samples, the rutting depth of the asphalt mixture treated with silicone resin after diesel and gasoline corrosion decreased by 11.6% and 18.8%, and the dynamic stability increased by 20.2% and 49.9%, respectively. The improvement of rutting depth and dynamic stability showed that the resistance of silicone resin to gasoline corrosion was greater than that of diesel oil. In addition, compared with the degree of improving the rutting resistance of asphalt mixture before oil corrosion, the range of reducing the rutting depth and improving the dynamic stability of the oil corrosion specimen is larger, which further indicates that the silicone resin has a better oil corrosion resistance.

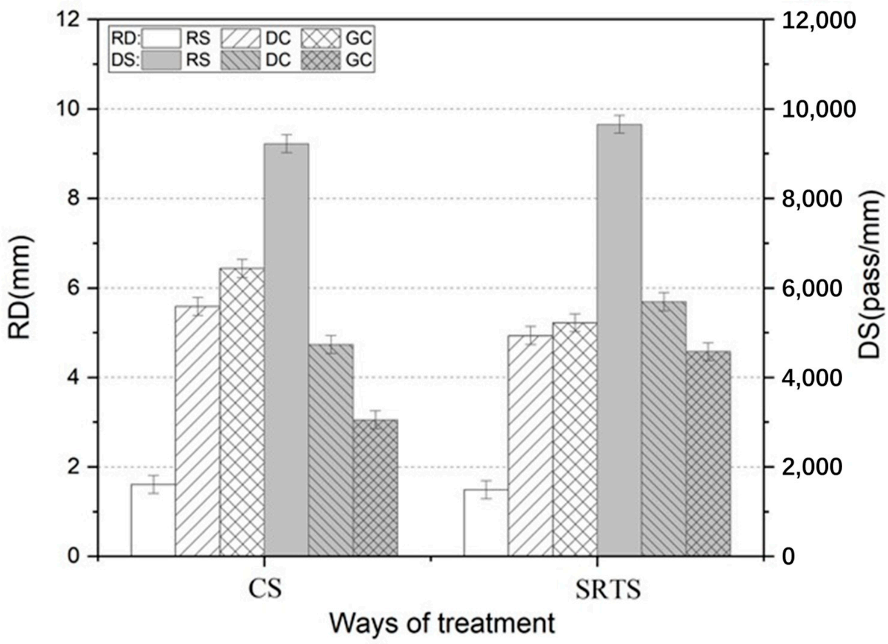

Figure 11. Wheel tracking test results.

3.6. Low-Temperature Properties

The flexural tensile strength and flexural strain of asphalt mixture obtained by the three-point bending test are shown in Figure 12. A larger ε_B generally indicates a better low-temperature cracking resistance for the asphalt mixture. The flexural strain of asphalt mixture before oil immersion is 2892 με, which meets the requirement of JTG F40-2004 specification ≥2500 με [36]. By silicone resin treatment, the flexural strain and flexural strength of asphalt mixture were increased by 9.1% and 11.0%, respectively. After diesel and gasoline corrosion, the bending-tensile strain of asphalt mixture were decreased by 43.1% and 53.0%, and the bending-tensile strength decreased by 75.3% and 78.0%, respectively. The decline range of bending-tensile strength was greater than that of bending-tensile strain, and the decline caused by gasoline corrosion was greater than that of diesel oil. Compared with the contrast samples, the flexural strain and flexural tensile strength of asphalt mixture after silicone resin treatment increased significantly, the flexural strain increased by 19.8% and 18.0%, and the flexural tensile strength increased by 48.5% and 32.9%. The improvement effect of silicone resin treatment on the flexural tensile strength of asphalt mixture after oil etching was significantly greater than that on the flexural strain. Additionally, the effect of silicone resin treatment on diesel corrosion improvement is greater than that of gasoline.

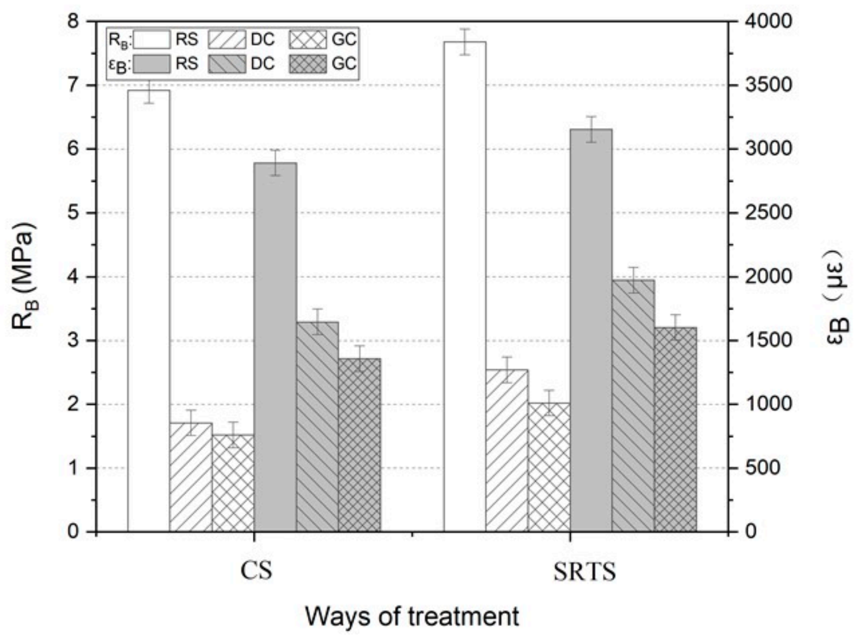

Figure 12. Three-point bending test results.

4. Conclusions

This paper studied the effect of silicone resin on the road performance of asphalt mixture and the corrosion resistance of diesel and gasoline. The contact angle test was used to analyze the infiltration of water, diesel and gasoline with asphalt and solid silicone resin. The Cantabro test, Marshall stability test, freeze–thaw splitting test, wheeling tracking test and three-point bending test were used to evaluate the changes in adhesion, strength, water stability, high and low-temperature properties of contrast samples and silicone treated samples before and after oil etching. The main conclusions are as follows:

(1) The contact angle between cured silicone resin and water is 102.2°, which has strong hydrophobicity and can play an excellent role in water damage resistance in asphalt mixture. The contact angles of gasoline and diesel oil with asphalt are 27.4° and 30.3° respectively, the contact angle between gasoline and asphalt is smaller and the solubility of asphalt is stronger. The contact angles between gasoline and diesel oil and cured silicone resin are 40.4° and 22.2°, respectively; the contact angle between diesel oil and cured silicone resin is smaller, which may cause more damage to the dissolution and corrosion of cured silicone resin.

(2) The asphalt mixture was treated with silicone resin, the immersion dispersion loss was reduced by 1.4%, the rutting depth by 10.0%; and increases were seen in the residual Marshall stability by 7.7%, in the freeze–thaw splitting residual strength ratio by 1.1%, the rutting dynamic stability by 4.7%, the low-temperature bending failure strength by 11.0% and the strain by 9.1%. The adhesion, water stability, high temperature rutting resistance and low-temperature cracking resistance of asphalt mixture were improved.

(3) Different types of fuel oil have different corrosion effects on asphalt mixtures. The compatibility of gasoline and asphalt is greater than that of diesel oil, and the performance attenuation range of asphalt mixture after gasoline corrosion is generally larger than that of diesel oil, indicating that the compatibility of fuel oil and asphalt has a certain correlation with the degradation degree of asphalt mixture performance after fuel oil corrosion.

(4) Silicon resin treatment can inhibit the corrosion of fuel oil to asphalt mixture, and the inhibition effect on corrosion of different fuel oils is different with different characterization indexes. It might because different characterization indexes have different sensitivity to the oil corrosion resistance of asphalt mixture treated with silicone resin.

On the other hand, the influence of silicone resin on the oil corrosion resistance of asphalt mixture is the result of the comprehensive effect of oil source on the dissolution and corrosion of asphalt and cured silicone resin, which needs to be further studied.

Author Contributions: X.G.: conceptualization, experiment, writing—original draft. L.P.: writing—review, supervision. S.X.: methodology, formal analysis and editing. Y.L.: visualization, data curation. Y.Z.: experiment, validation. All authors have read and agreed to the published version of the manuscript.

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Data Availability Statement: The raw/processed data required to reproduce these findings cannot be shared at this time as the data also forms part of an ongoing study.

Conflicts of Interest: The authors declare no conflict of interest.

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