

Research on shearing performance of asphalt mixture with Lucobit

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Abstract. To study the shearing performance of asphalt mixture with Lucobit, AC-13C and SUP-20 asphalt mixture with Lucobit were carried out the uniaxial penetration test and the direct shear test. The results show that the angle of internal friction of the same gradation and temperature has little difference, cohesion force of the same asphalt decrease with the rising of temperature at the same gradation, and Lucobit modifier can greatly improve the shearing performance of asphalt mixture for both AC-13C and SUP-20.

Introduction

The Lucobit modified agent is developed and applied for patent by German Basifu chemical industry group in 1966. The company of Lucobit has exclusive rights to produce a kind of polymer which is made up of the mixture of high quality polyethylene copolymer and a special kind of asphalt (ECB)^[1-3]. Asphalt mixture with Lucobit can improve coated force and plastic deformation capability of the asphalt, reduce the dosage of asphalt, and improve the stability of asphalt mixture under heat and pressure. To study the shearing performance of mixture with Lucobit of different asphalt binder, the asphalt mixture with the grading of AC-13C and SUP-20, the binder of 70#+0.4%PR, 70#+0.5% Lufu8000, 70#+7% Lucobit, SBS and 50# gilsonite were selected to make the uniaxial penetration test and direct shear test.

Contrastive analysis on the uniaxial penetration test results

The asphalt mixture with the grading of AC-13C and SUP-20, the binder of 70#+0.4%PR, 70#+0.5% Lufu8000, 70#+7% Lucobit, SBS and 50# gilsonite were selected to make the uniaxial penetration test on 60°C and 70°C. Test results of the uniaxial penetration are shown in table 1 and table 2.

Table 1 60°C uniaxial penetration test results of asphalt mixture with different asphalt

Mixture type		Penetration test		Unconfined compression test		τ_{\max} (MPa)	Φ (°)	C (MPa)
		Stress (MPa)	Deformation (mm)	Stress (MPa)	Deformation (mm)			
AC-13C	70# with 0.4%PR	3.6622	1.5007	1.5163	1.9922	1.2415	37.0112	0.3779
	70# with 7%Lucobit	4.0129	1.3841	1.6064	1.8842	1.3604	37.8841	0.3928
	70# with 0.5% Lufu8000	3.4315	1.5228	1.4422	1.9842	1.1633	36.5996	0.3627
	SBS modified	2.8125	1.1349	1.1763	1.7722	0.9534	36.7360	0.2949
	50# gilsonite	2.6248	1.1184	1.0723	1.647	0.8898	37.3670	0.2652
SUP-20	70# with 0.4%PR	3.6741	1.5523	1.5226	1.9054	1.2455	36.9868	0.3797
	70# with 7% Lucobit	4.3806	1.5762	1.7498	2.1142	1.4850	37.9381	0.4273
	70# with 0.5% Lufu8000	3.4521	1.7112	1.4613	2.0016	1.1703	36.3966	0.3691
	SBS modified	2.9042	1.7212	1.1906	2.1348	0.9845	37.2751	0.2950
	50# gilsonite	2.6475	1.2111	1.1140	1.7112	0.8975	36.5668	0.2803

Table 2 70°C uniaxial penetration test results of asphalt mixture with different asphalt

Mixture type		Penetration test		Unconfined compression test		τ_{\max} (MPa)	Φ (°)	C (MPa)
		Stress (MPa)	Deformation (mm)	Stress (MPa)	Deformation (mm)			
AC-13C	70# with 0.4%PR	1.5220	1.7244	0.6748	2.5540	0.5160	34.9893	0.1757
	70# with 7%Lucobit	1.6721	1.7067	0.7538	2.5248	0.5668	34.4377	0.1986
	70# with 0.5% Lufu8000	1.5043	1.8172	0.6451	2.5433	0.5100	36.0195	0.1643
	SBS modified	1.1719	1.3993	0.5199	2.3747	0.3973	34.9686	0.1354
	50# gilsonite	0.9847	1.2916	0.4416	2.4746	0.3338	34.6135	0.1159
SUP-20	70# with 0.4%PR	1.5883	1.9142	0.7133	2.6669	0.5384	34.5661	0.1874
	70# with 7%Lucobit	1.8223	1.9435	0.8457	2.8330	0.6178	33.4125	0.2276
	70# with 0.5% Lufu8000	1.5114	1.9766	0.6558	2.7944	0.5124	35.6669	0.1683
	SBS modified	1.2577	1.5084	0.5414	2.4719	0.4264	35.9067	0.1382
	50# gilsonite	0.9972	1.5542	0.4327	2.5042	0.3381	35.6660	0.1110

Table1 and Table2 show that, the angle of internal friction of the same gradation and temperature has little difference. The reason is the gradation of the mixture playing a decisive role in the angle of internal friction at the same temperature. The angle of internal friction has little difference at the same grading^[4,5].

Cohesion force of the same asphalt decrease with the rising of temperature at the same gradation. The asphalt binder of the mixture play a decisive role in the cohesion force at the same grading. The greater cohesive force show that the stronger bonding performance of the asphalt binder. At the same gradation and temperature, the size order of cohesive force is 70# with 7% Lucobit>70# with 0.4%PR >70# with 0.5% Lufu8000>SBS modified asphalt mixture>50# gilsonite.

The shearing strength τ_{\max} decrease with the rise of the temperature of the mixture at the same grading and asphalt binder, the cohesion force of the asphalt binder play a decisive role in the shearing strength at the same grading and temperature. The greater cohesive force show that the stronger shearing strength of the asphalt binder. At the same gradation, the size order of shear strength is 70# with 7% Lucobit>70# with 0.4%PR >70# with 0.5% Lufu8000>SBS modified asphalt mixture>50# gilsonite.

Contrastive analysis on the direct shear results

The asphalt mixture with the grading of AC-13C and SUP-20,the binder of 70#+0.4%PR, 70#+0.5% Lufu8000, 70#+7% Lucobit, SBS and 50# gilsonite were selected to make the direct shear test on 60°C and 70°C. Test results of the uniaxial penetration are shown in table3.

Table 3 Direct shear test results of asphalt mixture with different asphalt

Mixture type		60°C shear strength (MPa)	70°C shear strength (MPa)
AC-13C	70# with 0.4%PR	1.0316	0.3316
	70# with 7% Lucobit	1.1455	0.3638
	70# with 0.5% Lufu8000	0.9844	0.3006
	SBS modified	0.7536	0.1876
	50# gilsonite	0.5142	0.1124
SUP-20	70# with 0.4%PR	1.1144	0.3384
	70# with 7% Lucobit	1.2355	0.4178
	70# with 0.5% Lufu8000	1.0811	0.322
	SBS modified	0.8834	0.2122
	50# gilsonite	0.5227	0.1216

Table3 shows that, the direct shear strength decrease with the rising of the temperature. The size order of direct shear strength at the same gradation and temperature is 70# with 7% Lucobit>70# with 0.4%PR >70# with 0.5% Lufu8000>SBS modified asphalt mixture>50# gilsonite.

Conclusions

- (1) The angle of internal friction of the same gradation and temperature has little difference.
- (2) At the same gradation and temperature, the size order of cohesive forc and shearing strength is 70# with 7% Lucobit>70# with 0.4%PR >70# with 0.5% Lufu8000>SBS modified asphalt mixture>50# gilsonite.
- (3) The size order of direct shear strength at the same gradation and temperature is 70# with 7% Lucobit>70# with 0.4%PR >70# with 0.5% Lufu8000>SBS modified asphalt mixture>50# gilsonite.
- (4) Lucobit modifier can greatly improve the shearing performance of asphalt mixture for both AC-13C and SUP-20.

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