Polymer Modified Bitumen

ئامادەکردنی :

ئەندازیار /محمد احمد حمداحمد

ژمارەی پێناس/ ٩٠٧٣

وەک پێداویستی گۆڕینی پلەی ئەندازیاری لە ڕێپێدراو بۆ ڕاوێژکار

polymer modified bitumen

Polymer modified bitumen (PMB) is one of the specially designed bitumen grades that are used in making pavement, roads for heavy duty traffic and home roofing solutions to withstand extreme weather conditions. PMB is a normal bitumen with the added polymer, which gives it extra strength, high cohesiveness and resistance to fatigue, stripping and deformations, making it a favorable material for infrastructure.

Pavements designed and constructed for heavy-duty traffic and extreme weather conditions require specially designed engineered Bitumen Grades.

When a polymer is added to regular bitumen, it becomes more elastomeric, which provides it with additional elasticity. The polymer that is added is styrene butadiene styrene (SBS), which acts as a binder modification agent

The primary objective of SBS polymer modified bitumen is to

provide extra life to pavement, roads and construction designs. Some of the qualities

exhibited by PMB are:-

- Higher rigidity
- Increased resistance to deformation
- Increased resistance to cracks and stripping
- Better water resistance properties
- High durability

Advantage of using polymer modified bitumen

1- Stronger road with increased marshal stability value and greater Rigidity.

2- Better resistant towards rainwater and water stagnation.

3- No stripping and no potholes.

4- Better resistance to permanent deformation

5- Reduction in pores in aggregate and hence less rutting and raveling.
6- Much higher durability.

One of the projects which is used styrene butadiene styrene (SBS)

(Construction of Dukan-Chwarqurna Dual way Project From KM: 35+000 to 53+580) first stage / with bridges.

In our project we had three layers of flexible pavement which (Binder 1,2) and wearing surface as a last layer.

We used polymer in wearing surface, because the road has many loads.

Procedure for preparation polymer modified bitumen and used in the mix design of asphalt: -

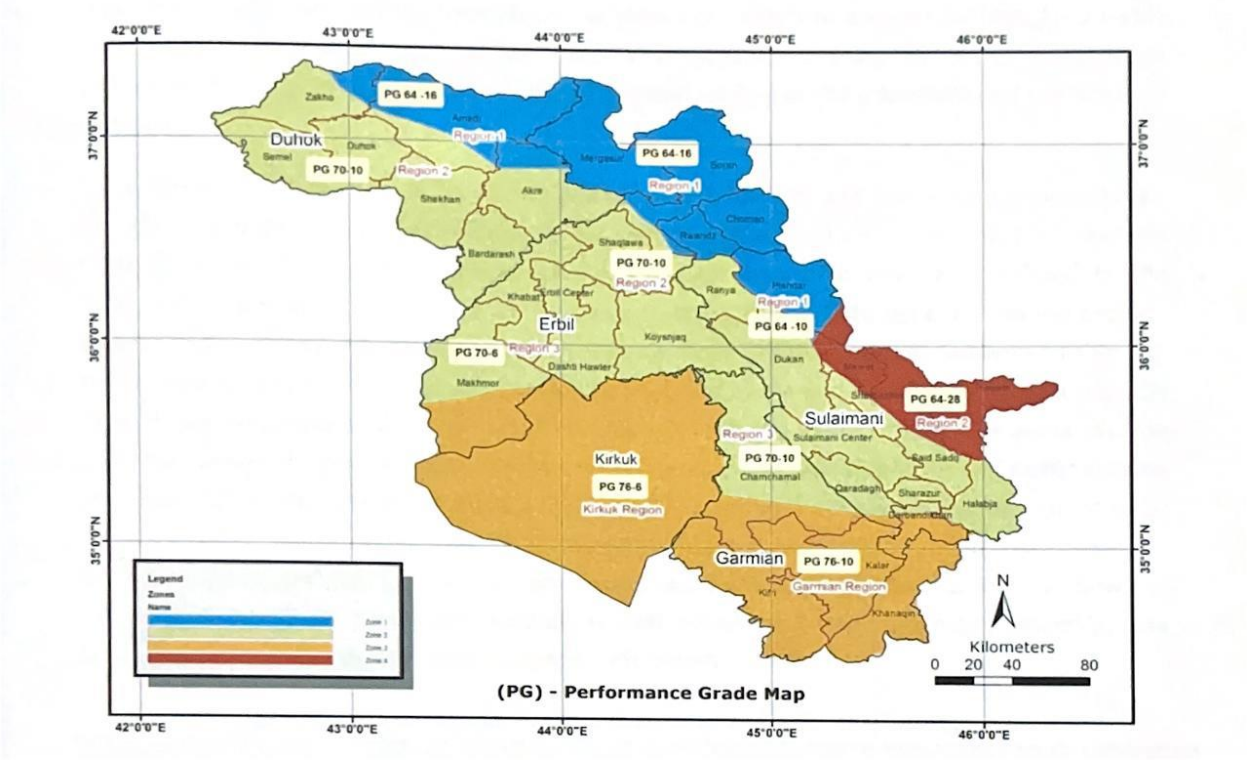
1- First time we installation the machine to prepare and mixing the styrene butadiene styrene (SBS) with bitumen in the site of the project.as below picture: -

2- We prepare for mix design of super pave by mixing the materials (coarse aggregate, fine aggregate, fine sand, filler, bitumen, polymer) and used in the last layer.

- **(0-5 mm)**
- **(5-12mm)**
- **(12-19mm)**

3- When use polymer in mix design of asphalt, must be determine the temperature of the zone of the project, because deferent ratio for preparation and mixing the (ABS) and bitumen which is start from (2-10) according to the weather.

In Kurdistan we decide and chose the fermeture by this map which is determine all zones:



Zones	Maximum air temperature, (° C)	Minimum air temperature, (° C)	(Region included)
Zone -1-	64	-16	Duhok-Region one, Erbil -Region one, Sulaymaniyah Region two.
Zone -2-	70	-10	Duhok-Region two, Erbil -Region two &three Sulaymaniyah Region three.
Zone -3-	76	-10	Garmyain-Region-one, Kirkuk -Region one,
Zone -4-	64	-28	Sulaymaniyah Region one.

We use Performance grade (PG) (-10, 82) for Rania and by three mixes of bitumen grade (40-50) and polymer (KRATON D1192) by (%3.5, %4, %4.5) and compere to table: -

Binder Grade Verification and Acceptance			
Test	Test Temperature	Acceptance Limit	Purpose of Test
Fresh Unaged Binder			
Flash Point	NA	≥ 230 °C	To ensure safety from fire
Viscosity	135 °C	≤ 3.0 Pa-s	To ensure workability
Rheology (G*/sinδ)	64 °C	≥1.0 KPa	To ensure rutting resistance
Binder Aged in the Rolling Thin Film Oven (RTFO)			
Mass Loss	163 °C	≤ 1.0%	To ensure durability
Rheology (G*/sinδ)	64 °C	≥2.2 KPa	To ensure rutting resistance
Binder after aging in RTFO and Pressure Agin g Vessel (PAV) at 110 °C			
Rheology (G*. sinδ)	25 °C	≤ 5.0 MPa	To ensure fatigue resistance
BBR Rheology (S)	-12 °C	≤ 300.0 MPa	To ensure thermal cracking resistance
BBR Rheology (m)	-12 °C	≥ 0.300	
Quality Control Tests – Checking for Consistency (unaged Binder)			
Softening Point C°	NA	60*-	ASTM D36
Penetration dmm	25	Report	ASTM D5
Tests for Polymer Modified Binders (Unaged Binder)			
Elastic Recovery %	25	65*	Elastic behavior ASTM D 6084
Different in softening point C°	NA	4*	Storage Stability - ASTM D7175

The sign (*) means that this values are applicable for binder grade PG 76 and above.

After check three samples and we decided to use **(% 4**) for all project.

إقليم كوردستان - العراق

مجلس الوزراء

وزارة اعمار و الاسكان

مديرية مختبر اربيل الانشائي

Kurdistan Regional Government
Council of Ministers
Ministry of Construction & Housing

ریمی کوردستان - عیّراق

ئەنجومەنی وەزیران

وەزارەتی ئاوەدان کردنەوە و نیشتەجێ کردن

بەڕێوەبەرایەتی تاقیگەی بیناسازی هەولێر

Form No.	PGR02	Revision No.	2.1a	Approved by	-	Approved on	-

Test Report /Bitumen Performance (PG)

Listed below, detailed test results of sample (s). Hope to pay its cost according to the attached payment billhead. "With appreciation"

Letter of test request		Date of sample receiving	Date of test finishing	No. of sample(s)	ECL Report	
No.	Date				No.	Date
1862	17/3/2021	17/3/2021		1	R-408721	27/05/2021
Name of Test Requester		Project Name/Sample Location			Contractor's Name	
D.M.P.R.B.R		Construction of (Dokan-Chwarqurna) Road with bridge First Stage / Ranya			USAS Co.	

Test	specification	unit	% of Additive	3.5
Penetration	ASTM D5	dmm	35	
Softening	ASTM D36	C°	61	
Flash	ASTM D92	C°	>240	
Elastic Recovery	ASTM 6084	%	62*	
RV	ASTM D4402	cP	<3000	
Compatibility In Terms Of Different In Softening Point	ASTM D7173	C°	-	

Parameter	Test Method	Test Temperature	Specification	Measured Value		T.G
Original Binder						
G*/SinΔ	ASTM D7175	82	≥1.0 kPa	1.01	kPa	
Short Term Aging By RTFO						
G*/SinΔ	ASTM D7175	82	≥2.2 kPa	2.4016	kPa	
Long Term Aging By PAV						
G* x SinΔ	ASTM D7175	40	Max 5000 kPa	5000	kPa	
S @ 60 sec	ASTM D6648	-10	Max 300 Mpa	59	Mpa	
m-Value @ 60 sec	ASTM D6648	-10	Min 0.3	0.39		
Performance Grade				82-10		

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Name of Test Requester		Project Name/Sample Location			Contractor's Name	
D.M.P.R.B.R		Construction of (Dokan-Chwarqurna) Road with bridge First Stage / Ranya			USAS Co.	

Test	specification	unit	% of Additive	4.0
Penetration	ASTM D5	dmm	32	
Softening	ASTM D36	C°	66	
Flash	ASTM D92	C°	70	
Elastic Recovery	ASTM 6084	%	>240	
RV	ASTM D4402	c.P	70	
Compatibility In Terms Of Different In Softening Point	ASTM D7173	C°	-	

Parameter	Test Method	Test Temperature	Specification	Measured Value	T.G
Original Binder					
G*/SinΔ	ASTM D7175	82	≥1.0 kPa	1.97 kPa	
Short Term Aging By RTFO					
G*/SinΔ	ASTM D7175	82	≥2.2 kPa	3.301 kPa	
Long Term Aging By PAV					
G* x SinΔ	ASTM D7175	40	Max 5000 kPa	<5000 kPa	
S @ 60 sec	ASTM D6648	-10	Max 300 Mpa	60 Mpa	
m-Value @ 60 sec	ASTM D6648	-10	Min 0.3	0.37	
Performance Grade				82-10	

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Name of Test Requester		Project Name/Sample Location			Contractor's Name	
D.M.P.R.B.R		Construction of (Dokan-Chwarqurna) Road with bridge First Stage / Ranya			USAS Co.	

Test	specification	unit	% of Additive	4.5
Penetration	ASTM D5	dmm	29	
Softening	ASTM D36	C°	71	
Flash	ASTM D92	C°	>240	
Elastic Recovery	ASTM 6084	%	80	
RV	ASTM D4402	cP	<3000	
Compatibility In Terms Of Different In Softening Point	ASTM D7173	C°	-	

Parameter	Test Method	Test Temperature	Specification	Measured Value		T.G
Original Binder						
G*/SinΔ	ASTM D7175	82	≥1.0 kPa	2.98	kPa	
Short Term Aging By RTFO						
G*/SinΔ	ASTM D7175	82	≥2.2 kPa	4.910	kPa	
Long Term Aging By PAV						
G* x SinΔ	ASTM D7175	40	Max 5000 kPa	<5000	kPa	
S @ 60 sec	ASTM D6648	-10	Max 300 Mpa	75	Mpa	
m-Value @ 60 sec	ASTM D6648	-10	Min 0.3	0.33		
Performance Grade				82-10		

Notes:

1. Samples were taken / extracted & brought by your staff (Mr. Mohammad A.).
2. The test methods are indicated for each of the tests above and the tests were performed at room temperature (..°C).
3. The results were evaluated according to **Your Required Specification or Performance.**
4. **"ISO 9001:2015 Certified", "ISO 17025:2017 Certified".**
5. The type of bitumen and modifier is selected by your side and we are not responsible about it.
6. The dose, of the additive is selected by your side and we are not responsible about it.
7. You should check the region/pavement temperature and traffic load before selecting the PG Grade.
8. The PMB should use as soon as possible to prevent the separation.
9. The sign (*) means that the result is out of your required specification.
10. The results represent the tested sample(s) only.

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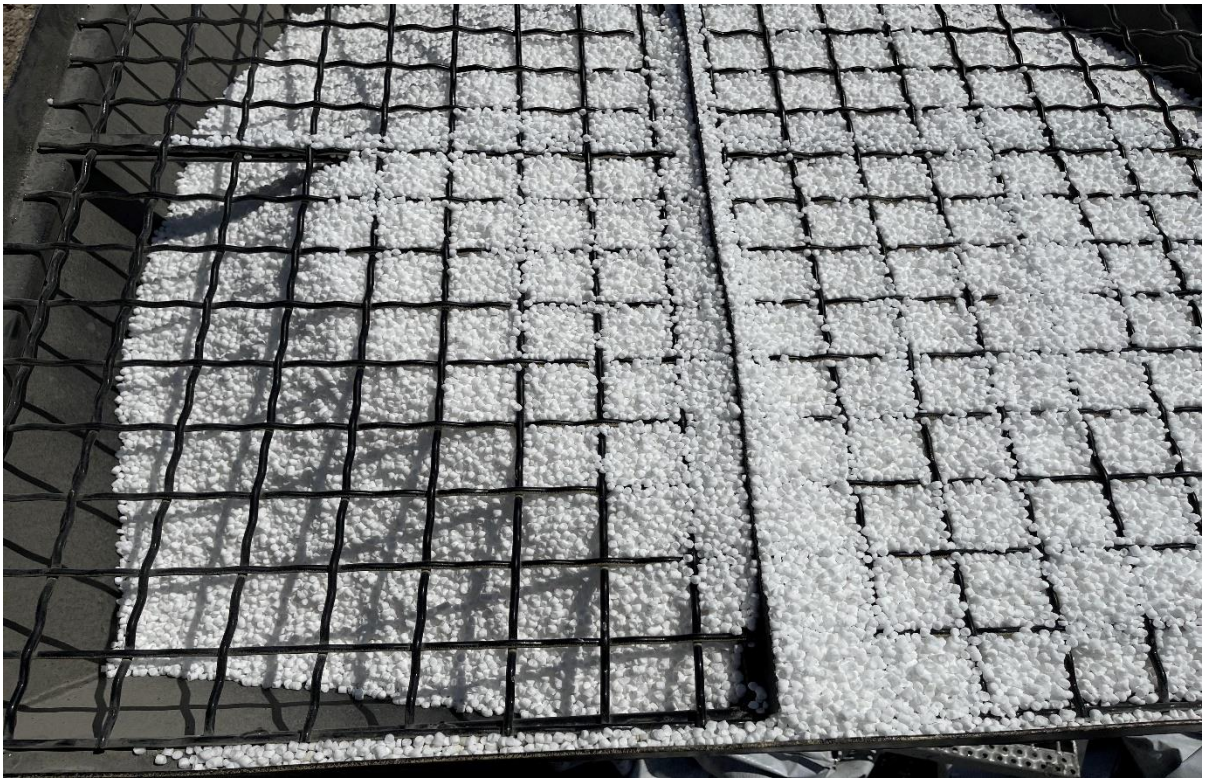
4- After get the mix design for the wearing surface and we start the work in the site, first time we mix polymer and bitumen by added (%4) of (SBS) to bitumen grade (40-50) and mix for (30 minute in temperature (180-220 Celsius) in the tank of the machine until the particle of the (SBS) dissolve in the mixture.



After that the mixture must be move to the main storage tank, and mixing by three motors for about at least (**6 hours**) before mix with aggregates and make asphalt.

Before use modified bitumen mix with aggregates must be test of (**softening point, penetration, and Elastic recovery) in the site laboratory**

5- Product the asphalt mixture by the temperature (180 Celsius) and move to the site of the road and lay by digital paver machine and compacted only by steel roller compacter

Conclusion and Recommendation: -

polymer is not so much used In Kurdistan, because of difficult process and expensive of it's price which is needed (1.5-2 $) for every square meter of asphalt, also, all projects have not surface course (wearing coat)

but in the future polymer must be use in all roads which undergo more loads.

References

1- introduction take form **RABIT (RAHA BITUMEN) company is one of the market leaders in production from google**

2- **My experience from projects**

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