Kurdistan Natural Asphalt As Paving & Mastic Asphalt Compared With Petroleum Base Asphalt

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ABSTRACT

The bituminous material of kurdistan has been studied for using it as paving, mastic,and water proofing asphalt.
The results showed that after treatment with waster motor oil or atmospheric distillation residue produced in kurdistan refinery.It was possible to produce base asphalt of different penetration grades between 40 to 300 in the ratios of 25,35,and 50% w/w bitumen within the international specifications,except ductility which can be achieved also by rasing temp.of petroleum distillation up to 360 °c.
Asphalt paving mixtures have been prepared using the local base asphalt of (40-50) penetration grade and mineral filler and fine aggregates according to AASHTO specifications using different asphalt ratios namely (4,4.5,and 5%w/w) with requirements of Marshall and deforming tests and compared with asphalt paving mixtures petroleum base asphalt produced in Baiji refinery, these laboratory works improved by plant application by paving (52) m of sulaimany-arbat road.
Then mastic asphalt according to the specifications ASTM D491-79 was prepared by mixing filler and aggregates with the locally prepared base asphalt in the following ratios (base asphalt 30%,filler 30%,fine aggregate 30%,coarse aggregate 10% w) by using four different fillers,namely (cement,sand,active clay,and sulfur) and all results compared with those obtained from mastic asphalt prepared using petroleum base asphalt produced in Baiji refinery.

INTRODUCTION

Asphalt is a very viscous liquid or solid material at room temperature. It behaves like thermal polymers,melts by hesting and solidifies when cooled,It is acomplex mixture of different high molecular wight componds and it may be concidered as acolloidal mixture of asphltenes, resins,aromatics,and many oxygen and sulfure compounds[1] Sokolov[2] gave the structure and properties of an asphalt binder and Halsted and woodrow[3] explained the relation of asphalt chemistry to physical properties and specifications and it's performance as binder. Poirier,sawatsley[4] showed the effect of adding petroleum distillation residues to asphalt cement and asphalt properties were correlated in term of composition (saturation, aroms., resins, asphultenes). Fry, Frank[5]

showed that the pumpability and workability of asphalt paving compounds are improved with heating to only 130-145°c by ading 2.5-15 wt%c_{18} tall oil fatt acid distillates.

Bissado[6] studied the relation between permanet deformation characteristics of asphalts paving mixtures interms of resistance to different marshall compaction levels, kennedy, et.al[7] described how to determine the extent, nature and severity of moisture-related damage to asphalt concrete mixtures used in pavement. Popeea et.al[8] showed the rule of asphalt in the composition and formation of mastic asphalt.

Blown asphalt is used as amopping coat in dumpproofing or as mopping cement in the contruction of membrance water proofing systems. Goodrich[9] showed that $Fecl_2$ catalyst decreases the time of air blowing of asphalt and the blown asphalt had softening point ~ 191°F and peneteration ~ 20 dmm at 77°F. Al-soufi and SARSAM[10] showed that by adding 8-9 wt% sulpher to vaccum residuum asphalt at 240 ± 5°c and reaction time of 15 minutes amaterial simillar to air-blown asphalt is obtained.

Asphalt has been used for many different purposes it used for producing light construction materials eg. blocks[11] in composition of autombil floor coverings[12], as flooring material with improved dampness-resistance and high resistance to ants and bacterial attack[13], petroleum asphalt-coal tar mixture used as coal binder[14] and also used as moisture- and corrision resistance coating for construction[15].

In this research the ability of using kurdistan natural asphalt to produce (paving, mastic, and water proofing) asphalt has been achieved by comparing with petroleum asphalt.

EXPERIMENTAL

Materials : Portland cemert, sand, gravel, sulfure, active clay, carbontetrachloride base asphalt (40-50) , blow asphalt (20-30) natural asphalt , petroleum rsidue, waste motor oil.

Apparatus :

1- Penetration apparatus
2- Soft point apparatus
3- Ductility apparatus
4- Over, Furnace, Water bath, Oil bath and thermometers.
5- Sieves No.(200,50,30,16,8,4)
6- Cleveland open cup flash point apparatus

Test methods :

1- Penetration - ASTM D-5 (IP-49)
2- Softening point- ASTM D-36 (IP-58)
3- Ductility - ASTM D-113
4- Solubility in ccl_4 - ASTM D 2042 (IP-47)
5- Flash point - ASTM D-92 (IP-36)
6- Marshall test-
7- Deforming test-
8- Sieve analysis - ASTM C-136

Procedures :

A) Natural asphalt of kurdistan:

The heated petroleum residue or waste motor oil was added to avessel containing the cracked and heated natural asphalt (200°c) then stirred by mechanical stirrier untill the blend was homogenous.

B) Mastic asphalt :

Many mastic blends have been prepard using different types of base asphalt and mineral filler the procedure may be summerized as follows:

While the asphalt was melted in afurnace or by direct flame. the mineral filler and aggregates were prepared using different sizes of sieves, then the molten asphalt was put in anopen vessel wich located in an oil

bath and the filler and aggregates were added gradually with continuous stirring until the mixture was completely homogenous and finally poured in to a lubricated metallic can prepared previously for this purpose.

C) Plant application test :

Tangaro plant was used for this purpose &it is a suitable plant for producing hot-mixed, hot- laid bituminous paving mixtures.

RESULTS AND DISCUSSION

A) Natural asphalt of Kurdistan :

The bitumenous material of kurdistan were divided in to three sample types. (brigh type, rockey type, and coal type). Then we consider the bright type as one sample and the mixture of equal quantities of the three types as another sample.

The samples were analyzed and compared with the results of petroleoum asphalt grade (40-50) and grade (20-30) blown, as shown in table(1).

Table(1) Physical and chemical properties of base asphalt and natural asphalt of Kurdistan

Testes	Results			
	Bright type	mixture	petroleum asphalt (40-50)	petroleum asphalt (20-30)
specific gravity at 20 c°		1.02	1.04	1.05
penetration (25c°, 100g, 5sec)		<zero	42	25
Softening point c° (Ring & ball)		>150	54	78
Solubility in CCl_4				
a) soluble % wt		40	99.5	99.5
b) insoluble % wt		60	0.5	0.5
Moisture %wt		4.71	Nil	Nil
Loss of heating (163 c°, 5hrs.)		0.5	0.3	0.2
Ash content % wt		12.7	-	-
Hydrocarbon content				
a) Carbon content %wt		-	-	-
b) hydrogen content %wt		-	-	-
c) Nitrogen content %wt		-	-	-
Volatile matter at 550 c° %wt		43.7	99.7	99.7
Fixed carbon %wt		56.3	0.3	0.3
Ductility at 25 c° (cm)		zero	>100	5

These results show clearly that the bright type sample may be considered as natural asphalt, but it needs some chemical treatment to change in to base asphalt. Many blends

have been prepared using bright type sample and waste motor oil and petroleum residue from Kurdistan refinery (cut up to 220c°) in different ratios as shown in table (2) .

Table (2) Different Blends and their penetrations

Bright sample %wt	waste motor oil %wt	penetration	petroleum resid-due %wt	penetration.
90	10	zero	10	zero
80	20	6	20	12
70	30	11	30	20
60	40	17	40	30
50	50	25	50	47
40	60	50	____	____
35	____	____	65	140
25	____	____	75	270

These results show that it is possible to produce base asphalt of grades (40-50) , (60-70) (85-100),(120-150),and(200-300) using different ratio of bright sample and waste oil or petroleum residue. Table (3) shows the results of full analysis of different three grades of base asphalt, which have been prepared from bright sample and petroleum residue of Kurdistan refinery.

Table (3)Physical properties of different grades of asphalt

Tests	*base asphalt grade (40-50)	**base asphalt grade (120-250)	Ψbase asphalt grade (200-300)
Sp.gr. 20°c	1.02	1.002	0.99
Flash point °c(o-c)	184	150	145
penetration (25°c,100g,5sec)	47	140	270
Softening point°c (ring &ball)	70	56	41.25
Ductility at 25°c(cm)	5.5	10	37
Loss on heating (163°c,5hrs)	1.5	1.7	1.9
Solubility in CCl_4 %wt	99.7	99.9	99.9

• composition = bright sample 50 %wt + pet. residue 50 %w.

** composition = bright sample 35 %wt + pet. residue 65 %wt.

Ψ composition = bright sample 25 %wt + pet. residue 75 %wt.

It is clear from these data that with increasing the ratio of petroleum residue. The grade and ductility of asphalt cement increase also and Flash point decreases, this means that improvement of ductility and flash point occurs by modification of petroleum residue specifications (i.e producing heavier residue with b.p ~ 360°c instead of the present

residue which has b.p ~ 260°c) and except in ductility and flash point, still these results show the agreement of the three penetration grades with the international specifications of asphalt cement used in high way construction[16].

To support this conclusion, a paving mixture was prepared using our local asphalt grade(40-50) with filler and fine aggregates prepared from local (sand, cement, gravel, and hydrated lime) according to international specifications[16].The result are shown in table (4) with comparison with results obtained for mixtures which have been prepared using Iraqi petroleum base asphalt produces in Baiji refinery, these results show the agreement of both base asphalt with requirements of marshall compaction test and deforming test according to the international specifications[16]

Table (4) Compaction and deforming properties of paving mixtures

Asphalt ratio	Tests	Using Iraqi petroleum base asphalt	using our local asphalt
4%wt	sp.gr,of mixture stability (kg) deforming (mm)	2.357 673 2.5	2.281 862 3.2
4.5%wt	sp.gr.of mixture stability (kg) deforming. (mm)	2.363 816 3.0	2.324 1035 3.9
5%wt	sp.gr. of mixture stability (kg) deforming. (mm)	2.392 678 3.5	2.364 1114 4.1

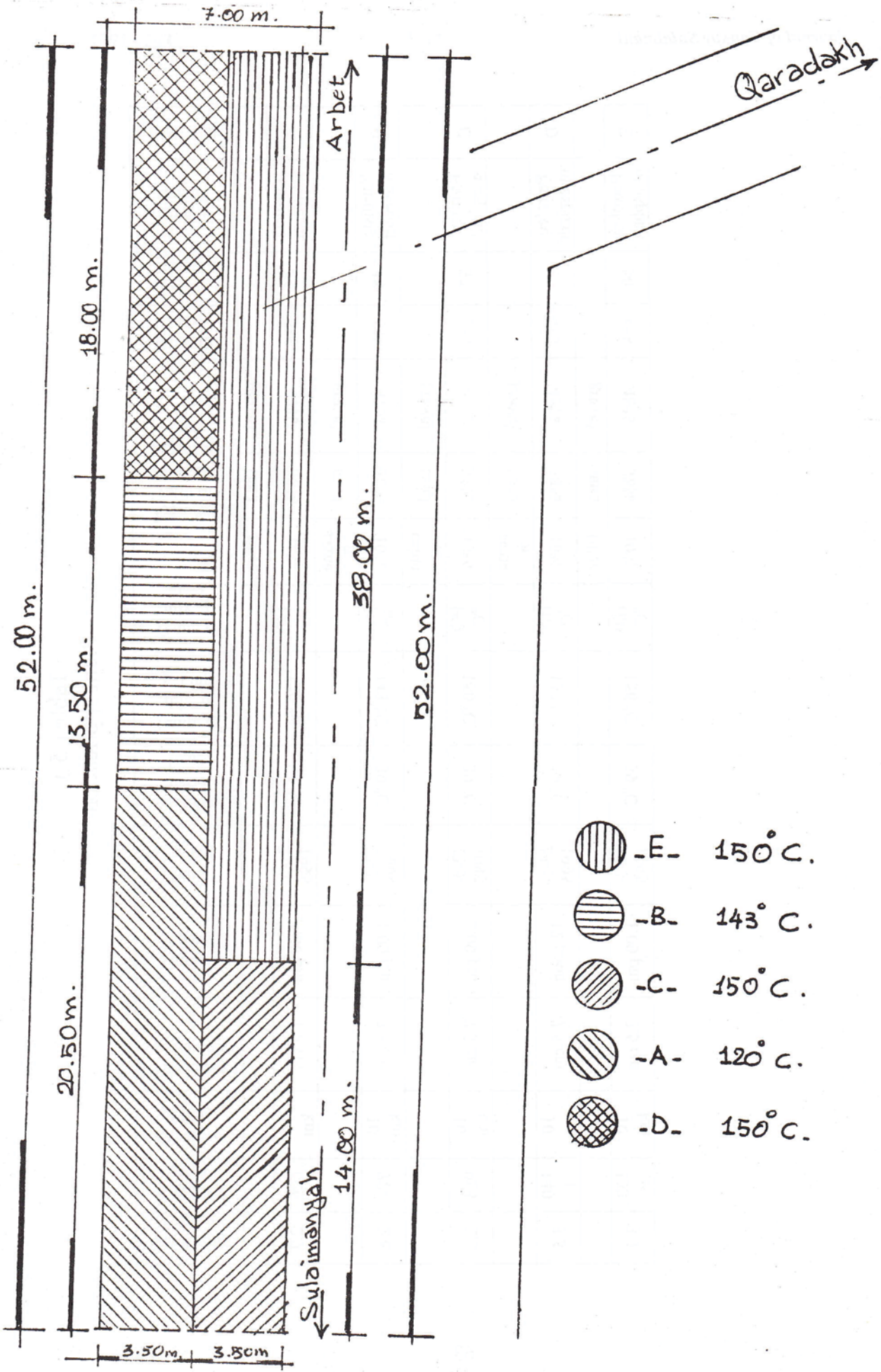
Notes:
(1) Each result is mean value of three tests.
(2) International specifications are:[16]
stability = 714kg (min)
deforming = 2-4 mm

The laboratory work was concluded by the application of the produced asphalt of grade (40-50) for paving 52 meters of Sulaimany - Arbat road and comparing that with Iraqi petroleum asphalt. The results are shown in Table (5) and the attached diagram: These results show the agreement of our locally produced asphalt with petroleum asphalt with requirements of marshall and deforming tests by using different types of fillers and aggregates.

B) Mastic asphalt: Eight mastic blends have been prepared by mixing our local asphalt and Iraqi blown asphalt separately with mineral filler and fine aggregate with specification shown in Table (6).

Table (5)
Plant application

som- bel	Type of asphalt	Penet-ration	Asphalt ratio	Type and ratio of filler and aggregate used			Temp. of mix at plant	Temp. of mix at paving	Atmosp-heric Temp.	Date of Paving	Time of Paving	Thickness of Paving	Distance of Plant	Stability (Kg)	Deforming (mm)
				gravel	sand	filler									
A	Kurdistan asphalt	48	5%	47%	38%	10%	140 °C	120 °C	37 °C	21-5-1995	4.00 pm	7.5 cm	10 km	626	2.7
				gravel	sand	cement									
B	Kurdistan asphalt	48	5%	47%	38%	10%	160 °C	143 °C	39 °C	22-5-1995	1.00 pm	7.5 cm	10 km	774	2.6
				gravel	sand	cement									
C	Kurdistan asphalt	37	5%	47%	38%	10%	160 °C	150 °C	39 °C	22-5-1995	2.00 pm	7.5 cm	10 km	984	2.8
				gravel	sand	cement									
D	Petroleum asphalt	50	4%	48%	38%	10%	163 °C	157 °C	39 °C	24-5-1995	12 noon	7.5 cm	10 km	1401	3.5
				gravel	sand	filler									
E	Petroleum asphalt	50	4%	48%	38%	10%	160 °C	156 °C	39 °C	24-5-1995	1.00 pm	7.5 cm	10 km	1339	3.7


7.00 m.
Arbet
Qaradakh
18.00 m.
52.00 m.
13.50 m.
38.00 m.
52.00 m.
20.50 m.
14.00 m.
Sulaimanyah
3.50m.
3.50m
-E- 150° C.
-B- 143° C.
-C- 150° C.
-A- 120° C.
-D- 150° C.

Table(6)Specifications of filler and aggregate

Sieve No.	Mineral filler %wt pass	Fine aggregate %wt pass
No. (4)	------	95-100
No. (8)	------	70-100
No. (16)	------	40-60
No. (30)	100	20-65
No. (50)	95-100	------
No. (200)	70-100	------

The aggregates prepared from sand, and mineral filler prepared from different four sources, namely they are sulfur, active clay, sand, and Portland cement. The composition of mastic blends were as follows in Table (7):

Table (7): Composition of mastic blend.

Property	Ratio wt%
1) Base asphalt (soluble completely in CCl_4)	30 %wt
2) Mineral filler insoluble in CCl_4, passing (No.200)sieve	30
3) Fine aggregate, passing (No.40) sieve and retained on (No.200)	30
4) Fine aggregate, passing (No.10) sieve and retained on (No.4)	10

The mastic blend with mineral filler prepared from sand was the best on. So it has been chosen because: 1) Sanel is very cheap 2) Active clay did combine with asphalt binder so the blend was disintegrate 3) Sulfur, although it gave very good characteristics but it is not exist in Kurdistan at this time.
Specification of mastic blends with filler prepared from sand were as follows in Table (8):

Table (8): Specification of mastic blend.

Tests	Kurdistan asphalt	petroleum asphalt
Softening point °c	95	88
Penetration	10	15
Ductility (base asphalt)	9	12

CONCLUSION:

The main points and conclusions of this paper may be summarized as follows:-

1- It is possible to change the bituminous material present in Kurdistan in to base asphalt.

2- This asphalt is very useful as water proofing material and for producing mastic asphalt.

3- Because of its low ductility value, it needs some improvement, and this is done by modification of the specification of petroleum residue produced in Kurdistan refinery.

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الأسفلت الطبيعي في كوردستان وأستخدامه كأسفلت التبليط والماستك مقارنة بالأسفلت الأساس البترولي

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الخلاصة

تم دراسة المادة البيتومينية الموجودة فى كوردستان لمعرفة مدى إمكانية الاستفادة منها لغرض تصنيع الاسفلت الأساس المستخدم فى تبليط الطرق وتغليف الانابيب وتسطيح السقوف. وقد بينت النتائج أنه بعد المعاملة مع زيت المحركات المستعمل او المتبقى من التقطير التجزيئى الجوى للبترول المنتج فى مصفى كوردستان يمكن انتاج الاسفلت الاساس بدرجات نفاذية مختلفة تتراوح ما بين (٤٠ الى ٣٠٠) وبأستخدام النسب التالية (٢٥، ٣٥، ٥٠% وزنا) من المادة البيتومينية وبموجب المواصفات العالمية عدا الأستطالة التى يمكن تحقيقها أيضا بتسخين البترول الى درجة حرارة ٣٦٠ درجة مئوية فى مصفى كوردستان،كما تم تحضير قوالب قيرية بأستخدام الاسفلت الاساس المنتج محليا ذى درجة نفاذية (٤٠-٥٠) ومواد مالئة وركام بتدرج مواصفات AASHTO وبنسب مختلفة للأسفلت هى (٤%،٤,٥%،٥% وزنا) ومطابقة هذه القوالب لمتطلبات فحص المارشال وفحص الزحف ثم قورنت هذه النتائج مع تلك المستحصلة بأستخدام نفس النسب أعلاه من الاسفلت الاساس المصنع من البترول فى مصفى بيجى.
ودعمت هذه النتائج المختبرية بأجراء تطبيق ميداني وذلك بتبليط (٥٢)م من طريق سليمانية-عربت وتطابقت النتائج العملية الميدانية مع نتائج العمل المختبرى، وتم تصنيع الماستك أيضا فى هذا البحث بموجب المواصفة ASTM D491-79 وذلك بمزج مواد أولية متوفرة محليا مع الاسفلت المنتج محليا وبالنسب التالية (أسفلت أساس ٣٠%، مادة مالئة ٣٠%، ركام بتدرج ناعم ٣٠%، ركام بتدرج خشن ١٠% وزنا).
وقد أستخدمت أربعة أنواع مختلفة من المواد المالئة هى:(سمنت،رمل،صلصال،كبريت) وقورنت النتائج بأعتماد الاسفلت البترولى المنتج فى مصفى بيجى كمصدر لتصنيع الأسفلت.

قیری بەردینی کوردستان و بەکارهێنانی بۆ دروستکردنی قیری قیرتاو و ماستیك بە بەراوردکردن لەگەڵ ئەسفەلتی بناغەیی پترۆلی

عبدالسلام رحیم کریم
زانکۆی سلیمانی / کۆلیجی زانست / بەشی کیمیا

کورتە

لێکۆلینەوەو توێژینەوەی تەواو لەسەر مادەی بیتومینی چیاکانی کوردستان کرا بە مەبەستی دەستنیشان کردنی ئەگەری بەکارهێنانی لە دروست کردنی قیری قیرتاو کردنی ڕێگاوبان و ڕووپۆش کردنی بۆری و پاخستنی لەسەر بانەکان . ئەنجامەکان دەریانخست کە پاش تێکەڵکردنی لەگەڵ ڕۆنی بەکارهێنراوی تۆتومبیل یان جێماوەی دۆزاندنی ئاسایی پترۆل کە لە پاڵاوتگای کوردستان وەدەست دێت . ئەکرێ ئەسفەلتی بناغەیی بە پلەی تێپەڕبوونی جیاواز لە نێوان (٤٠-٣٠٠) پلەی تێپەڕبوون بەرهەم بێت بە بەکارهێنانی ئەم ڕێژانە (٢٥ ، ٣٥ ، ٥٠٪کێش) لە مادەی بیتومینی یەکە وە بە پێی مواسەفاتی جیهانی جگە لە (درێژبوون) کە ئەوەش بە دەست دێت بە کۆلاندنی بترۆل بۆ پلەی ٣٦٠°س لە پاڵاوتگای کوردستان . هەروەها تێکەڵەی قیر دروست کرا بە بەکارهێنانی ئەسفەلتی بناغەیی خۆمالی پلە (٤٠-٥٠) و مەوادی ناوەخن و چەوری وورد درشت بە گوێرەی مواسەفاتی **AASHTO** و ڕێژەی جیاواز لە ئەسفەلت (٤٪ ، ٥ ، ٤٪ ، ٥٪کێش) بەکارهێنرا ، ئەنجامی ئەم تێکەڵانە جووت کرا لەگەڵ مواسەفات و پێداویستیەکانی شیکاری مارشال و کشان و بەراورد کران لەگەڵ ئەنجامی وەدەست کەوتوو لە ئەسفەلتی پترۆل کە لە پاڵاوتگەی بیجی دروست کراوە . پاشان پشتگیری ئەم ئەنجامە تاقیگەیی یانە بە ئیشێکی مەیدانی کرا ئەوەش بە قیرتاوکردنی ٥٢ مەترلە ڕێگای سلیمانی-عەربەت و ئەنجامە مەیدانی یەکان بە تەواوەتی جووت بوون لەگەڵ ئەنجامی تاقیگەدا . هەروەها (ماستك) دروست کرا بە پێی مواسەفاتی **ASTM D491-79** بە تێکەڵکردنی کەرەسەی سەرەتایی خۆمالی لەگەڵ ئەسفەلتە خۆمالی دروست کراوە کەدا و بەم ڕێژانە : (ئەسفەلتی بناغەیی ٣٠٪ ، ناوەخن ٣٠٪ ، چەوی وورد ٣٠٪ ، چەوی درشت ١٠٪) چوار جۆر مەوادی ناوەخن بەکارهێنرا لەم ئیشەدا کە ئەوانیش ئەمانەن (چیمەنتۆ ، ل ، گڵ ، گۆگرد) و ئەنجامەکان دیسان لەگەڵ ئەنجامی وەدەستهاتوو بە بەکارهێنانی ئەسفەلتی بترۆل کە لە پاڵاوتگەی بیجی دروست کراوە بەراوورد کرا .