KAZDORNII

**MINISTRY OF TRANSPORT AND COMMUNICATIONS OF PEPUBLIC OF KAZAKHSTAN**

**KAZAKHSTAN SCIENTIFIC RESEARCH ROAD INSTITUTE**


# CONCLUSION

**Laying the experimental site of pavement with top layer from stone macadam asphalt with «Tec-Road» rubber crumb modifier**

**Alma-Ata 2 0 12**

**Introduction**

Works in the part of the scientific and technical support of development batches production of stone mastic asphalt (SMA 20) with using tecRoad modifier and paving the top layer of pavement had been made according the agreement between the Administration of Passenger Transport and the Administration of Astana Highways.

The location of the experimental plot is Kurgaldzhinskaya road.

In the work participated:

Trade limited company ABZ «DS Neuburg» (manager I.B. Galenda) – production of development batches)

Trade limited company «DS Neuburg» (deputy director R.A.Buch) – construction of the experimental plot from stone mastic asphalt .

**Characteristics of raw materials**

For preparation of SMA 20 stone materials, mineral powder and bitumen for production of upper and lower asphalt layers were used:

- macadam of the Volgodonovskogo career with 10-20 mm fraction, 5-10 mm fraction;
- screening of gravel crushing of Volgodonovskogo career with 0-5 mm fraction ;
- activated mineral powder of Trade Limited Company «Tutas»;
- bitumen BND 90/130 of the Joint-Stock Company «PNXZ».

As the modifier additive tecRoad rubber granulate was used (Austria).

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The additive was packed in bags of 15 kg. The additive was added into a mixer with packing dissolved in hot mix.

**2 Preparation of asphalt mixtures on the asphalt plant of «DS Neuburg»**

The development batch of SMA20 was prepared jointly by the specialists of ABZ «DS Neuburg».

Production of trail mixture was done on the Amman mixing asphalt plant .

The quantity of raw materials was calculated for 2t of asphalt mixture. The grain composition was applied on the streets of this year in the process of SMA20 layer paving.

SMA20 composition with using tec-Road:

Macadam with fraction 10-20 mm - 62 %

Macadam with fraction . 5-10 mm - 10 %

Screening of crushing 0-5 mm - 18 %

Dust from crushing screenings (return of cyclone dust) - 3 %

Activated mineral powder - 7 %

Modifying tecRoad rubber granulate agent 1,5 % from mass of mixture (2 bags for 2 t of mixture )

Bitumen BND 90/130 - 5,2 %

Under the production SMA 20 the feed of tecroad (2 bags) was carried out on the heated to $190^0$C and weighed materials. Cold Mineral fines and bitumen under $150^0$C were fed through the weighing batchers. The mixture temperature under output was $165^0$C.

*5.1.3 The Result of SMA tests.*

The grain composition of released SMA with using tecRoad is shown on Figure 1. The results of samples tests from this mixture in Table 1.

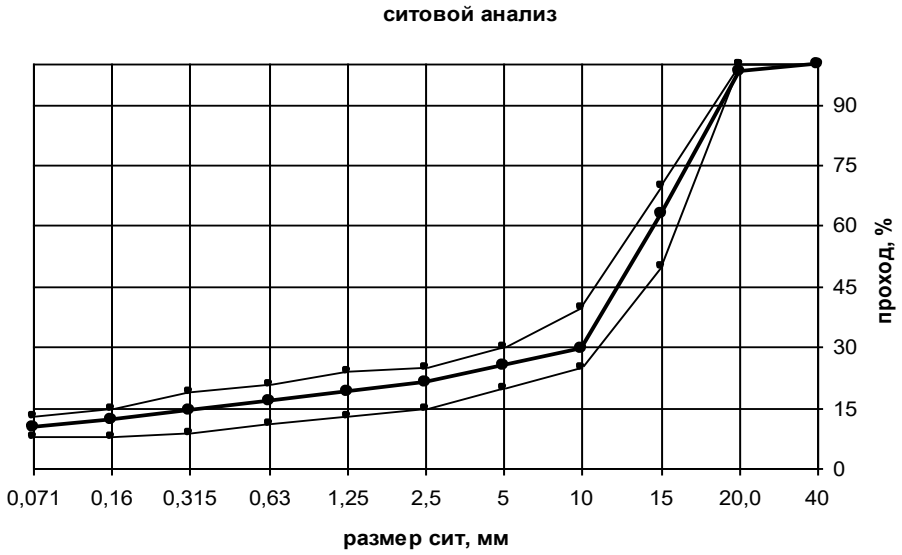


Figure 1– SMA 20 grain composition with tecRoad

SMA 20 grain composition with tecRoad according GOST 31015 “Asphalt and stone mastic asphalt mixtures. Specifications”. Flowing binding agent in the mixture with tecRoad without cellulose additive is 0,05%. Water saturation and porosity of asphalt samples according the requirements of GOST 31015.

The strength characteristics of SMA 20 with using tecRoad modifier corresponding with requirements of GOST 31015 (Table 1).

According the tests results the trial mix has been recommended:

- to use the grain size of mineral part SMA 20;
- the amount of bitumen for trial mix – 4,9%.

**Table 1. The physical and mechanical properties of SMA 20 with using tecRoad**

| **Additive, % from mass of mixture** | **Dripping of binding agent, %** | **Average density, g/cm$^3$** | **Water saturation, %** | **Porosity of mineral frame, %** | **Residual porosity, %** | **Ultimate compression strength, MPa, under temperature** | | **Ultimate tensile strength, under 0 °C, MPa,** | **Shear cohesion under 50 ° C, MPa** |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | 20 °C | 50 °C | | |
| Tec-Road 1,5 % | 0,05 | 2,46 | 3,0 | 16,2 | 3,5 | 3,0 | 1,1 | 3,0 | 0,2 |
| Requirements of GOST 31015 | no more 0,2 | - | 1,5-4,0 | | 2-4,5 | no less 2,5 | no less 0,7 | 3,0-6,5 | no less 0,2 |

## 2 Production of development batch of SMA20 with using tecRoad modifier

The composition of the development batch is corrected according the output tests results and accepted:

| | |
|---|---|
| Macadam with fraction 10-20 mm | - 62 % |
| Macadam with fraction 5-10 mm | - 10 % |
| Screening of crushing with fraction 0-5 mm | - 18 % |
| Dust from screening (cyclone dust return) | - 3 % |
| Mineral activated powder | - 7 % |
| Modifying rubber tecRoad agent | – 1,5 % from mass of mixture (2 bags for 2 t of mixture) |
| Bitumen BND 90/130 | - 4,9 % |

SMA20 production was organized 13th, September, 2012. The air temperature was 20-22$^0$C. The start of production was fixed at 12.15.

The production technique:

TecRoad was added manually on the heated dosed materials (2 bags for one batch, fugure 2). Then through batcher the mineral powder and bitumen were added. Total time of mixing was 80 sec. The temperature of SMA20 at the output – 165-168$^0$C.

**Figure 2 – Addition of tecRoad in the mixing plant**

During production first three pilot batches were prepared with the abnormality of tecRoad addition technology so as the result distribution on the top of ready mixture without mixing had been fixed. After correcting actions the technology of mixture preparing was fully worked out with positive result.

The control mixture of SMA20 was produced 14th September.
Composition of control mixture:

| | |
|---|---|
| Macadam with fraction 10-20 mm | - 62 % |
| Macadam with fraction 5-10 mm | - 10 % |
| Screening of crushing with fraction 0-5 mm | - 18 % |
| Dust from screening (cyclone dust return) | - 3 % |
| Mineral activated powder | - 7 % |
| Viatop-66 cellulose additive | - 0,5 % |
| Bitumen BND 90/130 | - 5,2 % |

## 2 Road works

Location of the experimental plot- Kurgaldzhinskaya road (in the direction of road police) with width of the driving lane equal 11,5 m and 107 m from crossroad of Bejsekova str. The length of experimental plot is 131 m.

Paving of top layer was carried out 13th, September,2012 under 20-22$^0$C air temperature. Start laying 15.00, the end -17.30 (the act attached).

Before SMA20 asphalt top laying the priming of cationic bitumen emulsion EBK-B-45 with rate of 0,4 – 0,5 l/m$^2$ was coated. The temperature of mixture under laying was 160-162$^0$C.

The asphalt laying was carried out by 2 asphalt pavers on the all width of driving lane. The compaction was carried out by 3 road rollers.

In the process of paving by 2 pavers the mixture looked fat. So as alternative solution 0,25% cellulose additive was added into mixture.

**Figure 3- SMA20 paving with using TecRoad**

From analysis of SMA samples test we concluded that the grain distribution of mineral part of the experimental mixture (figure 4) is corresponded to GOST 31015 for SMA20.

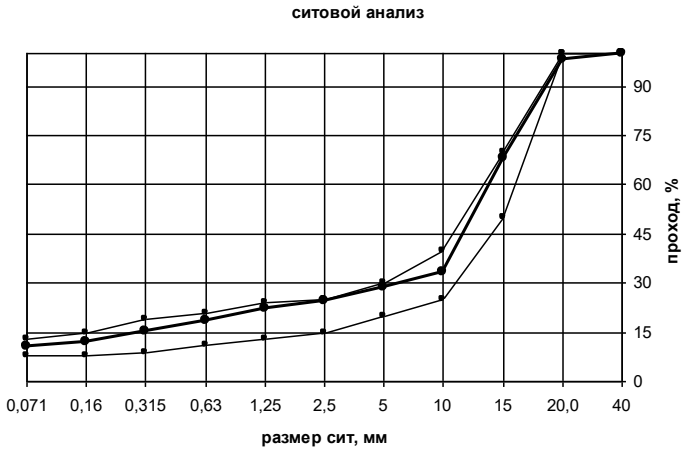


**Figure 4– The grain distribution of the experimental sample of SMA20 with using tecRoad**

The grain distribution of the control mixture is showed on the Figure 5. According the tests results the control mixture is corresponded to GOST 31015.

The content of binding agent in the experimental mixture with extracting method has been amounted 5,13%, with burning out amounted 6,4% under $500^0$C temperature (according the receipt: 4,9% bitumen, 1,5% tecRoad, 0,25% cellulose additive).

The bitumen content in the control mixture is 5,1%.

The flowing index which describes the stability of SMA20 in the experimental mixture was obtained as 0,02%, in the control mixture 0,09%.

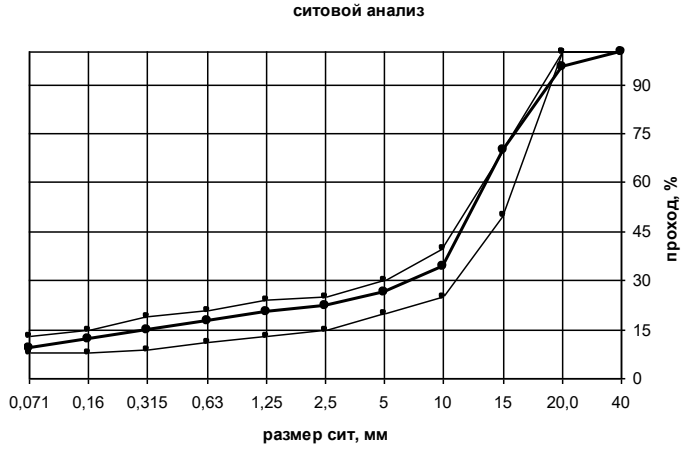


**Figure 5– The grain distribution of SMA20 control sample**

**Table 2. Physical and mechanical characteristics of SMA20 experimental sample with using tecRoad and control sample**

| Additive, % from mass of mineral part | Dripping of binding agent, % | Average density, g/cm$^3$ | Water saturation, % | Porosity of mineral frame, % | Residual porosity, % | Ultimate compression strength, MPa, under temperature | | Ultimate tensile strength, under 0 °C, MPa, | Shear cohesion under 50 ° C, MPa | Water resistance under long water saturation |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | 20 °C | 50 °C | | | |
| Control | 0,09 | 2,50 | 3,8 | 16,5 | 4,2 | 2,7 | 0,9 | 3,0 | 0,20 | 0,80 |
| tecRoad | 0,02 | 2,47 | 3,4 | 16,0 | 3,4 | 3,3 | 1,3 | 3,1 | 0,24 | 0,90 |
| Requirements GOST 31015 | no more 0,2 | - | 1,5-4,0 | | 2-4,5 | no less 2,5 | no less 0,7 | 3,0-6,5 | no less 0,2 | no less 0,75 |

The results of samples tests prepared from SMA20 for the control and experimental batches has been given in the Table 2.

Water saturation of samples prepared from the mixture with tecRoad equal 3,4%, for residual porosity 3,4%.

The strength characteristics in the samples with tecRoad much more than in control samples:

- compression strength index under $50^0$C more in 1,4;
- compression strength index under $20^0$C more in 1,2;
- share cohesion more in 1,2 more.

According to the requirements of GOST 31015 the compaction of SMA is controlled in compliance with the residual porosity characteristic of samples or water saturation characteristic. Samples are took no earlier than in a one day after paving.

For the determination of degree of compaction of the pavement top layer coring was implemented (Figure 6). The results of tests is given in the Table3.

Figure 6 – Coring

Таблица 3

| Place of coring | High of cores, cm | Average density of cores, g/cm$^3$ | Real density of mixture, g/cm$^3$ | Water saturation, % | Residual porosity, % |
|---|---|---|---|---|---|
| Start of experimental site, left side | 6,0 | 2,49 | 2,59 | 1,8 | 3,8 |
| End of experimental site, right side | 4,7 | 2,47 | 2,52 | 1,6 | 2,0 |
| Control site | 5,8 | 2,55 | 2,59 | 1,0 | 1,5 |
| Requirements of GOST 31015 | 6,0 (according design) | | | no more 4,0 | 2,5-4,5 |

The analysis of cores results shows the compaction of top layer of the pavement as for the experimental site as for the control site satisfying the

requirements of GOST 31015 in the part of water saturation and residual porosity characteristics.

## 3 Conclusion

1. The work was carried out with the purpose of determination of effectiveness of tecRoad modifier using in the SMA for improvement of the physical characteristics, mechanical and performance.

2. The test results revealed the disintegration resistance essential (dripping of binding agent 0,02% under standard 0,2%) owing to tecRoad application in the amount of 1,5% from weight of the mixture with bitumen BND 90/130 in SMA20 and 0,25% cellulose additive.

3. The addition of 1,5% tecRoad in SMA under use of bitumen BND 90/130 allows:

- to reduce water saturation on average 6%;
- to increase by 20% the ultimate compressive strength (under $20^0$C temperature);
- to increase by 40% the ultimate compressive strength (under $50^0$C temperature);
- to increase by 20% the shear strength (under $50^0$C temperature).

4. The technology of asphalt production and laying of SMA20 with tecRoad is approved. The development work demonstrate the possibility of use of the traditional ways of preparation and asphalt laying.

5. The experimental site must be monitored. An inspection of the experimental and control sites is planned in 2013 year in the conditions stable plus temperatures after winter period and autumn period in September-October.