Recycling of Grid Reinforced Asphalt Pavements

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ABSTRACT: It was determined in a field trial that asphalt layers which are reinforced with polyester reinforcing grids can be milled. Milling capacity is, however, reduced in comparison with unreinforced asphalt layers. More extensive laboratory tests show that reinforced milled materials can be reused in the mixture for asphalt base courses with a weight share of up to 30 % without any decrease in quality.

1 INTRODUCTION

For more than 20 years reinforcing grids made of high-tenacity polyester have been used for repair work and for preventing cracks in asphalt layers in roads and runways. In the course of extension or renovation work it may become necessary to remove an existing reinforced asphalt layer with a milling machine. The tests carried out here should on the one hand provide information as to whether milling reinforced asphalt layers is generally possible, and on the other hand an assessment is to be made regarding the suitability of the milled asphalt for use as a construction material for bituminous base courses (Schniering and Thurau, 1992).

2 DATA FOR THE EXPERIMENTAL ROAD

A 35 m long and 3 m wide section (the total width) of a rural road in Gescher, Germany, was used for the tests. The start and end points were selected so that at the start there was a 5 m long section without reinforcement and then a 30 m long section with reinforcement.

The construction of the bituminous pavement was determined by examining cores:

Wearing course in layer thicknesses between 4.5 - 7.0 cm, on the average 5.6 cm,

binder course in layer thicknesses between 4 - 7 cm,

bituminous subbase course below this.

The construction of the wearing course and the reinforcing grid took place in summer 1988. The reinforcing grid of type HaTelit(R) is a polyester filament product with an ultimate strength of 50 kN/m in both directions (N.N., 1992).

3 OBSERVATIONS DURING MILLING

Milling was carried out on August 26, 1992 with a Wirtgen SF 1000C cold planer which was set to a milling depth of 7 cm. Because of the size of the appliance, the width of the section milled in a single cycle was restricted to 1 m.

While the milling with the addition of water in the section without reinforcement was carried out without any problems at all, continuing milling in the section with reinforcement was only possible at a reduced, but acceptable, speed after the water had been switched off.

A total of 15 minutes was required for a stretch 35 m long and 1 m wide. This includes three short breaks to remove blockages in the lower area of the planer's belt conveyor. After an area of 70 m^2 had been milled, the residues of the reinforcing grid were removed from the planer and stored.

4 LABORATORY TESTS

Samples of 50 kg each were taken from the milled material:

Sample 1: Product from the section without reinforcement

Sample 2: Product from the section with reinforcement, wet-milled

Sample 3: Product from the section with reinforcement, dry-milled

The essential characteristics of the milled material samples are shown in Table 1.

In addition to this, sample 3 was examined with regard to the amount, form and distribution of the milled reinforcing grid. If an installation weight of "fresh" reinforcing grid of 260 g/m^2 is assumed, the result is that about 35 % of the reinforcement is on the planer shaft and approx.65 % in the milled material. A quantitative analysis of the reinforcing grid found in the milled material showed that approx. 15 % was in the form of thread bundles with knots (thread lengths to approx. 200 mm) and about 85 % in the form of single threads. The lengths of the single threads range from 8 mm to 300 mm. Fig. 1 gives the distribution of thread lengths in the milled material.

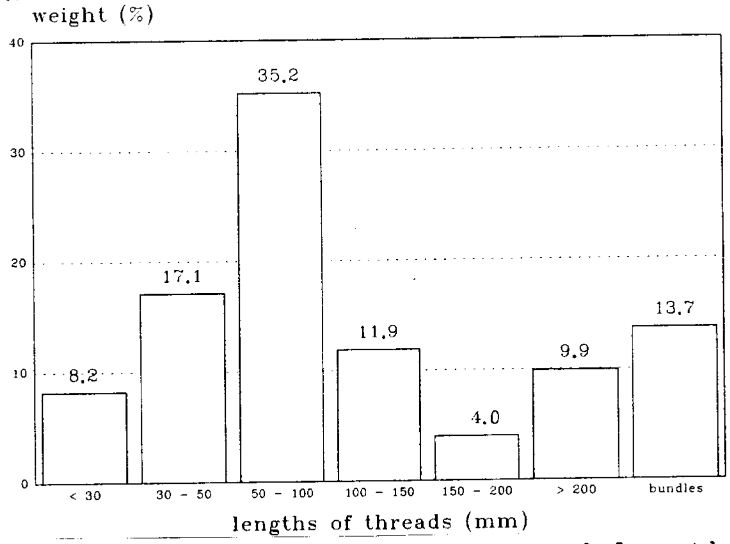

Fig. 1 Distribution of thread lengths of milled grid

5 EXPERIMENTS REGARDING REUTILISATION

Under the 'Additional Conditions for Road Construction Work' as amended in July 1991, the reutilization of milled asphalt in bituminous base courses up to 30 weight % is generally permitted in Germany.

For the sample mixtures, about 80 kg asphalt base course material class C was taken from a mixing plant. The composition of this material is shown in Table 1.

Mixtures with milled material shares of 10, 20 and 30 weight % were made from the asphalt mixture class C and samples 1 - 3. Three Marshall test specimens were produced from each mixture and their voids content, stability and flow value determined.

6 EVALUATION OF THE TEST RESULTS

In a comparison of the test results determined with samples 1 - 3 it can be seen that the milled material without reinforcement has a lower filler and binder content than the samples from the section with reinforcement. At the same time, the chippings content of this sample is considerably higher than with the comparative samples. The reason for this is possibly to be found in the thinner construction thickness of the

Table 1. Test results of milled asphalt and base course material class C

		Sample 1	Sample 2	Sample 3	Base course material
aggregate diameter					
> 16 mm	weight %	0.5	0.2	0.3	10.2
11 - 16 mm	weight %	3.7	2.4	2.1	23.0
8 - 11 mm	weight %	5.4	5.1	4.4	19.0
5 - 8 mm	weight %	11.3	14.3	12.1	8.4
2 - 5 mm	weight %	35.9	26.3	24.5	9.1
0.71 - 2 mm	weight %	10.9	10.9	12.9	7.9
0.25 - 0.71 mm	weight %	13.5	16.8	19.8	11.3
0.09 - 0.25 mm	weight %	8.1	9.4	9.7	4.8
< 0.09 mm	weight %	10.7	14.8	14.2	6.3
chippings content	weight %	56.8	48.1	43.4	69.7
sand content	weight %	32.5	37.1	42.4	24.0
binder content	weight %	5.6	6.2	6.1	4.3
softening point	° C	65.0	65.5	67.5	60.0
bulk density	g/cm^3	2.357	2.377	2.380	2.445
voids content	vol %	4.6	2.6	3.2	4.5
stability	kN	13.0	14.0	16.2	11.5
flow value	mm	3.5	3.4	3.9	2.9

wearing course in this section which led to a higher proportion of binder course material - which is generally richer in coarser grain and has a lower binder content than the wearing course layer - in the milled material.

The binder and filler contents of samples 2 and 3 do not display any serious differences. However, the chippings content of the dry-milled sample is 4.7 weight % below that of the wet-milled sample. This is probably caused by the lack of a cooling effect from the water which led to a clear warming up of the asphalt. This leads to individual chippings aggregate being removed more quickly from the compound and exposed to a higher fragmentation effect than is the case with cold asphalt. The effects of thermal stress are also seen in a higher softening point ring and ball as well as in a greater stability of the dry-milled asphalt in comparison with the wet-milled asphalt. This is important in so far as the reutilisation of milled asphalt with softening points greater than 70°C is not permitted.

The findings determined using the mixtures of milled material and asphalt base course material are shown in Table 2. There are no significant differences between the characteristics of the milled material without reinforcement and those of the wet-milled material with reinforcement. The greater increase in voids contents in the milled material without reinforcement was caused by the lower filler and binder contents of the asphalt concerned.

In comparison with these mixtures a clearly greater increase in stability can be seen in the case of dry-milled asphalt. Whereas the stability increases by a mere 14.8 % where the milled material share is increased from 10 % to 30 % in the mixture without reinforcement, in the case of dry-milled asphalt an increase in stability of 36.2 % was recorded. As

Table 2. Test results of the mixtures of milled asphalt and base course material

		Sample 1			Sample 2			Sample 3		
milled asphalt content	wt %	10	20	30	10	20	30	10	20	30
chippings content	wt %	68.4	67.1	65.8	67.5	65.4	63.2	67.1	64.4	61.8
sand content	wt %	24.9	25.7	26.6	25.3	26.6	27.9	25.8	27.7	29.5
filler content	wt %	6.7	7.2	7.6	7.2	8.0	8.9	7.1	7.9	8.7
binder content	wt %	4.43	4.56	4.69	4.49	4.68	4.87	4.48	4.66	4.84
softening point	° C	60.5	61.0	61.5	60.6	61.1	61.7	60.8	61.5	62.3
bulk density	g/cm^3	2.443	2.424	2.389	2.440	2.422	2.407	2.436	2.422	2.406
voids content	vol %	4.2	4.6	5.6	4.2	4.4	4.6	4.4	4.6	4.8
stability	kN	11.5	12.0	13.2	11.4	12.2	13.5	11.6	13.4	15.8
flow value	mm	3.6	3.1	2.8	3.6	3.4	3.1	3.5	3.2	3.1

the voids content of 4.8 vol. % shows, this mixture still possesses a satisfactory degree of workability.

7 CONCLUSIONS

The tests carried out permit the conclusion that milling reinforced asphalt layers and the reutilisation of the milled material to a maximum of 30 % in the production of bituminous base course material is possible in principle. The mixtures examined fulfil the requirements of ZTVT-StB 86 for class C bituminous base course material not only with regard to composition but also with regard to mix material characteristics.

REFERENCES

Der Bundesminister für Verkehr (1986/1990) Zusätzliche Technische Vertragsbedingungen und Richtlinien für Tragschichten im Straßenbau, Forschungsgesellschaft für Straßen- und Verkehrswesen, Cologne

N.N. (1992) HaTelit(R) - Roads without cracks, Leaflet, HUESKER Synthetic, Gescher

Schniering, A. and Thurau, W. (1992) Untersuchungen an einer armierten Asphaltbefestigung hinsichtlich der Ausbaumöglichkeiten durch Fräsen sowie der Wiederverwendbarkeit des Fräsgutes, Report unpublished, Schniering Ingenieurgesellschaft mbH, Essen