

The long-term performance of a surface dressing trial on A413, Amersham

Prepared for Quality Services, Highways Agency

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First Published 1997

ISSN 0968-4107

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Executive Summary

This report describes the analysis of data from a kilometre of surface dressing which was laid in 1988 on the A413 at Amersham, Buckinghamshire, to provide a test site of varying micro-texture and macro-texture. This trial site provided a wide range of aggregate sources and sizes, all applied with the same binder on to a rolled asphalt substrate, part of which was left exposed as a control section. The macro-texture performance of this site has been closely monitored by Buckinghamshire County Council and the considerable quantity of data accumulated has been analysed to investigate possible relationships between surface dressing performance, aggregate properties, and the original design.

After nearly nine years in service, all the surface dressings in the trial performed well despite the use of non-ideal aggregate sizes and types of surface dressing. On back analysis, the binder spread rates used were found to generally concur with the fourth edition of Road Note 39; this helps to validate the current recommendations.

The linear rates of decay of macro-texture during the first two years in service were found to be proportional to the Flakiness Index of the primary aggregate. However, absolute values of macro-texture cannot be confidently predicted for the life of a surface dressing from the data types normally available within current UK practice. Therefore, macro-texture must be strongly influenced by one or more other properties which are not currently recognised.

There is a need for further research in order to develop a method of predicting the macro-texture performance of a surface dressing at design stage. The large number of variables to be monitored would point to laboratory-scale simulations rather than further site trials at this stage. Any new research project should be preceded by a review of the experience elsewhere, particularly from New Zealand, and to define a list of “new” properties to be studied, such as ALD, Angularity, Shape Index (draft CEN Method) and the racking-in effect.

The report gives details of the trial itself, summarises all data collected, draws conclusions, and makes recommendations for future developments in surface dressing design.

1 Introduction

A kilometre of surface dressing was laid in 1988 on the A413 at Amersham, Buckinghamshire, to provide a test site of varying micro-texture and macro-texture. This was needed at that time for development of the GripTester, which was then in its infancy. The site became an extremely useful facility for precision trials of GripTester and SCRIM, which have been reported elsewhere (Roe, 1993; CSS GripTester User Group, 1995).

As a trial site with a wide range of aggregate sources and sizes, all applied with the same binder on to a rolled asphalt substrate, part of which was left exposed as a control section, it is also of interest to surface dressing designers. As such, the macro-texture performance of this site has been closely monitored by Buckinghamshire County Council. By 1995, a considerable quantity of data had accumulated and the Transport Research Laboratory commissioned Buckinghamshire County Council to undertake a review of the trial. This involved some further testing and investigation of all possible relationships between surface dressing performance, aggregate properties, and the original design.

This report gives details of the trial itself, summarises all data collected, draws conclusions, and makes recommendations for future developments in surface dressing design. In that it covers the chippings used in a surface dressing, it is a companion to an earlier report on the binders used (Carswell, 1994).

2 Trial site

2.1 Layout of the trial

Although the original purpose was to provide a test site of varying micro-texture and macro-texture, it was appreciated from the outset that the site could usefully double as a surface dressing aggregates trial. Therefore, records of tests on aggregate quality and of design details were kept and are now considered in this report.

The site is situated in Lane 1 of the northbound carriageway of the A413 just north of Amersham Bypass. The layout is shown in Figure 1. Section 1 is rolled asphalt, with coated chippings with a polished stone value (PSV) of 68, laid in 1985. Section 2 is rolled asphalt with coated chippings of unknown (but probably about 60) PSV laid in 1964. The remaining seven sections, 3 to 9, are all surface dressings laid directly on to the same asphalt as found in Section 2. Each of the nine sections is 120 metres long. Lane 2 alongside Sections 2 to 9 was also surface dressed at the same time using the same design as Section 9.

The site is reasonably straight and level, but not perfectly so. The lane width is 3.60 metres and the nearside wheel-path was taken to be 1.00 metre from kerb-line for the purposes of subsequent testing. In the area of Section 7, a very slight left hand bend may cause some variability of actual wheel-path position.

2.2 Surface dressing design

In 1988, Buckinghamshire County Council had let its annual surface dressing contract to Clugston Asphalt Limited, of Scunthorpe. The contract involved a performance specification in which the Contractor was entirely responsible for selection of materials and design. The A413 at Amersham was scheduled as one of the sites within the contract. The proposal to use part of it for a trial was accepted by the Contractor and, although the Client was obliged to relax some of the performance requirements, the Contractor was still entrusted with the design in terms of the rates of spread for both binder and chippings.

The Client took responsibility for selection, purchasing and checking of all aggregates. He also investigated the traffic flow, finding it to be 500 commercial vehicles per day, and carried out a surface hardness probe survey. The probe survey comprised ten representative readings per section and was carried out at a temperature of 25°C. The average corrected result for each section is given in Table 1.

The Contractor decided to use a proprietary polymer modified bitumen emulsion binder, known as “Novalastic”, for the entire site. However, its rate of spread was to be varied for each section in order to suit the individual aggregate and measured surface hardness. In deciding each rate of spread, the Contractor had the second edition of Road Note 39 (TRRL, 1981) available as a starting point, but in practice the rates were increased considerably on account of:

- the “racked-in method” being chosen for some sections
- the non-ideal aggregate sizes, and
- experience with the proprietary binder.

The designs as finally decided are shown in Table 1.

2.3 Aggregate quality

Chipping supplies were ordered, delivered and tested well in advance of the planned installation date. The nature of the trial had been explained to all suppliers in the hope that materials of “ideal” grading and shape would be delivered. The specification was BS 63: Part 2 (BSI, 1987) with an additional requirement of a maximum Flakiness Index limit of 25. Apart from two samples showing minor non-compliances, the overall standard of quality was excellent. The test results are summarised in Tables 2, 3 and 4.

2.4 Surface dressing operations

A major challenge was to ensure a consistent high standard of work through the site. The key to this would normally be continuity of operations, but the layout of this site required a change of chipping sources and change of binder spread rate every 120 m. Therefore, progress was far from continuous, although every effort was made at the planning stage to simplify the logistics and to minimise any risk of errors.

All chippings were stored in well-separated stockpiles in a disused length of road immediately adjacent to the southern end of the site. A materials technician, in radio contact with the supervisor, attended this chipping dump

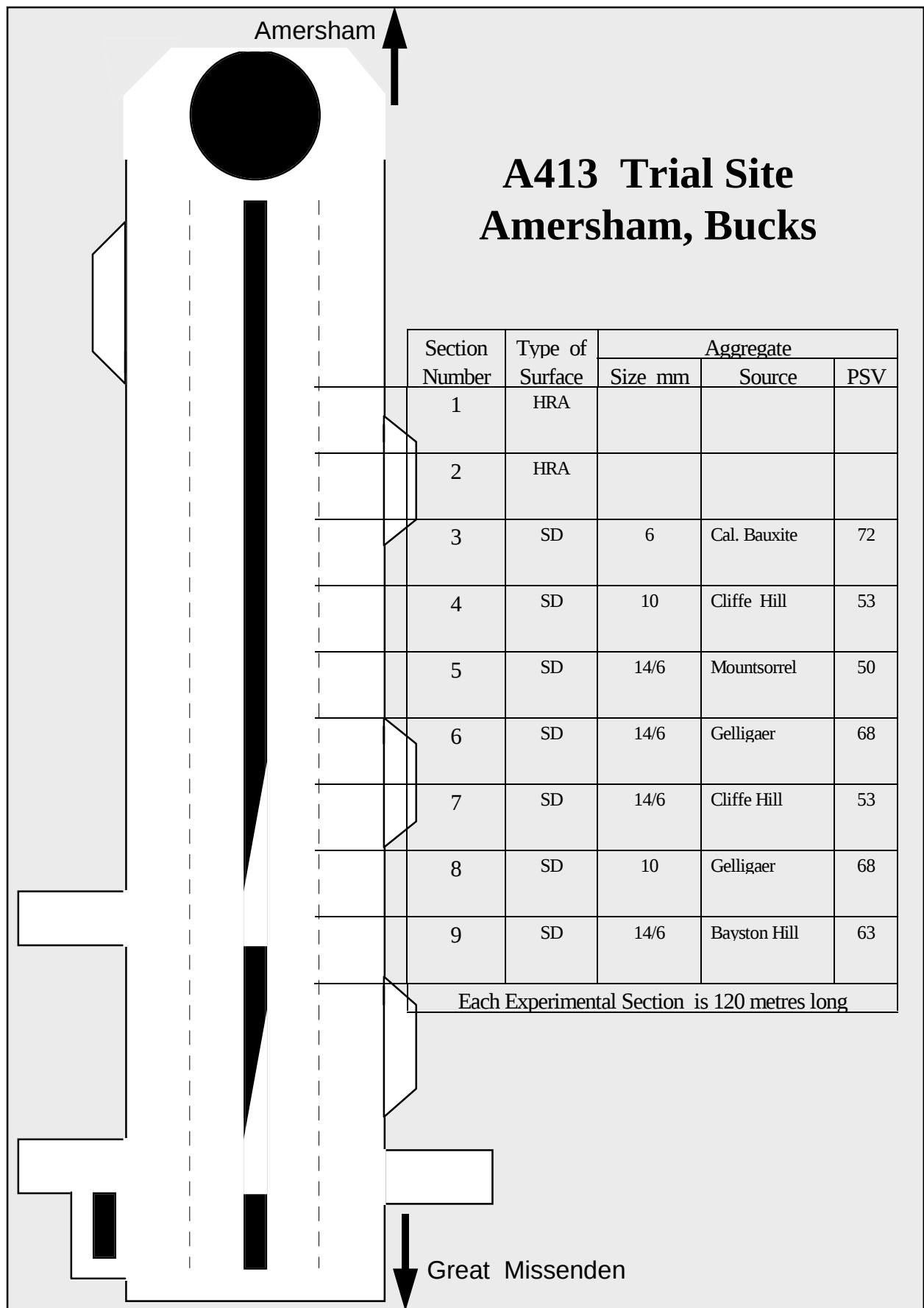


Figure 1 Layout of A413 trial site at Amersham, Buckinghamshire

Table 1 Surface dressing designs

Section number	Corrected average hardness probe penetration (mm)	Hardness category (Road Note 39)	Type of dressing	Aggregate nominal size (mm)	Primary layer* type	Source	Binder type	Rate of spread (L/m ²)
3	7.5	Normal	Single	6	Cal.Bauxite	Guyana	Novalastic	1.4
4	6.0	Normal	Single	10	Granite	Cliffe Hill	Novalastic	1.75
5	5.0	Normal	Racked-In	14/6	Granite	Mountsorrel	Novalastic	2.0
6	4.5	Normal/Hard	Racked-In	14/6	Gritstone	Gelligaer	Novalastic	2.0
7	7.5	Normal	Racked In	14/6	Granite	Cliffe Hill	Novalastic	2.0
8	4.0	Hard	Single	10	Gritstone	Gelligaer	Novalastic	1.75
9	3.0	Hard	Racked-In	14/6	Gritstone	Bayston Hill	Novalastic	2.0

*For "Racked-in" sections, the secondary layer was 6 mm gritstone from Bayston Hill in each case.

Table 2 Grading of 6 mm size chippings

Section No.	3		5, 6, 7, 9	
Aggregate	Type	Source	Calcined Bauxite Guyana	(secondary) Gritstone Bayston Hill
Passing BS sieve size	Retained on BS sieve size	Specification (per cent)	Test result (per cent)	Test result (per cent)
10 mm	-	100	100	100
6.3 mm	-	85 - 100	89	88
3.35 mm	-	0 - 35	11	17
2.36 mm	-	0 - 10	2	10
600 µm	-	0 - 2	0.2	3*
75 µm	-	0 - 1	0.1	1.2*
6.3 mm	3.35 mm	65 minimum	78	71

* Too fine

Table 3 Grading and shape of 10 mm size chippings

Section No.	4		8	
Aggregate	Type	Source	Granite Cliffe Hill	Gritstone Gelligaer
Passing BS sieve size	Retained on BS sieve size	Specification (per cent)	Test result (per cent)	Test result (per cent)
14 mm	-	100	100	100
10 mm	-	85 - 100	96	97
6.3 mm	-	0 - 35	17	14
5 mm	-	0 - 10	5	6
2.36 mm	-	0 - 2	1	1
75 µm	-	0 - 1	0.3	0.7
10 mm	6.3 mm	65 minimum	79	83
Flakiness Index		25 maximum	7	18

Table 4 Grading and shape of 14 mm size chippings

Section No.	5		6		7		9	
Aggregate	Type	Source	Granite Mountsorrel	Gritstone Gelligaer	Granite Cliffe Hill	Gritstone Bayston Hill		
Passing BS sieve size	Retained on BS sieve size	Specification (per cent)	Test result (per cent)	Test result (per cent)	Test result (per cent)	Test result† (per cent)		
20 mm	-	100	100	100	100	100		
14 mm	-	85 - 100	94	94	98	91		
10 mm	-	0 - 35	23	11	25	8		
6.3 mm	-	0 - 7	3	1	11*	1		
2.36 mm	-	0 - 2	1	1	2	1		
75 µm	-	0 - 1	0.2	0.4	0.4	0.3		
14 mm	10 mm	65 minimum	70	83	73	83		
Flakiness index		25 maximum	18	16	10	13		

* Too coarse

† Average of two samples

throughout the operations to ensure that all supplies being loaded were correct and uncontaminated. Three chipping spreaders were used, all of them being Phoenix self-propelled variable width machines.

Binder was applied using a standard ACMAR slotted jet spray-bar of variable width. The machine was known to have good control over its application rate of spread from results of carpet-tile tests on adjacent sites. However, no such tests were attempted on the trial sections because they would have caused a further loss of continuity. Nevertheless, it is unfortunate that data on actual rate of spread for each section is not available.

A major advantage when surface dressing multi-lane dual carriageways is the ability to close a complete lane to all traffic. This allowed all of the work to be undertaken carefully, particularly the stage of after-sweeping. Further sweeping was continued during the following three days in order to minimise the risk of any section being contaminated by migration of loose chippings from elsewhere on the site.

3 Data collection

3.1 Performance data

The original purpose of this work was simply to provide a test track of varying micro-texture and macro-texture. Therefore, the frequency of long term performance monitoring was not planned to be regular, although there have been sufficient data collection events to make this study worthwhile. At various times, tests have been carried out with SCRIM, GripTester, Pendulum, High Speed Texture Meter, Sand Patch Test and the TRL Mini Texture Meter (MTM). Only the latter was used on every occasion and so macro-texture measured by the MTM is the starting

point for this study of surface dressing performance.

The method of using the MTM was to select the “Other Surfaces” programme on the equipment and to test one section at a time, along the nearside wheel-track using a transverse rod and plumb-line to maintain a standard distance of 1.0 metre out from the kerb. Figure 2 shows this in operation. Results are printed out as an average value of sensor measured texture depth (SMTD) in millimetres for every ten metres travelled. To eliminate 20 m of the transition zone at every section boundary, the first and last of the twelve results were discarded and the mean SMTD result for the central 100 m of each section was calculated. All such results for the eight sets of measurements since October 1988 are given in Table 5. These data are also presented graphically in Figure 3, to compare the “texture decay” exhibited by each type of dressing in comparison with the two rolled asphalt surfaces, shown as dotted lines. The graph is broken up into 3 phases (Section 4.2), during each of which the “texture decay” behaviour of the various sections appears to be different.

Table 5 Average SMTD results by section

<i>Date of measurement</i>	<i>Oct. 1988</i>	<i>Sept. 1989</i>	<i>Apr. 1990</i>	<i>Nov. 1990</i>	<i>Mar. 1992</i>	<i>June 1994</i>	<i>Feb. 1996</i>	<i>Oct. 1996</i>
<i>Age (years)</i>	<i>0.17</i>	<i>1.08</i>	<i>1.67</i>	<i>2.25</i>	<i>3.67</i>	<i>5.83</i>	<i>7.50</i>	<i>8.17</i>
Section 1	0.87	0.80	0.76	0.79	0.91	0.93	0.99	0.98
Section 2	0.58	0.62	0.64	0.55	0.66	0.66	0.62	0.60
Section 3	0.80	0.69	0.61	0.54	0.58	0.52	0.43	0.45
Section 4	1.25	1.10	1.04	1.04	0.95	0.86	0.45	0.78
Section 5	1.59	1.20	1.26	1.01	1.10	0.93	0.72	0.73
Section 6	1.61	1.30	1.20	1.08	1.08	0.85	0.66	0.70
Section 7	1.88	1.80	1.73	1.69	1.59	1.55	1.37	1.37
Section 8	1.14	0.94	0.88	0.72	0.71	0.69	0.43	0.41
Section 9	2.08	1.90	1.83	1.75	1.74	1.68	1.40	1.65



Figure 2 Location system in operation on TRL Mini Texture Meter

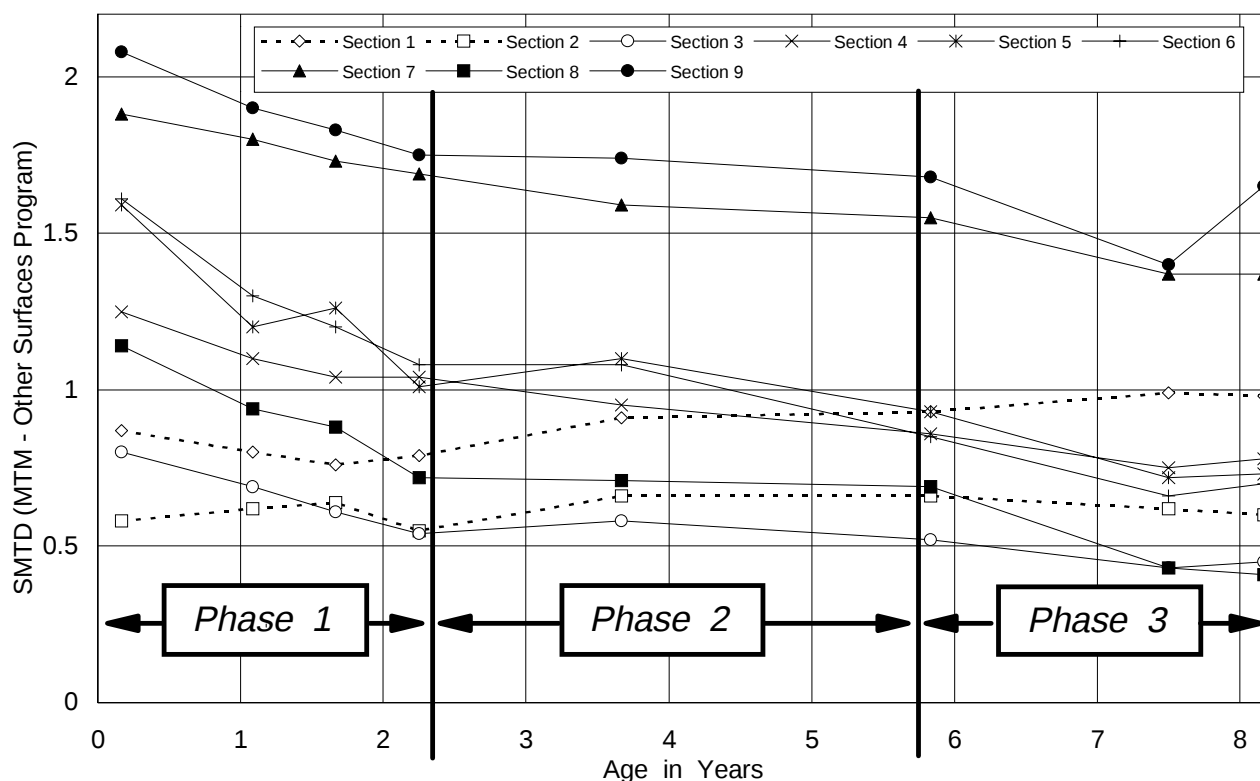


Figure 3 Macro-texture performance

3.2 Special condition survey

In February 1996, a detailed examination of the surface dressings was carried in addition to measuring the SMTD by Mini Texture Meter in order to be able to investigate the correlation of MTM with the sand-patch method for in-service surface dressings. Although such correlations have been investigated for rolled asphalt wearing courses, none have yet been published or accepted nationally for use on surface dressings.

The MTM tests on Sections 3 to 9 were carried out in duplicate for the nearside wheel-track with an additional test location in the oil lane (that is, between the wheel-tracks). All test results are given in Appendix A, which also shows the mean results for the nearside wheel-track tests and the overall section mean results.

The tests along the oil lane can be used to identify changes from the original texture with time but without significant trafficking by comparison with the initial texture depth as measured in the wheel-path. The differences are given in Table 6, which shows an average drop of 0.44 mm or 70 per cent. This drop is similar to, although slightly greater on average than, the drop occurring in the wheel-path during Phase 1 of the decay cycle.

Sand-patch tests were carried out using the method of BS 598: Part 105 (BSI, 1990) at fourteen representative locations within sections 5, 6, 7, 8 and 9. These locations were also midway within one or other of the ten metre intervals of MTM testing, so that each sand-patch test result could be plotted against its nearest corresponding MTM result as in Figure 4.

Embedment of chippings is a fundamental assumption within the Road Note 39 approach to design of surface dressings. The actual degree of chipping embedment

Table 6 Loss of texture depth with limited trafficking

Section	Wheel-path SMTD Initial (mm)	Phase 1/2 SMTD (mm)	Oil lane SMTD (mm)	Initial/oil lane SMTD Difference (mm)	Ratio (per cent)
3	0.80	0.54	0.61	0.19	76
4	1.25	1.03	0.99	0.26	79
5	1.58	1.01	1.03	0.55	65
6	1.61	1.08	1.04	0.57	65
7	1.87	1.69	1.53	0.34	82
8	1.14	0.73	0.56	0.58	49
9	2.08	1.75	1.52	0.56	73
Mean	1.47	1.12	1.04	0.44	70

achieved, if measured directly, could be correlated with the data already available. Such measurement in-situ was considered to be impractical; therefore, five core samples were drilled from each section for laboratory examination. Photographs of the surface of a core from each section are shown in Appendix B.

In the Laboratory, attempts to remove the chippings after warming the cores (to about 60°C) whilst inspecting their apparent degree of embedment proved inconclusive. Similarly, the in-situ grading and Flakiness Index of the chippings was not possible to reliably measure. This lack of success resulted mainly from the following three reasons:

- Very little visible evidence of embedment into the asphalt substrate could be seen.
- The 6 mm secondary aggregates present in Sections 5, 6, 7 and 9 would have invalidated any grading comparisons.

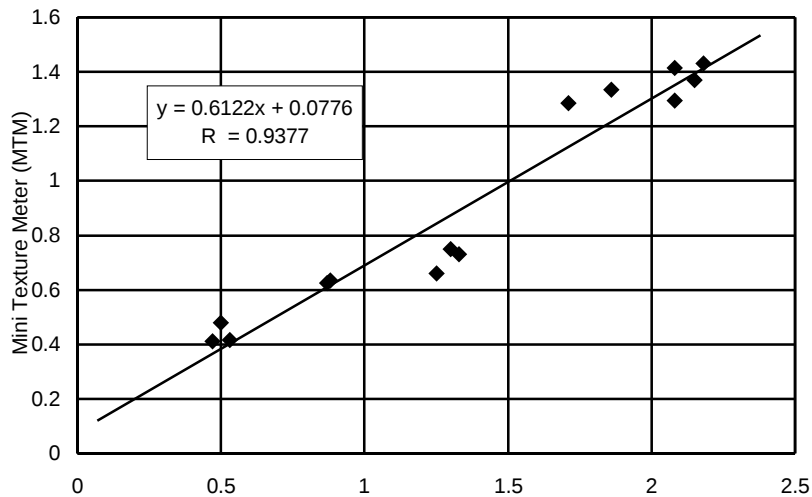


Figure 4 Correlation between Sand-patch and MTM texture depths

- Many of the primary aggregate particles, particularly the softer gritstone of Sections 6 and 8, had incipient fractures which readily disintegrated when lateral support was removed.

Therefore, in the absence of any quantitative measurements for embedment or condition, all information from a visual inspection of the cores, and from the site in general, have been summarised in Table 7.

Table 7 Visual condition assessment of site and core samples (February 1996)

Section No.	Observations
3	Slight rutting and very slight chipping loss in both wheel tracks. Some of the large chippings have shattered into smaller particles.
4	Very slight chipping loss overall, slight tendency to bleed in wheel tracks. Many transverse reflective cracks. Some of the chippings have shattered into smaller particles.
5	Very slight chipping loss overall. Several transverse reflective cracks in the offside wheel track. Many of the chippings have shattered into smaller particles.
6	Very slight chipping loss in the oil lane only. Very slight tendency to bleed in wheel tracks. Many of the chippings have shattered into smaller particles which may in themselves have become re-orientated.
7	Some chipping loss, mainly in the oil lane. Occasional chippings have split in half.
8	Slight tendency to fatting up but otherwise satisfactory. At least half of the chippings have shattered into smaller particles. Aggregate abrasion has now resulted in a smooth surface profile, with underlying aggregate showing through by January 1997.
9	Extensive fretting in channel. Some fretting in wheel tracks. Occasional fretting in oil lane. Some chippings have shattered into smaller particles.

4 Analysis and review

4.1 Regression analysis

Figure 3 shows that, although Section 5 tended to be rather more erratic with regard to changes in macro-texture with time, the other six sections all followed a broadly similar pattern. Third order polynomial equations were fitted for all seven sections which produced very good fits.

However, a satisfactory multi-parameter relationship to estimate macro-texture could not be identified using the known aggregate and site properties, as summarised in Table 8, even for a single point in time.

Table 8 Summary of aggregate properties

Section No.	3	4	5	6	7	8	9
Primary aggregate size (mm)	6.3	10	14	14	14	10	14
Nominal size (per cent)	78	79	70	83	73	83	83
Flakiness index	10*	7	18	16	10	18	13
Undersize (per cent)	11	17	23	11	25	14	8
Oversize (per cent)	11	4	6	6	2	3	9
Surface hardness probe penetration (mm)	7.5	6	5	4.5	7.5	4	3

* Estimated value

Therefore, one or more other properties (such as average least dimension and/or angularity) must be factors in determining the macro-texture provided by a surface dressing and, hence, the absolute values of macro-texture cannot be accurately estimated from the data normally available within current UK practice.

The average least dimension (ALD) is an aggregate property that is used within a rational method of surface dressing design pioneered many years ago in New Zealand, but not widely adopted in Europe. The least dimension of particles can be measured directly, or can be estimated from flakiness index and particle size distribution using a nomogram. The ALD values for the chippings on this site could only be estimated from the nomogram because ALD measurements were not made when the surface dressings were laid. However, no satisfactory relationship or model

could be found to relate the macro-texture with the parameters even with ALD included.

Therefore, no method of accurately predicting the absolute values of macro-texture from the data normally available within current UK practice and ALD was found, and further parameter(s) may need to be measured before such a model can be developed.

4.2 Phases within the life of a surface dressing

The whole period under review can be sensibly divided into three phases, as marked on Figure 3 and described as follows:

- Phase 1: Rapid linear decay of texture
- Phase 2: Very slow linear decay of texture
- Phase 3: Erratic behaviour.

The first phase can be readily explained by the combined mechanisms of chipping re-orientation, embedment and initial abrasion of “high-spots”, until a stable mosaic had been formed. Chipping re-orientation is probably the major factor here because it does not continue indefinitely (unless the dressing is prone to fretting).

The second phase reflects fairly stable conditions, but with continued steady loss of macro-texture. This must be inevitably caused by continued slow embedment and/or abrasion, and/or fragmentation.

The third phase shows texture decay continuing, but at variable rates, followed by some sections starting to regain texture. Increased texture values at this age can be

attributed to fretting. Thus, this phase of erratic behaviour may represent the onset of failure conditions.

It can be seen from Figure 3 that the rate of texture decay was similar for all sections in Phase 2, but not in Phase 1. Therefore, this rate of decay was studied further. Figure 5 shows Phase 1 data more clearly with the addition of linear regression trend lines and their equations for each section.

The rates of decay of the texture depth (represented by the slope of each line in Figure 5) were plotted against the various aggregate properties given in Table 8. Once again, various models of “Shape and Size Index” were tried, including the one previously published in BS 594 (BSI, 1973), but the best correlation was found to be with Flakiness Index alone and this is shown in Figure 6.

4.3 Review of design

Given the success of all seven sections surface dressed (nearly nine years service at the time of writing), it is useful to study how this has been achieved in terms of the actual designs chosen.

A traffic flow of 500 commercial vehicles per day had been used by the designer. A permanent traffic count installation exists within the trial site which has been operating continuous since 1987; however, the data is only in terms of total vehicles for Lanes 1 and 2 combined. A classified manual count in 1989 confirmed 500 cv/l/d as being valid for Lane 1. In June 1996, automatic vehicle counter/classifier pads were installed in Lanes 1 and 2 for

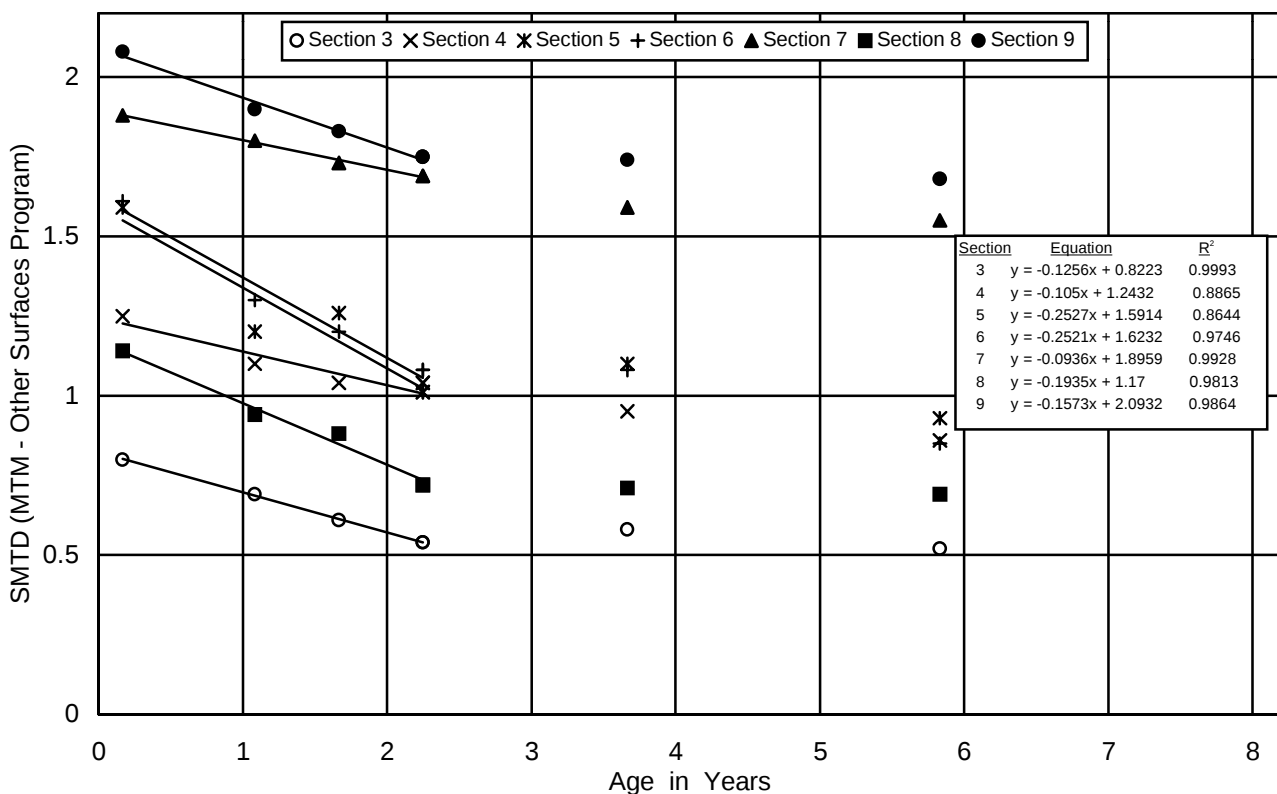


Figure 5 First phase of linear decay of texture depth

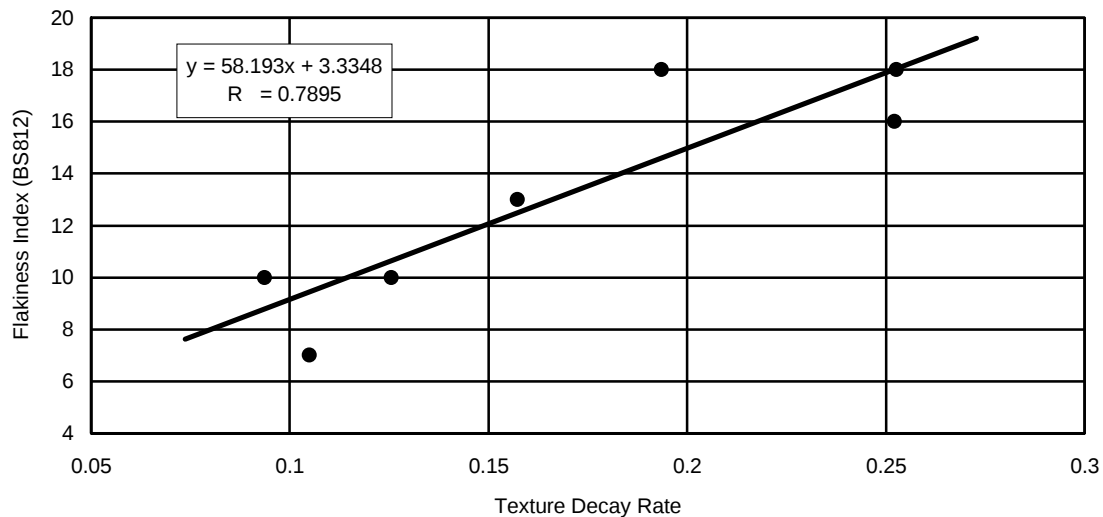


Figure 6 Flakiness index against rate of decay of texture

a two week period. This provided useful information on the split between lanes and the proportions of commercial vehicles in both lanes. Summarising all data available, the average traffic flow in Lane 1 from 1988 to 1996 has been 530 cv/l/d and 7,080 total vehicles/l/d.

Road Note 39 has been revised twice since 1988 and the latest (fourth) edition (Nicholls, 1996) can be compared with the actual designs proven by this trial. Only two of the trial sections, Section 5 and 7, have a type and size of dressing now recommended by Road Note 39. This is not surprising because the original aim of the trial had been to use a deliberately wide range of aggregates and sizes. However, Tables 10 and 11 of Road Note 39 do enable binder spread rates to be designed for some aggregate sizes beyond those normally recommended. Therefore, the process could be followed through, using the known site/aggregate properties and traffic flows. The current binder spread rate recommendations were found to compare closely with those originally chosen by Clugston Asphalt Limited in 1988, as shown in Table 9.

Table 9 Comparison with Road Note 39, 4th edition

Section No.	Aggregate size (mm)	Road note 39 Categories		Binder Spread rate (L/m ²)	Actual original target (L/m ²)
3	6	A7	B8	1.4	1.4
4	10	A9	B11	1.7	1.75
5	14/6	A12	B13	1.9	2.0
6	14/6	A13	B14	2.0	2.0
7	14/6	A12	B13	1.9	2.0
8	10	A9	B10	1.6	1.75
9	14/6	A13	B14	2.0	2.0

5 Conclusions and recommendations

5.1 Conclusions

The principal conclusions from this investigation are as follows:

- 1 All dressings in the trial have performed well despite non-ideal aggregate sizes and types of surface dressing being used.
- 2 The binder spread rates actually used generally concur with the fourth edition of Road Note 39.
- 3 The linear rate of decay of macro-texture during the first two years was proportional to the Flakiness Index of the primary aggregate.
- 4 The macro-texture of the relatively untrafficked area of the surface dressings reduced by about 70 per cent, less than in the wheel-paths overall but about the same as during the first two years there.
- 5 Absolute values of macro-texture cannot be confidently predicted from the data types normally available within current UK practice. Therefore, macro-texture must be strongly influenced by one or more other properties which are not currently recognised.

5.2 Recommendations

A method of predicting the macro-texture performance of a surface dressing at design stage would be an extremely useful tool for all parties involved in performance contracts. However, further inputs to such a method need to be identified and the effect of multiple dressings, such as “racked-in”, upon texture needs to be properly understood, because the study of this was not possible within the current project.

Thus, there is a need for further research. The large number of variables to be monitored would point to laboratory-scale simulations rather than further site trials at this stage. Any new research project should be preceded by a review of the experience elsewhere, particularly from

New Zealand, and to define a list of “new” properties to be studied, such as ALD, Angularity, Shape Index (draft CEN Method) and the racking-in effect.

6 Acknowledgements

This Report was prepared jointly by the Civil Engineering Resource Centre of the Transport Research Laboratory and the Civil Engineering Laboratory of Hyder Consulting Limited; the latter was Buckinghamshire County Council’s Highways Laboratory until 30 September 1996. This report is published by the Transport Research Laboratory with permission of Mr J L Currell, Head of Transportation, Buckinghamshire County Council, whose assistance is gratefully acknowledged.

Success of the trial was largely due to the efforts of Martin Broadbridge and Ken Rilatt who were Surface Dressing Manager and Supervisor respectively for Clugston Asphalt Limited at the time of installation. The surface dressing of the trial site was partly funded by Findlay Irvine Limited of Penicuik; the subsequent research project was funded by the Highways Agency of the Department of Transport.

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Appendix A: Sensor measured texture depth results in February 1996

Table A.1 Section 3 SMTD results

Chainage	oil lane	ns w/t 1	ns w/t 2	ns w/t mean
10	0.60	0.44	0.43	0.435
20	0.60	0.43	0.40	0.415
30	0.63	0.45	0.44	0.445
40	0.64	0.37	0.41	0.39
50	0.59	0.33	0.36	0.345
60	0.66	0.41	0.46	0.435
70	0.57	0.43	0.42	0.425
80	0.55	0.45	0.43	0.44
90	0.58	0.44	0.43	0.435
100	0.63	0.45	0.46	0.455
110	0.64	0.48	0.46	0.47
120	0.63	0.44	0.43	0.435
Mean (Ch. 20 - 110)	0.61			0.43

ns w/t = nearside wheel-track

Table A.2 Section 4 SMTD results

Chainage	oil lane	ns w/t 1	ns w/t 2	ns w/t mean
10	0.95	0.66	0.67	0.665
20	1.02	0.75	0.71	0.73
30	0.92	0.77	0.82	0.795
40	0.86	0.83	0.78	0.805
50	1.08	0.81	0.78	0.805
60	0.93	0.67	0.77	0.72
70	0.99	0.76	0.72	0.74
80	0.98	0.66	0.71	0.685
90	0.97	0.76	0.72	0.74
100	1.07	0.79	0.75	0.77
110	1.09	0.77	0.75	0.76
120	0.96	0.85	0.86	0.855
Mean (Ch. 20 - 110)	0.99			0.75

ns w/t = nearside wheel-track

Table A.3 Section 5 SMTD results

Chainage	oil lane	ns w/t 1	ns w/t 2	ns w/t mean
10	0.99	0.70	0.71	0.705
20	0.97	0.65	0.66	0.655
30	1.02	0.72	0.79	0.755
40	0.99	0.70	0.70	0.70
50	1.07	0.71	0.72	0.715
60	1.00	0.75	0.73	0.74
70	0.94	0.72	0.70	0.71
80	1.05	0.75	0.71	0.73
90	1.06	0.72	0.70	0.71
100	1.10	0.73	0.75	0.74
110	1.13	0.75	0.76	0.755
120	1.21	0.77	0.74	0.755
Mean (Ch. 20 - 110)	1.03			0.72

ns w/t = nearside wheel-track

Table A.4 Section 6 SMTD results

Chainage	oil lane	ns w/t 1	ns w/t 2	ns w/t mean
10	1.04	0.59	0.63	0.61
20	1.05	0.65	0.55	0.60
30	0.93	0.65	0.63	0.64
40	0.95	0.63	0.64	0.635
50	0.99	0.64	0.64	0.64
60	0.95	0.60	0.65	0.625
70	1.09	0.67	0.67	0.67
80	1.08	0.66	0.66	0.66
90	1.17	0.73	0.74	0.735
100	1.11	0.73	0.71	0.72
110	1.05	0.69	0.65	0.67
120	0.95	0.68	0.68	0.68
Mean (Ch. 20 - 110)	1.04			0.66

ns w/t = nearside wheel-track

Table A.5 Section 7 SMTD results

<i>Chainage</i>	<i>oil lane</i>	<i>ns w/t 1</i>	<i>ns w/t 2</i>	<i>ns w/t mean</i>
10	1.67	1.45	1.45	1.45
20	1.55	1.39	1.37	1.38
30	1.43	1.34	1.33	1.335
40	1.59	1.35	1.32	1.335
50	1.36	1.20	1.23	1.215
60	1.50	1.39	1.44	1.415
70	1.51	1.43	1.48	1.455
80	1.44	1.29	1.30	1.295
90	1.67	1.38	1.30	1.34
100	1.50	1.24	1.24	1.24
110	1.73	1.72	1.70	1.71
120	1.55	1.36	1.33	1.345
Mean (Ch. 20 - 110)	1.53			1.37

ns w/t = nearside wheel-track

Table A.6 Section 8 SMTD results

<i>Chainage</i>	<i>oil lane</i>	<i>ns w/t 1</i>	<i>ns w/t 2</i>	<i>ns w/t mean</i>
10	0.63	0.42	0.42	0.42
20	0.59	0.43	0.43	0.43
30	0.55	0.41	0.41	0.41
40	0.58	0.42	0.46	0.44
50	0.51	0.40	0.40	0.40
60	0.44	0.46	0.37	0.415
70	0.55	0.41	0.41	0.41
80	0.62	0.38	0.44	0.41
90	0.51	0.40	0.43	0.415
100	0.54	0.47	0.47	0.47
110	0.73	0.50	0.46	0.48
120	0.61	0.47	0.47	0.47
Mean (Ch. 20 - 110)	0.56			0.43

ns w/t = nearside wheel-track

Table A.7 Section 9 SMTD results

<i>Chainage</i>	<i>oil lane</i>	<i>ns w/t 1</i>	<i>ns w/t 2</i>	<i>ns w/t mean</i>
10	1.39	1.25	1.25	1.25
20	1.43	1.37	1.32	1.345
30	1.52	1.47	1.35	1.41
40	1.59	1.37	1.37	1.37
50	1.50	1.37	1.32	1.345
60	1.54	1.32	1.25	1.285
70	1.56	1.36	1.44	1.40
80	1.49	1.46	1.40	1.43
90	1.55	1.44	1.48	1.46
100	1.51	1.43	1.43	1.43
110	1.46	1.51	1.49	1.50
120	1.45	1.47	1.42	1.445
Mean (Ch. 20 - 110)	1.52			1.40

ns w/t = nearside wheel-track

Appendix B: Photographs of cores extracted from each section

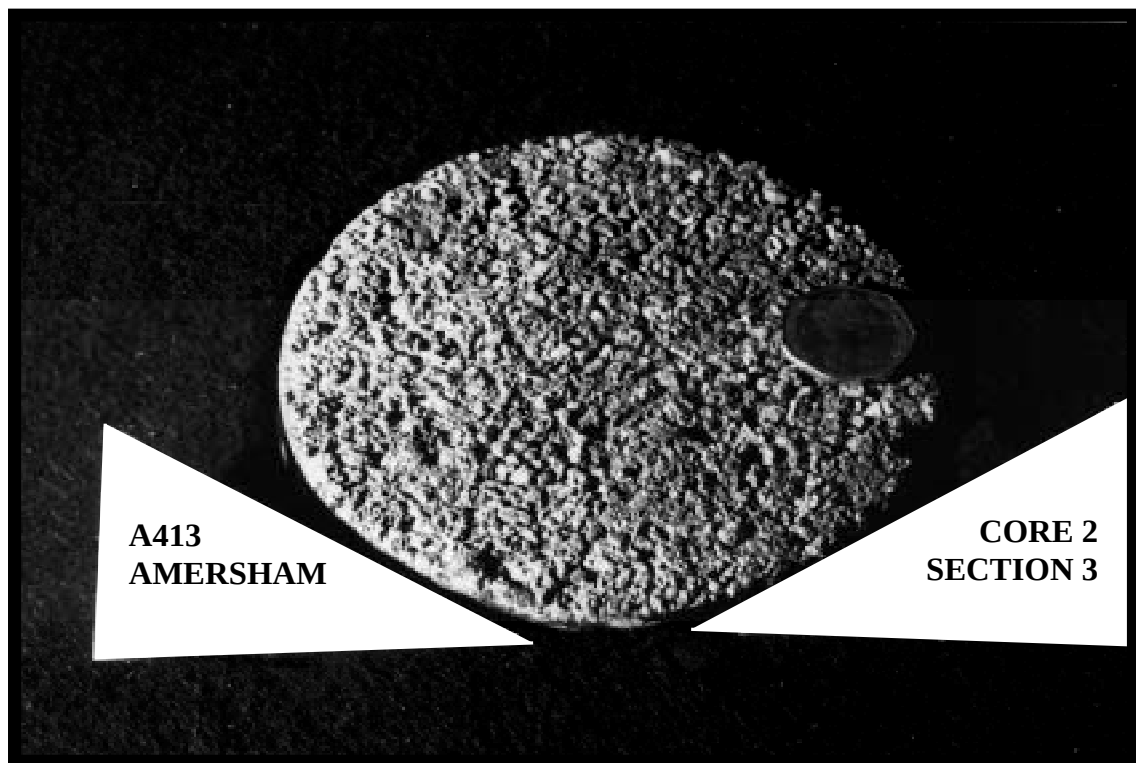


Figure B1 Section 3, single dressing with 6 mm Guyanese calcined bauxite

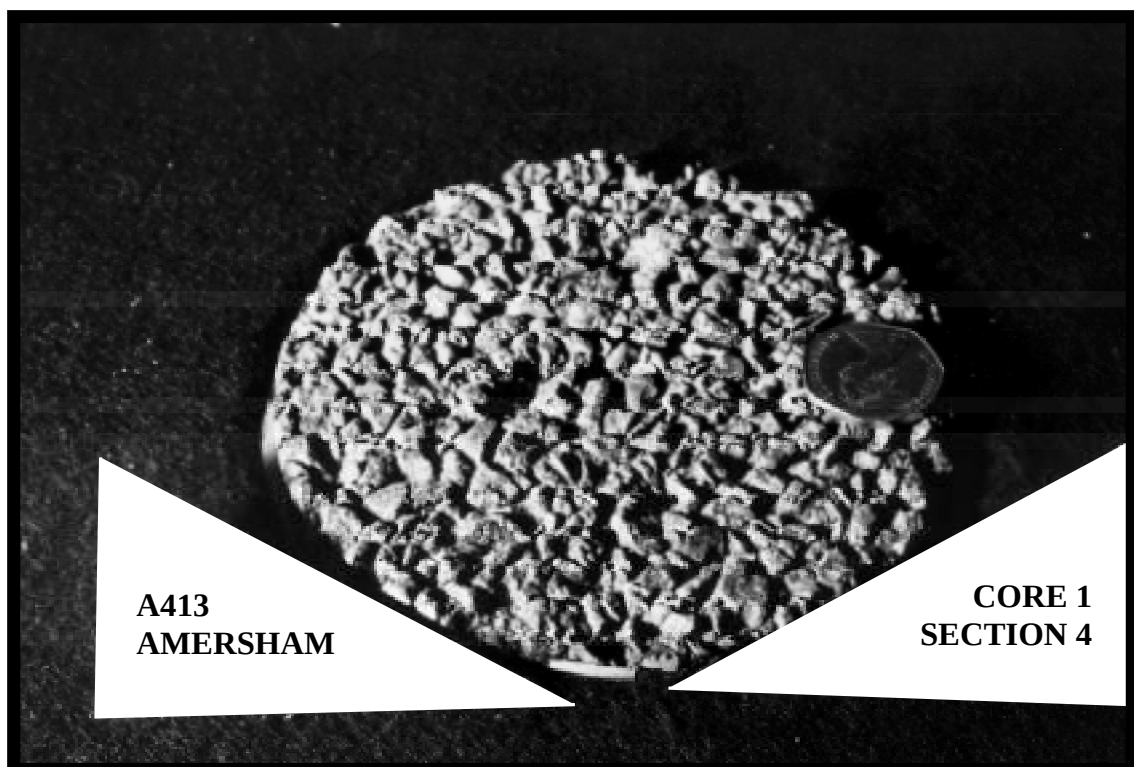


Figure B2 Section 4, single dressing with 10 mm Cliffe Hill granite

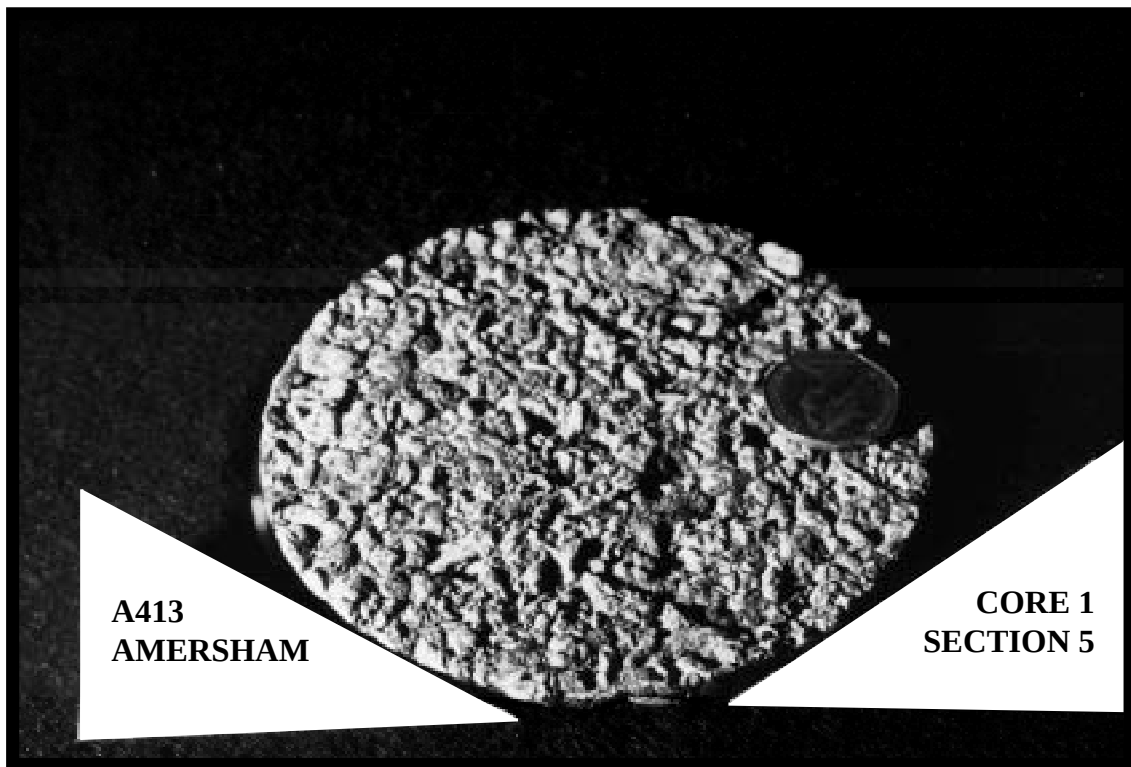


Figure B3 Section 5, racked-in dressing with 14/6 mm Mountsorrel granite

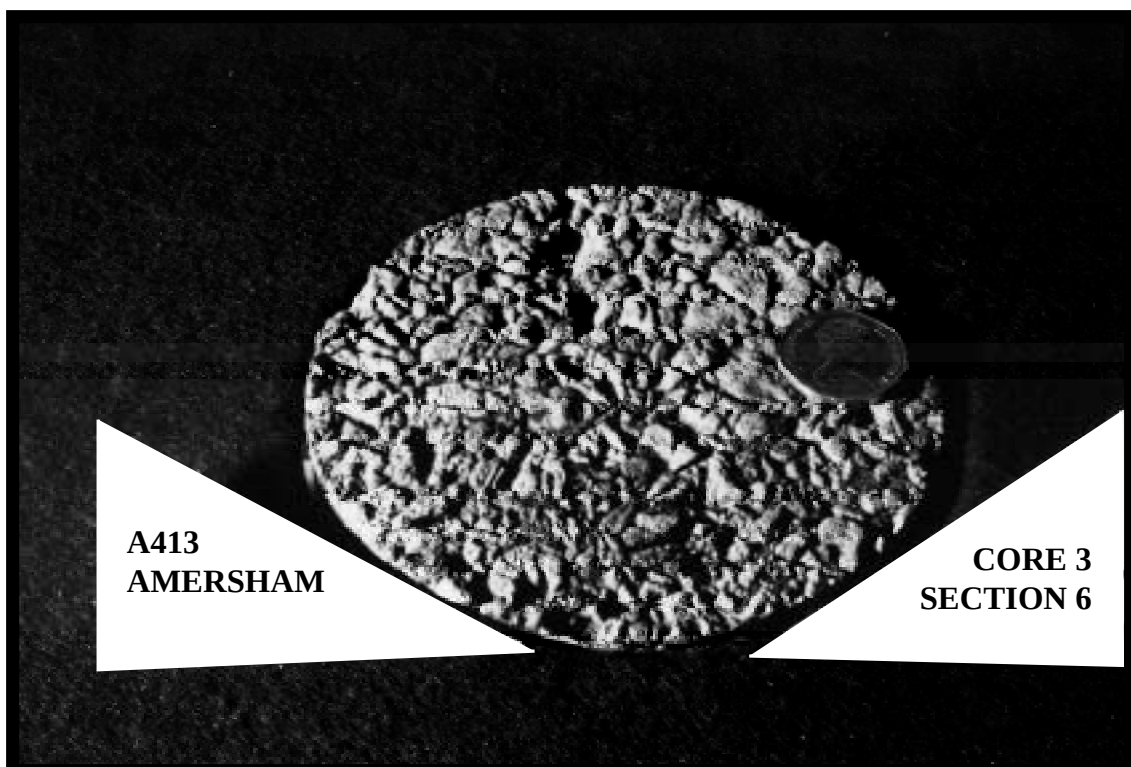


Figure B4 Section 6, racked-in dressing with 14/6 mm Gelligaer gritstone

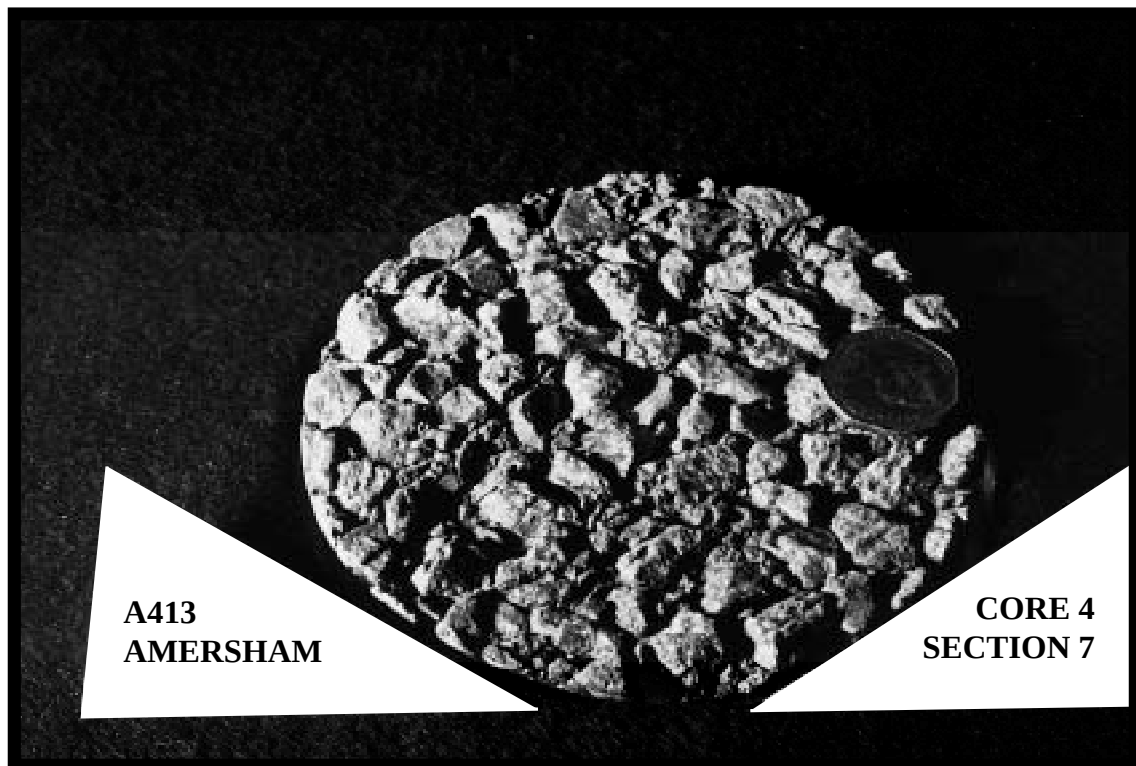


Figure B5 Section 7, raked-in dressing with 14/6 mm Cliffe Hill granite

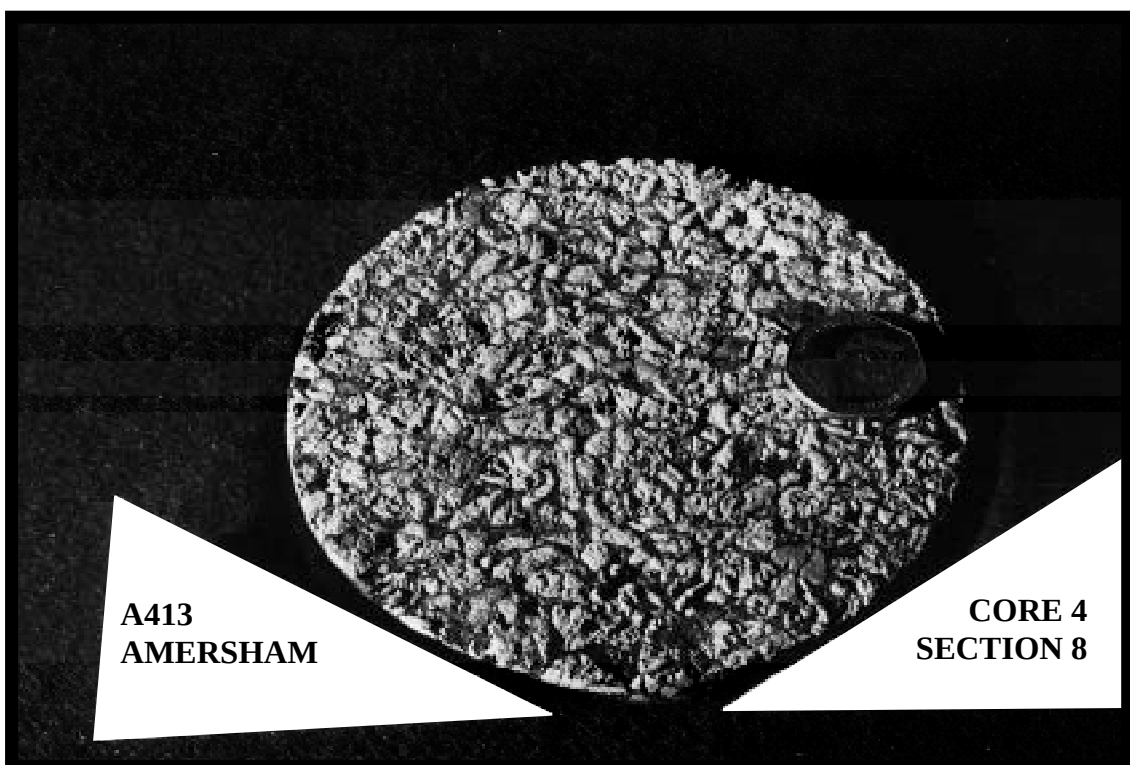


Figure B6 Section 8, single dressing with 10 mm Gelligaer gritstone

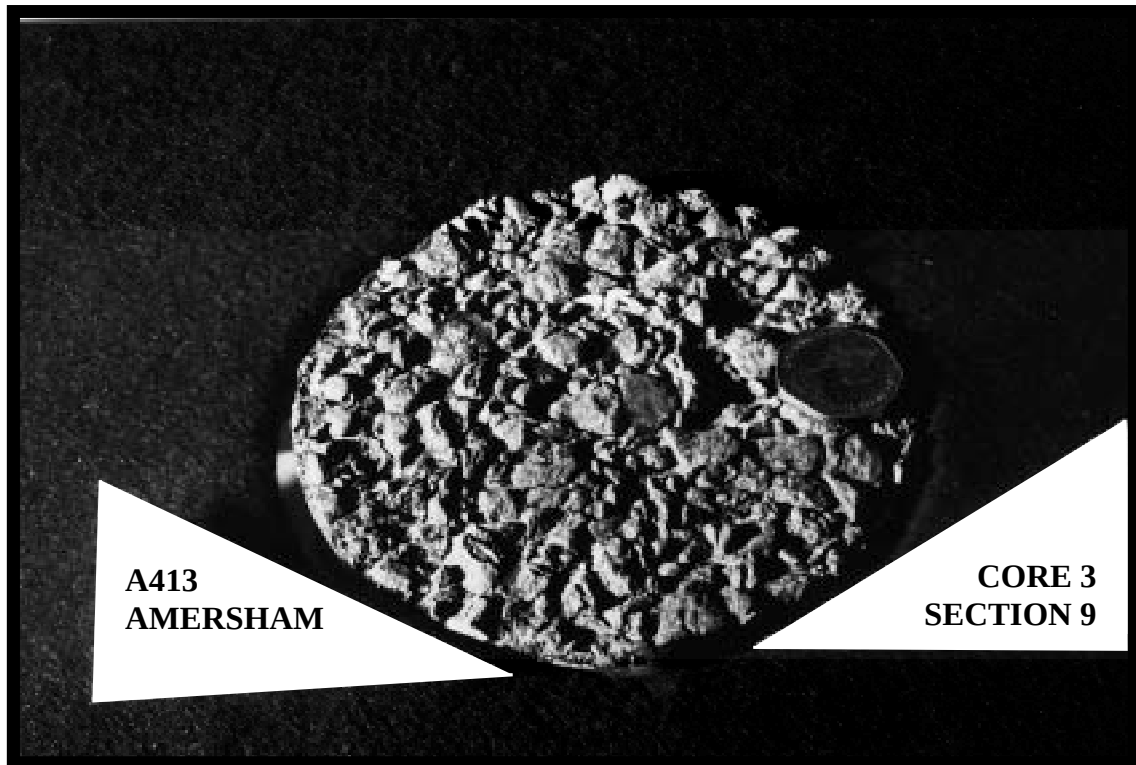


Figure B7 Section 10, racked-in dressing with 14/6 mm Bayston Hill gritstone

Abstract

A length of road with sections each having been surface dressed to a different design, originally laid down as a test site with varying micro-texture and macro-texture, was monitored for changes with time in the properties of the different sections. All dressings have performed well despite non-ideal aggregate sizes and types of surface dressing having been used. The linear rate of decay of macro-texture during the first two years was proportional to the Flakiness Index of the primary aggregate whilst absolute values of macro-texture cannot be confidently predicted from the data types normally available within current United Kingdom practice. Therefore, macro-texture must be strongly influenced by one or more properties currently un-recognised and further work will be required, and data collected, to develop a method of predicting surface dressing macro-texture performance at the design stage.

Related publications

PR12 *The testing and performance of surface dressing binders for heavily trafficked roads* by J Carswell. 1994 (price code E, £20)

RN39 *Design guide for road surface dressing* by J C Nicholls. 1996 (price code J, £35)

PR79 *Road trials of thin wearing course materials* by J C Nicholls, J F Potter, J Carswell and P Langdale. 1995 Price code H, £30)

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