CONSTRUCTION

The main features of Chapter 6

RECYCLING / BSM TECHNOLOGY

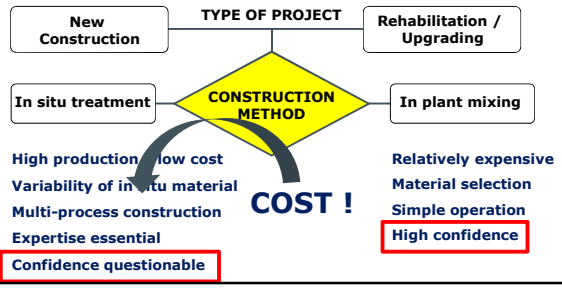
SARF Webinar

Wednesday 22nd September 2021

Presentation by:

Dave Collings

Figure 6.1 BSM Construction Options (Page 68)



TG2 (2020) Chapter 6. (34 pages)

6.1 In Situ Treatment (Page 69)	
6.2 ... using Recyclers (Pages 69 to 87)	19 pages
6.3 ... using Conventional Equipment (Pages 87 to 90)	4 pages
6.4 In Plant Treatment (Pages 90 to 99)	10 pages
6.5 Curing and Trafficking (Page 99)	
6.6 Surfacing (Page 100)	
6.7 Constructing Trial Sections (Page 101)	
Appendix D. Quality Control (Page 196 to 210)	10 pages

6.2 In Situ Treatment using Recyclers

6.2.1 Factors influencing the work

6.2.1.1 Project specific details

6.2.1.2 Material in the recycling horizon

6.2.1.3 Preliminary work requirements

6.2.1.4 Equipment selection

6.2.1.5 Site personnel

6.2.1.6 The cut plan

6.2.1.7 Traffic accommodation

6.2.1.8 Logistics

6.2.2 Executing the work

6.2.2.1 Preliminary work

6.2.2.2 The recycling operation

6.2.2.3 Primary compaction

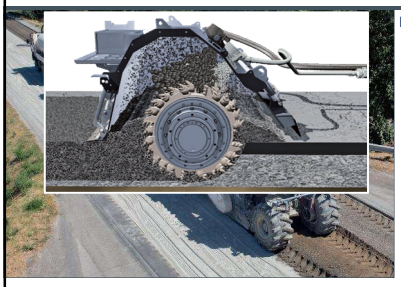
6.2.2.4 Processing the compacted material

4

IN SITU RECYCLERS

5

WHEEL-MOUNTED RECYCLERS



MULTI-PURPOSE RECYCLERS

Main features

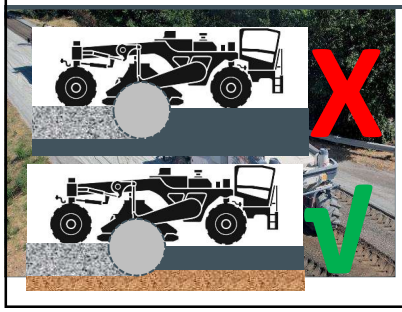
Ability to cut deep

(Variable mixing chamber)

September 2020

6

WHEEL-MOUNTED RECYCLERS



Ability to cut deep
(Variable mixing chamber)

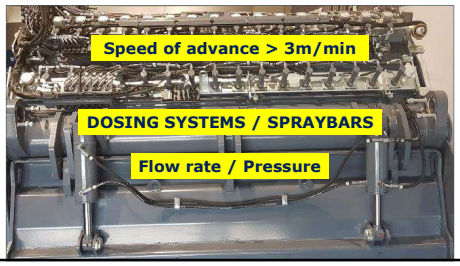
Hardness limitations
(Cannot work within thick HMA)

Not always…
Minimum advance speed required

- » Total HMA thickness
- » Hardness of aged HMA
- » Strongly cemented layers

WHEEL-MOUNTED RECYCLERS

Minimum advance speed required



WHEEL-MOUNTED RECYCLERS

VOLUME INCREASE
(after compaction)

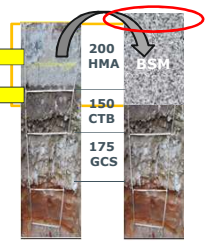
± 230mm
(10 - 15%)

± 105mm
(5 - 10%)

Working windrow
(Grader processing)

Application rates
(Density difference)

RECYCLE 300mm



Ability to cut deep
(Variable mixing chamber)

Hardness limitations
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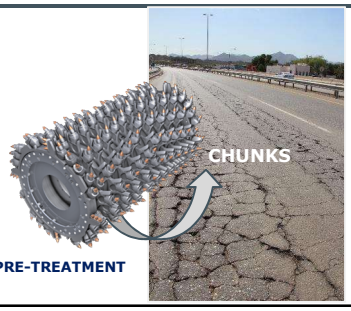
Material bulking
(In situ material always "grows")

WHEEL-MOUNTED RECYCLERS



Ability to cut deep
(Variable mixing chamber)

Hardness limitations
(Cannot work within thick HMA)

Material bulking
(In situ material always "grows")

Grading / pulverisation
(Up cutting)

10

WHEEL-MOUNTED RECYCLERS

Ability to cut deep
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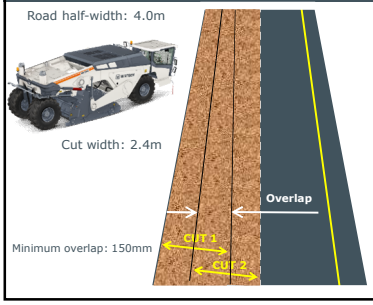
Grading / pulverisation
(Up cutting)

Mix quality
(Variable in situ material)

11

WHEEL-MOUNTED RECYCLERS



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(Variable mixing chamber)

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Grading / pulverisation
(Up cutting)

Mix quality
(Variable in situ material)

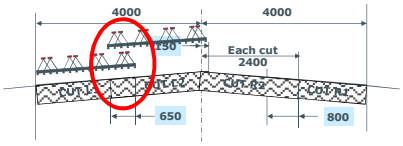
Construction joints
(Cut width < lane width)

12

WHEEL-MOUNTED RECYCLERS

CUT PLANS (Imperative)

SPRAYBAR SETTINGS



OVERLAPS BETWEEN CUTS

(Avoid wheel paths)

13

WHEEL-MOUNTED RECYCLERS

Step 1 Pre-work

Pre-shaping
Pre-pulverising
Spreading active filler

Step 2 Recycle and pre-compact

Step 3 Processing and finishing

Ability to cut deep
(Variable mixing chamber)

Hardness limitations
(Cannot work within thick HMA)

Material bulking
(In situ material always "grows")

Grading / pulverisation
(Up cutting)

Mix quality
(Variable in situ material)

Construction joints
(Cut width < lane width)

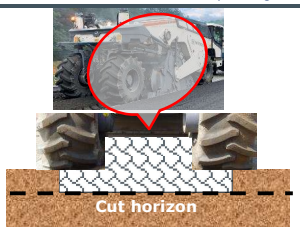
Multiple processes
(Mixing, processing)

14

WHEEL-MOUNTED RECYCLERS

Step 1 Pre-work

Pre-shaping
Pre-pulverising
Spreading active filler



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(Variable mixing chamber)

Hardness limitations
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Grading / pulverisation
(Up cutting)

Mix quality
(Variable in situ material)

Construction joints
(Cut width < lane width)

Multiple processes
(Mixing, processing)

15

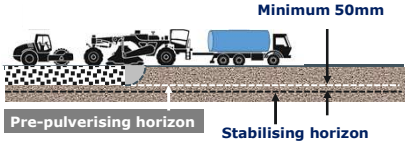
Pre-shaping by milling

16

WHEEL-MOUNTED RECYCLERS

Step 1 Pre-work

Pre-shaping
Pre-pulverising
Spreading active filler



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Mix quality
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Construction joints
(Cut width < lane width)

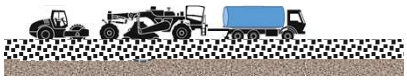
Multiple processes
(Mixing, processing)

17

WHEEL-MOUNTED RECYCLERS

Step 1 Pre-work

Pre-pulverising



Ability to cut deep
(Variable mixing chamber)

Hardness limitations
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Material bulking
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Mix quality
(Variable in situ material)

Construction joints
(Cut width < lane width)

Multiple processes
(Mixing, processing)

18

WHEEL-MOUNTED RECYCLERS

Step 1 **Pre-work** Pre-pulverising

Cut levels
Pre-compact

Ability to cut deep
(Variable mixing chamber)

Hardness limitations
(Cannot work within thick HMA)

Material bulking
(In situ material always "grows")

Grading / pulverisation
(Up cutting)

Mix quality
(Variable in situ material)

Construction joints
(Cut width < lane width)

Multiple processes
(Mixing, processing)

19

WHEEL-MOUNTED RECYCLERS

Step 1 **Pre-work** Pre-pulverising

Adjust recycling depth
Set application rate

Stabilising horizon

Ability to cut deep
(Variable mixing chamber)

Hardness limitations
(Cannot work within thick HMA)

Material bulking
(In situ material always "grows")

Grading / pulverisation
(Up cutting)

Mix quality
(Variable in situ material)

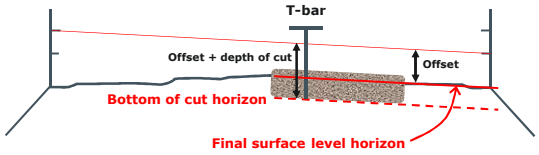
Construction joints
(Cut width < lane width)

Multiple processes
(Mixing, processing)

20

Checking the cut depth

Use the survey control poles for probing to check cut depth



21

Checking the cut depth

22

WHEEL-MOUNTED RECYCLERS

Step 1 Pre-work

SPREADING ACTIVE FILLER

- Ability to cut deep (Variable mixing chamber)
- Hardness limitations (Cannot work within thick HMA)
- Material bulking (In situ material always "grows")
- Grading / pulverisation (Up cutting)
- Mix quality (Variable in situ material)
- Construction joints (Cut width < lane width)
- **Multiple processes** (Mixing, processing)

23

SPREAD RATE

= 200mm

= 1% (by mass)

= 2100kg/m³

1 = 4.2kg/m²

≈ 1100kg/m³

3m

3.8mm !

24

SPREADING ACTIVE FILLER

PAGE 1.

"Cement addition should never exceed 1%"

If > 1% then it's not BSM, it's cemented

(i.e. Different material, different technology)

The quantities of residual bitumen in stabilisation do not typically exceed 2.5% (by mass) of the dry aggregate. In most situations, active filler in the form of cement or hydrated lime is also added to the mix. **Cement addition should never exceed 1%.** If more than 1% is added, the material should be considered a cement-treated material and the guidelines in TRH13 should be followed.

SPREADING ACTIVE FILLER

Standard mix design test (ITS = Indirect Tensile Strength)

Bitumen addition	(%)	**2.2**	**2.2**
Type / amount of active filler	(%)	None	1% Cement
Moulding moisture content	(%)	8.4	8.5
TEST RESULTS			
ITS_{DRY}	(kPa)	**243**	**259**
Moisture content at break	(%)	2.4	2.5
Dry density	(kg/m^3)	2257	2248
Temperature at break	(°C)	25.1	24.9
Displacement	(mm)	2.1	2.2
ITS_{WET}	(kPa)	**58**	**126**
Moisture content at break	(%)	6.3	6.1
Dry density	(kg/m^3)	2254	2247
Temperature at break	(°C)	24.9	25.0
Displacement	(mm)	2.8	2.3

Same bitumen addition
Active filler addition

"EFFECT OF ACTIVE FILLER"

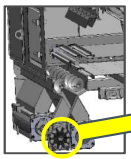
i.e. 1% cement addition increases the saturated strength by >100%

SPECIAL HAND SPREADERS

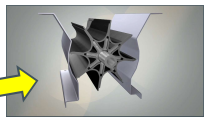
27

SPECIALISED SPREADERS

STREUMASTER



CELLULAR WHEEL



Uniform and accurate for low application rates

28

WHEEL-MOUNTED RECYCLERS

Step 1 **Pre-work**

Pre-shaping
Pre-pulverising
Spreading active filler

Step 2 **Recycle and pre-compact**

Step 3 **Processing and finishing**

Ability to cut deep
(Variable mixing chamber)

Hardness limitations
(Cannot work within thick HMA)

Material bulking
(In situ material always "grows")

Grading / pulverisation
(Up cutting)

Mix quality
(Variable in situ material)

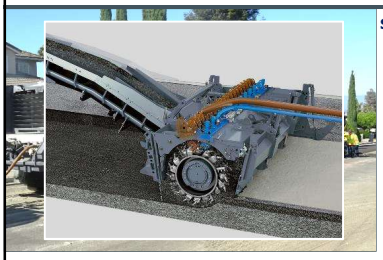
Construction joints
(Cut width < lane width)

Multiple processes
(Mixing, processing)

29

3-day Training Course for Recycling

TRACK-MOUNTED RECYCLERS



SPECIAL-PURPOSE RECYCLERS

Ideal for hard material
(Can work within HMA layers)

Full lane width
(3.8m width of cut)

Good fragmentation
(Down cutting)

Limited depth
(Fixed mixing chamber)

Paver laid
(Large track-mounted paver)

Dealing with bulking
(Slew conveyor)

31

6.4 In Plant Treatment

6.4.1 Mixing plant

6.4.2 Input materials

6.4.2 i. Material to be treated

6.4.2 ii. Bitumen stabilising agent

6.4.2 iii. Active filler

6.4.2 iv. Water

6.4.3 Mixing

6.4.4 Stockpiling the mixed material

6.4.5 Transporting BSM

6.4.6 Layer construction using a paver

6.4.6.1 Paver and screed

6.4.6.2 Compaction equipment

6.4.6.3 Paving thick layers

6.4.6.4 Construction requirements

6.4.6.4 i Paver set up

6.4.6.4 ii Paving the layer

6.4.6.4 iii Construction joints

6.4.6.4 iv Compacting the paved BSM

6.4.7 Layer construction using graders

6.4.8 Layer construction using labour

32

In Plant Treatment. Main features

Control of input material
(Stockpile / test / blend)

Uniform mix
(Computer controlled dosing)

Choice of placing method
(Paver / grader / manual)

Stockpiling (BSM-foam)
(Separate dependencies)

33

Paving BSM layers (single lane)

Managing centre-line shape (½-width construction)

Paving second lane

Paving second lane

Complete rolling first half-width

Chapter 6. Construction

Questions?