Surface course recycling

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SCI, Recycling and re-using asphalt
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Background to presentation

Feasibility study 2002-2005

- Thin surfacings Increasing quantity of high PSV stone
- Valuable resource
- Desk and Laboratory study
- Field trials

Development of best practice guide 2006-2009

- More laboratory work
- Monitoring of site trials for medium term performance
- Monitoring of major resurfacing schemes

Re-Road

- Monitoring of site trials and schemes for longer term performance

Industry practice

General use of planings

- Recycled back into asphalt
- Generally into base and binder course layers
- Use in capping and Type 1 sub-base
- Insignificant quantities going to landfill
- Increasing quantities and value of application

Industry practice

Asphalt plant capability

- Very varied
- 20 % of plants can add 10-15 %
- 20% can add in excess of 30 %
- Remainder up to 10 %
- Quantity added also depends on availability of a suitable source
- Modification of asphalt plant needs to be economic

Trials

1. Pilot scale trial – Renishaw, June 2002
2. A1(M) Hatfield, January 2004
3. A405 Bricket Wood, August 2004

Renishaw trial

Construction, June 2002

- **Laying of 30 % RA section**
  - **Added binder reduced by 1.2%**

- **15 % RA section**
  - **Added binder reduced by 0.6%**

- **Completed site**

Renishaw Trial

Results after up to 9 years service

Recovered Pen and Softening Point	▪ Pen 29, 20, 26 (original added binder 40/60) ▪ S.P. 58.8, 64.2, 63
Viscosity	▪ Results for all sections comparable (after 75 months service)
Deformation Resistance	▪ Control and 30 % sections in the range 0.9 – 1.1 mm/h (after 75 months service)
Visual Assessment	▪ All sections 'Moderate / Acceptable' after nearly 9 years service (surveyed March 2011)

Renishaw trial

Visual survey March 2011 (Re-road)

▪ Day joint between 15% and 30% RA sections

▪ Site subject to infrequent but heavy (turning) traffic

A1(M) Hatfield

Ch 0	Ch 175	Ch 278	Ch 382	Ch 597
20 mm SMA control Section 1	20 mm SMA with 10% RAP Section 2	14 mm SMA with 10% RAP Section 3	14mm SMA control Section 4	

MP 32 / 9 — Northbound, Lane 1 → — MP 33 / 5

A1(M) Hatfield trial

▪ Night time laying, in January
▪ Surface temperature sub-zero for later sections

▪ 10 % RA, 20mm section
▪ Limited by asphalt plant capability
▪ RA content from HRA PCC (requires 2 stage planing op if full depth of HRA is to be removed)

A1M Hatfield

Results after 55 months service

Recovered Pen and Softening Point	▪ All sections comparable
Viscosity	▪ All sections comparable
Deformation Resistance	▪ All sections comparable 0.4-0.5 mm/h
Visual Assessment	▪ All sections 'Good' after 55 months service

A405 Bricket Wood - schematic

TAC control Section1	TAC 10% RA	TAC 30% RA	TSMA 10% RA	TSMA 30% RA	TSMA Control Section 6

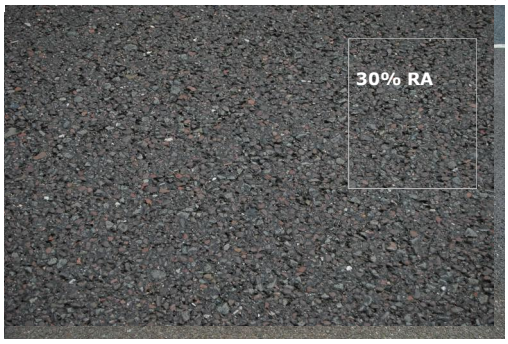
Trial located on the NB carriageway linking the M1 J6 to the M25 J21a

A405 Bricket Wood

Results after 6 years service (September 2010)

Recovered Pen and Softening Point	▪ TAC sections. ▪ Penetration 67, 64, 43 (93, 89, 66) ▪ S.P. 67.2, 60.6, 58 (66, 68.6, 60.6)
Viscosity (after 49 months)	▪ TAC sections comparable ▪ TSMA sections comparable
Deformation Resistance	▪ TAC sections 0.7, 0.7, 0.6 mm/h
Visual Assessment	▪ TAC sections all 'Moderate' some cracing and aggregate loss. ▪ TSMA sections affected by 'unbound' binder course. 30% better than 10% Assessed as A-S-A

A405 Bricket Wood – TAC September 2010



Schemes – M4 Cardiff

M4 Cardiff

- Re-laid in 1994 (12 years old)
- Pen 24/26, SP 70/68.2
- Client (Welsh Assembly) demanded 25% be incorporated in to the new surfacing
- Cemex, August 2006
- Site assessed as 'Moderate' in November 2010 (51 months service)

Deformation resistance 0.3mm/h / 0.5 mm/h

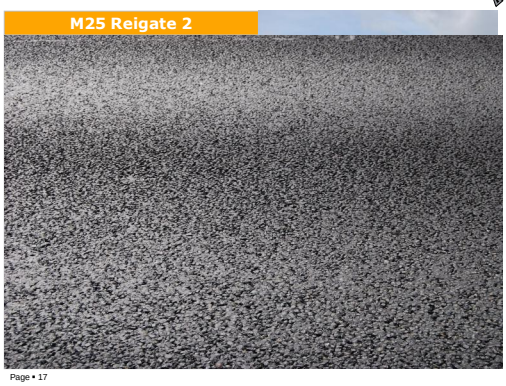
Schemes – M25 Reigate 1

M25 Reigate 1

- PA laid in 1996 (11 years old)
- Client (Mouchel) demanded re-use of PA RA into new surface course layer
- Tarmac, August 2008
- Energy audit undertaken to evaluated any potential additional benefits of using RA for this scheme (PPR 304)
- Visual assessment in October 2010, 'Good'

Schemes – M25 Reigate 2

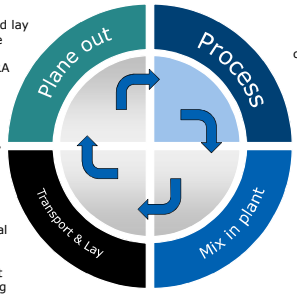
M25 Reigate 2



Genral sequence for schemes

General sequence

First shift plane out and lay 100% virgin aggregate materials. Subsequent shifts, surfacing with RA



RA screened if necessary, and QA checks for compatibility with new surfacing

Transport and lay material in conventional manner (potential to use delivery wagons to return to plant with planings for following shift)

Add RA to mixture.

(Feed mechanism dependant on plant)

Best Practice Guide

ROAD NOTE 43

Best practice guide for recycling into surface course

NOW PUBLISHED
ISBN 978-1-84608-853-7
TRL / IHS

Design and planning advice

Materials production advice

Mixture design advice

Development of flow charts

- Identify aggregate properties
- Are they suitable?
- Determine grading, binder content and recovered binder properites
- Select target RA proportion
  - Calculate maximum practical
  - Check plant capability

Step 1 | **Step 2** | **Step 3** | **Step 4**

- Assume initial active binder
  - 0-25 % if < 15 pen
  - 25-50 % if 15-30 pen
  - 75 % if > 30 pen
- Design initial trial mixture
- Determine binder drainage
- If target RA ≤ 10 %, use trial mixture
- If target RA > 10 %, determine volumetric properties

Development of flow charts

- Determine recovered binder properties
- Check volumetrics acceptable?
- Does trial mixture comply?
  - Yes, continue
  - No, re-design

Step 5 | **Step 6** | **Step 7** | **Step 8**

- Is RA content > 20 %?
  - Yes, determine wheel-tracking and other specified performance requirements
  - No, do not
- Check performance as part of normal QA

Administration – The first step is often the most difficult

Planning advice

- Suppliers can plan for routine use of 10% of RA in their proprietary thin surfacing products.
- Clients can require large proportions of RA on large projects where the surface being replaced is of a consistent material.
- The ownership of planings should be clearly defined in tender documents.
- The ownership should be passed to a party that is interested in using them as RA at the highest level.

Material design advice

- For large proportions of RA, access to samples of RA as early as practicable should assist in meeting deadlines and increasing the opportunities for recycling into surface course layers.

Departures from standard

Planning advice

- When working on trunk roads with more than 10% RA, apply for a departure from standard as soon as practicable.
- Assume that the PSV and AAV are at the set limit for the source site if no further information is available.

Material design advice

- Ensure that the HAPAS certificate includes the use of the required proportion of RA if a certificated product is needed.
- Ensure that both sources of aggregate comply with the requirements rather than testing the blended aggregates if possible.

Reclaiming asphalt - Care during recovery will avoid more processing later

Planning advice

- The planings should be separated into that from surface courses and that from other layers as a minimum.

- **Efficient transport movements can reduce the carbon and save money**

Production advice

- Avoid contamination as far as possible – **Keep it clean!**
- Excessive water should not be added during planing as this can lead to additional requirements for processing and drying at the plant later. Add just enough water to plane effectively.
- Carry out routine visual assessment; if noticeable, assess the extent of contaminants.

Analysis and processing – Know your limits

Mixture design advice
- Binder film must be allowed for when separating RA fractions.

Planing advice
- The extent of processing is dependent on the proportion of RA added and the RA variability.

- **Particle distribution**
- **Keep processing to a minimum for economy**

Production advice
- The removal of oversize particles is essential.
- The removal of fine material should reduce moisture content and susceptibility to moisture and is essential where detritus is present.

Binder content and condition

- **The RA binder is a valuable resource**
- **Could be considered an inconvenience as its effectiveness is often not known**

Material design advice
- The analysis process (solvent method) has to be modified for a majority of the aged soluble bitumen to be extracted.
- The binder drainage test can be used as a simple screening test to assess the active binder in the RA.
- The requirement for the penetration of the added binder can be calculated, but will not be necessary for 10% RA or less.

Quality control - Designs need to be validated, but the level of checks should be appropriate

- **The aim is consistency**
- **Construction – no change**

Planning advice
- The aggregate grading and physical properties and binder content need to be monitored regularly.

Material design advice
- The variability of RA needs to be allowed for in any mixture design.

Reclaimed asphalt mix design - Needs to be correct (aim for success, not perfection)

- **HAPAS**
- **Nothing is as simple as we hope it will be**

Material design advice
- The design will need to be changed if the RA properties vary.
- The influence of any change will depend upon how much RA is being added.
- Changes in the binder properties will be more significant for large proportions of RA.

Planning advice
- HAPAS certificates will need to be explicitly extended before the addition of RA is permitted within the scheme – unless a departure has been given.

Long-term monitoring - We can only advance through knowledge of how past works performed

Material design advice
- Long-term monitoring may lead to improvements in the mixture design procedure.

Planning advice
- Long-term monitoring can be used to influence future policy.

Conclusions I

- Site and laboratory trials have shown that it is feasible to recycle surface course materials into new thin surfacings
- Addition of up to 40 % RA into surface course has been demonstrated
- Comparable performance demonstrated after 9 years service for 30 % RA and control mixtures
- HAPAS certification for up to 10% RA should be relatively straight forward for existing products
- Three major resurfacing schemes demonstrate practicality
- Implications of incorporating RA into surface course mixtures will:
  - reduce need for relatively scarce virgin aggregates with high skid-resistance properties
  - make better use of this resource by using it in high value closed loop recycling applications

Conclusions II

- Use expected to increase
- Routine addition of up to 10% RA as the norm? Little and often
- Addition of larger amounts: Go Large on schemes
- Sustainability issues will be the drivers for increased adoption
  - Technological developments in asphalt plant should allow increased and routine use of RA in surfacing layers?
- RN43 covers issues relating to good practice
  - Much of the advice is also applicable to lower asphalt layers
    - Some restrictions for surface course layers not applicable to lower layers

Questions?