


# Recycling with larger proportions for lower layers



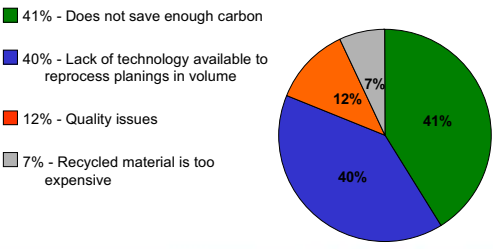
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## Summary


- Why recycle into hot mix asphalt?
- Specifications
- Direct to mixer recycling
- Larger proportions of RAP – Parallel driers



## Why not recycle into asphalt?



- 41% - Does not save enough carbon
- 40% - Lack of technology available to reprocess plantings in volume
- 12% - Quality issues
- 7% - Recycled material is too expensive



## Why recycle into asphalt?

- Majority of roads constructed and maintained using asphalt
- Physical properties and durability well understood
- Reduce material carbon footprint – 25%
- "Linear Quarry " Readily available source of aggregate and bitumen 2 billion tonne reserves?






## Specifications

- No recycling in BS594:1 (HRA) and BS4987:1 (Macadam)
- SHW recognition in CI902
- All changes with EN 13108
  - Based on 10+ years of European experience
  - Reclaimed asphalt recognised in product standards
  - Part 8 specifically for Reclaimed Asphalt
- Revised SHW CI902
  - Defines added binder grades
  - Specifies testing rates dependant on percentage RAP addition
  - Links to PD6691




## Direct to mixer recycling

- Superheat virgin aggregate
  - Add cold damp RAP direct to mixer
- Advantages
  - Simple engineering solution
- Disadvantages
  - Steam evacuation issue
  - Slow start up
  - Higher fuel usage
  - Limited to 20% addition by thermodynamics

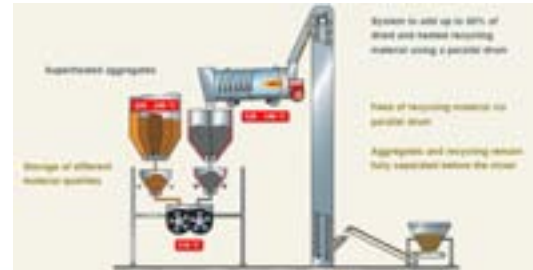
## Alternatives to direct to mixer approach

- Drum Plants:
  - RAP added cold via collar into mixing stage
- Add RAP into drier feed?
  - Further hardening of binder
  - Clogging of screens
  - Bag house damage
  - Emissions increase



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## RAP Drier system



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## Advantages of Parallel Driers

- Maximises RAP addition to asphalt
- Improves sustainability of asphalt
- Avoids steam build up
- Emission free
- Produces consistent product



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## RAP Processing



- Sources – Breakout, returned loads, planings, plant errors
- Consistency – Blend sources
- Control to EN13108-8

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## Consistent homogeneous product

Grading/Binder Content



Penetration/Softening Point



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## Process Control

- Recovered penetration of RAP
- Calculate mixed material penetration – add a softer binder
- Recovered penetration of mixed material
- Stiffness of AC mixes
- Compliance with standard grading and binder content requirements etc...



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## Physical properties

AC32HDM Base 40/60 Des

SNF Content	9%	9%	
Min Density (kg/m <sup>3</sup> )	2.450	2.450	
Max Density (kg/m <sup>3</sup> )	2.500	2.500	
Minimum Bulk Density (kg/m <sup>3</sup> )	2.300	2.300	
True Voids (%)	0.0	0.0	Max 1%
Relative to voids (%)	1.0	1.0	Max 0.5%
Min. Packing Rate (kg/m <sup>3</sup> )	1.8	1.8	Max 1.1
Min. Voids (kg/m <sup>3</sup> )	0.6	0.6	Max 1.2
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## Embodied carbon

	CO <sub>2</sub> e/t (%)
Aggregate	13
Filler	2
Bitumen	33
Energy – dry/heat	42
Energy – mix/other	10
<b>Total</b>	<b>100</b>

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