Use of reclaimed asphalt in the surface course – the effect on friction

Alan Dunford
20th May 2014
Use of reclaimed asphalt

Base layers
Use of reclaimed asphalt

Base layers
Use of reclaimed asphalt

Surface course

[Diagram showing Base, Sub-base, Surface, and an arrow pointing to Surface course]
Use of reclaimed asphalt
Reclaimed asphalt – current practice

- Various reclaimed asphalt stockpiles (200 tonnes to 15,000 tonnes)
- Not generally separated by source
- Some petrographic classification
  - Not possible, or difficult to carry out normal lab tests (e.g. PSV)
- Currently used in small quantities in the surface course (5% to 10%)
- Road Note 43 suggests incorporation up to 30% is feasible
Principle - mixing coarse aggregate

Coarse aggregate A
\[ \mu = a \]

Coarse aggregate B
\[ \mu = b \]

Coarse aggregates A and B
\[ \mu = a/2 + b/2 \]
Principle - mixing coarse aggregate

Friction ($\mu_{PWS60}$)

- Greywacke
- Siltstone
Principle - mixing coarse aggregate

Friction ($\mu_{w50}$)

- Greywacke
- Greywacke / Siltstone
- Siltstone
Principle - mixing coarse aggregate

Friction ($\mu_{w50}$)

- Siltstone
- Granite
Principle - mixing coarse aggregate

Siltstone
Siltstone / Granite
Granite

Friction ($\mu_{w50}$)
Principle - mixing coarse aggregate

Friction ($\mu_{PS50}$)

Greywacke

Limestone
Principle - mixing coarse aggregate

![Graph showing friction coefficient for different aggregates.](chart)

- **Greywacke**
- **Greywacke / Limestone**
- **Limestone**
Principle - mixing reclaimed asphalt

- Friction ($\mu_{PWS60}$)
  - Greywacke
  - Reclaimed asphalt

Friction levels comparison graph.
Principle - mixing reclaimed asphalt

Friction (µWS50)

Greywacke

Reclaimed asphalt
Principle - mixing reclaimed asphalt

Friction ($\mu_{w50}$)

- Greywacke
- Reclaimed asphalt

[Diagram showing comparison between Greywacke and Reclaimed asphalt with question mark]
Principle - mixing reclaimed asphalt

Friction ($\mu_{\text{PWS50}}$)

- Greywacke
- Reclaimed asphalt
Principle - mixing reclaimed asphalt
Principle - mixing reclaimed asphalt
Principle - mixing reclaimed asphalt
Laboratory investigation

- Reclaimed asphalt from mixed stockpile
- Incorporate into SMA in different proportions by mass
- Measure friction
- Compare with effect of adding limestone virgin aggregate
Laboratory investigation – mixing RA

![Graph showing percentage passing through sieves of different sizes, with target min and max lines.](image-url)
Laboratory investigation – mixing RA

The graph shows the percentage passing through sieves of different sizes (in mm). The y-axis represents the percentage passing, and the x-axis represents the sieve size in mm. Two target lines are indicated: Target Min and Target Max. The line labeled "0%" represents the actual percentage passing for different sieve sizes.
Laboratory investigation – mixing RA

Percentage passing vs. Sieve size / mm for 0% and 48% mixing ratio.

Target Min and Target Max lines indicate the desired range for percentage passing.

Graph shows that the percentage passing increases with sieve size for both 0% and 48% mixing ratios.
Laboratory investigation – friction

Friction ($\mu_{P_{60}}$)

Percentage limestone or RA, by mass

- Reclaimed asphalt
- Limestone
Laboratory investigation – friction

Friction ($\mu_{w500}$)

Percentage limestone or RA, by mass

- Reclaimed asphalt
- Limestone
- Reclaimed asphalt
- Limestone
Laboratory investigation – friction

Friction ($\mu_{PWS60}$)

Reclaimed asphalt
Limestone
Reclaimed asphalt
Limestone
Reclaimed asphalt
Limestone

Percentage limestone or RA, by mass
Laboratory investigation – friction

![Graph showing the relationship between friction (μ) and percentage limestone or reclaimed asphalt (RA), by mass. The graph compares reclaimed asphalt and limestone across different mass percentages.]
Laboratory investigation – friction

[Bar chart showing the friction (μPWS60) as a function of percentage limestone or RA, by mass. The chart compares reclaimed asphalt, limestone, and reclaimed asphalt-limestone mixtures.]
Laboratory investigation – friction

Friction ($\mu_{w60}$) vs. Percentage limestone or RA, by mass.

- Reclaimed asphalt
- Limestone

Graph showing the effect of percentage limestone or RA on friction for both materials.
Laboratory investigation – next steps

- Reclaimed asphalt from more stockpiles
- Addition of RA to other virgin aggregates
- Explore aggregate variability within stockpiles
- Reclaimed asphalt from surface course stockpile or planings
Scenarios

- Surface course RA
  - Original surface course properties well known, and meet requirements of new location.
  - Original surface course properties well known, but do not meet requirements of new location.
  - Original surface course properties not well known.

- Mixed RA
Scenarios

- **Surface course RA**
  - Original surface course properties well known, and meet requirements of new location. *No restriction on amount of RA.*
  - Original surface course properties well known, but do not meet requirements of new location.
  - Original surface course properties not well known.

- **Mixed RA**
Scenarios

- Surface course RA
  - Original surface course properties well known, and meet requirements of new location. **No restriction on amount of RA.**
  - Original surface course properties well known, but do not meet requirements of new location. **Dependent on virgin aggregate used. Predict blended friction using mass ratio formula.**
  - Original surface course properties not well known.

- Mixed RA
**Scenarios**

- **Surface course RA**
  - Original surface course properties well known, and meet requirements of new location. **No restriction on amount of RA.**
  - Original surface course properties well known, but do not meet requirements of new location. **Dependent on virgin aggregate used. Predict blended friction using mass ratio formula.**
  - Original surface course properties not well known. **Depends on new location requirement. If low/medium PSV required then no restriction on RA addition. If high PSV required then restrict to 10% unless lab investigation suggests otherwise.**

- **Mixed RA**
Scenarios

- **Surface course RA**
  - Original surface course properties well known, and meet requirements of new location. *No restriction on amount of RA.*
  - Original surface course properties well known, but do not meet requirements of new location. *Dependent on virgin aggregate used. Predict blended friction using mass ratio formula.*
  - Original surface course properties not well known. *Depends on new location requirement. If low/medium PSV required then no restriction on RA addition. If high PSV required then restrict to 10% unless lab investigation suggests otherwise.*

- **Mixed RA**
  - 10% restriction, for now.
  - Lab work suggests potential for relaxation.
Thank you

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Thank you

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TRL color palette

Main TRL PowerPoint colour swatches

Additional colors: gray scale

Diagram colors