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Pavement Materials

Rubber Recycling

Paulo Pereira

Head of Transport Infrastructures Research Group

Department of Civil Engineering - University of Minho – Portugal

Review of the state-of-the-art and -practice

Rubber Recycling in Road Pavements

- Used in the modification of the asphalt – wet process
- Used as aggregates in the asphalt mixtures – dry process

Wet process

- Rubber fixes the maltenes reducing the ageing of the binder
- Presence of crumb rubber allows increasing the binder content
  - Higher binder content produces asphalt rubber mixes with
    - Improved fatigue resistance
    - Improved reflective cracking resistance
  - Permanent deformation is ensured by aggregate gradation

Dry process – “only” used to consume crumb rubber. Reduced performance

Contribution to develop more sustainable pavements

Rubber contributes to the development of more sustainable pavements

- **Higher fatigue life and higher reflective cracking resistance**
  - **Lower life cycle costs**
  - **Lower overlay thickness (important in urban areas)**
  - **Less maintenance operations**
  - **Less use of new materials (aggregates and asphalt)**
- **The use of suitable aggregate gradations**
  - **Less noise**
  - **More friction**

Current gaps in knowledge

More efficient pavement design methods

- **Mainly for new pavements, not only based on fatigue performance**
- **But also for pavement overlays**

Binder-aggregate interaction characterization

- **How to improve that interaction**
- **Effect of moisture on that interaction and on the AR mixtures**

Asphalt rubber mixtures

- **Compaction at low temperatures (night, winter)**
- **Recycling of asphalt rubber mixtures**

The main research questions

More efficient pavement design methods

- **Why fatigue life is not enough to predict AR pavement life?**
- **Are the shift factors needed to predict AR pavement life?**
- **Is the continuous damage approach valid for AR pavements?**
- **Which mechanisms must be considered to study overlay performance?**

Which laboratory test must be developed to evaluate reflective cracking?

Linear viscoelastic approach is adequate to study pavement performance?

The main research questions

Asphalt-rubber-aggregate interaction characterization

- **How do the asphalt and the crumb rubber interact?**
- **What factors can improve asphalt-crumb rubber interaction?**
- **How do the binder (asphalt-rubber) and the aggregates interact?**
- **What factors can improve binder-aggregate interaction?**

How to develop a model to consider moisture? Which test must be used to study moisture? How can moisture be modelled?

How can ageing be studied separately during AR binder and AR mixture production phases? Which test should be used to assess AR ageing?

How do the constituents of the AR mixture interact at a microstructural level (chemical, physical and microscopic analysis)?

How can AR mixtures be used in roundabouts (ravelling)?

The main research questions

Asphalt rubber mixtures

- **Which materials/additives can be used to reduce AR viscosity at production temperatures?**
- **What is the lowest air temperature for compaction of AR mixtures?**
- **Is recycling of asphalt rubber mixtures feasible?**

How does new asphalt rubber binder interact with the old asphalt rubber (AR recycling)?

The maltenes protection (lower aging) is kept valid in asphalt rubber recycling?

Is it possible to develop AR mixtures with higher performance based on the microstructural evaluation of its constituents? Their interaction can be improved to prevent some distresses?