

HIGHRAP PROJECT RESULTS

"Highly Recycled Asphalt Pavements" full report: <https://www.empa.ch/web/s308/highrap>
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Objective: Develop recommendations for high asphalt pavement recycling

FULL-SCALE RAP CRUSHING AND SCREENING EXPERIMENT

- Max Reclaimed Asphalt Pavement (RAP) content can be limited by too much fines in RAP
- Chunk, Breakdown, and Filler increase (CBF) indexes allowed to quantitatively characterize RAP processing using sieve analysis. Calculator developed and available

FULL-SCALE MILLING EXPERIMENT

- RAP did not age during milling
- Aggregate angularity did not change during milling
- RAP agglomerations increase with increasing speed and less filler is generated

RAP CHARACTERIZATION

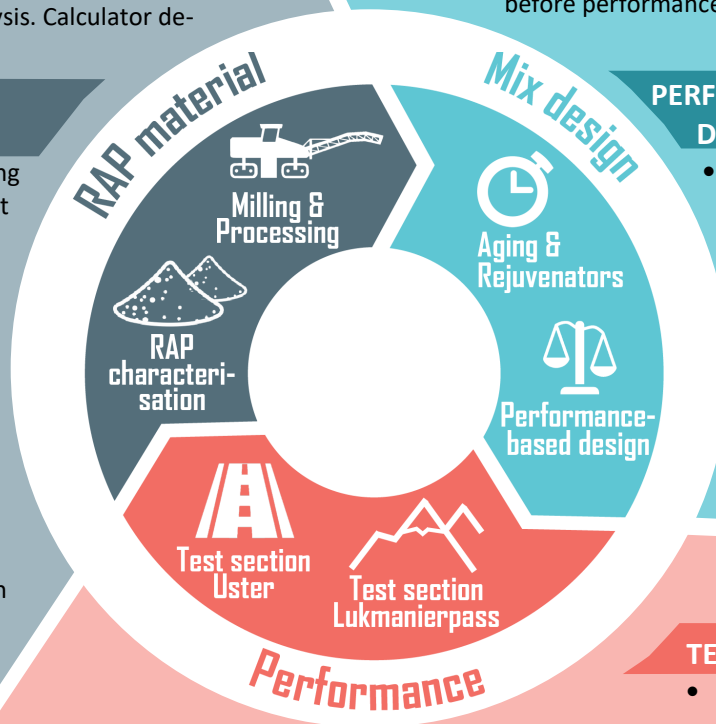
- The current RAP test methods are inefficient
- In some cases RAP was not homogeneous
- Fragmentation and Cohesion tests evaluated but further research is necessary to develop rapid RAP characterization tests

REJUVENATOR SELECTION & MIX AGING RESISTANCE

- Dosage based on penetration. Calculator developed & available
- RTFO+2xPAV aging simulated RAP binder properties
- Rejuvenated binder blends—not prone to accelerated aging
- No aging for lab mixes required to replicate plant-production before performance tests

PERFORMANCE-BASED MIX DESIGN

- Cracking test (SCB) and plastic deformation test (CC or Marshall) used to optimize binder content
 - Conventional mix design requirements mostly fulfilled
 - Additional binder and mixture used to confirm the final designs (e.g. low-temperature cracking test, FRT, BTSV, Glover-Rowe test, MSCR)



TEST SECTION ON HIGH TRAFFIC (T3) STREET

- 30 % RAP used in wearing course with good performance in PmB 45/80-80 grade; with 60% RAP not possible to reach this grade
- 40-50 % RAP likely allows to reach PmB 45/80-65 grade
- 65% RAP used in unmodified binder course—with good performance

TEST SECTION AT >1900M

- 85 % RAP was used in foundation course mixtures with good performance
- 60-70 % RAP was used in base course with good performance
- Good thermal cracking resistance for all mixtures

RECOMMENDATIONS

- Use RAP ≤ 30 % in PmB wearing course (PmB 45/80-80) and ≤ 50 % in PmB base/binder course (PmB 45/80-65)
- Use RAP in high altitude ≤ 70 % in base/binder course and ≤ 85 % in foundation course
- (Higher RAP contents can be considered with proof of performance)
- Permit high RAP use only if high RAP homogeneity of RAP is ensured (especially binder content & properties)
- Use performance-based mix design for type testing (testing of cracking resistance is especially important)
- Select rejuvenator dosage based on target penetration
- Approve rejuvenator/soft binder by testing aging resistance (RTFO+2xPAV): test mass loss & penetration
- Ensure correspondence to conventional extracted binder & mixture test requirements
- Consider MSCR binder test for RAP use in PmB mixtures
- Use CBF indexes to optimize RAP crushing and screening
- Consider using high-PmB to reach the target PmB grade
- Implement these recommendations after local validation

PARTICIPANTS



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