REVIVE ASPHALT REJUVENATOR

USED FOR HIGH RAP MIXES

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Using recycled materials to replace virgin aggregates, asphalt will reduce both the energy consumed and CO$_2$ produced during raw material extraction and processing,” says Dr. J. Richard Willis, NCAT associate research professor.

“Additionally, using the combination of recycled materials and local materials reduces energy required to transport raw materials and the asphalt mixture.”
Recently there have been an increasing number of state highway agencies reporting pre-mature cracking in relatively new asphalt pavements. A similarity in many of these pavements is the high content of recycled asphalt binder.
WITH THE USE OF A REJUVENATOR

- What is a Rejuvenator
- Rejuvenators
  - Oils that mix with the hard aged asphalt to soften it
- Pavement oxidation
  - The asphalt in the pavement continually get stiffer with age until it cracks excessively
WHY USE A REJUVENATOR

- **Economics**
  - High return on utilization of RAP stockpiles
  - Reduces working capital needed for asphalt inventory

- **Engineering**
  - Restore properties of aged oxidized asphalt mixes
  - Improved mix flexibility

- **Environmental benefits**
  - Reduce consumption of raw materials (aggregate, asphalt binders and reduce or eliminate volatile organic compounds - VOCs)
THREE MAIN TYPES OF REJUVENATORS

• Renewable Bio-based Rejuvenators 🌿
  ◦ REVIVE
  ◦ No VOCs formula

• Aromatics
  ◦ Hydrolene, Reclamite, etc.

• REOBs
  ◦ refined engine oil bottoms, refined waste materials, refined waste fast food vegetable oils
REJUVENATOR MIX DESIGN PROCESS

- Select rejuvenator type
- Select rejuvenator dosage range through balancing both PG and aging requirements of rejuvenated binder
- Finalize rejuvenator dosage through balancing rutting (HWT) and cracking (Ideal-CT) or (ITS) requirements of asphalt mixture
Softened 2 Grades starting with 64-22

REVIVE

<6% ADDITIVE NEEDED
- ORIGINAL AND RTFO DSR
  in spec
- RTFO MASS LOSS
  easily in spec
- BBR Slope
  easily in spec
- BBR STIFFNESS
  easily in spec

8.8% ADDITIVE NEEDED
- ORIGINAL AND RTFO DSR
  in spec
- RTFO MASS LOSS
  Out of spec high
- BBR Slope
  easily in spec
- BBR STIFFNESS
  Out of spec high
- CANNOT MEET PG 52-34 PG GRADE

Aromatics and REOBS

12.8% additive needed
- Original and RTFO DSR
  in spec
- RTFO Mass Loss
  easily in spec
- BBR Slope
  easily in spec
- BBR stiffness
  Out of spec high
- May meet PG 52-34 grade with more additive
MIX TESTING

ITS – INDIRECT TENSILE STRENGTH

Stiffness indicator
TENNESSEE DOT
MIX PERFORMANCE EVALUATION

PERFORMANCE OF A BITUMINOUS ASPHALT MIXTURE WITH THE AID OF REVIVE 1114 LIQUID ADDITIVE REJUVENATOR

- Performance evaluation methods
  - Ideal –CT for crack resistance (Generally a value of 70 has been recommended by NCAT and is currently in the VDOT Spec.)
  - Rutting – Hamburg Wheel Rut Test (HWT) less than 12mm @ 20k passes
  - Current TDOT Spec. 20%, Max Binder Replace

- Current TDOT 411D Asphalt Design
  - Replaced Asphalt Binder (14.9%)
  - 7% RAP  3% RAS
  - TSR – 80.6

- High Rap 411D Asphalt Design
  - Replaced Asphalt Binder (28.5%)
  - 22% RAP  3% RAS
  - TSR - 82.4
RESEARCH CONCLUSIONS

• HIGH RAP MIX DESIGN OUT PERFORMED CURRENT TDOT 411-D MIXES

• IMPROVED IDEAL CT CRACKING TEST AND PERFORMED WELL IN THE RUTTING TEST.

• THE LONGITUDINAL JOINTS PERFORMED BETTER USING REJUVENATOR

• GIVEN THESE RESULTS MAKES WAY FOR TDOT DISCUSSION OF A MORE BALANCED MIX DESIGN.

• 2017 TDOT HAD 1,081,220.02 TONS OF MIXES, PUT IN PLACE, CONTAINING ANTI-SKID MATERIAL WITH AN INDUSTRY AVERAGE RAP USAGE OF APPROXIMATELY 9%.

• IF INDUSTRY COULD INCREASE THE RAP USAGE BY AN AVERAGE OF 20% MORE, IT WOULD AID A DEPLETING RESOURCE OF ANTI-SKID MATERIAL BY STRETCH IT ANOTHER 110,000 TONS THRU THE USE OF MORE RAP, EACH YEAR.

• IN TERMS OF $, IT WOULD GIVE TDOT ANOTHER $2.5 - $3 MILLION TO WORK WITH EVERY YEAR, JUST BY REPLACING STONE WITH RAP. PLUS ANOTHER $4.3M IN BINDER SAVINGS.

• WITH THE MAIN IDEA OF GETTING QUALITY ROADS IN RETURN.
WASHINGTON STATE GREAT NORTHWEST CONTRACTORS RECOGNIZE BENEFITS OF REVIVE 1114

- Binder replacement increased to 30% in most cases and up to 40%
- Revive reduces the stiffness of the binder preventing premature cracking
- Increased mix workability in the field with the benefits of density improvements
- With the addition of Revive the ODSR’s align with the original desired binder grade ODSR
- Revive dosage ranges from 1.0% to 4.8% (bwvb) by weight of virgin binder
- Rap usage increased 10 to 20%
- 40% binder replacement currently limited by state DOT
- Reduction in overall mix cost
- Contractors plan to increase product usage for increased profitability
REVIVE Rejuvenator

ENVIRONMENTAL

REDUCED EMISSIONS @ HMA PLANT AND PAVER
REDUCED CONSUMPTION OF RAW MATERIALS, ASPHALT CEMENT, AGGREGATES, ENERGY CONSUMPTION, TRUCKING FOR EVERY 150,000 TONS OF HMA PRODUCED WITH AN INCREASE IN 15% RAP
Reduce consumption of Virgin Asphalt Binder by 2,700 Tons or 108 TL Delivered from Terminal To HMA Plant

PERFORMANCE

OXIDIZES AT LOWER RATE THAN VIRGIN BINDER
ORIGINAL AND RTFO DSR IN SPEC
RTFO MASS LOSS EASILY IN SPEC
BBR SLOPE AND BBR STIFFNESS EASILY IN SPEC
REDUCED EXCESSIVE AGING AS A RESULT OF INCREASED USE OF OXIDIZED ASPHALT
INCREASED WORKABILITY
LONGER TRANSPORT TIMES
COLD WEATHER PAVING (NIGHT WORK)
HIGHER PRODUCTION RATE