Life-prolonging preventive maintenance techniques for porous asphalt

Objective: Increase service life PA by preventive maintenance

The end of service life of Porous Asphalt (PA) is determined by excessive loss of stones from the surface, called raveling. Raveling is caused by a complex of factors like possible drainage of the mortar (transport, construction, early life), direct loading via the stones, water pressure under the tire, accelerated aging of the bitumen from the surface, crumbling, etcetera. In the field raveling mainly occurs after the bitumen in the top of the PA layer is strongly aged. Due to the ageing of the bitumen, the mortar bonding bridges between the stones become more brittle, which makes them more sensitive for (micro) cracks, erosion, adhesion loss between stone and the mortar, which probably will lead to raveling.

Traditional maintenance scheme
At the moment the standard maintenance strategy for PA is as follows. Due to the heavy loading of the slow lane, this lane has to be replaced on average after 11 years. The fast lane(s), however have an average service life of 17 years. So the PA layer of the slow lanes is milled of and a new PA inlay is placed. After 17 years carriageway wide PA is replaced with new PA. All the lanes (emergency, slow, fast lanes) are paved hot to hot together in one run with echelon pavers. This is not a satisfying maintenance strategy, as the new PA inlay of the slow lane has to be replaced far too early.

Preventive maintenance with rejuvenators
The service life of existing PA in the slow lane can also be extended with a preventive maintenance measure by adding bitumen from the surface, which could fill and heal micro-cracks, rejuvenate the aged bitumen in the mortar and add bitumen to the mortar bonding bridges. In case of a balanced approach the functional properties will stay intact, because the air voids content will hardly change.

Rijkswaterstaat (RWS) has challenged the Dutch entrepeneurs to develop life prolonging preventive maintenance techniques for PA based on rejuvenators. Three potential rejuvenating products, that could fulfill the requirements of RWS, were offered:
- Pentack® of producer ESHA (bitumen emulsion system), applied by ESHA
- Modiseal® ZX of producer Latexfalt (hot polymer modified bitumen), applied by contractor BAM
- Modimuls® ZV of producer Latexfalt (bitumen emulsion system), applied by contractor Heijmans.

Lab research on rejuvenators
The microscopic observations clearly show that products Modiseal ZX and Modimuls ZV are viable as bitumen addition at the mortar bonding bridges. The mortar bonding bridges are surrounded with new bitumen and they also fill micro-cracks. With the same technique no separate bitumen could be detected on the Pentack samples.

With UV-lightning used by ESHA it can be shown that Pentack also adds bitumen to the mortar of Porous Asphalt.

Lab research on rejuvenators
CT (nano) scan & Microscope

The microscopic observations clearly show that products Modiseal ZX and Modimuls ZV are viable as bitumen addition at the mortar bonding bridges. The microscope observations clearly show that products Modiseal ZX and Modimuls ZV are viable as bitumen addition at the mortar bonding bridges. With the same technique no separate bitumen could be detected on the Pentack samples.

In-situ research on rejuvenators
Laser Crack Measurement System (LCMS)
A Laser Crack Measurement System (LCMS) is used to determine raveling on Porous Asphalt. The system acquires high-resolution 3D measurements of road surfaces by means of high-speed laser triangulation. The maintenance system is capable of determining the pavement type, measuring the amount of raveling and remaining service life on Porous Asphalt in the Netherlands. Every year LCMS measurements are conducted on every Dutch Highway, giving information about the raveling rate. The end of service life of Porous Asphalt is reached when the stone loss is 25%. Traditionally, after 11 years the PA layer of the slow lane is milled and a new PA inlay is placed. In the new preventive maintenance scheme, using the data from the LCMS measurements, after approximately 5 years a rejuvenator is preventive sprayed on the slow lane which delays the raveling process. This will increase the service life of PA with at least 4 years.

Conclusion
The 3 rejuvenators can be used as an innovative, preventive & cost affective maintenance method for PA.