Focus area Multi-Scaling and Microstructure of road materials

The research focus area “Multi-Scaling and Microstructure” investigates road materials at a fundamental scale where performance enhancing or limiting phenomena find their origin. The goal is to further the fundamental understanding of:

- Road materials behavior with respect to environmental effects such as water and temperature.
- Interaction of bitumen with other substances, in particular with minerals
- Targeted development of modern road materials

Microstructure

In order to characterize the microstructure of asphalt concrete, environmental scanning electron microscope (ESEM) and optical microscope and computer tomography have been used. Other methods are continuously investigated for their suitability for asphalt concrete materials. Research conducted has shown that well performing and sub-optimally performing pavements display evidence of suboptimal microstructure that could lead to premature failure. Microstructural features due to different compaction methods, polymer modification and homogeneity of void structure can be investigated.

Micro-tensile tests

At Empa using a developed in-house test setup the tensile behavior of viscoelastic bitumenous films confined between mineral aggregates or steel as adherends, can be investigated in the brittle and ductile regimes. Uniaxial specimens can be fabricated employing a prototype set up developed in this group allowing construction of micro-scale thin films and visualization of failure phenomena. The effect of key parameters, namely, temperature, binder type, adherend type (stainless steel and mineral aggregate), and water conditioning can be investigated.

Multi-Scaling

In cooperation with other focus areas in the lab, information obtained from the microstructural, micro-tensile and other related characterization techniques is used to determine the origin of performance limiting or enhancing phenomena. Examples of materials of current interest are porous asphalt, recycled asphalt and multi functional pavement materials.

Selected publications


3. dos Santos, S., Poularakos L.D. and Partl, M.N. Crystalline structures in tetracosane-asphaltene films RSC Advances 2016, 6, 41561


ESEM micrograph of a porous asphalt concrete sample showing formation of microcracks during compaction and formation of fibrils at the edge of aggregates due to polymer modification.

3D reconstruction of the void phase from CT-scan of porous asphalt