Session of "Fokus Materialchemie" – Wednesday, **14.01.2026** 14:00
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Characterization and Efficiency of Rejuvenators in restoring Reclaimed Asphalt Pavement

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Bitumen is an important construction material, used not only in the paving industry, but also as a waterproof sealant. As it is derived from crude oil, it is highly susceptible to oxidative and lightinduced ageing, which causes changes to its chemical composition. These factors lead to the degeneration of bitumen over its lifespan and result in material failure. In particular, the top 5 cm of the asphalt surface course includes these heavily aged materials and needs to be removed regularly. This material is called reclaimed asphalt pavement (RAP). Recycling and reusing these RAP materials is crucial to establishing a more sustainable road industry. However, due to the aforementioned ageing processes, it is not possible to recycle bitumen directly as its properties have changed and need to be restored. One method of achieving this is to use rejuvenators — mostly low-viscosity oils derived from vegetable oils or wood residues — to restore the chemical and physical properties of the bitumen, enabling it to be reused in a circular pavement economy.

This study aimed to characterize different commercially available rejuvenators based on literature and information provided by manufacturers, as well as the targeted use of spectroscopic methods, particularly infrared spectroscopy (IR). The categorization scheme derived from this study was based on the origin and main functional groups of the corresponding additives. Two groups of additives (acidic and saturated/unsaturated esters) were then studied in more detail in terms of their susceptibility to ageing using IR, nuclear magnetic resonance spectroscopy (NMR), electron paramagnetic resonance (EPR) and fluorescence spectroscopy (FS). Furthermore, the compatibility of these additives with bitumen was assessed using the Hansen Solubility Parameter (HSP) and Differential Scanning Calorimetry (DSC). Another goal was to highlight the limitations of the methods employed and adapt them for the more complex task of determining the oxidation state of the bitumen and additives in the mixture.