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3s2 Supply chain transition: managing tools and sustainability assessment of innovations

MINIMISING ENVIRONMENTAL IMPACTS WHILE MAXIMISING RESOURCE CIRCULARITY: THE CASE OF BIOBASED ASPHALT

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Given the current threats of climate change and resource scarcity, it is paramount to develop new products that minimise impacts on the environment and maximise the circularity of resources. While these two goals are usually aligned, some cases, like biobased asphalt applications, present particular challenges. For instance, recycling is the best end-of-life option from a resource efficiency perspective. However, landfilling of biogenic non-degradable material leads to permanent carbon sequestration. To fully understand the potential benefits and impacts of biobased circular innovations, we need metrics able to capture their complexity from both a circular and environmental point of view. This study explores the impacts and benefits of lignin-based and bitumen-based asphalts by applying a combination of metrics, including a circularity and biogenic carbon storage (BCS) assessment, to different types of lignin-based and bitumen-based asphalts.

Three different asphalt mixtures are assessed: Stone Mastic Asphalt (SMA), Asphalt Concrete (AC) and Porous Asphalt (ZOAB in Dutch), under two scenarios: lignin-based and bitumen-based. The analysis is done by calculating the Material Circularity Index (MCI) and a newly developed indicator quantifying the BCS of products after a definite amount of recycling cycles (over a 100-year time horizon). The results are also compared to the carbon footprint and ECI (environmental costs indicator) calculated with life cycle assessment. The results indicate that lignin-based AC asphalt has the highest circularity value due to its higher recycled content. When looking at the ECI and climate change indicators, lignin-based AC asphalt also stands as the option with the lowest impacts, showing good alignment with material circularity. However, the BCS analysis revealed higher biogenic carbon storage for ZOAB asphalt due to the higher amount of biogenic material permanently landfilled in a 100-year time horizon.

Through the case of biobased asphalts, this study explores the role of different indicators in measuring the effects of circular strategies and provides a discussion on which combination of indicators can be best used to avoid burden shifting and consider trade-offs in biobased supply chains.

Keywords: circular economy, biobased, asphalt, metrics, carbon