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Opening letter of RILEM TC 325-APS: Investigating the sustainability of alternative paving materials

Davide Lo Presti[1*], Emmanuel Chailleux[2], Rita Kleizienė[3], Ana Jiménez del Barco Carrion[4], Joao Santos[5], Pamela Haverkamp[6], Kamilla Vasconcelos[7], Katarina Varveri[8], David Hernando[9], Anand Sreeram[10], Filippo Giustozzi[11], Cesare Sangiorgi[12]

[1]Chair of TC 325-APS, University of Palermo, Italy
[2]Deputy chair of TC 325-APS, University Gustave Eiffel, France
[3]Vilnius Gediminas Technical University, Lithuania
[4]University of Granada, Spain
[5]University of Twente, The Netherlands
[6]RWTH Aachen University, Germany
[7]University of São Paulo, Brazil
[8]Delft University of Technology, the Netherlands
[9]University of Antwerp, Belgium
[10]University of Nottingham, United Kingdom
[11]Royal Melbourne Institute of Technology University, Australia
[12]University of Bologna, Italy

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Abstract

Material scientists and road pavement technologists recognize the potential for recycling and re-engineering end-of-life products to support the circular economy paradigm. The previous TC 279-WMR committee successfully investigated the utilization of waste and secondary materials in bituminous mixtures, generating significant interest and recommendations for their implementation in road construction. Building upon this foundation two RILEM committees have been established with the objective of developing a long-term strategy to minimize the use of conventional materials through the integration of alternative materials (AMs) engineered and re-used and/or recycled by incorporating them in bituminous mixtures, hence serving as Alternative Paving Materials (APMS) for surface layers. The present paper describes the vision of one of these committees, the technical committee APM-Sustainability (TC 325-APS), which will focus its efforts on assessing the sustainability of incorporating AMs within conventional bituminous paving materials with an approach linked to the following three technical groups (TGs): TG1 will look at developing *Life Cycle Sustainability Assessment* protocols for APMs to investigating their environmental, economic, and social impacts; TG2 will examine the *Recyclability Potential* of APMs; while TG3 will explore novel methods to identify and evaluate *Pollutants Risk Potential* associated with APMs. This comprehensive initiative aims to investigate the sustainability of adopting AMs in road construction, focusing the attention on the following selected APMs: recycled tire rubber, recycled plastics, and bio-based binders. The aims of the RILEM TC 325-APS aligns with Sustainable Development Goals 6, 9, 10, 11, 12, 13, 14, 15, 17 and with the principles of the circular economy and resilience. TC 325-APS is a multidisciplinary team with members from all over the globe, cooperating to provide practical recommendations and develop a long-term vision for the future of road construction materials.

Keywords: Pavement, Alternative materials, Alternative paving materials, Recyclability potential, Life cycle sustainability assessment, Life cycle analysis, Leaching, Toxicoology, Novel pollutants.

1 Introduction

The establishment of the RILEM Technical Committee on Alternative Paving Materials – Sustainability (TC 325-APS) is rooted in the critical global imperative of advancing sustainable infrastructure development. Bituminous mixtures have conventionally relied heavily on virgin aggregates and petroleum-derived binders, resources associated with

*Corresponding author: Davide Lo Presti, E-mail: davide.lopresti@unipa.it

considerable environmental, economic, and social burdens. Consequently, the paving industry increasingly seeks to reduce resource depletion, lower carbon footprints, and enhance circular economy practices through the integration of alternative paving materials (APMs). In other words, engineering is already at the service of the "circular economy" and it is already turning goods at the end of their service life into resources for many other products' cycles. However, the road pavement industry, society and governing bodies are still considering these end-of-life products as waste and secondary materials. The activities of the previous RILEM TC 279-WMR, aimed at commencing the fundamental research on the feasibility of incorporating waste and secondary materials in bituminous mixtures, have seen significant participation, proving the great interest of the sector in these topics, and their outcomes did provide enormous evidence and recommendations for valorising Waste and Secondary Materials for Roads (Cannone Falchetto et al. 2024). It is on this wave of enthusiasm and global participation that RILEM Cluster F, after few consultations, has identified two twin initiative TC 325-APS (Alternative Paving Materials – Sustainability and TC 323-323-APD (Alternative Paving Materials – Design and Performance) to build upon and lead towards a long-term vision contemplating the reduction of raw materials as well as the possible phasing-out of bituminous materials within the built environment of a post-fossil fuel society.

1.1 Background

The opening letter of TC 323-APD (Cannone-Falchetto et al. 2025) provides a comprehensive technical foundation for this effort. Furthermore, numerous scientific studies highlight significant knowledge gaps in the comprehensive sustainability of maximizing "Alternative materials" (AM) content in bituminous mixtures, serving as Alternative Paving Materials (APMs). Notably, the absence of comprehensive Life-Cycle Sustainability Assessment (LCSA) methodologies, which consistently include environmental, economic, and social factors across clearly defined system boundaries, limits the accuracy and reliability of current sustainability evaluations (Costa et al.,2019; Hackenhaar et al., 2024). Additionally, the performance-sustainability trade-offs inherent in utilizing high proportions of recycled materials are poorly understood, especially concerning long-term durability, fatigue resistance, moisture susceptibility, and rutting performance (Brito et al., 2016; Shi et al., 2023). Furthermore, the variability in the sources and qualities of AMs highlights the urgent need for standardized testing protocols and validated field-scale trials to ensure consistency and safety across diverse applications (APSE, 2017). Similarly, although initial studies indicate the feasibility of recycling bituminous mixtures containing reclaimed materials like eclaimed asphalt pavement (RAP), recycled plastics, and crumb rubber, significant uncertainties remain regarding their subsequent recycling cycles and long-term performance retention (Bilema et al., 2021; Bocci et al., 2023; Vijayan et al., 2024; Lopez-Montero et al., 2025). Systematic research into recyclability will not only validate the potential environmental and economic benefits of repeated reuse but also identify potential technical limitations, such as the progressive degradation of material properties or challenges in rejuvenation processes ((Kim et al., 2025)). Thus, comprehensive recyclability assessments will enable more informed decisions, optimize resource efficiency, reduce environmental impact, and support sustainable pavement management strategies. Furthermore, the European Asphalt Pavement Association (EAPA) has flagged emerging risks, such as microplastics and additive leaching released from ageing pavements—a concern demanding rigorous environmental and human-health impact assessments (EAPA, 2023). Addressing these gaps through systematic research is essential for realizing the full sustainability potential of maximizing AM content in pavement materials.

This calls for an interdisciplinary approach transcending traditional boundaries of civil engineering and materials science. As such, RILEM TC 325-APS intentionally positions itself as a multidisciplinary, cooperative international platform, bringing together experts in material science, chemistry, chemical engineering, civil engineering, biology, environmental science, and other related disciplines.

1.2 TC 325-APS vision

To begin with, the proposed TC offers a clear shift in terminology. Rather than focusing on waste and/or secondary materials (as in TC WMR), the terminology will consider paving material 'alternatives' to the conventional bituminous mixtures. Furthermore, this TC will aim at investigating the SUSTAINABILITY of using APMs as full and/or significant partial replacement of conventional components of bituminous mixtures, such as aggregates, bitumen, synthetic polymers and any other fossil-fuel derived additive/admixture, with indeed AMs and will assess the Sustainability of incorporating them in bituminous mixtures to serve as APMs for surface layers. The initial target is to replace at least 25% of each conventional bituminous mixture component with AMs. However, whenever possible, each task group targets to practical recommendations for a broader implementation of APMs engineered with full replacement.

To align with Sustainable Development Goals 6, 9, 10, 11, 12, 13, 14, 15, 17 and the principles of the circular economy and resilience of paving materials in a post-fossil fuel society, this comprehensive initiative aims to promote the adoption of fossil-free materials in road construction and it will focus the attention on selected AMs only: *recycled tire rubber, recycled plastics, and bio-based binder*. Recycled tire rubber and recycled plastics already hold a higher technology readiness level and have also been partially investigated by TC 279-WMR (Presti et al., 2023). TC 325-APS will complete the remaining research questions on the sustainability of these APMs. This is not the case for bio-based materials, which have never been investigated within RILEM Cluster F TCs and thus will be included for the first time in TC 325-APS and TC 323-APD.

1.3 Gathering feedback from CLUSTER F

This approach was supported by the RILEM Cluster F scientific community that initiated two parallel committees: APM-Sustainability (TC 325-APS) and APM-Design & Performance (TC 323-APD). Also at later stage, and within a specific interactive Workshop delivered during the annual meeting at TU Delft, 2-4 October 2024, the attendees have been grouped into smaller discussion groups to gather indications related to the structure of the TC 325-APS and overall to the main goal of assessing the Sustainability of incorporating AMs in bituminous mixtures to serve as Alternative Paving Materials (APMs). The main outcomes of the discussion are listed below:

- Bituminous mixture recyclability is an important feature; will the APMs be reusable and recyclable?
- Recycled plastic modified asphalt (RPMA) has a risk of emitting microplastics due to degradation of bituminous materials. It is necessary to set up indicators related to microplastic release.
- Application of APMs is complex because of regulation issues related to the risk of new material performance.
- During the production and compaction of Crum Rubber Modified Asphalt (CRMA) mixture at high temperatures (160-200°C), the emission of Volatile Organic Compounds (VOCs) and Polycyclic Aromatic Hydrocarbons (PAHs) is typically observed. Some VOCs are classified as hazardous air pollutants (HAPs) and may cause respiratory issues, whereas PAHs are carcinogenic (e.g., benzo[a]pyrene), and therefore, might impose negative social impact on road workers.
- Bio-based binders often contain light organic compounds, and their health impacts deserve careful consideration, especially as their use increases in paving applications (workers safety).
- The processing of biomass and bio-based binders must be considered since it involves treatment of organic materials. Although their processing is generally more sustainable than petroleum-based bitumen binder, toxicity risks do exist.
- Transporting alternative paving materials (e.g., crumb rubber, recycled plastics, bio-based binders) poses unique logistical, environmental, and economic challenges compared to traditional components for surface layers of flexible pavements.
- AMs like crumb rubber, recycled plastics, and bio-based binders are promoted for sustainability, but their potential health impacts on workers and on nearby residents must be carefully assessed. Specific aspects such as the release of microplastics or the potential toxicity of processing biomass should be assessed.
- Assessing the social aspects of these materials is considered a difficult, yet necessary exercise to be carried out.
- Social assessment should be considered, and public trust, especially from road users and drivers, must be earned. This is a critical social factor when adopting APMs. The perception of safety, durability, and reliability can directly influence the success of sustainable infrastructure.
- APMs have the potential to reduce waste disposal, but they are not automatically cheaper than conventional materials. In fact, initial costs often increase due to processing, quality control, and logistics. Assessing the economic dimensions is a key aspect.

1.4 TC 325-APS approach and structure

In compliance with the gathered feedback and due to the complex nature of this effort, TC 325-APS intends to evolve towards a multidisciplinary team made of material scientists, chemists, chemical engineers, civil engineers, biologists, and others. The TC 325-APS aims to be an international cooperative platform, expanding RILEM membership and influencing beyond traditional civil engineering and materials science sectors to answer the fundamental question: "Is maximizing the content of AMs in bituminous mixtures sustainable?" Three problematics will be addressed in the TC. The first one deals with benchmarking of the environmental, economic and social impacts of bituminous mixtures with and without APMs. The second one deals with methodologies to assess the recyclability potential of APMs, by first defining the recyclability potential of any bituminous mixtures. The third deals with potential environmental and health concerns linked to the risk that incorporating AMs could create novel pollutants. These three problematics structure the TC 325-APS in three technical groups (TG), as depicted in the figure below and described in the next sections.

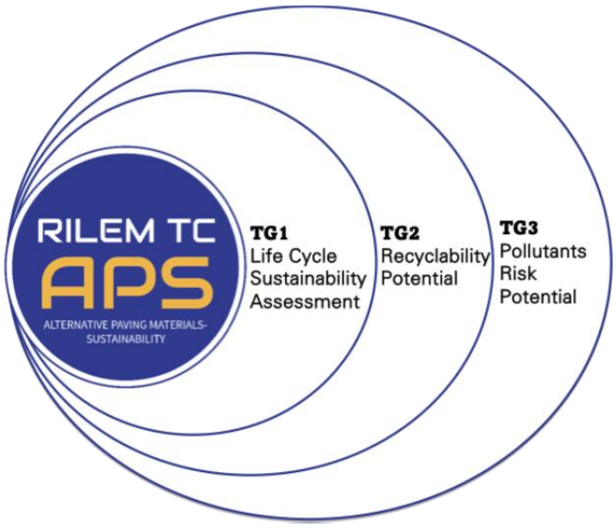

Figure 1. TC 325-APS approach and structure.

2 TG1 – Life cycle sustainability assessment

What is the environmental, economic, and social impact of increasing the content of Ams within the bituminous mixtures?

Due to current sustainability concerns, the utilization of AMs in new bituminous mixtures should not only be proven to be mechanically feasible but also sustainable. Life Cycle Sustainability Assessment (LCSA) is a powerful tool to evaluate such requirement. For any civil engineering work or product, LCSA is defined as a "combination of the assessments of environmental, social and economic performance taking into account the technical requirements and functional requirements of a civil engineering work or an assembled system (part of works), expressed at the civil engineering works level" (EN 15643-5).

In the road pavement sector, LCSA exercises are still dependent on the assumptions of each analyst, which makes their results not trustworthy for stakeholders to use them for decision-making. This situation is more extreme when APMs come into play. In this regard, LCSA exercises should be standardized, understandable and accessible for every practitioner.

Within this framework, TG1 aims at advancing the development of the LCSA of bituminous mixtures containing specific AMs. For this purpose, this TG is built upon the research initiated by TG4 of TC 279-WMR, to assess the environmental impact of bituminous mixtures with waste and secondary materials and extend to economic and social assessment. This TG will explore materials with and without selected APMs, namely recycled tyre rubber, plastics and bio-based binders. The main objective is to enrich existing methodologies through extensive data collection and LCSA studies, implementing a cradle-to-gate approach.

2.1 Challenges

The development of this TG is associated with three primary challenges: 1) Integrating the three pillars of sustainability within LCSA poses a significant difficulty, as each dimension—environmental, economic, and social—is currently at a different stage of methodological maturity. In particular, Social Life Cycle Assessment (S-LCA) remains underdeveloped in comparison to Life Cycle Assessment (LCA) and Life Cycle Costing (LCC); 2) Applying LCSA to APMs presents specific methodological challenges, notably in the definition of critical variables such as system boundaries, cut-off rules, and end-of-life scenarios. These aspects are often complex and context-dependent in the case of APMs; 3) Data collection for LCSA is a labor-intensive process, further complicated by the limited awareness among stakeholders regarding appropriate data collection protocols and intended use of the data. Additionally, there is often reluctance to share information, particularly in relation to social and economic impacts, due to confidentiality concerns or a lack of established metrics.

2.2 Methodology

There is no ISO standard that defines LCA as covering all three sustainability pillars, hence here we propose to use a LCSA framework with a unified, consistent boundary extending from raw-material supply through to plant manufacturing (A1-A3). This cohesive approach ensures direct transparency and comparability across all three sustainability dimensions, overcoming the siloed limitations of previous studies. This formulation is commonly used by UNEP/SETAC Life Cycle Initiative and uniquely integrates Environmental-LCA (ISO 14040/44), Social-LCA (UNEP/SETAC and ISO 14075), and Life Cycle Costing (LCC) (ISO 15686-5). The three-pillar framework is widely referred to as:

Life Cycle Sustainability Assessment (LCSA) = Environmental LCA + Life Cycle Costing (LCC) + Social LCA (S-LCA).

A data collection campaign is planned based on the design of an LCSA data collection tool (DCT) for bituminous mixtures, which will be designed by updating the previous tool developed for LCA data collection in Rilem Technical Committee TC 279-WMR. The DCT is designed to facilitate the systematic collection of data for phases A1–A3 (EN 15804). It will be distributed to all TG participants to ensure consistent data gathering across multiple case studies, including both conventional bituminous mixtures and mixtures incorporating APMs. Once the data are received, two exercises will be performed: 1) a benchmarking of the environmental, economic, and social impacts of bituminous mixtures (using the data from the conventional bituminous mixtures case studies, benchmarks will be defined); 2) a cradle-to-gate LCSA of bituminous mixtures containing AMs. Using the data of the case studies with APMs, their LCSA will be performed, and the results will be compared to the benchmarks obtained in the previous step. As far as the LCA is concerned, the

Team: The team is led by Ana Jiménez del Barco Carrión (University of Granada, Spain) and co-led by Joao Santos (University of Twente, The Netherlands) and Pamela Haverkamp (Aachen University, Germany).

Structure: TG1 has been divided into three subtasks, each dedicated to one pillar of sustainability, as follows:

- TG1.1 E-LCA (extending benchmarking values of environmental impact indicators, as defined in EN 15804)
- TG1.2 LCC (adds an economic perspective to the E-LCA by creating industry average values for economic indicators)
- TG1.3 S-LCA (creating databases related to newly proposed social impact indicators for bituminous mixtures)

Expected results: The expected outcomes of this TG are as follows:

- Development of a DCT tailored for conducting LCSA of bituminous mixtures, encompassing both conventional formulations and those incorporating APMs.
- Definition of sustainability impact indicators across the three dimensions of LCSA.
- Establishment of benchmarking values for all defined indicators, enabling consistent interpretation, comparison, and performance evaluation.
- Guidelines for reducing negative sustainability impacts, offering strategic insights and best practices for improving the overall sustainability profile of bituminous mixtures.

3 TG2 – Recyclability potential of APMs

Will incorporating Ams within the bituminous mixtures affect its recyclability potential?

3.1 Challenges

In the context of increasing environmental pressures and resource scarcity, recyclability has become a key concept in materials science, waste management, and circular economy strategies. A clear understanding of how recyclability is defined is essential for designing sustainable materials and evaluating the environmental performance of products.

The European Commission (2018) defines recyclability as "*the ability of waste materials to re-enter the production process in the form of new raw materials or products*". This definition emphasizes the functional reintegration of waste into productive cycles and reflects the broader goals of the circular economy: to reduce dependence on virgin resources and mitigate environmental impacts.

The International Organization for Standardization, ISO 18604:2013 standard provides a more operational perspective, describing recyclability as "*the ability of a material to be diverted from the waste stream through processes such as collection, sorting, cleaning, and reprocessing into raw materials for the production of new items*". This definition underscores the importance of systematic infrastructure—from waste collection to reprocessing—and implies that a material is only truly recyclable if these steps can be carried out effectively and economically without compromising material integrity.

The United Nations Environment Programme, UNEP (2013) frames recyclability as "*the extent to which a material can be collected, processed, and returned to the economic cycle with minimal loss of material quality and performance*". This view introduces a qualitative dimension by highlighting that high recyclability also depends on the preservation of material properties throughout the recycling process. This definition aligns with the growing emphasis on closed-loop recycling and maintaining high-value material flows within the economy.

Together, these definitions illustrate that recyclability in the context of APMs involves not only the technical feasibility of recovering and reprocessing these materials, but also the ability to preserve their functional properties, such as mechanical performance and durability, throughout the recycling process. Understanding and applying these perspectives is essential for evaluating the long-term sustainability of APMs and ensuring their compatibility with circular economy principles in road construction.

A key consideration in the evaluation of AMs for pavement applications lies in determining the appropriate focus of investigation. One approach is to study the alternative material in its virgin state, to understand its intrinsic properties and how it evolves, degrades, or ages when incorporated into a pavement mixture over time. Alternatively, emphasis could be placed on the recyclability and performance of aged mixtures already extracted from in-service pavements, regardless of their original composition. This latter perspective prioritizes the practical assessment of whether reclaimed materials, despite unknown or variable constituents, can be effectively reused in new pavement structures.

3.2 Methodology

There is no internationally recognized protocol to assess the recyclability potential of bituminous mixtures, hence a core group of TG2 established a round robin to evaluate different testing protocols using filed-RAP derived from APMs (named aRAP). Once defined the methodology will be extended to a wider group of participants using local aRAPs. In parallel, recognizing the complexity of field performance, the group also emphasized the importance of simulating aged conditions using an artificial aging protocol, thereby generating alternative RAP (named aRAP) for controlled testing. Additionally, the establishment of a performance benchmark was recommended to support comparative analysis.

Subsequent developments focused on identifying relevant testing methodologies for aRAP. The University of Antwerp proposed a multiphase analytical testing approach designed to accommodate diverse material behaviors. Central to these discussions were the precise definition of recyclability, specifically distinguishing between recyclability potential and recyclability efficiency. While the necessity of binder extraction and recovery remains a point of debate, the group highlighted that solubilization is often essential for comprehensive chemical characterization. Consequently, a recyclability assessment framework was developed to address the unique chemo-rheological properties of aRAPs. To further minimize bias, the group reaffirmed its commitment to blind testing and refined the scope of TG2 to critical performance-based research questions.

The operational phase involved significant international cooperation, coordinated by the shipping of aRAP1 (Université Gustave Eiffel, France), aRAP2 (University of São Paulo, Brazil), and aRAP3 (University of Minho, Portugal). Technical inquiries were raised regarding the efficacy of commercial recycling agents (RAs) across various aRAP compositions.

Innovative protocols shared by TU Delft represent a significant advancement, utilizing FTIR and DSC to characterize aRAPs without the need for traditional binder extraction. Finally, the group acknowledged the geographic variability of aRAP characteristics, emphasizing that safety and testing protocols must account for regional contaminants, such as asbestos and coal tar.

Team: The TG2 team is led by Kamilla Vasconcelos (University of São Paulo, Brazil) and co-led by Aikaterini Varveri (TU Delft, The Netherlands), David Hernando (University of Antwerp, Belgium) and Anand Sreeram (University of Nottingham, UK).

Structure: The group had made substantial progress toward experimental execution. The aRAPs were shipped in April 2025. The group outlined a two-phase experimental framework and forecast synergies with TC 323-APD:

- Task 2.1: Recyclability Potential protocol: aRAP1, aRAP2, and aRAP3 was sent to eight laboratories (in Belgium, Brazil, France, Italy, Portugal, The Netherlands, Spain and UK) so that different research groups could perform distinct tests on the same materials, with the objective of supporting the selection of the methodology to be proposed by TG2 (ongoing activity at the time of this paper preparation).
- Task 2.2: Interlaboratory study: a larger number of participants, in which each group will test their own aRAP will be using the Recyclability Potential protocol defined earlier.

Expected results: The expected outcomes of this TG are as follows:

- Literature review about "Recyclability potential of APMs".
- Testing framework for identifying aRAP composition and solvent selection.
- Proposed methodology for evaluating the recyclability potential of APMs.

4 TG3 – Pollutanta risk potential from APMs

Is there a risk of potential noxious substances being released by bituminous mixtures that incorporate Ams?

4.1 Challenges

Bituminous pavements are continuously exposed to traffic and environmental conditions throughout their service life, which can lead to the accumulation and generation of pollutants within the pavement structure. During rainfall, these contaminants and contaminants inherently released by the bituminous materials can leach into the underlying soil and potentially reach groundwater systems. Another emerging concern is the generation of microplastics from flexible pavements, primarily due to surface wear and abrasion under traffic loads. With the increasing incorporation of AMs such as crumb rubber, recycled plastic waste, and bio binders into bituminous mixtures, assessing whether these materials introduce additional environmental burdens through leaching and microplastic release is essential. Although these issues have started to gain attention among researchers, studies on the ecotoxicity of leachates and microplastics generated by road materials remain limited. Technical Group 3 (TG3) aims to address these knowledge gaps by assessing the environmental risks, particularly leaching, microplastic generation and ecotoxicity associated with APMs used in road pavements.

4.2 Methodology

The experimental work will be structured in consecutive phases. The first phase will involve leaching and ecotoxicity testing of individual, loose materials (i.e. crumb rubber, recycled waste plastic, bio-based binders, conventional bitumen and aggregates) sourced from various countries collaborating within TG3. The next phase will involve preparing compacted samples containing each type of AMs and conducting leaching and ecotoxicity testing. Finally, the generation and characterisation of microplastics from APMs under simulated wear conditions will be investigated. A key challenge is to ensure methodological consistency across different laboratories, particularly regarding sample preparation and test conditions. Thus, to ensure consistency across participating laboratories, TG3 will adopt the *United States Environmental Protection Agency, 2017. SW-846 Test Method 1315: Mass Transfer Rates of Constituents in Monolithic or Compacted Granular Materials Using a Semi-Dynamic Tank Leaching Procedure* as the standardised leaching protocol. Metals and polycyclic aromatic hydrocarbons (PAHs) present in the leachate will be analysed using inductively coupled plasma mass spectrometry (ICP-MS) and gas chromatography-mass spectrometry (GC-MS), respectively. The initial ecotoxicity screening will be performed using the Microtox test, a well-known and readily available test worldwide, which evaluates the inhibition of bioluminescence in marine bacteria. This testing will later be expanded to include a broader range of bioassays.

Team: The TG3 group comprises researchers from 12 universities across 11 countries, coordinated under the leadership of Filippo Giustozzi (RMIT University, Melbourne, Australia) and co-led with Cesare Sangiorgi from the University of Bologna, Italy.

Structure: As detailed previously, the first phase of the study will focus on leaching and ecotoxicity testing and is expected to span approximately one year. Seven of the 11 participating countries will be actively involved in experimental work, whereas the others will provide knowledge-based support and help with data analysis. A group of laboratories will carry out leaching experiments and analyse the chemical composition of the leachates, while ecotoxicology laboratories will assess the biological impact of the leachates through 54 standardized ecotoxicity tests. As a result, the following tasks have been identified:

- TG3.1 Analysis of leachates from AMs (assessing the potential release of leachates directly from AMs).
- TG3.2 Analysis of leachates from bituminous mixtures incorporating AMs (assessing the potential release of leachates from bituminous mixtures that incorporate AMs).
- TG3.1 Potential release of microplastics from APMs (review of procedures to artificially produce micro-plastics from APMs and their consequent analyses).
- TG3.3 Ecotoxicological impacts of leachates from APMs.

Expected results: The study is expected to:

- Identify trends in contaminant release from AMs sourced across different geographic regions.
- Evaluate the ecotoxicological risk of leachates on aquatic life and quantify and characterize microplastic emissions from APMs in road pavements.
- Based on these findings, TG3 will provide recommendations for the safe and environmentally responsible use of APMs in road construction.

5 Conclusions

RILEM TC 325-APS rises from years of dialogue opened within Cluster F and culminated in a tailored workshop whose key outcomes highlighted the importance of carrying on evaluating APMs for flexible pavement surface layers while trying establishing potential issues with recyclability, environmental and health risks (such as microplastic release, VOC and PAH emissions, and toxicity from bio-based binders), regulatory and performance-related challenges, and logistical issues associated with transporting AMs. The discussions also emphasized the need to assess social aspects, including worker safety, public trust, and user perception, as well as economic considerations, noting that APMs are not inherently cost-effective despite their waste-reuse potential. The road pavement scientific community, with both academia and industry, consider resolving the research questions mentioned above as fundamental and crucial steps for shifting towards alternatives materials, even before engineering well-performing bituminous mixtures incorporating them. Therefore, in cooperation with Cluster F leadership and the twin Technical Committee on Design of Alternative Paving materials (TC 323-APD), the RILEM TC 325-APS aims to be an international cooperative platform, expanding RILEM membership beyond traditional civil engineers and materials scientists, to investigate whether using APMs in road pavements is beneficial for current and future generations. The outcomes of this investigation will be operationalized through immediate practical recommendations as well as a long-term vision for the use of APMs in flexible pavements.

Statement

This article has been prepared by the TC chairs and TG leaders of RILEM TC 325-APS - Alternative Paving Materials – Sustainability

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Authorship statement (CRediT)

Davide Lo Presti: Conceptualization; Methodology; Writing – Original Draft; Writing – Review & Editing; Visualization; Project coordination. **Emmanuel Chailleux:** Writing – Original Draft; Writing – Review & Editing; Visualization; Project secretariat. **Rita Kleizienė:** Writing – Original Draft; Writing – Review & Editing; Project administration. **Ana Jiménez del Barco Carrion:** Methodology; Writing – Original Draft; Writing – Review & Editing. **Joao Santos:** Methodology; Writing – Review & Editing. **Pamela Haverkamp:** Methodology; Writing – Review & Editing. **Kamilla Vasconcelos:** Methodology; Writing – Original Draft; Writing – Review & Editing. **Katerina Varveri:** Methodology; Writing – Review & Editing. **David Hernando:** Methodology; Writing – Review & Editing. **Anand Sreeram:** Methodology; Writing – Review & Editing. **Filippo Giustozzi:** Methodology; Writing – Original Draft; Writing – Review & Editing. **Cesare Sangiorgi:** Methodology; Writing – Review & Editing.

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