Doctoral course on Asphalt Recycling

Date and location: 23 August 2025 (1 day), Hanoi, Vietnam

Overview of the course

This short course provides an in-depth understanding of asphalt pavement recycling techniques, their advantages, and their role in sustainable road construction. Participants will learn about hot, warm and, cold recycling, recycling additives, and an introduction to Life Cycle Assessment (LCA) for asphalt recycling. The course is designed for doctoral researchers as well as engineers, and professionals in the road construction industry who want to enhance their knowledge of sustainable pavement materials.
This course is based on recent scientific data described in the literature, as well as the recognized skills of researchers involved in these topics.

Objectives

The aim is to deepen students' knowledge in:
- Understand the importance of asphalt recycling in sustainable infrastructure development;
- Identify and explain the different recycling techniques used in asphalt pavement rehabilitation;
- Analyze the role of additives in enhancing recycled asphalt performance;
- Evaluate the quality control and performance assessment methods for recycled asphalt mixtures;
- Apply Life Cycle Assessment (LCA) to assess the environmental impact of asphalt recycling;

Target audience

The courses are aimed at doctoral/post-doctoral students in the field of asphalt materials and Highway Engineering, however, practicing engineers and professionals from highway sector will also tremendously benefit from participating in this course.

Prerequisites

Basic knowledge in civil engineering.

Program

SATURDAY (23 Aug.)			SATURDAY (23 Aug.)		
MORNING			AFTERNOON		
Lecture 1	• **Fundamentals and Techniques of Asphalt Recycling** ○ Introduction to asphalt recycling ○ Hot and Warm Asphalt Recycling. ○ Cold Recycling Techniques	Prof. Gabriele Tebaldi and Prof. Hassan Baaj	Lecture 2	**Recycling Additives, Performance, and Sustainability** ○ Recycling Additives ○ Performance and Quality Control ○ Introduction to Life Cycle Assessment (LCA)	Prof. Eshan Dave and Prof. Hassan Baaj

Detailed content

This course covers the fundamentals and advanced techniques of asphalt pavement recycling, focusing on hot and warm recycling through use of recycled or reclaimed asphalt pavement (RAP), cold recycling using foam

bitumen and emulsion as stabilizing agents, recycling additives (sometime referred to as rejuvenators), and sustainability assessment using Life Cycle Assessment (LCA). The morning session introduces asphalt recycling, discussing its benefits, limitations, and comparison with conventional pavement materials. It then delves into hot and warm asphalt recycling, explaining the production processes, material properties, and challenges such as binder aging and effects of mix storage time on properties. The session continues with cold recycling, detailing the principles, benefits, and applications of both foamed bitumen and bitumen emulsion in road rehabilitation. The afternoon session shifts to recycling additives covering rejuvenators that enhance the performance of recycled asphalt. The course also explores performance assessment and quality control, including laboratory and field-testing methods to ensure durability and structural integrity. Finally, it introduces Life Cycle Assessment (LCA) as a sustainability evaluation tool, highlighting environmental indicators like energy consumption, emissions, and resource efficiency. Case studies and discussions throughout the course provide practical insights into real-world applications and future directions for sustainable asphalt recycling.

Topic 1: Fundamentals and Techniques of Asphalt Recycling

1.1 Introduction to Asphalt Recycling

- Definition and significance of asphalt recycling
- Benefits of recycling: Environmental, economic, and technical aspects
- Comparison between traditional and recycled asphalt pavement

1.2 Hot and Warm Asphalt Recycling

- Hot Recycling
  - Definition and key principles
  - Processes in hot mix asphalt (HMA) plants
  - Reclaimed Asphalt Pavement (RAP) content and its effect on mixture properties
  - Mix design and material selection adjustments to incorporate RAP
  - Challenges: Binder aging, performance concerns
- Warm Recycling
  - Differences between hot and warm mix recycling
  - Technologies used in warm mix recycling
  - Advantages: Lower energy consumption, reduced emissions

1.3 Cold Recycling Techniques

- Cold Recycling with Foam Bitumen
  - Definition and principles of foamed bitumen
  - Process of foaming and mixing
  - Mechanical properties, field performance and mix design
- Cold Recycling with Bitumen Emulsion
  - Properties and benefits of bitumen emulsion
  - Mixing, curing, and compaction process
  - Applications and case studies

Topic 2: Recycling Additives, Performance, and Sustainability

2.1 Recycling Additives

- Rejuvenators: Restoring aged bitumen properties
- Mix design adjustments to incorporate rejuvenators
- Production adjustments for use of rejuvenators
- Dosage of recycling agents, performance and mixtures with high amount of RAP
- Case studies of additive applications

2.2 Performance and Quality Control

- Laboratory tests: Complex modulus, fatigue and fracture resistance
- Field monitoring and long-term performance assessment
- Specifications and guidelines for recycled asphalt use
- Canadian experience with recycled RAP

2.3 Introduction to Life Cycle Assessment (LCA)

- Definition and significance of LCA
- Environmental indicators: Energy consumption, carbon footprint, material reuse

- Comparison of asphalt recycling techniques using LCA
- Case study: Evaluating sustainability of different recycling approaches

Speakers

	***Dr. Eshan Dave*** is Professor of Civil and Environmental Engineering and Graduate Program Coordinator at the University of New Hampshire in United States. He is a Fellow of RILEM and the author of over 140 journal papers. His research focuses on improving the resilience of pavement infrastructure through the use of performance-oriented design and analysis coupled with use of life cycle assessment to make adaptation decisions. He received his bachelor's degree in civil engineering from the Sardar Patel University of India in 2001 and his MS and PhD from the University of Illinois in 2003 and 2009 respectively. He is convener of the cluster F of RILEM and member of the RILEM Bureau.
	***Dr. Gabriele Tebaldi*** is an Associate Professor in Construction of Road, Railways, and Airport at the Department of Engineering and Architecture of the University of Parma (National Scientific Qualification for Full Professor Position awarded in November 2017), he is also a Visiting Research Professor at the Department of Civil & Environmental Engineering of University of New Hampshire. Gabriele's research interests include asphalt recycling, performance of bituminous materials, pavement performance evaluation, use of byproducts in asphalt mixtures. Gabriele is a RILEM Fellow, and in RILEM he is a member of the Development Advisory Committee and Chairman of TC 308-PAR Performance-based Asphalt Recycling. Gabriele is Chairman of the European Asphalt Technology, Fellow Member of the Association of Asphalt Paving Technologists, Editor in Chief of the journal Road Materials and Pavement Design, and Associate Editor of the journal Materials and Structures.
	**Dr. Hassan Baaj** is a Professor and Director of the Centre for Pavement and Transportation Technology at the University of Waterloo, where he also serves as Associate Dean of Research and External Partnerships. He holds the Norman McLeod Chair in Sustainable Pavement Engineering. Dr. Baaj earned a Master's from the *École Nationale des Travaux Publics de l'État* (1998) and a Ph.D. from the *Institut National des Sciences Appliquées* in Lyon, France. In 2020, he completed a Master's in Business, Entrepreneurship, and Technology (MBET) at the University of Waterloo. After a postdoctoral fellowship at the National Research Council of Canada, he joined Colas Canada in 2003, leading innovative road projects in collaboration with government and academic institutions. In 2008, he moved to Lafarge in France, managing R&D in infrastructure engineering. Dr. Baaj chaired committees for the Transportation Association of Canada and RILEM and was elected a RILEM Expert in 2020 and a Fellow of the Canadian Society of Civil Engineering in 2025. Dr. Baaj holds three patents in sustainable pavement materials and recycling and his current research focuses on smart pavements, sustainable and innovative pavement materials, self-healing asphalt materials and 3D printing of concrete.

Fees and registration to the course: https://rilemweek2025.sciencesconf.org/resource/page/id/12

More details about the conference: https://rilemweek2025.sciencesconf.org/