

BIOROADPAV® – New Biobinders for Application in Road Pavements

Summary

The BioRoadPAV® project intends to develop advanced research on bio-based asphalt materials for road pavement construction and maintenance.

The main objectives of the project can be established at three levels:

- Design and evaluate the performance and durability in the laboratory of the biobinders – bio-bitumen and bio-emulsion – from bio-oil, through the characterization in terms of rheology, chemical, microstructure, and aging.
- Design and evaluate the performance and durability of the bio-asphalt mixture in the laboratory using the biobinders, through mechanical characterization and including aging evaluation.
- Production of the biomaterials – bio-bitumen, bio-emulsion, and bio-asphalt mixture – at a pre-industrial level to be used to construct a full-scale road section for performance validation in real conditions.

The project uses bio-oil extracted from wood residues (biomass) through an innovative liquefaction process. This process consists of depolymerizing lignin, cellulose, and hemicellulose, allowing the transformation of wood residues into an oligomeric mixture. The final product is a combination of branched polymers consisting of a bio-oil with lower polycyclic aromatic hydrocarbons (PAHs) content than the bitumen from crude oil. After extracting the sugars and distilling the light fractions, the residue – heavy fraction of the bio-oil – presents physical and mechanical characteristics identical to the paving bitumen. This innovative process has been intensively investigated at Instituto Superior Técnico (IST).

The BioRoadPAV® project consists of nine tasks to be conducted in the laboratory and field conditions. The main tasks are: research and development of the new biobinders; characterization and validation of the new biobinders; application of the new biobinders in road pavements – laboratory validation: formulation and initial characterization (Technology Readiness Level – TRL 4); application of the new biobinders in road pavements – laboratory validation: long term performance and durability (Technology

Readiness Level – TRL 4); application of the new biobinders in road pavements – application in a full-scale pilot section (Technology Readiness Level – TRL 8); and life cycle assessment and life cycle cost analysis.

The initial activities of formulation, characterization, and validation of the new biobinders will be carried out in the laboratory and aim: firstly, to establish the entire process of transformation of bio-oil into the heavy fraction; and, secondly, to assess its potential to substitute the paving bitumen from crude oil and to produce the new biobinders: biobitumen and bio-emulsion. The resistance to aging of biobinders and their performance will be evaluated through RTFOT (Rolling Thin Film Oven Test) and PAV (Pressure Aging Vessel), considering the construction (production, spreading and compaction) and service periods. At the end of these activities, it is expected to have the selection of biobinders with potential use in bituminous mixtures and emulsions.

Subsequent activities will be dedicated to validating the incorporation of the biobitumen in asphalt mixtures and emulsions – bio-asphalt mixtures and bio-emulsions– in the laboratory and a full-scale road section. Formulation and mechanical tests will be carried out on a bituminous concrete for wearing course (AC 14 surf 35/50). The durability will be investigated based on an innovative accelerated aging process, using ultraviolet radiation and humidity, developed at IST: TEAGE – Técnico Accelerated aGing. In complement, a full-scale road section will be constructed to validate the technology of biomaterials production at a pre-industrial level. The full-scale road section will be monitored through structural and functional tests.

The last activities will concern the assessment of the environmental impacts based on Life Cycle Assessment (LCA) and the costs analysis during life cycle through the Life Cycle Cost Analysis (LCCA), incorporating the results obtained in previous activities. The bio-based technology developed in the BioRoadPAV® project will be compared with current road construction and maintenance techniques. The analysis will be based on the ISO 14040 series. SimaPro software and the corresponding Ecoinvent database will be used.



Project Reference

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Leading Institution

LUSASFAL – Derivados Asfálticos de Portugal, S.A. (Portugal)

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CERIS

153 377.15€

Project Website

bioroadpav.pt

