BIOPHALT, a high-performance plant-based asphalt

Developed by Eiffage Route and Tested by APRR on the A40 motorway

Eiffage has developed a plant-based asphalt composed of a bio-sourced binder (derived from by-products of the forestry and paper industry) and recycled road-surfacing materials. The use of this mix significantly reduces CO2 emissions linked to road construction activities.

Starting date of the project	Project delivered in October 2020
Project Localisation Places of implementation of the project at this stage and targeted geography if replicable.	**A40 motorway - Saint-Cyr-sur-Menthon (Ain)**
Project objectives Type of climate innovation of the project with a description of the problem/issue addressed	Replace traditional mixes made from bitumen binders by a mix that uses a plant-based binder and recycled road-surfacing materials.
Detailed project description	Eiffage Route, the road subsidiary of the Eiffage Group's Infrastructures division, attaches strategic importance to respect for the environment. At a time when the use of fossil fuels and fossil resources must be reduced, the R&D teams at Eiffage Route, which has its own studies and research centres in Ciry-Salsogne in the Aisne region and in Corbas near Lyon, have succeeded in substituting plant-based materials for bitumen and in regenerating recycled materials using plant-based binders that are not derived from oil. They have developed several eco-responsible mixes. Biophalt® is one of these. It is a high-performance plant-based mix with a resistance that makes it suitable for all types of traffic, including heavy motorway. Carrying the Bio-sourced label, Biophalt® is a winner of the Routes & Rues 2019 call for innovation projects (CIRR) issued by IDRRIM and the French Ministry of Ecological Transition and Solidarity (MTES). **Biophalt® is a warm asphalt mix with high-performance mechanical and environmental properties.** It is formulated using a new generation of plant-based binder derived from by-products of the French forestry industry. While maintaining the performance of a conventional mix, Biophalt® is an optimum low-carbon mix thanks to a combination of several innovations: - a high rate of recovery (≥ 30%) of aggregates planed from the existing surface, offering the same level of resistance and durability as surfaces made with a conventional mix, - the use of a plant-based binder offering a high level of regeneration, **as a 100% substitute for conventional bitumen binder** (the use of bio-sourced materials does not compete with the food industry, the constituents of Biophalt® being by-products of the pine and paper industries), - energy savings thanks to a lower production temperature: the mix is produced at a 20°C to 30°C lower temperature than conventional mixes. Biophalt® is produced in a conventional asphalt plant using a warm, energy-efficient process. It has the same range of application as a conventional mix. It is formulated in the laboratory in compliance with the performance standards in force. Biophalt® can be used as a base, as a binder or as a surface coating, with no limits in terms of traffic and for a range of granular sizes. **Biophalt® is 100% recyclable.** **Formula** The Biophalt® formula and the manufacturing process are protected by a patent. The components are derived from the pine industry and in particular from pitch, a residue from the distillation of tall oil, which is not widely used in industry today. **Production and application** The production of Biophalt® binder uses a mixing process similar to that of polymer bitumen. Biophalt® can be used as a classic binder without the need to adapt industrial equipment. The minimum coating and spreading temperatures are however slightly lower (130°C and 115°C respectively).

	Eiffage Route is carrying out the first Biophalt ® trials on a motorway surface - in this case, a section of the A40 motorway between Mâcon (Saône-et-Loire) and Bourg-en-Bresse (Ain).

Main project's drivers for reducing the greenhouse gas emissions

Reduction levers	Details on the aspects of the project
☐ Energy and resource efficiency (including behaviour)	
☐ Energy Decarbonisation	
x Energy efficiency improvements	Reduced energy consumption thanks to the use of a warm asphalt mix
x Improving efficiency in non-energy resources	- Use of bio-sourced materials - 40% recycling in the section of asphalt aggregates from the existing road surface - a performance that allows a significant amount of natural resources (aggregates and binder) to be preserved.
x Emissions absorption: creation of carbon sinks, negative emissions (BECCS, CCU/S, ...)	Bio-sourced materials make it possible to store carbon in the biomass used (wood).
☐ Financing low-carbon producers or disinvestment from carbon assets	
☐ Reduction of other greenhouse gases emission	

Emission scope(s) on which the project has a significant impact and quantification of GHG emission reductions per emission scope

	Aspects of the project contributing to the reduction of emissions by emission category	Quantification of associated GHG emissions by emission category *Please follow the quantification methodology used in the Afep guidelines.*
Reduction of the company's carbon dependency		
Scope 1 *Direct emissions generated by the company's activity.*	- Reductions in oil consumption for heat required in the production of warm asphalt (the use of warm asphalt, temperature reduced by 20°C to 30°C compared with hot mixes) - Replacement of conventional bitumen with bio-sourced materials	Production: +35.5 tCO2eq. Freight entering the site: +10.4 tCO2eq. Application: +16.8 tCO2eq. Freight leaving the site: +10.3 tCO2eq. = total scope 1:73 tCO2eq.
Scope 2 *Indirect emissions associated with the company's electricity and heat consumption.*		
Scope 3 *Emissions induced (upstream or downstream) by the company's activities, products and/or services in its value chain.*	- use of plant-based binder - 40% recycling in the section of asphalt aggregates from the existing road surface	Extraction of materials: -80.4 tCO2eq. Transport Upstream 2.5 tCO2eq
Increase of carbon sinks		
Emissions Absorption *Carbon sinks creation, (BECCS, CCU/S, …)*	The bio-sourced binder stores carbon during the growth phase of the material (pine trees) it is composed of	-87 tCO2eq.
GHG emissions avoided by the company at third parties		
Avoided Emissions *Emissions avoided by the activities, products and/or services in charge of the project, or by the financing of emission reduction projects.*		

Clarification on the calculation or other remarks:
The construction of 1 linear kilometre of motorway lanes using conventional asphalt requires 1021 tonnes of asphalt.

For 1021 tonnes of conventional asphalt, the following is required:
- 44 tonnes of bitumen
- 597 167 MJ of gaz for heating (170°C)
- 817 tonnes of non-recycled road-surfacing materials (representing 80% of total requirements, the rest from recycling)

	The use of conventional asphalt results in the emission of 59.6 tCO2eq, per 1 linear kilometre of motorway lanes. The construction of 1 linear kilometre of motorway lanes using Biophalt requires 1021 tonnes of Biophalt asphalt. **For 1021 tonnes of bio-sourced asphalt, the following is required:** - **29 tonnes** of bio-sourced wood-based materials - **544 926 MJ** of gaz for heating (135°C) - **613 tonnes** of non-recycled road surfacing materials (representing 60% of total requirements, the rest from recycling) The use of Biophalt results in the emission of -**2.5 tCO2eq** per 1 linear kilometre of motorway lanes. In addition, we can consider that **for 1 tonne of Biophalt mix, 46,5 kg of CO2 are stored**. Emissions in teqCO2 per 1 linear kilometre of motorway lanes / Extraction of materials / Transport upstream / Production / Freight entering the site / Application / Freight leaving the site / total Conventional: 19,6 / 1,7 / 19,6 / 5,2 / 8,4 / 5,2 / 59.6 Biophalt: -40,2 / 1,3 / 17,8 / 5,2 / 8,4 / 5,2 / -2.5 The Life Cycle Assessment (LCA) studies the environmental aspects and potential impacts throughout the lifespan of a product, including raw materials, production, transport, use and disposal. The general principle is defined by NF EN ISO14040: 2006 and NF EN ISO 14044: 2006 standards and the list of environmental indicators taken in part from NF EN 15804 standard.
Modality of verification of the quantification.	**Calculation standard used (ADEME base, GHG protocol, etc.):** The methodology applied complies with the GHG protocol **Verification of the calculation (internal or external):** Calculations were carried out using SEVE software, developed and managed by Routes de France, on the basis of Biophalt® data and verified by an independent third party according to the EN 15804 standard.
Other environmental and social benefits of the project	 <u>Attractiveness</u> The A40 project enabled APRR, Eiffage Route and the Epsilon design office to join forces around a common goal. The synergies provided by each of these different stakeholders have made this project an **effective low-carbon and sustainable motorway demonstrator**. <u>Well-being</u> **The Biophalt® binder eliminates bitumen fumes and therefore improves air quality around work sites for residents and site workers alike**. In addition, the use of a warm asphalt mix, with a temperature 20°C to 30°C lower than a hot mix, reduces discomfort for workers on construction sites, who are subjected to high temperatures during the asphalt application process. <u>Social cohesion</u> **Biophalt® helps to develop French wood industry sectors**, since the by-products generated by the paper industry, the manufacture of kraft paper pulp in particular, used to manufacture the binder of this plant-based mix come from French forests. <u>Environmental preservation / enhancement</u> The use of bio-sourced products in the road industry contributes to limiting global warming because they allow **carbon storage** during photosynthesis. Consequently, a project promoting the use of bio-sourced materials contributes to limiting global warming by creating carbon sinks. In addition, the forests from which the wood for the production of Biophalt® is obtained are sustainably managed, which promotes the preservation of biodiversity. Therefore, the use of renewable resources and energy savings are the major advantages of Biophalt® asphalt mixes. <u>Resilience</u> **Biophalt® has been submitted for the approval of an independent research institute to test its resilience**: tests carried out by the Gustave Eiffel University at the Nantes fatigue carousel in 2017, established that Biophalt® was equally or even more durable over time than a conventional asphalt.

	Responsible use of resources **The use of the Biophalt® binder allows a reduction in pressure on natural resources in several ways**: - **the use of bio-sourced materials that do not compete with the food industry,** the constituents of Biophalt® being by-products of the pine and paper industry, - the use of warm mixes allowing **a reduction in fuel consumption**, - **40% recycling in the section of aggregates** from the existing road surface. This performance allows a significant quantity of natural resources (aggregates and binder) to be preserved.
Project maturity level	☐ Prototype laboratory test (TRL 7) ☐ Real life testing (TRL 7-8) ☐ Pre-commercial prototype (TRL 9) ☐ Small-scale implementation ☒ **Medium to large scale implementation** **Remarks**: click here to enter the level of maturity of the project
Capacity and conditions of the project reproducibility, with associated climate impact mitigation potential	The project is intended to be reproduced for several similar operations, the interest project owners are showing in low-carbon solutions will enable Biophalt® to be industrialised on a larger scale. In addition, this binder can be used for a variety of road types – ranging from light to heavy traffic.
Amount of investment made (in €)	€400,000
Economic profitability of the project (ROI)	☐ ST (0-3 years) **x MT (4-10 years**) ☐ LT (> 10 years) **Remarks:** click here to enter the information
Engaged partnerships	Studies on the binder's resilience and low-carbon advantages were carried out jointly by Eiffage Route and the University of Nottingham as part of the BioRepavation project.
Open comments from the project owner	/
More about the project	
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Project URL links	https://www.eiffageroute.com/files/live/sites/route/files/Activit%C3%A9s/Solutions/BIOPHALT_ENROBES_2020.pdf https://voyage.aprr.fr/autoroute-info/chaussee-au-bilan-carbone-neutre-une-premiere-sur-lautoroute
Illustrations of the project	Video of Biophalt® application during renovation of a section of the A40 motorway between Mâcon (Saône-et-Loire) and Bourg-en-Bresse (Ain)