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Bioasphalt: from microalgae to “green roads”?

Microalgae offer a highly promising alternative to petroleum products without competing for resources used in the food industry. They have now been used for the first time to make — asphalt! Researchers at the CEISAM (Chimie et Interdisciplinarité: Synthèse, Analyse, Modélisation - CNRS / Université de Nantes), GEPEA (Génie des Procédés Environnement et Agroalimentaire - CNRS / Université de Nantes / ONIRIS / Ecole des Mines de Nantes), IFSTTAR (Matériaux pour Infrastructures de Transport) and CEMHTI (Conditions Extrêmes et Matériaux: Haute Température et Irradiation - CNRS), working in collaboration with the company AlgoSource Technologies, have proved the viability of bioasphalt, demonstrating its close similarity to the “real” asphalt used to pave roads. Their findings have been published in the April issue of *ACS Sustainable Chemistry & Engineering.*

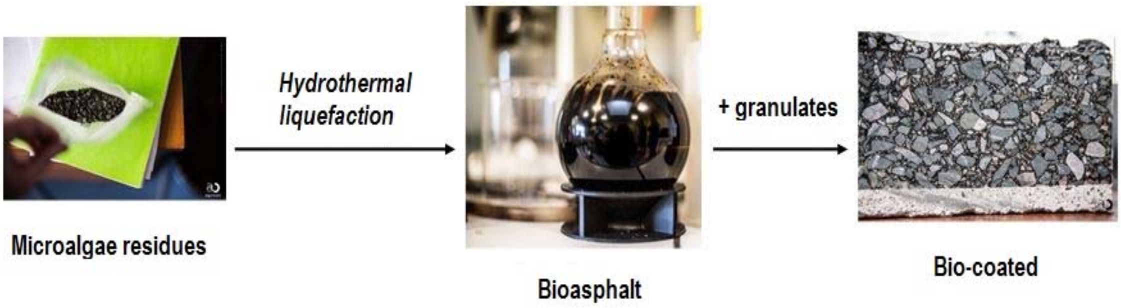
Microalgae have long been known for their use in applications like cosmetic dyes and food supplements. In more recent years, the idea has emerged of refining them, for example to produce biofuels. Today, microalgae are recognized as a promising alternative to petroleum. The development of efficient, cost-effective processes could make a whole range of useful microalgae derivatives available.

As part of the “Algoroute” program, funded by France's Pays de la Loire region, researchers at laboratories based in Nantes and Orléans[1] have produced bioasphalt from microalgae residues resulting, for example, from the extraction of hydrosoluble proteins for the cosmetics industry. They used a hydrothermal liquefaction process, i.e. pressurized water (in a subcritical state), to transform this microalgae waste into a black, viscous, hydrophobic substance (bioasphalt) that closely resembles petroleum-derived asphalt (see illustration below). The process currently achieves a conversion efficiency of 55%.

Even though the chemical composition of bioasphalt is completely different from its petroleum-derived counterpart, they have similarities, including their black color and rheological properties.[1] A liquid at temperatures exceeding 100°C, bioasphalt can be used to coat mineral aggregates; viscoelastic at -20°C to 60°C, it ensures the cohesion of the granular structure while supporting mechanical loads and relaxing stress. Trials are underway to analyze the material’s behavior over time, as well as cost-effectiveness studies to evaluate its potential for large-scale production.

This innovation offers a new possible option for the road building industry, which is entirely dependent on petroleum today. The types of bioasphalt developed so far relied on oils of agricultural origin (which could be needed for human nutrition) or from the paper industry, mixed with resins to improve their viscoelastic properties. Microalgae, whose cultivation does not require the use of arable land, thus offer an attractive solution.

[1] *Rheology is the study of the flow and deformation of materials in response to an applied force.*



Process for the production of bioasphalt from microalgae. *© les films du cercle rouge*

Images available from the CNRS photo archive, phototheque@cnrs.fr.

For further information, watch a video on this research project © Université de Nantes

Bibliography

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