



**Centre of Excellence**  
for Decarbonising Roads

ACLA

## Technical Note

### Abstract

The trial evaluated the use of ACLA, a carbon-negative, drop-in asphalt aggregate that permanently sequesters CO<sub>2</sub>. Adding 3–10% of ACLA to asphalt mix can achieve net-zero mixes with minimal process changes, suitable for roads and other paved surfaces.

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# Executive Summary

This report documents and evaluates the live trial of ACLA on the King street -Kilsyth, King Street – Coatbridge and St Johns – Coatbridge carparks in North Lanarkshire (October 2025). The trial assessed carbon savings, operational viability, technical performance impact, wider environmental benefits and the potential for wider application.

## Introduction

The ACLA asphalt aggregate alternative according to manufacturer's claims represents a forward-thinking initiative in UK highways infrastructure, aligning with industry priorities for sustainability, resilience, and improved safety. Developed and manufactured in the UK by Low Carbon Materials (LCM), ACLA is claimed to be a carbon-negative aggregate engineered using sequestration technology to capture and permanently store atmospheric CO<sub>2</sub> within the material. According to manufacturer's claims, each tonne of ACLA removes ~748–798 kg CO<sub>2</sub>e from the atmosphere, enabling the production of 'net-zero asphalt' when incorporated into binder course mixes at typical inclusion rates of 3–10% by weight.

Designed as a 'drop-in' replacement for conventional mineral aggregates, LCM claims that ACLA requires no changes to existing asphalt production methods. The material is a lightweight (around 50% lighter than standard stone), gravel-like aggregate with particle size ranging from 4–10mm. According to further manufacturer claim offering operational advantages such as improved handling, reduced manual strain, and safer working conditions during asphalt laying. Its claimed 'carbon-negative' performance is achieved through the use of biogenic carbon sources and carbonation processes, resulting in permanently stored carbon within the aggregate structure.

This trial, delivered through the Live Labs 2 programme, aims to evaluate the suitability of ACLA asphalt for wider adoption on local roads across the UK, with a particular focus on North Lanarkshire. Further aims of the trial are to quantify environmental benefits, such as reduced embodied carbon and assess short-term and long-term material performance, alongside operational impacts including ease of installation, material efficiency, and enhancements to road-worker safety on site.

By benchmarking the performance of the ACLA against conventional alternatives, the project will generate valuable insights into lifecycle costs, material resilience, and real-world performance under UK climate and traffic conditions. These findings will support future procurement and specification strategies, contributing to the sector's transition toward more sustainable, lower-carbon, and economically efficient asphalt solutions.

## Methodology

For this trial, the comparison material was the conventional FyfePave AC10 mix, a standard asphalt concrete surface course containing a 10 mm nominal maximum aggregate size. In this designation, "AC" identifies the mixture as asphalt concrete, while "10" specifies the upper aggregate size limit used to achieve a medium-graded, durable surfacing material widely adopted across the UK network. This mix served as the baseline against an asphalt mix which incorporated ACLA, this was done to assess whether comparable performance could be maintained while reducing embodied carbon.

The trial material itself was produced in accordance with the asphalt mix recipe identified as a warm-bio AC20 Dense 40/60 ACLA. Here, 20 mm Dense denotes a dense-graded asphalt mixture with a 20 mm nominal maximum aggregate size. The 40/60 refers to the penetration grade of the bitumen binder, indicating a penetration range of 0.4–0.6 mm under standard test conditions (25 °C, 100 g load, 5 seconds). This grade provides a relatively stiff binder, improving stability and resistance to rutting under traffic loading. The term *warm-bio* refers to the use of a warm-mix asphalt technology incorporating a bio-based additive. This reduces the mixing and laying temperatures compared with conventional hot-mix asphalt, lowering fuel consumption, minimising CO<sub>2</sub> emissions, and improving working conditions while maintaining comparable mechanical performance. Full details of the warm-bio AC20 40/60 ACLA asphalt recipe used for this trial are provided below:

- 20mm – 16.8%
- 14mm – 20.1%
- 10mm – 9.5%
- 6mm – 8.6%
- Fines – 16.1%
- Reclaimed filler – 5.1%
- Binder Content – 3.8%
- RAP – 13.5%
- ACLA – 6.5%

Real-world trials were conducted across three locations: King Street in both Kilsyth and Coatbridge, and the St Johns car park in Coatbridge. Full closures were implemented at each site to allow uninterrupted installation. The King Street trials took place on the 2<sup>nd</sup> and 3<sup>rd</sup> of September 2025 and included the placement of 276.3 tonnes of ACLA AC20 alongside 136.54 tonnes of conventional AC10 FyfePave. At St Johns, works carried out on the 9th and 10th of September 2025 involved laying 151.02 tonnes of conventional FyfePave. The Kilsyth site followed on the 16th and 17th of September 2025, during which 114.6 tonnes of conventional FyfePave were installed.

A standardised suite of plant and equipment was used across all trial sites to ensure consistency in handling, laying, and compaction. This included a JCB 3CX backhoe loader, a deadweight roller, a Robert McCarroll paver, a HAMM roller, and a DAF XDC 450 FAD truck. Using standard machinery across locations ensured that any observed differences in performance could be attributed to material behaviour rather than variations in equipment or technique.

## Environmental & Sustainability

Refer to '[Input reference to Carbon Report when I know it](#)' for details of carbon and sustainability findings.

## Limitations

There are several limitations that affect the conclusions that can be drawn from the current product trial. Firstly, the duration of the trial has been insufficient to allow for any meaningful assessment of the product's long-term performance. Sufficient time has not elapsed since the trials were completed therefore no definitive long-term analysis cannot yet be completed. In addition, no operative feedback has been recorded or provided, limiting the understanding of how the materials performed during practical handling, installation, and day-to-day site operations.

The environment in which the trials were carried out also restricts the scope of the findings. All trials took place on small car parks, which means the results cannot be used to infer how the product would behave under higher-speed or heavier-traffic conditions. To determine suitability for roadways, a separate trial specifically designed for running traffic would be required. Another significant limitation is the absence of in-house laboratory or in-situ testing. Although the supplier has provided third-party test results for parameters such as Air Voids, Indirect Tensile Stiffness Modulus, Wheel tracking, and Indirect Tensile Strength Ratio, these results carry inherent uncertainty because the testing was not conducted internally or by a laboratory commissioned directly on behalf of the Live Labs 2 initiative. As such, the validity of the supplied data cannot be independently verified. Refer to Table 1 for the results of the laboratory tests supplied by LCM.

There are also gaps in the laying records supplied by the operative team. While delivery temperatures were documented for all materials brought to site, no laying temperatures were recorded for any product, and only the ACLA material included a rolling-temperature reading, which appears to have been taken during compaction, although this is not stated explicitly. This presents a key limitation when interpreting the trial results, as the absence of consistent temperature records restricts the ability to verify whether materials were laid and compacted within the correct temperature windows.

As a result, any observed performance differences may be influenced as much by unknown temperature-related construction variables as by the inherent characteristics of the materials themselves.

Finally, two further data gaps limit the robustness of any analysis. No information has been provided regarding the amount of waste generated during the works, restricting evaluation of material efficiency and environmental impact. Additionally, the application rate for the ACLA material was not recorded, preventing accurate assessment of its usage, coverage, or performance in comparison with other products. These combined limitations should be considered when interpreting the results of the trial and determining next steps.

## Review and Discussion of 3<sup>rd</sup> Party Laboratory Tests

As part of this assessment of the material, this technical note has incorporated lab test data provided by LCM from the A64 Birmingham case study and therefore the validity of the data cannot be confirmed and assessments have been made based on interpretations of the data.

**Table 1** – Laboratory Test Results for Conventional Surface Course and Surface Course with ACLA

	Reference	WARM BIO AC 20 40/60	WARM BIO AC 20 40/60 + ACLA
Grading	31.5	100	100
	20	96	98
	14	80	74
	10	69	59
	6.3	52	46
	4.0	42	37
	2.0	30	28
	0.5	18	18
	0.25	13	13
Bitumen	0.063	7.0	6.6
	Found B/C (%)	4.4	4.5
Voids	Refusal Air Voids (%)	0.7	0.5
	In Situ Gauge Air Voids (%)	3.9	3.1
Stiffness	ITSM (MPa)	9742	9996
Wheel Tracking	WTS <sub>air</sub>	0.05	0.05
	PRD (%)	4.1	3.7
Water Sensitivity	ITSR (%)	86	95

Based on interpretation of the comparative results between the warm-bio AC 20 40/60 mix and the same mix incorporating ACLA provided by LCM shows that its inclusion in the asphalt mixture has no negative impact on overall material performance. In this designation, WARM BIO AC 20 40/60 refers to an asphalt concrete binder course produced using a bio-based warm-mix (WARM BIO) and containing a 20 mm nominal maximum aggregate size (AC 20), with a 40/60 penetration grade binder providing a relatively stiff bitumen. The aggregate grading for both mixtures are closely aligned, with only minor variations in the percentage passing at individual sieve sizes.

In terms of binder content, the mix containing ACLA shows a marginally higher found binder content (4.5%) compared with the reference mix (4.4%). This increase is very small and does not suggest any detrimental impact on coating, workability, or durability. Voids-related metrics also demonstrate positive or neutral effects. Refusal air voids fall from 0.7% to 0.5% with ACLA, and in-situ gauge air voids reduce from 3.9% to 3.1%. Both changes reflect a slightly denser, more compacted mixture, which can be advantageous for long-term resistance to moisture ingress and deformation.

When interpreting the data provided by LCM it appears the mechanical performance remains strong with the inclusion of ACLA. Stiffness, measured through the Indirect Tensile Stiffness Modulus (ITSM) test, increases from 9742 MPa to 9996 MPa, indicating that the ACLA treated mix maintains, and even slightly improves structural rigidity. Wheel-tracking resistance shows similar values across both mixtures, with the Wheel Tracking Slope in Air ( $WTS_{air}$ ) remaining at 0.05 and the Proportional Rut Depth (PRD) reducing from 4.1% to 3.7% with ACLA, suggesting improved resistance to deformation under load.

A particularly notable performance indicator is the Indirect Tensile Strength Ratio (ITSR), which assesses durability under moisture conditioning. The ITSR of the ACLA mix increases from 86% to 95%. Based on the interpretation of this result, it appears the inclusion of ACLA may improve water sensitivity performance and suggests that the presence of ACLA enhances resistance to moisture-induced damage. Achieving a 95% ITSR may be a strong indicator of long-term durability, supporting LCM's claims that ACLA contributes positively to the mixture's performance.

## Conclusions & Recommendations

To build on the early findings of the ACLA asphalt trial and fully understand its suitability for broader deployment, several additional stages of assessment are recommended. Further trials are recommended to be undertaken on routes subject to higher-speed traffic and heavier vehicle loading, including LGVs and HGVs, to validate the material's structural performance under more demanding conditions. Complementary laboratory testing is also required to independently verify the performance values provided by LCM and to ensure consistency across different production batches.

Should additional trials be conducted if the current RAG rating for the material remains low due to limited evidence, it would be beneficial to implement more comprehensive and structured data collection relating to both weather conditions and material laying and rolling temperatures. Capturing this information at regular, predefined intervals throughout trial days would support deeper analysis of how environmental factors influence the workability, compaction, and early-life performance of the ACLA-modified asphalt. Consistent monitoring of parameters such as ambient temperature, humidity, wind speed, surface temperature, and in-mix material temperatures would provide a richer dataset for correlating field performance with installation conditions, ultimately strengthening the reliability of the product's long-term evaluation.

A longer-term observation and monitoring period will be essential to evaluate the product's durability, resistance to weathering, and overall lifespan in comparison with conventional asphalt. This should be supported by pavement coring, both at the initial installation stage and after a predetermined interval, to assess compaction quality, internal structure, and any early signs of degradation. Comparing these cores with those from traditional asphalt will help determine how the ACLA additive influences material longevity and performance throughout the pavement's lifecycle.

Following the submission of this Technical Note, The University of Nottingham will be undertaking their own lab testing which will allow for further technical analysis of this Innovation.