Pioneering Sustainable Pavements

Insights from Boulder County's warm mix asphalt trial

IN THE QUEST FOR MORE sustainable and efficient road construction methodologies, the transition from Hot Mix Asphalt (HMA) to Warm Mix Asphalt (WMA) stands out as a beacon of innovation and environmental stewardship. Originating from a collaboration among Arkema, Holcim Group Companies, and Boulder County, the WMA trial represents a compelling case study for successfully pursuing sustainable paving solutions. The initiative seeks to innovate and inspire an industry-wide reevaluation of traditional practices: prioritizing environmental stewardship without compromising paving quality. Details shared here highlight the critical findings from the trial and create

production methods. Highlighting these traditional practices that have served the

industry well underscores the potential for improvement. The average production temperature for HMA stood at 320°F, with a compaction process ranging from 260°F to 280°F. This demonstrates the efficiency of conventional methods yet hints at the environmental and operational benefits of reduced temperatures.

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Unlike traditional HMA, WMA allows our industry to create more durable, high-

performing roads while minimizing environmental impact. By modifying the binder and using warm mix additives, we work with the asphalt at lower temperatures, achieving benefits such as reduced emissions, enhanced moisture protection, extended paving seasons, improved workability, and cost savings throughout the pavement's life cycle. Boulder County's trial demonstrated the feasibility of reducing production temperatures by 45-50°F and by 60°F to 210°F for compaction of True WMA without compromising on density or performance. This finding could have profound implications for the industry's carbon footprint and environmental impact.

Impact Category	Potential Impact per ton (WMA)	Potential Impact per ton (HMA)
Global Warming Potential (GWP-100)	62.84 kg CO_2 equiv	71.62 kg CO_2 equiv
Ozone Depletion Potential (ODP)	1.09x10-7 kg CFC-11 equiv	1.09x10-7 kg CFC-11 equiv
Eutrophication Potential (EP)	1.20x10-2 kg N equiv	1.14x10-2 kg N equiv
Acidification Potential (AP)	1.90x10-1 kg SO_2 equiv	2.21x10-1 kg SO_2 equiv
Photochemical Ozone Creation Potential (POCP)	3.35 kg O_3 equiv	3.48 kg O_3 equiv

One of the most striking outcomes of the Boulder County WMA trial was the demonstrated potential to lower the carbon footprint associated with road construction. The use of WMA facilitated significant temperature reductions, which, in turn, led to a decrease in energy consumption and emissions.

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The trial's findings illuminated the path towards more sustainable construction practices by reducing the Global Warming Potential (GWP). The data shows that the GWP for the WMA design is 62.84 kg CO_2 Equivalents, whereas for the HMA design, it is 71.62 kg CO_2 Equivalents. Utilization of WMA facilitated a 12.26% reduction in GWP/CO_2 equivalents compared to the HMA design.

Mitigation here enhances on-site workers' safety and comfort, demonstrating a significant potential improvement in responsible construction practices.

(a) (b) (c)

Key concerns during the adoption phase of new technologies are often the potential impacts on performance and quality. The Boulder County trial helps to allay these concerns by demonstrating that WMA, especially at reduced temperatures, does not compromise achievable density or compaction efficiency. Reassuring stakeholders that choosing a greener path will not mean sacrificing the durability or lifespan of the asphalt remains critical. In evaluating WMA, we aimed to understand how adding warm mix additive and lowering the temperatures during mix production affect the effort needed for compaction. By employing a compactability methodology, the team analyzed the resistive efforts using gyratory compactors in the laboratory. The analysis showed a notable decrease in resistance, indicating a substantial reduction in compaction effort when using WMA at lower temperatures. The reduction in compaction effort proved to be a pivotal advantage, indicating the potential for increased efficiency and ease of application in paving operations.

At the heart of this initiative is a deep-seated commitment to collaboration. This "partnership approach" ensured consistent and controlled temperature reductions enhancing compaction performance and environmental outcomes. This project's success story is a testament to what can be achieved when diverse stakeholders unite with a common goal: to pave the way for a more sustainable future. Incorporating feedback from key stakeholders, Holcim and Boulder County, the WMA trial demonstrated significant advancements in asphalt construction. Both partners have

reduces stress on operators, and the absence of blue smoke, highlighting a more environmentally friendly production process. Holcim also celebrated this endeavor as a

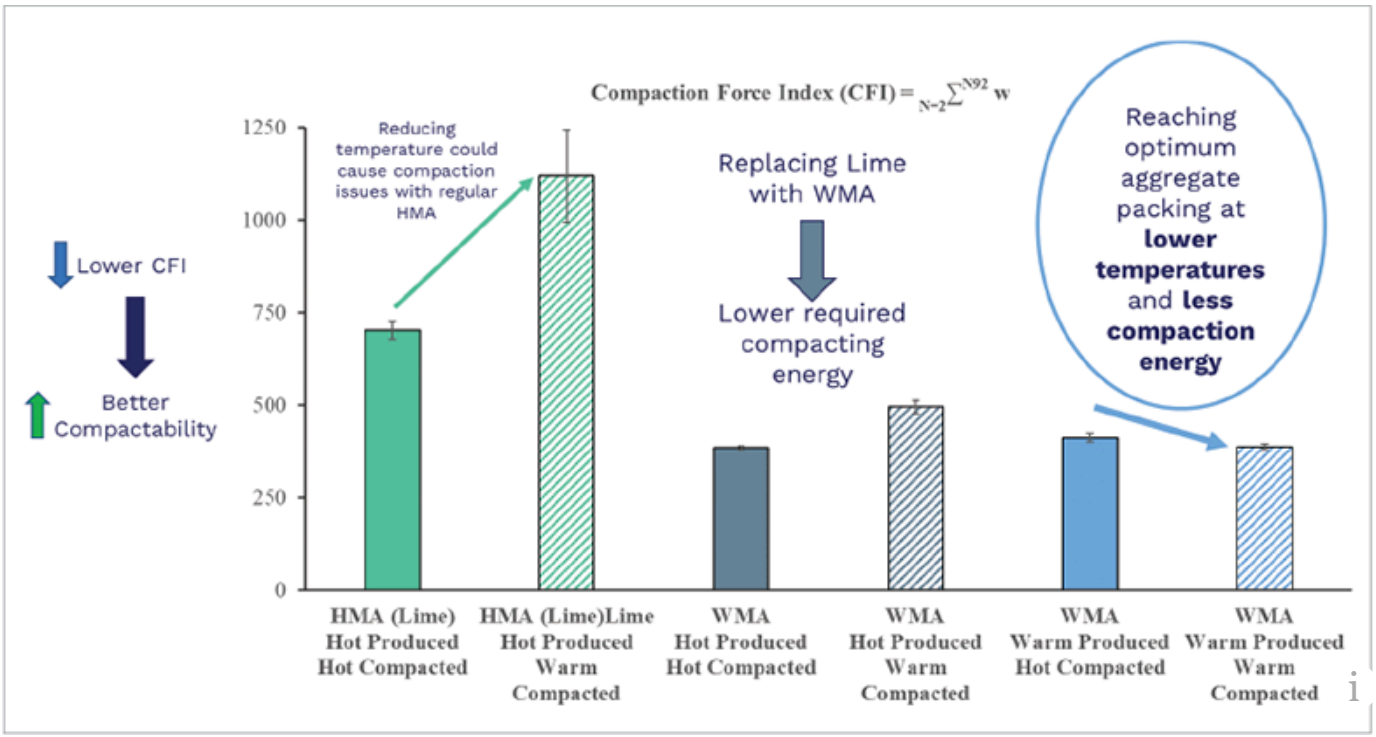
historic milestone, marking the first use of such a mixture in Colorado in over two decades.

"In discussing recent advancements in asphalt technology, it's clear that the benefits are noteworthy. From the absence of 'blue smoke' during paving to the increased workability and potential for greater longevity, these improvements offer promising prospects for road infrastructure. Aside from the scientific data, there are some non-scientific aspects I'd like to mention," said Jeff Carr, Boulder County Operations/Project Supervisor, Road Maintenance Division, Public Works, "which I found noteworthy:"

1. The absence of lime in the mix aligns with environmental sustainability goals.
2. The reduced need for rolling to achieve densities indirectly benefits the environment by decreasing fuel consumption and CO_2 emissions.

These advancements mark significant progress towards more resilient and visually appealing asphalt solutions."

As the industry stands at the crossroads of tradition and innovation, our collective success is a compelling call to action. The evidence is clear: adopting WMA technologies and practices presents an opportunity to reduce environmental impacts, improve worker safety, and maintain, if not enhance, the quality of our road infrastructure.



Showcasing the potential for reduced temperatures without compromising quality is a critical step demonstrating feasibility of this technology for adoption industry wide. As we look to the future, the lessons learned from Boulder County's initiative will undoubtedly play a crucial role in shaping the road construction practices of tomorrow via improved sustainability and collaboration.

Further, this collaboration encourages us to reconsider our current methods, innovate, and embrace new solutions that promise immediate benefits and could contribute to the sustainable stewardship of our industry. By sharing our insights and experiences

Zero future is possible. To get there, prioritizing WMA technology advancement is a

significant step forward. Ahead of us lies the path of opportunity to transform the road construction industry by anchoring it in environmental care, responsibility, and collective action.

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