NET ZERO GOALS AT THE MOLECULAR LEVEL

BY SANDY LENDER

TO INCREASE THE use of RAP and decrease production temperatures for a long-lived pavement, a plant-based rejuvenator assists in net zero inputs.

It appears the writing is on the wall for industry to increase the percentage of recycled product in asphalt mix designs and encourage the use of warm-mix asphalt (WMA) technologies not only in name, but in fuel-reducing practice as well.

NAPA Vice President for Engineering, Research, and Technology Richard Willis said it can be a disservice to use WMA practices for compaction-enhancement characteristics only, when the achievement of reducing temperatures during production offers producers credit toward energy and greenhouse gas emissions (GHGs) reduction.

At the Warner Babcock Institute for Green Chemistry (WBI), the innovative concept of allowing molecules to naturally perform has given way to a variety of technologies, including two that can assist asphalt pavement mix-design specialists, municipal planners, and other road stakeholders.

Those products are the Delta S plant-based asphalt rejuvenator and Delta Mist penetrating asphalt spray rejuvenator. They are available to the industry through Collaborative Aggregates LLC (CollAgg), which was formed to commercialize the green chemistry construction products and

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infrastructure materials formulated by WBI. For this article, we will mention Delta S technology's current contributions to NAPA's net zero carbon emissions goal, and we will discuss how the rejuvenator is assisting in higher reclaimed asphalt pavement (RAP) and WMA goals for the membership.

Researchers at WBI recognized elements in nature don't collide violently; they don't use great amounts of heat or energy to force reactions with one another. Scientists force that upon them, using energy or heat. Delta S was created by packaging molecules in a unique delivery system and allowing them to naturally perform the maneuvers they want to perform, without adding energy or heat. The result is a plant-based asphalt rejuvenator designed to naturally do what it wants to do: restore life to an oxidized binder molecule.

BUY CLEAN ASPHALT EPDS

When the White House published the "Executive Order on Catalyzing Clean Energy Industries and Jobs Through Federal Sustainability" in December 2021, detailing federal projects will be adopting "buy clean" practices, the industry push to share its product category rules (PCRs) and environmental product declarations (EPDs) within lifecycle matrices took on greater importance. It's time to look holistically at the pavement and at how each element—each input—is contributing to a reduced carbon footprint for the lifecycle of the pavement. If an additive can assist in reducing production temperature, a "major player," then that additive should be explored.

In most cases, there are emissions associated with the manufacture of additives. That value is entered as an input when calculating the EPD of an asphalt mix. What Willis explained is each additive offers something in return for its emissions input. In the case of Delta S, which has a minimal input due to its nature described above, the benefit it offers in reduced production temperature and lengthened pavement life contributes to the pavement mixture's lifecycle offering. "Additives that lengthen the life of the pavement are advantageous," Willis said.

At this time, Willis explained, "In the construction materials space, concrete and steel are receiving significant outside funding to help reduce their carbon footprint. The asphalt industry is not getting that assistance. This is not a time to rest on our laurels. When I talk to FHWA, they're not interested in what we have done prior to now; they're interested in what we can do going forward."

Collaboration for a Clean Road Ahead

By bringing partners together—NCAT, agencies, and companies like C.W. Matthews and Commercial Asphalt—industry is building a network for achieving not only reduced RAP piles around the country; we're building a road forward toward a net zero future.

To build a more resilient pavement for the DOT is a win. To do it with more recycled material therein is a win for the planet. For the asphalt industry, we will meet net-zero goals when we can increase recycled product use while maintaining or reducing production temperatures, and achieving improved pavement performance for a longer-lived, resilient pavement.

NAPA Member C.W. Matthews assists in reducing RAP stockpiles in the state of Georgia by increasing RAP percentages in its mixes.

Adding rejuvenator at a commercial asphalt plant during a test-and-control project with RAP.

Among other goals going forward, the industry aims to reduce temperatures to achieve reduced blue smoke potential and reduced fuel consumption, use higher percentages of RAP in mix designs, and lengthen the life of pavements with balanced mix designs offering optimized performance. That may require balancing the mix with inputs that offset their low-emissions value with high return.

LOW INPUT, HIGH RETURN EXAMPLES

As SAPAs engage with state departments of transportation (DOTs) to allow higher percentages of RAP in mix designs, the onus is on industry to prove these high RAP pavements will continue to perform as resilient pavements. With the national average of RAP for a surface course at only 21.1%, entities such as NCAT and MnROAD have offered states and members of industry opportunity to experiment with higher percentages of RAP and different dosages of rejuvenators, warm-mix additives, and the like to find multiple options to present to agencies for increasing the use of recycled product.

In the most recent Test Track report from NCAT, Dr. Nam Tran shared the facts from Sections N1 and N7. In Cracking Group control section N1, Tran shares, the surface layer was built using a typical U.S. mix design of 9.5 mm NMAS PG67-22 with 20% RAP. In Section N7, researchers originally added 5% post-consumer recycled asphalt shingles (RAS) and dosed the PG67-22 virgin binder with 10% Delta S by weight of the recycled binders available in the RAP and RAS.

Researchers found the use of RAS was ill-advised and subsequent mill-and-paving without silo storage of the mix proved the necessity for storage to give Delta S time to interact with the binder. Such experimentation with industry professionals is invaluable as we seek ways to curb emissions from inputs, and offered the opportunity to develop an alternate mix design with a higher RAP percentage for the wearing course of Section N7.

Tran writes in the NCAT report: "This mix would have 35% RAP with a recycled binder ratio similar to that of the original surface mixture in Section N7. Because this mix design did not include RAS (even though it had a similar recycled binder ratio), the Delta S dosage was reduced to 5% by weight of the aged RAP binder, which was half the dosage originally used in the N7 surface mix. The N7 surface mixture was redesigned to compare directly with the N1 surface mix with 20% RAP, which is the control mix for the Cracking Group experiment. The Delta S dosage was determined to give the 35% RAP mixture in Section N7 a similar flexibility index (FI) determined by the Illinois Flexibility Index Test (I-FIT) to that of the 20% RAP mixture in Section N1 (2). Finally, it was determined that the mixture would be kept in a silo for two hours before paving so that the rejuvenator could interact with the RAP binder."

Continuing experimentation at the Test Track and MnROAD offers NAPA membership insight that would otherwise take decades to unveil. Building resilient systems with lower carbon inputs will come about through the continued efforts of NAPA partners who participate in such tests and trials.

Beyond controlled test sections like those at the NCAT Test Track and MnROAD, success with low-emission additives is happening for companies in the field. An example that comes from necessity shows an increased use of RAP for C.W. Matthews, facilitated by rejuvenator use, assisting in decreasing RAP stockpiles in the state of Georgia.

For the C.W. Matthews team, increasing RAP percentages with a plant-based rejuvenator gave them the opportunity to experiment at their highest production plant in the Metro-Atlanta area with 50% RAP mix designs and improved cracking resistance in the final pavement—without increasing their net zero mapping inputs. They included a control section with 35% RAP and a combined liquid asphalt binder of 5.5% in their project; a section with 50% RAP and Delta S, and a combined liquid asphalt binder of 5.7%; and a section with 50% RAP with elevated liquid AC content for a combined liquid asphalt binder of 6.1%. No increase in production temperatures was required with the Delta S injection and the plant-based rejuvenator offered an environmentally friendly binder treatment. The team also reported little difference in workability in the field for its Delta S mix design.

More recently, the team at Commercial Asphalt took on a high-RAP project for the Minnesota DOT to reconstruct portions of Hwy. 95. Commercial Asphalt coordinated with NCAT to perform lab work and produced 1,400 tons of asphalt mix with 48% RAP for Park Construction to place and compact. While officials at MnDOT say RAP stockpiles in the state are "nothing like they have in, say, California," they are still large enough to warrant attention.