



DRY MIX RUBBER ADDITIVE FOR HIGH-PERFORMANCE PAVED SURFACES

SmartMIX™

An Innovative, Pre-Treated
Rubber Solution for the
Asphalt Industry

SmartMIX™ At a Glance

- A dry, free-flowing asphalt additive derived from recycled tire rubber. It is designed to be incorporated into asphalt mixes at the mix plant
- A pavement properties enhancer vs. the traditional binder modifier
- Use is controlled at the mix plant by an on/off switch; meaning there is never wasted material
- Will yield a pavement surface competitive with a polymer-modified application, with similar or better properties, and at a lower cost

In 2019, Liberty Tire Recycling introduced a new dry-mix rubber additive for high-performance paved surfaces. Called SmartMIX™, this innovative material is produced with next-generation technology that enhances any asphalt mix for improved compaction, flexibility and durability.

While rubber asphalt additives have been used for decades to increase pavement safety and performance, the challenges of liquid storage and handling has made the process expensive and complex. SmartMIX™ simplifies rubber enhancement and makes it more cost-effective.

Field-tested and proven in hot and cold climates, SmartMIX™ is made from recycled tires – featuring sustainability, cost-effectiveness, safety and performance. For rubberized asphalt projects, it offers up to a 50 percent reduction in modifier costs and an overall savings of up to 15%. The dry-mix material is produced on-demand in variable amounts, allowing shipments to scale for major infrastructure, commercial uses and small residential projects.

SmartMIX™ works with any mix design, including dense grade, and is compatible with the most commonly-used asphalt binders, additives and liquid agents. After pre-swelling at Liberty's specialized, first-of-its kind processing facility, SmartMIX™ is ready to use, shipping to job sites in bulk bags, where it handles as a dry powder.

The material enters the mix without the need for a field blender, and is compatible with warm-mix processes and other traditional paving equipment and field-mix operations. For even higher performance pavements, SmartMIX™ can be used at up to 20 percent by weight of the binder in gap-graded or open-graded mixes.

SmartMIX™ also allows more effective use of reclaimed asphalt pavement (RAP). The mix may be used at up to 45% of any mix, maximizing cost savings and making RAP less brittle, easier to handle and compact, and more crack-resistant.

Based on new Reacted Rubber Particle Technology, SmartMIX™ offers a sustainable, long-lasting and low-maintenance alternative to traditional asphalt additives. The following details the processes and technology used to develop and deploy this new, innovative product.

Limitations of Traditional Liquid Binding Processes

Traditional methods for adding rubber to asphalt use expensive blending equipment, require extra heating, agitation, and additional rubberized asphalt reaction and storage tanks. Adding rubber to the asphalt liquid is called a "wet process". When everything goes perfectly, the wet process material can perform exceptionally well. But, the science is not always exact in that asphalt binder composition can vary from one supplier to the next, or even when the binder is considered to be the same performance grade¹. This can happen, for example, when gasoline prices stay high, refiners take as much of the lighter fractions of the crude oil (that make asphalt good), and turn them into gasoline or other higher value liquids.

These light ends in asphalt, called Maltenes, are diminishing in the asphalt supply. In a wet process, where the rubber is interacted with the asphalt liquid from 45 minutes to 4 hours, the rubber is said to be "reacted" when the absorption of maltenes and swelling stops, and the viscosity of the rubberized asphalt binder stabilizes.

The extra heating and blending of the liquid to accelerate the interaction with the rubber is expensive and can take a long time. Extra time and expense are not good to add at the mixing plant when construction schedules race against the weather and time.

When under-reacted rubberized binder is used in an asphalt mix, swelling caused by continued maltene absorption can push the aggregate material apart, resulting in a loss of compaction, raveling or pre-mature cracking in the pavement.²

To address liquid volatility, Liberty completes the SmartMIX™ absorption process before delivery, allowing the customer to receive a ready-to-use product and thereby avoiding costly, unpredictable and complex high-temperature on-site wet reaction processes.

The process used to produce and deploy SmartMIX™ overcomes the limitations of traditional blending methods used for rubber additives. SmartMIX™ uses an extender oil, with a rich Maltene content, to produce an engineered product with adequate light fractions to make a higher quality and more crack resistant asphalt mix.



**UP TO A 50% REDUCTION
IN MODIFIER COSTS**

SmartMIX™: Best of Wet and Dry Processes

The liquid absorption “wet” process utilized to produce SmartMIX™ achieves an accurate and predictable absorption result by pre-swelling rubber material at Liberty’s specialized plant, under controlled conditions. The reaction of rubber and binder at job sites can be sub-optimal. These complex field operations with extra tanks and equipment are not required for using SmartMIX™.

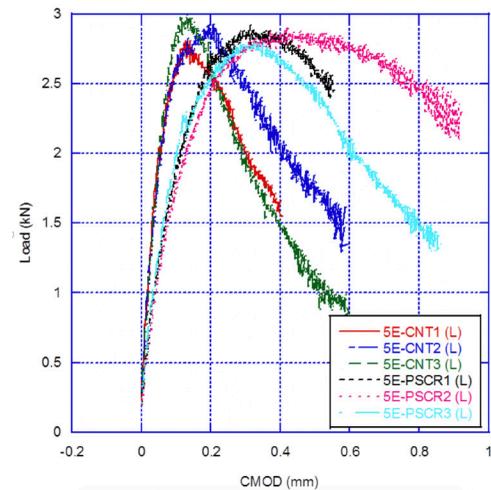
By the time SmartMIX™ is shipped, it is fully reacted, resulting in a dry powder that is of uniform quality, easy to ship and handle, and weighs/measures accurately in the field. SmartMIX™ is best utilized in Balanced Mix Design Specifications, where rutting and cracking can be easily reduced.

Testing & Performance

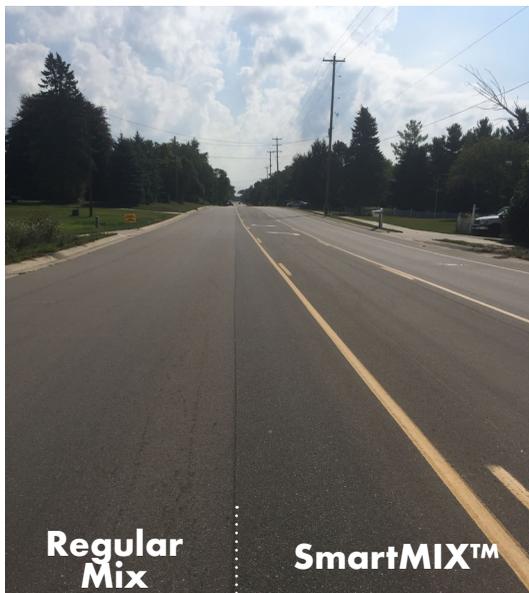
Comparative field testing has proven that SmartMIX™ performance is equivalent to that of polymer modifiers, and that it offers a viable alternative for extending pavement life. Cracks take longer to propagate through SmartMIX™, resulting in lower life-cycle costs. On a one inch overlay, for example, the 30-year cost per square yard for SmartMIX™ is estimated at \$9.28 versus \$12.84 for traditional asphalt.

In addition, SmartMIX™ modified asphalt mixtures have proven successful when tested with the Hamburg Wheel Tracking device. SmartMIX™ can help mixes resist rutting, permanent deformation, and reduce moisture susceptibility. SmartMIX™ improves mixture resistance to thermal degradation, cracking and fracture properties at low temperatures as demonstrated by the disk-shaped compact tension (DCT) test. The distribution of SmartMIX™ throughout the structure of the mix provides greater endurance in the mix to resist fracture over time and loading. SmartMIX™ performs well in both hot and cold climates.

The rubber used to make SmartMIX™ is a fine particle 20 mesh or smaller to easily fit into Dense grade and Superpave mixes. SmartMIX™ works well with SMA, Gap Grade and Open Grade mixes used in premium, low noise, splash and spray resistant highway surfaces.



DCT Test Results (5E1-Field Mixtures)



Michigan Field Test

In August 2015, SmartMIX™ was successfully field tested on Lake Lansing Road, from East Saginaw Hwy (I-69 BR) East to Lac Du Mont Drive in Lansing Michigan. Test parameters:

- 1 mile of hot mix asphalt cold-milling, crushing, shaping & repaving
- 9,085 Total tons asphalt mix
- 6,378 Tons of regular HMA
- 2,707 tons of SmartMIX™ Modified
- SmartMIX™ utilized in base course, structural layer & surface course
- 36,897 lbs. of SmartMIX™
- Mixtures compliant with MDOT Superpave 3E1, 4E1, and 5E1 Mixes (standard dense grade highway mix with design life of 1 million Equivalent Single Axle Load (ESALs)).
- Mixtures contain 33% RAP
- Binder in mixes unmodified PG 58-28

Source: “Evaluation of Mixture with Pre-Swollen Crumb Rubber in the Laboratory and Field Sections Constructed at Lake Lansing Road (Haslett, MI).” Project Number: C/U-1433030. Final Report – Submitted by Michigan State University Department of Civil & Environmental Engineering. Authors: Sepehr Soleimani and M. Emin Kutay, Ph.D., P.E., October 28, 2015.

GO GREEN WITH LIBERTY

For a 1-mile section of four lane highway,
up to 6,000 recycled tires are used
to create a safer, more durable roadway.

Sustainability Benefits

SmartMIX™ is manufactured using recycled tires. Recycling diverts millions of scrap tires from landfills, and gives this highly-engineered material a new life in rubberized pavements.

Recycling saves impressive amounts of energy, which ultimately reduces greenhouse gas emissions. For example, recycling four tires reduces CO2 by approximately 323 pounds, equivalent to 18 gallons of gasoline.

SmartMIX™ allows contractors to greatly increase the percentage of Recycled Asphalt Pavement (RAP) in their mixes

- Creates a sustainable solution to the growing quantities of RAP being generated each year
- Greatly reduces cost by providing a high-performing mix with much higher RAP content
- A common concern with high RAP mixes is the brittle nature of the material. SmartMIX™ has superior binding characteristics to help contractors use RAP effectively and in greater quantities

As contractors and developers worldwide experience a shortage of high-quality aggregate³, SmartMIX™ can also enable the use of material previously considered undesirable for paving projects.

Liberty SmartMIX™ is available in the U.S. and Canada.
To learn more, contact us:

Conclusion

The technological advancement represented by SmartMIX™ builds on decades of industry experience with rubberized asphalt mixes and liquid binding processes. The shortcomings of these processes are well-known: High cost, complexity, unpredictable results and variable performance.

By taking the “wet” binding process out of the field and into a controlled manufacturing environment, SmartMIX™ produces a dry product that is pre-treated with a high degree of accuracy, and delivered in amounts tailored to large and small asphalt paving projects.

Based on sound science and manufactured using proprietary technology, SmartMIX™ is a viable solution for asphalt projects in which performance, cost-effectiveness, sustainability and long-term durability are customer priorities.

1 “Performance Characteristics of Asphalt Mixtures Incorporating Treated Ground Tire Rubber Added During the Mixing Process” Dr. Walaa S. Mogawer, PE, F.ASCE Director -Highway Sustainability Research Center Professor of Civil & Environmental Engineering University of Massachusetts; Innovative Research in Asphalt Pavements, Tuesday March 21st, 2017 - 92nd AAPT Annual Meeting Symposium.

2 “The Chemical + Physical Properties of Asphalt-Rubber Mixtures, Part 1- Basic Material Behavior” Report: ADOT-RS-14(162) July 1977 Prepared by: E. L. Green + William J Tolonen, Material Sciences, Arizona Department of Transportation

3 <https://business.financialpost.com/commodities/alarm-bells-ringing-globally-as-world-begins-running-out-of-sand>.

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About Liberty Tire Recycling

Liberty Tire Recycling collects more than 190 million tires each year across North America, transforming 2.9 billion pounds of rubber into eco-friendly material for smart, safe and innovative products. Nearly 350 million scrap tires are generated annually in the U.S., many of them stored in dangerous, abandoned locations. Liberty has remediated more than 150 sites containing 40 million scrap tires and plays a vital role in the nation’s recycling and sustainability infrastructure.



Liberty
TIRE RECYCLING