

Rediset[®] LQ



Superior warm-mix additives for exceptional coating, compaction, and moisture resistance

Nouryon

Beyond warm-mix

Rediset LQ products are easy to use liquids that are more than just warm mix additives.

Rediset LQ provides:

- Superior workability and compaction even at reduced temperatures.
- Active adhesion that enables coating of incompletely dried aggregates, prevents stripping and improves long term moisture resistance for extra asphalt durability.
- Easy to use liquid products that can be stored and added at the plant with suitable dosage equipment.
- Green light to open roads to traffic sooner.
- Enhanced foamed asphalt warm-mix properties.

Warm-mix asphalt (WMA) improves working conditions, paving performance, and the environment. By reducing fuel consumption at the hot-mix plant, warm-mix reduces the carbon footprint of asphalt paving, and the lower paving temperatures virtually eliminate emissions and odors.

The use of WMA technology extends the paving season, allows longer haul distances and enables cool weather and night paving. Warm-mix reduces binder aging during mixing and paving and helps density targets to be met which together should lead to more durable pavements. While the general benefits of WMA technology are now well-established in the field, the actual results may vary widely between systems, making the choice of treatment important.

Convenient, low dosage & cost-competitive

Simply dose Rediset LQ into the bitumen line or weigh kettle at the hot-mix plant. Rediset LQ can be conveniently metered into the mix with the same kind of dosing systems that are used for liquid anti-stripping additives. Rediset LQ can also be pre-blended with the bitumen at the terminal or at the refinery. It will not alter the binder properties and PG grade at the recommended dosages or add significant cost to your mix. Rediset LQ provides various benefits for a small increase in cost. Rediset LQ also functions as an anti-strip, which results in savings



Typical dosing system ELF-SGP-D system for metering Rediset LQ into bitumen.

as the need for additional additives is eliminated. Mixes prepared using Rediset LQ will meet national and local moisture sensitivity specifications and Rediset LQ is often approved for use both as a warm-mix additive and as an anti-stripping agent.

Recommended dosage

The recommended dosage is based on the percent of Rediset LQ by the effective binder weight. The recommendations have been established based on laboratory tests and field trials with the particular mix.

Table 1: Recommended dosages

Application	Dosage (%)
Warm-mix (standard paving and PG grades)	0.4-0.6
Compaction aid	0.3-0.5
High-RAP, PMB and higher PG binders	0.5-0.75
Foam warm-mixes	0.3-0.5

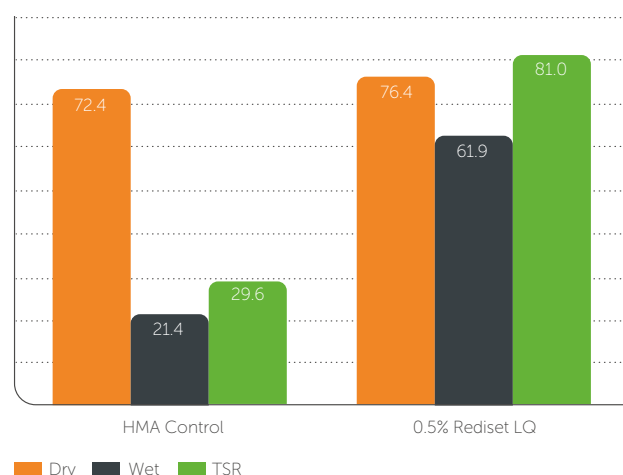
Active adhesion improves coating even in wet conditions

Pave longer-lasting roads

Roadways constructed with Rediset LQ-modified asphalt mixtures demonstrate exceptional moisture resistance.

Active adhesion provided by the product enables good coating even with small amounts of residual moisture in the aggregate mix which can result from the lower mixing and drying temperatures of warm-mix processes. Rediset LQ enables the bitumen to displace residual water from the aggregate surface, and creates a strong chemical bond between the aggregate and the bitumen that is resistant to water action in the long term.

Figure A



Rediset LQ - modified warm-mix asphalt exhibits superior conditioned indirect tensile strength, and an improved tensile strength ratio compared with traditional hot-mix asphalt. Rediset LQ dosage by the weight of PG 64-22 asphalt binder. Test performed according to AASHTO T 283 procedure.

Table 2: Indirect Tensile Strength Ratios

Mix*	Dosage of Rediset LQ % of bitumen	Binder PG	Penetration (Appx)	RAP content (%)	Production or preparation temperature (°C/°F)	TSR/ITSR (%)
81 BIT 140G	0	58-28	85	50	146 (295)	89
81 BIT 140G	0.65	58-28	85	50	132 (270)	88
81 BIT 140G	0.75	58-28	85	50	132 (270)	87
BIT, N50 19.0 REC base	0.5	58-28	85	40	132 (270)	86
BIT, N50 19.0 REC binder	0.5	64-22	65	20	132 (270)	95
BIT, N70 19.0 REC surface	0.5	64-22	65	10	132 (270)	91
BIT, N70 19.0 REC binder	0.5	64-22	65	15	132 (270)	88
10 to < 30 Million ESAL 12.5mm Superpave FC2 (HL-1)	0.5	64-28	65	15	154 (310)	95.2

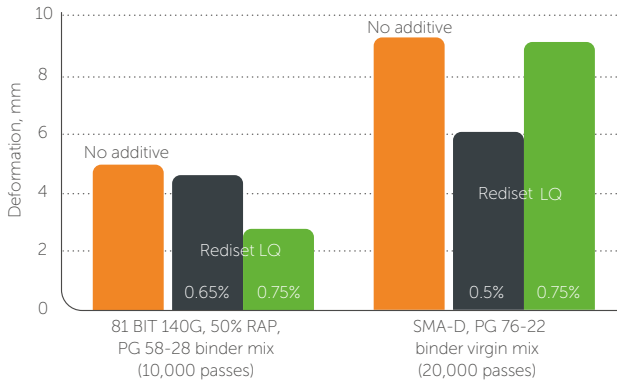
* Thermea. N50=number of gyrations in Gyratory compactor to get target air voids. ESAL=Equivalent Single Axle Load.

Achieve superior performance

Combat moisture damage

Performance testing in the field and the laboratory demonstrates that when compared with its hot-mix asphalt (HMA) counterparts, mixes treated with Rediset LQ exhibit favorable Hamburg Wheel-Track test results (Figure B), indicating strong resistance to moisture damage. Real-world field projects, in addition to laboratory studies (Table 2), continue to build a library of data demonstrating that the use of Rediset LQ will yield superior, long-lasting roads.

Figure B

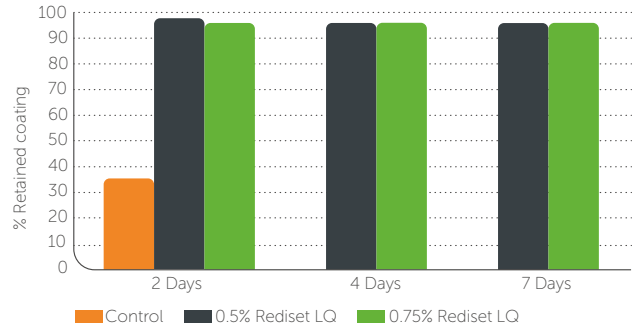


Bitumen containing Rediset LQ exhibits improved resistance to deformation and moisture. Hamburg wheel tracking data from Chicago Testing Laboratory Inc., and PaveTex, USA. Testing based on AASHTO T 324.

Maintain activity after hot storage

Rediset LQ contains heat-stable ingredients. When using pen grade bitumen or for instance pen 85/PG 58-28 binder, Rediset LQ-modified binders maintain excellent activity after storage for extended periods of time. Figure C shows that even after conditioning the binder for seven days, aggregate coated with Rediset LQ-modified binder retained significant coverage as evaluated by the Static Immersion Test (AASHTO T 182). Thorough lab evaluation of each binder is highly recommended because certain asphalt binder properties and additives, such as PPA modification, will influence the results of this test.

Figure C



Rediset LQ exhibits exceptional heat stability in standard, unmodified binder, for a minimum of seven days. The AASHTO T 182 method was followed after various days of conditioning the Rediset LQ-modified asphalt binder at 177°C / 350°F.

Table 3: Hamburg wheel tracking results

Mix*	Dosage of Rediset LQ (%/binder)	Binder PG	Penetration (Appx)	RAP content (%)
<30 Million ESAL 12.5mm NMAS Superpave, WMA	0.5	64-22	65	0
<30 Million ESAL 12.5mm NMAS	0	64-22	65	0
Superpave, HMA control 81 BIT 140G HMA Control	0	58-28	85	50
81 BIT 140G WMA (1)	0.65	58-28	85	50
81 BIT 140G WMA (2)	0.75	58-28	85	50
BIT, N50 19.0 REC WMA base	0.5	58-28	85	40
BIT, N50 19.0 REC WMA binder	0.5	64-22	65	20
BIT, N70 19.0 REC WMA surface	0.5	64-22	65	10
BIT, N70 19.0 REC WMA binder	0.5	64-22	65	15
SMA-D	0	76-22	PMB (base pen 65)	0
SMA-D	0.5	76-22	PMB (base pen 65)	0
SMA-D	0.75	76-22	PMB (base pen 65)	0

WMA= Warm Mix Asphalt. HMA=Hot Mix Asphalt. N50= Number of gyrations in Gyratory compactor to get target air voids. SMA=Stone Mastic Asphalt. *Therma. ESAL=Equivalent Single Axle Load. NMAS=Nominal Maximum Aggregate Size.

Experience exceptional compaction & workability

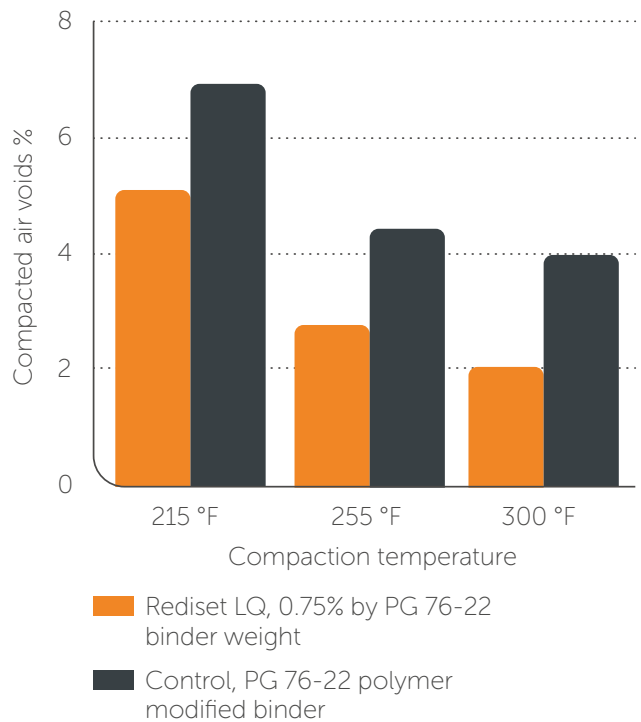
Rediset LQ changes the way bitumen and aggregate interact at the interface by reducing surface tension of the bitumen. This enables reduction of mixing and compaction temperatures or simply helps the compaction of difficult mixes.

Maintaining good compaction is made easier with Rediset LQ. Cold weather and night paving are no longer a challenge. Longer hauls are less troublesome as Rediset LQ maintains the workability of the mix and results in better densities even in the face of cooler ambient temperatures (Figure D).



Density measurements being collected from pavement laid using Rediset LQ technology at the O'Hare Airport modernization project.

Figure D



Achieve better compaction with Rediset LQ. Mix design: 12.5mm, coarse graded Superpave mix. Reference is hot-mix asphalt. Testing performed using Marshall Compaction Method (AASHTO T 245).

Asphalt content (%)	Production or preparation temperature (°C/°F)	Hamburg result (mm @ # passes)	Spec	Test type
5.3	116 (240)	12.5 @ 11,850	<12.5mm @ 10,000 passes, 50°C	AASHTO T324
5.3	146 (295)	12.5 @ 16,345	<12.5mm @ 10,000 passes, 50°C	AASHTO T324
4.8	146 (295)	4.85 @ 10,000	<12.5mm @ 10,000 passes, 50°C	IL DOT
4.8	132 (270)	4.65 @ 10,000	<12.5mm @ 10,000 passes, 50°C	IL DOT
4.8	132 (270)	2.94 @ 10,000	<12.5mm @ 10,000 passes, 50°C	IL DOT
4.5	132 (270)	9.28 @ 20,000	<12.5mm @ 10,000 passes, 50°C	IL DOT
4.9	132 (270)	7.55 @ 20,000	<12.5mm @ 10,000 passes, 50°C	IL DOT
5.6	132 (270)	5.83 @ 20,000	<12.5mm @ 10,000 passes, 50°C	IL DOT
4.9	132 (270)	9.73 @ 20,000	<12.5mm @ 10,000 passes, 50°C	IL DOT
6.1	135 (275)	9.3 @ 20,000	<12.5mm @ 20,000 passes, 50°C	TX-242-F (based on AASHTO T324)
6.1	135 (275)	6.3 @ 20,000	<12.5mm @ 20,000 passes, 50°C	TX-242-F (based on AASHTO T324)
6.1	135 (275)	9.3 @ 20,000	<12.5mm @ 20,000 passes, 50°C	TX-242-F (based on AASHTO T324)

Extend the paving season while still easily meeting specifications

Lower paving temperatures and open roadways sooner

Use Rediset LQ as a warm-mix additive to produce and pave asphalt mixes at significantly lower temperatures than with regular hot-mixes. Reap the benefits of 22-33°C / 40-60°F temperature reductions, or even more, by cutting fuel consumption and saving money and energy. What is more, reducing mix temperature behind the paver by more than 22°C / or 40°F will virtually eliminate vapors and aerosols, ensuring a much safer working environment for the paving crew. After you've capitalized on the superior compaction and performance inherent to Rediset LQ technology, the pavement can be opened to traffic earlier than anticipated due to a shorter cooling time.

Prolong the service life of the roadway by easily meeting density specifications thanks to enhanced compaction and improved moisture resistance in the presence of Rediset LQ. At both warm- and hot-mix temperatures, Rediset LQ can reduce the compacted air voids by at least a percentage point.



The crew of K-Five Construction Company on their first day of laying Rediset LQ modified pavement at O'Hare Airport.

Table 4: Examples of temperature reductions when using Rediset LQ

LQ dosage basis binder (%)	Binder PG	Mix type**	RAP content (%)	Binder content (%)	Mat thickness (cm)	Air T (°C)	Air T (°F)	Production T (°C)	Production T (°F)	Screed T (°C)	Screed T (°F)	Production T reduction* (°C)	Production T reduction* (°F)
0.65	58-28	81 BIT 140G	50	4.8	15	20	68	129	265	110-115	230-240	25	45
0.75	58-28	81 BIT 140G	50	4.8	15	20	68	104-121	220-255	96-99	205-210	33	60
0.5	64-22	N70	10	~5	4	18-21	65-70	135	275	127-129	260-265	25	40
0.5	64-22	12.5 mm NMA Superpave	0	5.3	4	23	74	127	260	113	235	33	60
0.5	58-28, 64-22	BIT N50/N70 & ATPB	10-40	4.5-5.6	8-15	10-27	50-80	127-132	260-270	118	<245	25-28	40-50
0.55	64-22	12.5 mm NMA Superpave	15	5.2	15	4-9	40-48	121	250	99-104	210-220	28	50

* The temperature reductions are based on comparison with traditional HMA temperatures for equivalent mixes.

** Thermea. NMA = Nominal Maximum Aggregate Size. N50 = Number of gyrations in Gyrotory compactor to get targeted air voids.

Using foam warm-mix asphalt?



Rediset LQ enhances and improves the properties of foam warm-mixes

The addition of Rediset LQ simply dosed into the bitumen at 0.3 to 0.5% in the binder can significantly improve the properties of foam mixes.

This small addition of Rediset LQ to foamed bitumen leads to:

- Enhanced aggregate coating.
- Significantly lower mix and paving temperatures compared to normal foam mix.
- Dramatically Improved moisture resistance.
- Elimination of clumping when mixes are stored for extended times in the silo.
- Extended period of workability and compactability.

Rediset LQ's active adhesion technology enables bitumen to coat aggregate even in the presence of moisture, which is present as a consequence of the foaming process.

This active adhesion property not only enables coating but also prevents stripping and significantly improves the mix's moisture resistance properties without the need for additional anti-strip treatments. With the addition

of Rediset LQ, the temperature of foam mixes can be further reduced; field studies have demonstrated a 22 to 33°C / 40 to 60°F temperature reduction compared to an equivalent hot-mix. These lower temperatures further enhance the environmental benefits of the FWMA process.

Foam mixes containing Rediset LQ are significantly more workable and exhibit a wider compaction window compared to regular foam warm-mix. Moreover, if overnight storage in the silo is required, Rediset LQ has been shown to maintain workability and allow for paving the following day.

Contact us directly for detailed product information
and sample request at asphalt@nouryon.com

USA and Canada

Global Headquarters
Chicago, USA
T +1 312 544 7000

China

Regional Headquarters
Shanghai, China
T +86 21 2220 5000

Europe

Regional Headquarters
Stenungsund, Sweden
T +46 303 850 00

South America

Regional sales office
Itupeva, Brazil
T +55 11 4591 8938

South East Asia

Regional Headquarters
Singapore
T +65 6635 5183

Middle East

Regional sales office
Dubai, United Arab Emirates
T +971 4247 1500

**Central America and
Caribbean**

Regional sales office
Mexico City, Mexico
T +52 55 5261 7895

India

Regional sales office
Mumbai, India
T +91 22 6842 6700

Russia

Regional sales office
Moscow, Russia
T +7 495 766 1606

We are a global specialty chemicals leader. Markets worldwide rely on our essential chemistry in the manufacture of everyday products such as fuels, plastics, coatings, asphalt, agrochemicals, personal care and lubricants items. Building on our nearly 400-year history, the dedication of our 10,000 employees, and our shared commitment to business growth, strong financial performance, safety, sustainability and innovation, we have established a world-class business and built strong partnerships with our customers. We operate in over 80 countries around the world and our portfolio industry-leading brands includes Redicote®, Rediset®, Wetfix®, and Kling® Beta.

For more information visit
surfacechemistry.nouryon.com/markets/asphalt

Products mentioned are trademarks
and registered in many countries.

The information presented herein
is true and accurate to the best
of our knowledge, but without
any guarantee unless explicitly
given. Since the conditions of
use are beyond our control, we
disclaim any liability, including
patent infringement, incurred in
connection with the use of these
product data or suggestions.

Nouryon