Rediset® WMX

Premium warm-mix additive for superior, long-lasting roads
The construction and maintenance of our road network inevitably consumes raw materials and uses energy, leading to carbon emissions. But these environmental impacts can be reduced by using low energy processes, by re-using and recycling materials wherever possible, by utilizing local aggregate sources, and by building durable roadways, which minimize the need for replacement and the traffic delays associated with roadworks.

Warm-mix is a process for the production of asphalt mixes at lower than traditional temperatures, thus reducing fuel consumption and carbon footprint. It also virtually eliminates vapors and aerosols generated in the paving process, thereby providing a better working environment for the paving crew. Rediset WMX is an additive that not only allows the processing of asphalt mixes at lower temperatures, but also allows the compaction of asphalt mixes containing high contents of reclaimed asphalt pavement (RAP). By enhancing the adhesion of the bitumen to the aggregate, Rediset WMX also allows the utilization of a wider range of aggregates and provides longer-lasting roadways resistant to the effects of aging and water.

**Rediset WMX Provides:**

1. Modified mixes with superior workability and compaction compared to other warm-mix technologies.
   - Good results at reduced temperatures (typically 30°C lower) even with difficult-to-compact mixes such as stone mastic asphalts (SMAs), Polymer Modified Bitumen (PMB) and crumb-rubber-modified (CRM) mixes.

2. Active adhesion and antistripping effect to meet any concerns about higher moisture levels in the aggregate resulting from the lower mixing and drying temperatures.

3. The possibility to use higher dosage levels if needed, without compromising bitumen properties.

4. Good heat stability – treated bitumen can be stored hot for two weeks without any negative effect on performance.

5. Unmatched versatility – works with a wide spectrum of bitumens, aggregates and mixes.

6. Extended silo storage for asphalt mixes at required temperatures, with no loss of its warm-mix and adhesion promoter properties.

7. Modified mixes that can be opened to traffic sooner than other warm-mix technologies and much sooner than hot-mixes.
Excellent compaction with stone mastic asphalts (SMAs) in Beaumont, TX, US.

Rediset WMX can be used to reduce mixing and compaction temperatures or solely as a compaction aid. Its ability to significantly improve compaction has been demonstrated in various projects around the world. In some cases, the mixes can be produced at higher temperatures and hauled over longer distances for paving and still get good compaction.

**Cold weather and night paving**

Enhanced compaction is especially useful during the cooler conditions at the beginning and end of the paving season, or while paving at night.

The compaction process should result in the correct density (air voids) of the asphalt mixture. Failure to meet design density is likely to lead to early deformation, moisture damage and reduced service life of the pavement. In cold conditions, a conventional hot mixture may cool rapidly during transport to the job site, and once placed on the road, making compaction difficult. The result could be low density (high air voids).

Adding Rediset WMX to the binder changes the surface chemistry of the mix and makes it easier to compact. The warm-mix additive can be used as a compaction aid at small dosages such as 1 percent by binder weight or 0.06 percent by the weight of the total asphalt mix. Rediset WMX has been successfully used as a compaction aid in difficult-to-compact mixes such as stone mastic asphalt, crumb-rubber-modified mixes and polymer-modified mixes.

Good compaction with PG 76-22 polymer-modified asphalt mix in Dallas, TX, US in cool weather conditions (5°C).

Excellent compaction with stone mastic asphalts (SMAs) in Beaumont, TX, US.
**Adhesion and stripping**

Stripping, caused by water displacement of bitumen, will eventually lead to chip loss, potholes, rutting and raveling, and ultimately to early pavement failure. Rediset® WMX is formulated to improve the adhesion between the aggregate and the bitumen and prevent stripping, thus prolonging the service life of the road (Figures A and B). The resulting decrease in the need for more materials, production and construction will lower the impact on the environment significantly.

In some regions local aggregates have a high stripping tendency and suitable aggregates may need to be brought in from far afield. Rediset WMX provides an adhesion promoting effect, which can allow the use of local aggregates and consequently reducing energy and emissions associated with transport of materials.

**Active adhesion**

The lower mixing temperatures made possible by warm-mix technologies may lead to some residual water remaining in the aggregate, which could prevent the aggregate from being fully coated, or lead to future moisture damage. The active adhesion agent contained in Rediset WMX will enable the modified asphalt mix to displace water from the aggregate surface, enabling not only the coating of the aggregate but also the creation of a strong chemical bond between the aggregate and bitumen that is resistant to the action of water.

**Figure A – Hamburg wheel track data**

- **No Additive (18,000 cycles)**
- **2% Hydrated Lime by Wt of Mix (20,000 cycles)**
- **0.1% Rediset® by Wt. of Mix (20,000 cycles)**

Hamburg wheel tracking test data from PaveTex, TX, US. The test measures both deformation and water sensitivity of the mixture. Texas Type D surface course with 5.2% PG 70-28 bitumen.

**Figure B – Indirect Tensile Strength Ratio**

Indirect tensile strength ratio data comparing reference mix with and without antistripping agent Wetfix AP17 prepared at 150°C (302°F) with Rediset WMX treated mix at 120°C (248°F). Data from a study by the Development Fund of the Swedish Construction Industry (SBUF).
Warm-mix technology enables asphalt mixes to be produced effectively at lower temperatures. Mixes modified with Rediset® WMX are produced and compacted at temperatures 30°C or 54°F lower than temperatures for regular hot mixes. The lower production temperatures made possible by the use of Rediset WMX cut fuel consumption by up to 25 percent (Figure C). Additionally, compaction made possible by the use of Rediset WMX is superior despite the lower temperatures (Figure D).

Reducing the temperature of the mix behind the paver by more than 30°C virtually eliminates vapors and aerosols (Figures E and F). This is especially true for polymer-modified and crumb rubber modified mixes which, because of the higher paving temperatures typically used for these difficult-to-compact mixes, would otherwise create huge amounts of fumes behind the paver.

**Figure C: Fuel consumption per ton of mix**

- Liters of fuel
- Saltsjöbaden project: Hot mix 8, Warm mix 6
- E20 project: Hot mix 7, Warm mix 5

**Figure E: Oil mist particles mg/m³**

- A: Polymer Modified Bitumen
- B: Polymer Modified Bitumen treated with Rediset WMX at 30°C or 54°F lower temp.
- C: Threshold limit

**Figure D: Air voids data graph**

- Air voids %
- No. passes: 1 to 37
- 1.5% Rediset, Reference

**Figure F: Dust particles above the screed mg/m³**

- A: Polymer Modified Bitumen
- B: Polymer Modified Bitumen treated with Rediset WMX at 30°C or 54°F lower temp.

Measurement of fumes above the screed in SBUF project in Sweden, PMB mix.
Rediset® WMX designed with versatility in mind

Rediset WMX is a solid additive in the form of pastilles and designed in such a manner that it does not have a negative effect on the binder in its high-temperature or low-temperature properties of bitumen at a wider dosage level (Table 1).

<table>
<thead>
<tr>
<th>Binder</th>
<th>PG 76-22</th>
<th>PG 76-22</th>
<th>PG 64-22</th>
<th>PG 64-22</th>
</tr>
</thead>
<tbody>
<tr>
<td>Original binder</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>G'/sin delta at 10rad/s kPa at 76°C or 64°C</td>
<td>1.31</td>
<td>1.49</td>
<td>1.05</td>
<td>1.43</td>
</tr>
<tr>
<td>RTFOT Residue</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>G'/sin delta kPa at 10 rad/sec, kPa at 76°C or 64°C</td>
<td>3.664</td>
<td>2.668</td>
<td>2.51</td>
<td>2.88</td>
</tr>
<tr>
<td>PAV Residue</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>BBRⅠ's, 60s, MPA at -12°C</td>
<td>146</td>
<td>154</td>
<td>200</td>
<td>122</td>
</tr>
<tr>
<td>BBRⅠ'm, 60s at -12°C</td>
<td>0.314</td>
<td>0.314</td>
<td>0.337</td>
<td>0.363</td>
</tr>
<tr>
<td>PG grade maintained</td>
<td>76 - 22</td>
<td>76 - 22</td>
<td>64 - 22</td>
<td>64 - 22</td>
</tr>
</tbody>
</table>

Heat stability

Rediset WMX has heat-stable ingredients. Rediset WMX-modified bitumen can be stored in hot conditions for two weeks without altering the warm-mix property or the anti-stripping property of Rediset WMX. This has been demonstrated in the laboratory (Figure H) and in field trials.

A tank of PG 76-22 binder modified with 2% Rediset WMX was stored for nine days at a temperature of 170-175°C (340 to 350°F). This bitumen was used in a trial after nine days without any loss in performance.

Additional benefits

Rediset WMX can be used with a wide spectrum of mixes

Rediset WMX is designed to work with a wide spectrum of asphalts, aggregates and mixes, so it isn’t necessary to use a different additive for different mixes. This has been clearly demonstrated in field projects involving different mixes and grades of asphalt in many countries around the world (Figure G).
Rediset WMX-modified mixes can be stored for extended periods of time

Rediset WMX-modified mixes do not require water to function as a warm-mix and so, unlike foamed mixes, Rediset WMX-modified mixes will not lose their warm-mix property when stored for lengthy periods. They will remain workable over these periods as long as they are maintained at the required temperature for compaction, which is typically 30°C or 54°F lower than that required for hot mixes.

Early opening to traffic

Rediset WMX-modified mixes can be opened to traffic after compaction much earlier than regular hot-mix and sooner than other warm-mix technologies. This is especially advantageous when paving in residential areas or where there is a lot of cross traffic. An SMA warm-mix project with Rediset WMX, when completed in Texas, USA, in Spring 2010, was opened to traffic within a half-hour to one hour after compaction. An equivalent hot-mix project would have been opened to traffic after four hours (Figure C). The Quality Control manager commented that a regular hot-mix project opened to traffic at such a short time would have fallen apart completely.

Recommended dosage and method of addition of Rediset WMX

<table>
<thead>
<tr>
<th>Recommended dosage levels</th>
</tr>
</thead>
<tbody>
<tr>
<td>% Rediset by the weight of the binder</td>
</tr>
<tr>
<td>Compaction aid</td>
</tr>
<tr>
<td>Warm mix</td>
</tr>
<tr>
<td>Warm mix</td>
</tr>
<tr>
<td>Improved workability</td>
</tr>
</tbody>
</table>

Rediset WMX is a solid additive that is supplied in bead/pastille form in 50-lb bags or in super-sacks as required. It can be pre-blended into the asphalt binder or it can be directly dosed into the mixer at the hot-mix plant, as follows:

1. Add into the binder feed collar leading into the batch mixer while the binder is being dosed or add to the aggregate mix immediately after the binder is added and then mixed.
2. Add directly into the aggregate mixing drum by dosing through the RAP collar or the line near the RAP collar.
3. Hold in a smaller heated tank above 120°C (250°F) as a molten liquid and inject into the binder line supplying the batch or drum mixer through dosing meters.

Good compaction and earlier opening to traffic at SMA Project with Rediset WMX at a busy intersection in Jasper, TX, US.
AkzoNobel is a leading global paints and coatings company and a major producer of specialty chemicals. We supply industries and consumers worldwide with innovative products and are passionate about developing sustainable answers for our customers. Our portfolio includes well-known brands such as Dulux, Sikkens, International and Eka. Headquartered in Amsterdam, the Netherlands, we are consistently ranked as one of the leaders in the area of sustainability. With operations in more than 80 countries, our 50,000 people around the world are committed to delivering leading products and technologies to meet the growing demands of our fast-changing world.