With today's rapidly aging infrastructure, government agencies, bitumen producers and contractors are being challenged to build longer-lasting roads with technologies that not only perform well, but are also cost-effective and operationally efficient, while ensuring worker comfort and safety. Traditional warm mix additives do not fully address these challenges. Many traditional additives make field compaction easier and help pavements last longer, but when added to bitumen, most emit smoke and foul-smelling fumes that are uncomfortable for plant and paving crew personnel as well as citizens. Moreover, these additives pose operational challenges since they are incompatible with some bitumen modifiers.

Road Science's WarmGrip line of warm mix additives fully addresses today's challenges. WarmGrip eradicates the smoke and odor problems typical of traditional additives, and offers safeguards for workers by using chemistry that is safer and less hazardous. WarmGrip's compaction-improving and adhesion-promoting technology makes roads easier and faster to construct, and longer-lasting while improving contractor profitability. WarmGrip adds operational flexibility to the bitumen terminal or mix plant since it is compatible with all bitumen modifiers, and will not interact with other bitumen and mix components to adversely affect bitumen properties and grading.

**WORKER-FRIENDLY WARM MIX CHEMISTRY FOR ALL BITUMENS**

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**BENEFITS**

- Odorless in hot bitumen for improved plant and paving crew comfort
- Smokeless in hot bitumen eradicating the need for vapor control equipment, and eliminating worker and citizen complaints
- Non-amine based chemistry
- Compatible with polyphosphoric acid (PPA)
- Eliminates need to have more than one additive at terminal or mix plant
- Compatible with all aggregate types
- Makes compaction easier enabling improved mat density with fewer roller passes, even with high recycled asphalt pavement (RAP) mixes
- Remains effective in bitumen stored at 160 °C for several weeks to months
- Allows for reduced mix and compaction temperatures which saves energy costs, extends paving season and lengthens haul distance
- Allows the utilization of increased amounts of RAP and recycled asphalt shingles (RAS)
- Extends pavement life by promoting better chemical adhesion of bitumen to aggregate
- Protects pavement from stripping and moisture damage caused distresses such as raveling, rutting and pothole formation

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**IMPROVED OPERATIONAL EFFICIENCY**

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**LONGER-LASTING ROADS**

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MARKET APPLICATIONS

BITUMEN PAVING USING:
- Non-modified bitumens
- Modified bitumens including those modified with:
  - Polyphosphoric acid (PPA)
  - Styrene-butadiene-styrene (SBS)
  - Styrene-butadiene rubber (SBR)
  - Ethylene-vinyl acetate (EVA) polymers
  - Ground tire rubber (GTR)
  - Recycled Asphalt Shingles (RAS)

AGGREGATE TYPES INCLUDING:
- Granite
- Diabase
- Diorite
- Basalt
- Gabbro
- Rhyolite
- Andesite
- Dacite
- Chert
- Marble
- Quartzite
- Gneiss
- Natural Sand and Gravel
- Limestone
- Dolomite
- Sandstone
- Slag
- Recycled Asphalt Pavement (RAP)

WARMGRIP VS. TRADITIONAL WARM MIX ADDITIVES

<table>
<thead>
<tr>
<th>Comparison Criteria</th>
<th>WarmGrip D-450 EU</th>
<th>Traditional Warm Mix Additives</th>
</tr>
</thead>
<tbody>
<tr>
<td>Safer for workers</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Odorless</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Smokeless</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Compatible with all bitumens</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Protects against moisture damage</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Makes compaction easier</td>
<td>✓</td>
<td>✓</td>
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<tr>
<td>Efficacy with prolonged storage in hot bitumen</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>No heated storage required</td>
<td>✓</td>
<td></td>
</tr>
</tbody>
</table>

THE ROAD SCIENCE ADVANTAGE

ArrMaz’s Road Science division is a leader in the development of bitumen additives, emulsifiers and paving and recycling system technologies for the bitumen industry worldwide. Our offerings span the entire customer value chain from producing key chemical components for bitumen refineries, terminals, emulsion plants and hot mix bitumen plants, to providing laboratory and field engineering support of pavement applications. Road Science delivers responsive, comprehensive and dependable customer support, focused on helping our customers succeed. Through our experienced staff of professionals and world-class, American Association of State Highway and Transportation Officials (AASHTO) re:source accredited laboratory, we work alongside our customers to:

- Improve product quality and consistency
- Improve product performance
- Bring new products to market
- Solve product problems
- Increase profitability
- Increase operational efficiency

Contact Road Science today and learn how WarmGrip can help you make the grade.

Call 918-960-3800, email customerservice@roadscience.net or visit our website at roadscience.net for further information.