Maxlink Bitumen Modifier Pellet

Bitumen has long been used in road construction because of its waterproofing properties. Bitumen is a highly viscous liquid and has the tendency to become brittle at low temperatures and soft at high temperatures. Despite continuous improvements to its production, mixing and pavement technologies, bitumen when used alone in asphalt concrete mixes to pave roads cannot surmount the destructive action caused by the accelerated wear from heavy traffic and harsh climates and meet the increasing demand for safer and quieter roads.

Polymer modification of bitumen is helping to meet these challenges today. When polymers, additives, fillers and stabilizers are incorporated into bitumen, the modification has been shown to improve binder's properties including increased resistance to rutting, fatigue and reflective cracking and improved durability properties compared to conventional **asphalt concrete** (**AC**) mixtures. When blended into **hot mix asphalt** (**HMA**), its workability is improved and the mix is easier to place and compact.

Millions of tons of **polymer modified bitumen** (**PMB**) have been used worldwide by the road construction industry.

Polymer Modification of Bitumen

Polymers used to improve bitumen properties are usually elastomers, i.e. polymers having both viscosity and elasticity properties, or simply termed as rubber. Those elastomers used in polymer (or rubber) modified bitumen could be grouped into thermosets and thermoplastic elastomers.

Thermosets flow under stress when heated, but when cooled, cannot be re-softened by heat. **Tyre-derived crumb rubber** (**CRM)** is a common thermoset to modify bitumen. Thermosets are generally stronger than thermoplastic modifiers and are better suited to high-temperature applications.

Thermoplastic elastomers (**TPE**) are a class of copolymers with both thermoplastic and elastomeric properties, combining the viscoelastic advantages of rubber and the easier processing characteristics of plastic. Thermoplastic materials soften and become plastic-like when heated but return to their hardened state upon cooling. Some of the TPE's used in PMB include SBS, SBR, EVA, PP and PE.

CRM Modified Bitumen

Excessive permanent deformation in the form of rutting due to high-temperature service and thermal cracking attributed to low-temperature service are two major problems affecting the performance of AC pavements.

When rubber modified bitumen (also called rubberized asphalt binder or asphalt rubber) is the binder used in preparing HMA, the **rubberized asphalt concrete** (**RAC**) produced has better properties than AC, especially in extreme weather conditions and heavy-duty traffic.

Rubber modification of asphalt concrete mixes is accomplished by 2 methods:- dry process and wet process.

The **Dry Process** is any method that includes CRM as a substitute for 1% to 3 % of the aggregate in an asphalt concrete paving mixture and thus is more an aggregate modifier or filler, not as part of the bitumen binder.

The **Wet Process** is the method of modifying bitumen with CRM before incorporating the binder into the asphalt paving materials. It requires thorough mixing of CRM in hot bitumen and holding the resulting blend at elevated temperatures for a designated period of time to promote an interaction between CRM and bitumen. This is the most widely used method for modifying bitumen with CRM or other modifiers.

The Wet Process is again sub-divided into 2 methods for blending the binders, based on their viscosity ranges:-

The **Terminal Blend** (or No Agitation Wet Process) is a **CRM Modified Bitumen** (**CRMB)** with rotational viscosity of less than 1.5 Pa-sec. CRM content for such blend is generally less than 10% of total binder. This type of binder does not require constant agitation to keep the rubber particles dispersed in the hot bitumen mix.

The **Field Blend** (or High Viscosity Wet Process) is a CRMB with a rotational viscosity of more than 1.5 Pa-sec. At least 15% CRM by binder weight is typically required to achieve the threshold viscosity. This type of binder requires constant agitation to keep the modifier particles well dispersed, and is usually stored in heated tanks where special paddles keep the bituminous binder agitated and properly mixed.

The Field Blend or High Viscosity CRMB is the more widely used binder for processing RAC, whether for HMA or spray applications.

Advantages of **RAC,** also called **Asphalt Rubber Hot Mix** (**ARHM**), over conventional **Asphalt Concrete** (**AC**):-

- Improved durability when used as surface course or overlay due to better resistance to rutting and fatigue cracking. RAC is not only less brittle at low temperature, but also offer better heat resistance at higher temperature. RAC is also more resistant to stripping of binder film due to moisture damage.
- Gap-graded RAC-G costs more than conventional mixes, but when used as surface course, interlayer or overlay in resurfacing jobs, only half the thickness is required. There is potential cost saving from lower material costs and shorter construction time.
- Increased flexibility when used as chip seals or **stress absorbing membrane interlayers** (**SAMI**) due to better reflective cracking resistance.
- Reduction in tyre/pavement noise.
- Provides a skid-resistant surface.

However, certain limitations have prevented RAC from gaining wider acceptance, i.e.:-

- Specialized blending equipment and storage facility are required and the higher capital outlay would be a deterrent for RAC to be used for smaller jobs.
- The RAC binder has to be kept at high temperature and stirred continuously during storage to prevent segregation of particles in the binder.
- The binder has to be used within a specific time after blending, after which viscosity will drop and reheating or reprocessing may be required.
- This production method and delivery mode is different from conventional asphalt system; as such, asphalt suppliers are deterred from making the switch to produce RAC.
- The binder content required for RAC (ARHM) is higher than that for AC, thereby increasing total mixture cost. CRM, a 3D crosslink network of natural and synthetic rubbers reinforced with carbon black, will absorb the light oils from the bitumen during the reaction which results in the swelling and softening of the rubber, which in turn increases the viscosity of the modified binder. However, the RAC (ARHM) mix would require the use of at least 20% more liquid bitumen than is needed in a conventional hot-mix pavement. In some cases, bitumen concentration may be increased by 40-60% which will improve performance but also increase HMA cost.

WDRA

The **Stabilized Rubber Modified Asphalt** (**WDRA**) has been developed to further improve the performance of RAC by combining proprietary devulcanizing processes with patented pelletizing technology.

WDRA is produced in 2 steps:-

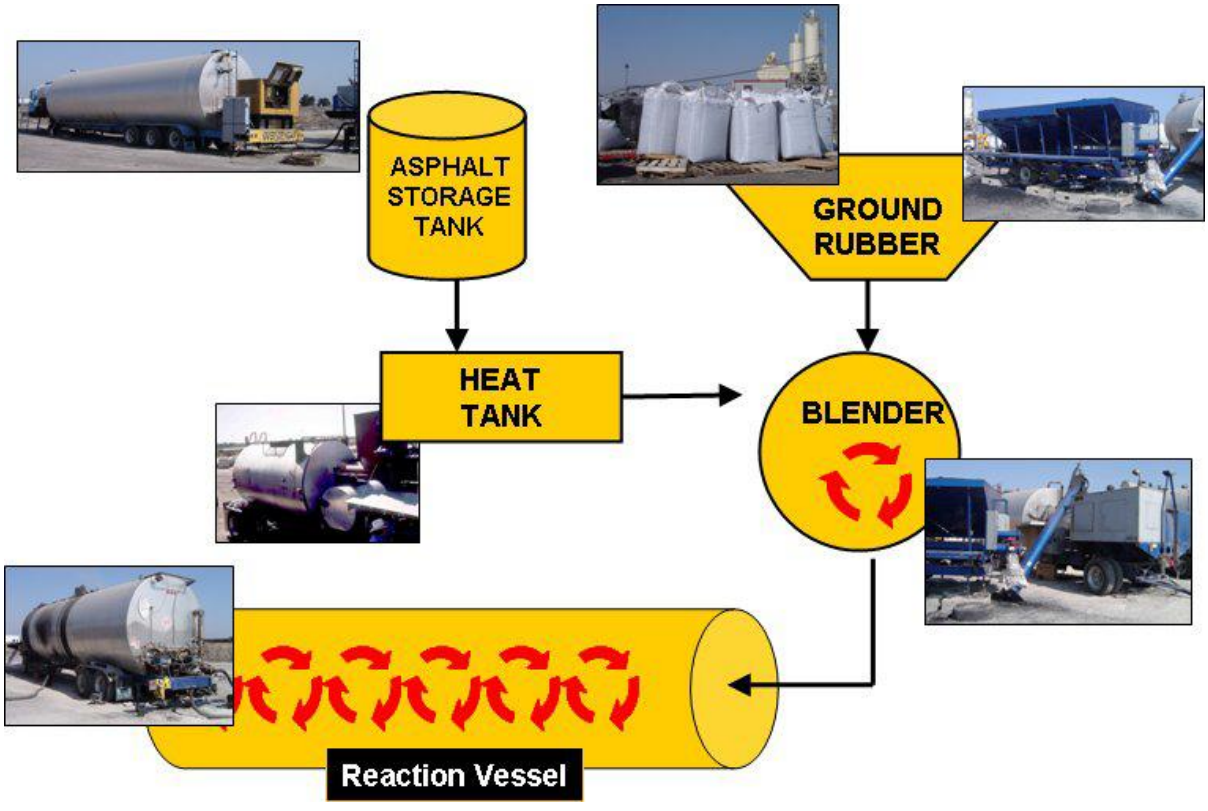
Step 1

CRM is firstly devulcanized in the patented continuous screw devulcanizer, then blended with polyolefin and other modifiers, stabilizers and additives, and finally granulated to make WDRA modifier pellets.

Step 2

WDRA modifier pellets are mixed with hot bitumen in a heated tank and passed through a colloid mill where they are sheared into tiny particles and dispersed evenly into the binder, and the resulting blend transferred to a heated tank where paddles keep it continuously agitated and held at 170 - 180°C for a designated period of time to allow the modifiers and bitumen to interact. The stabilized WDRA binder is delivered to a HMA plant, by any type of haul truck customarily used for transporting AC, where it is discharged into tanks and pumped into the pugmill to be mixed with mineral aggregates to produce hot mixture.

Typical RAC Binder Production



Advantages of WDRA over conventional RAC and SBS Modified Asphalt:-

- Stability and durability is as good or even better than SBS modified asphalt, registering better performance in low temperature cracking resistance, anti-stripping, flexibility, fluidity and workability. Compatibility of the materials that goes into making the WDRA binder increased the cohesion of the binder with aggregate and contributed to its chemical stability.
- Binder concentration is lower than conventional RAC and same as SBS modified asphalt when used in all the common mixture designs, thereby lowering total mixture cost.
- Increased flexibility when used as chip seals or SAMI applications due to better reflective cracking resistance.
- Better resistance to UV light due to the release of carbon black, antioxidants and antiozonants from the devulcanized CRM which contain UV inhibiting properties.

Maxlink WDRA Technology – The Solution to Road Builders

Maxlink has incorporated the patented WDRA technology into developing asphalt to meet these demands:-

- regions experiencing large daily/seasonal temperature variations
- pavements subjected to high ambient temperatures over long periods
- roads subjected to high stress such as heavy traffic, steep inclines and sharp curves
- pavements exposed to strong ultra-violet light
- pavements requiring better drainage and grip
- areas where better sound insulation and noise reduction is required
- used for a wider selection of mix designs
- thinner pavement layer to do the job, leading to saving in construction cost
- easier to place and compact during construction

Maxlink WDRA pavement solutions represent a more durable and stable alternative to your road construction or maintenance requirements at a significantly reduced cost.

Maxlink WDRA Bitumen Modifier – The Solution to Asphalt Plants

Maxlink WDRA bitumen modifiers are produced in pellets. This innovative pelletizing technology provides a stable delivery system for binder modifiers and additives, making it possible to supply almost any combination of bitumen modifiers in a convenient ready-to-use form.

Among the benefits Maxlink WDRA pellets offer to the asphalt manufacturers include:-

- **Processing**
  Same equipment and processes used to blend SBS-modified asphalt would be suitable for producing WDRA hot mixes and spray applications. WDRA pellets could be used for most of the common mixture designs.

- **Performance**
  WDRA pellets could be used independently or together with SBS and/or other polymers to offer similar or superior performance.
- **Flexibility**
  Asphalt manufacturers could customise mix designs to suit different customer needs and easily switch production from one mix design to another by changing the type of WDRA pellets and vary the concentration simply by adding more or less the amount of pellets used.
- **Logistics**
  WDRA pellets are customised for each mixture design and can be produced in advance and stored at ambient temperature in bulk or bags until required for processing.
- **Cost stability**
  Prices of virgin polymers fluctuate in tandem with oil prices and may be subjected to shortages when oil prices spike. WDRA prices are more stable and thus costing for each job can be more accurate and competitive.
- **Human and Environmentally-friendly**
  Waste polymers are used in making the WDRA modifier pellets, making this a very eco-friendly technology. Materials used in producing WDRA pellets conform to REACH standards, and using them would not be injurious to the health of workers or residents near paving jobs.

Maxlink WDRA pellets represent a simpler more efficient way to modify your bitumen asphalt mixes at a significantly reduced cost.

Maxlink WDRA Solutions – A Viable Commercial and Sustainable Ecological Opportunity

Governments all over the world today are focussing on environmental and health issues caused by scrap tyres and other post-consumption waste materials and are promoting the recycling of these materials for sustainable development.

Despite the proven performance benefits and obvious cost advantage of using recycled polymers for RAC, its usage has been limited. Specialized equipment and technology were required to mix these recycled materials with the other modifiers, additives and stabilizers. The additional cost incurred in acquiring the additional equipment often cancels out whatever short-term cost saving from using the materials.

Pelletizing the modifiers at a central production facility and delivering the stabilized pellets to be blended with bitumen at the terminal supplying the HMA plants means equipment investment is only necessary for one production facility, thus making extensive usage of WDRA possible. A wider range of cost-saving materials could also be used to produce the modifier pellets.

A WDRA mix would use more than 1,000 scrap tyres to pave each lane-km in a 50mm resurfacing project. These tyres would have otherwise ended up in a landfill - polluting the environment, creating fire risks and becoming a breeding ground for disease-spreading mosquitoes and vermin. Using them for our roads is our answer to the call to reduce, reuse and recycle.

Maxlink WDRA technology provides you a viable commercial and sustainable ecological solution to a serious challenge to our eco-system.

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