Session 11.0

Construction Practices

by

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Construction Considerations for Production and Placement of Asphalt-Rubber Pavements

Initially standard asphalt industry equipment was used to produce AR binders. The CRM was added to the hot asphalt cement by use of a crude conveyor system dumping the rubber into a spreader truck (or reaction vessel) through the dome lid. This conventional equipment did not contain internal augers or any other means of mixing the two components together. As a result, the consistency of the early asphalt rubber binder materials was, at best, questionable. However this equipment evolved rapidly and within a few years, specialty equipment was being fabricated with mixing augers and with the ability to handle the viscous and abrasive asphalt rubber material. Throughout the 1970’s, the equipment evolved dramatically and many experimental devices were developed. In 1980 the most significant piece of equipment in the history of the asphalt rubber industry was developed, the AR blending unit. The new blending unit provided thorough and complete mixing (wetting) and constant agitation of the rubber particles with the asphalt cement, and thus a consistent and more predictable reaction. From the earlier prototype, this blender has evolved to the Heater-Blender units that are used today. Further, as the use of asphalt rubber binder has increased, special metering equipment has been developed to accurately deliver this high viscosity material to hot-mix plants (both drum and batch).

The fabrication of asphalt rubber equipment for use with hot-mix plants has developed to a point of turn key convenience for various contractors around the country. Asphalt rubber metering equipment can easily be hooked up to both drum and batch hot mix plants. When a drum plant is utilized, a two or three way valve is installed in the existing asphalt feed line on the output side of the asphalt pump. The asphalt-rubber metering equipment is then plumbed to the valve to feed the asphalt-rubber binder accurately (as per specifications) to the hot mix plant. When a batch plant is utilized the valve is again installed directly onto the supply line leading to the weigh bucket. If necessary, a separate supply line can be installed in the pug mill itself. However, the quick and easy installation into the supply line is the procedure gener-
ally preferred by most contractors. As with the drum plant, the asphalt rubber metering equipment is plumbed into the new valve. Special pumps are used by the AR supplier to prevent damage to conventional asphalt pumps. Depending on certain variables associated with individual projects, the binder supply lines, after plumbing is complete, may or may not need to be heated. Continuous run plants generally do not require heated lines. The capability exists to heat the lines on each project if necessary. There is little if any change to standard hot-mix plant operations when using AR binder instead of asphalt cement. Typically mixes with AR binder can be produced at plant operating temperatures similar to those of standard mixes. There are no reports of AR residue accumulating in hot plants, and there is no additional cleaning or flushing required when hot-mix with asphalt rubber binder is produced. After standard hot mix-production procedures are complete the asphalt rubber hot mix material can be stored in a heated or insulated silo. To date the longest time frame has seen a 36-hour storage period with no problems using the material.

The transport of the asphalt rubber hot mix material from the hot plant to the project site can be accomplished by the use of a number of different types of trucks, i.e., 10 wheel dump trucks, semi end dump trucks, transfers, or belly dumps. This, of course, depends on what type of paving operation is being utilized. Wetting agents for the truck beds should be either soapy water or silicone emulsion. No solvent based wetting agents will be allowed, due to deleterious effects on the asphalt rubber binder.

11.1.3 Laydown and Compaction

As the asphalt rubber hot mix is delivered to the construction site, it can be placed utilizing both conventional paving procedures or with a pickup type of paving train. Standard paving specifications that refer to asphalt-rubber hot-mix materials are normally used to select mixing, laydown and compaction criteria. The following temperature ranges are common for asphalt-rubber hot-mix applications:

(a) Hot Plant Mixing Temperature  280 to 310°F
(b) Laydown Temperature  270 to 300°F
(c) Compaction Temperature  Above 240°F

The breakdown rolling should begin immediately. Breakdown rollers should stay as close as possible to the laydown machine without causing pickup or excessive movement. Two to four passes in the vibratory mode (full width of mat) with a double drum steel wheel roller, high fre-
quency, low amplitude should provide adequate density before the mix drops below 240°F. However, particularly for dense and gap-graded mixes, rolling patterns for each asphalt rubber hot mix should be determined on the construction site at the beginning of placement. As with standard asphalt concrete, the lower the temperature, the less compactive effort is achieved. Finish rolling may be delayed until the temperature of the mat has cooled to 250°F. The number of rollers required to achieve proper density is directly effected by the expected mix production schedules, width of paving lanes, mat thickness, surface condition and temperatures (surface, ambient, and materials). It is critical to achieve the desired density while the mat is still hot.

Pneumatic-tired rollers should not be used due to the increased adhesiveness of the AR binder to the rubber tires. Steel drums should be equipped with pads and a watering system. If the newly placed asphalt rubber HMA pavement must be opened to traffic prior to fully cooling, a blotter material may be required to prevent pick-up or tracking of the mix. Blotter material should consist of clean, dry washed fine aggregate or sand. A very light application rate of 1 to 3 pounds per square yard is typically used.

There are minor differences in the actual handling of the asphalt-rubber hot-mix materials. As the laydown crew gains experience and becomes accustomed to the different behaviors of AR HMA mixes, no major problems are associated with raking or shoveling of the mix in a timely manner. Again, as long as this type of work is done while the mix is at or above 240°F, there should be no problems associated with the workability of the asphalt-rubber hot mix.

It should also be noted that only minor differences may exist regarding the construction procedures for Dense, Gap or Open-Graded asphalt-rubber mixtures. Also, it should be noted, varied crumb rubber percentages do not affect construction procedures.

The quality, thus acceptance, of asphalt-rubber materials depends on three basic considerations:

1. **Equipment**—The equipment should be of quality manufacture and fabricated specifically to have the capability to heat, combine, and react the various components into a homogeneous mixture and to apply or supply these materials as to individual project specifications.
2. **Asphalt-Rubber Binder Design**—The acceptance of component materials can be accomplished by any of three procedures.
   a. Materials certification from materials suppliers.
   b. Pre-job laboratory testing.
   c. Laboratory testing of field samples.

Pre-job testing is the most common way to establish criteria for comparable field testing. During the pre-job testing various physical properties are evaluated.

A. Viscosity  
B. Softening Point  
C. Resilience  
D. Needle & Cone penetration  
E. Ductility  
F. Aged residue retention

Through the above evaluation a target viscosity is determined which is the control testing criteria for the asphalt-rubber binder in the field.

3. **Asphalt-Rubber Concrete (ARC) Mix Design.** After the A/R binder has been designed according to local climate and project specification criteria then the AR-HMA mix design is performed. Standard mix design methods may be used with minor modification to procedures. However, evaluation criteria of mix design data often differs significantly from that of conventional asphalt concrete.

The developmental history of the asphalt-rubber industry has led to many advancements in modified pavement technology. This knowledge in turn, has led to the development of other systems also reacting recycled ground tire rubber with asphalt cement. These alternate systems show great promise and have been used on an experimental basis in many areas of the country.

11.1.5 References


2. Gap-Graded asphalt-Rubber Mix in the City of Phoenix, Joe o. Cano, P.E., Equbalali Charania, Ph.D., P.E., Dong C. Wong,
Construction Practices Using Dry Process—
Rubber Modified Asphalt Concrete (RUMAC)

11.2 Dry Process—
Rubber Modified
Hot-mix Asphalt
Construction

11.2.1 Materials
Handling and Feed

CRM

Varying types of mixes may be designed to incorporate dry CRM into paving materials.

All dry process technologies include handling and storage of crumb rubber at the hot mix production site. To date, rubber has been packaged either in polyethylene bags of approximately 60 lbs., or larger bulk sacks of approximately one (1) ton in capacity. Both forms of rubber packaging are palletized and require tied down plastic sheeting for additional moisture protection during storage.

Pallets are handled with fork lifts and standard conveyor belts are used for polyethylene bags or premixed crumb rubber.
Crumb rubber is generally fed into the weigh hopper or pug mill of a batch plant or the RAP (recycled asphalt pavement) collar or RAP feed system on a drum plant. Where graded CRM is used, dispersion of the rubber throughout the hot mix must be ensured.

A calibrated conveying system for loose CRM must be established. As with any loose, granular material, the need for slatted conveyors to prevent rollback and material segregation will depend on the angle of incline and specific characteristics of the material.

Polyethylene bags can be added via conveyor belts to pug mill. When polyethylene bags are added directly into the pugmill, dry mix time should be increased to ensure thorough rubber distribution. Five to fifteen seconds is a typical batch cycle increase time. This time can be reduced or eliminated by improving efficiencies in the feed equipment.

**Mineral Filler**

Where PlusRide mastic asphalt type mixes designed with CRM and mineral filled binders are being produced, mineral filler may be fed with lime feed equipment or storage silo’s systems designed for this purpose.

**Quality Assurance in CRM Feed**

For the PlusRide mastic asphalt gap graded mix, uniformity of rubber gradation is assured by premixing graded factions of rubber prior to conveying into the weigh hopper of a batch plant or the RAP feed collar or RAP feed device of the drum plant.

**Feed Control—Materials Proportioning**

Feed equipment for CRM should be interlocked with plant controls to assure correct proportioning. This is particularly important for the continuous material feed systems used for drum plants. Essential to proper proportioning of crumb rubber modifiers is an electronic interlock to plant controls. Because rubber is added by weight, no compensation needs to be made for the difference in specific gravity between rubber...
and aggregate. A pneumatic feed system has been desired for use of PlusRide asphalt projects in 1993.

**Drum Plants**

Crumb rubber should be introduced far enough from the discharge end of the drum to ensure thorough mixing and coating of the rubber particles. In practice, configurations adequate for RAP introduction have been adequate to ensure homogeneous mixes when CRM is introduced.

**Batch Plants**

It may be necessary to increase the dry mix time when introducing CRM into batch mixes. Batch mix time could be optimized by introducing CRM uniformly along the axis of the auger.

**Quality Assurance**

The acceptability of mixing can be determined by extraction of the rubber from random samples to determine uniformity of distribution.

**Storage and Transport**

Once blended and mixed, rubber modified asphalt concrete’s are stored and transported using conventional equipment. As with any mix, wetting agents used for truck beds should be non-petroleum based agents. Use of conveying belts made of rubber compounds is to be avoided to eliminate the possibility to sticking and segregation of mix. Mixes are generally handled at a slightly elevated temperature range as compared to conventional dense-graded mixes, temperature limits need to be strictly observed in order to ensure necessary compaction. Storage temperature should be maintained above the desired placement temperature.

Paving with RUMAC requires no modification to equipment or procedures. Standard transport equipment and pavers are used and no special instruction is required.

Because rubber modified asphalt concrete’s are carefully designed mixes, compaction to specified voids should be assured.

**Equipment and Procedures**

Pneumatic tired rollers are generally not used for RUMAC as they are potentially more prone to material pick up. Soap solutions are recommended on steel wheeled roller drums. Steel wheeled rollers are used.
for both breakdown and finish rolling. Hand work should be carried out immediately while RUMAC paving materials are hot.

Although rolling to 140°F has been specified in the past for PlusRide mats, the rate of heat loss during compaction to stable density does not appear to differ measurably from that of unmodified paving mixtures. Experience has shown that maximum density is achieved with essentially the same rolling patterns used for conventional dense-graded mixtures.

**Quality Control Sampling and Testing**

As with conventional asphaltic concrete, compactive effort should be monitored with nuclear density gauge during paving operations.

The rolling pattern required to achieve target density should be established with a test strip. Current PlusRide formulations are compacted in the same manner as dense-graded mixes. There is no minimum temperature to which PlusRide must be rolled, rather rolling should continue in accordance with the established rolling pattern.

The relative accuracy of nuclear density gauges is not affected by the presence of rubber in RUMAC mixes. The accuracy of nuclear density gauges are, however, greatly affected by surface texture. Where texturized surfaces, such as that exhibited by PlusRide mixes, are being sought, density should be confirmed by core sampling, with nuclear density gauges being used during paving only to establish that maximum compactive effort has been achieved.