

RAP PROCESSING METHODS IMPROVE QUALITY & ECONOMY

When ODOT instituted the option of allowing higher RAP (Reclaimed Asphalt Pavement) amounts in asphalt mixtures it was necessary to develop a specification that ensured RAP was sufficiently processed for this purpose. ODOT and FPO worked jointly to create a dual-method specification that retained traditional RAP processing requirements and created more stringent requirements for asphalt mixtures incorporating high RAP amounts.

RAP requirements are specified under 401.04 of Supplemental Specification 800 (current version dated 4-20-2012). The specification cites two methods from which a contractor may choose based on the desired RAP usage. Though the specification cites two “methods,” there are four allowable processes – two for each method.

Method 1 Standard RAP

Method 1 Standard RAP defines two processes for RAP processing depending on the nature of the project.

Method 1 – Process 1

The first requires a processed and tested stockpile of RAP. The purpose of the processing during the stockpile construction is to ensure the RAP composition (i.e. aggregate gradation and asphalt binder content) is reasonably uniform. Processing methods are determined by the asphalt mixture manufacturer and may involve crushing and screening. Testing provisions are in the specification to ensure uniformity throughout the stockpile. Once stockpile uniformity is determined acceptable, the RAP is further processed in-line during asphalt mixture production. The in-line process sieves the RAP to ensure correct particle size for incorporating RAP into the new asphalt mixtures.

For mixtures used in surface courses, in-line processing ensures RAP particle size is less than 0.75 inch. For this purpose, a screen having mesh openings of 0.75 inch is placed in-line to the RAP conveyance used to feed the asphalt mixing plant. For intermediate and base course mixtures maximum RAP particle size is 2 inches and an in-line screen having

mesh openings of 2 inches is used. The specification does include this caveat: *Ensure that the RAP is the proper size to allow for complete breakdown in the plant.*

Though not specifically related to RAP processing, it is noteworthy that mixes that incorporate polymer binders have limitations on the amount of RAP that can be used. Discussion of those limitations is beyond the scope of this article; however, more information can be obtained by contacting the FPO office.

Method 1 – Process 2

The second process allowed under Method 1 consists of the introduction of RAP directly into the asphalt plant through a “stream process.” That process requires RAP acquisition be from a specific project to ensure the RAP composition is uniform. Separately tested stockpiles are not required. Using the stream-process presumes the uniformity of the material stream is consistent since in general, asphalt reclaimed from within a specific project is typically consistent in composition. This is true so long as the cold-milling process used in reclaiming the asphalt runs at a consistent depth. This is an

important factor in that surface, intermediate and base course mixes differ in asphalt binder content and gradation; to vary the depth of milling will compromise RAP uniformity.

Procuring RAP in a stream process as described above is often referred to as “concurrent RAP.” This name came about by the nature of the asphalt construction process; that is, the asphalt mixture manufacturing runs “concurrent” to the acquiring of RAP from the roadway being paved. Think of it as a loop where the existing asphalt pavement is reclaimed (by cold-milling), the reclaimed material (RAP) is then hauled to the asphalt plant and reincorporated into new asphalt mix.

The Method 1 – Process 2 specifications state that concurrent project RAP must be taken from one existing mix type on the concurrent project, or two existing mix types if both mix types are taken at the same time in

one pass of the milling machine. Screening requirements are the same as described for Method 1 – Process 1.

The limitation of the processes described in Method 1 is that the variability in RAP composition restricts use to lower RAP content. The method, however, is well suited for asphalt manufacturers incorporating modest amounts of RAP since in such cases final mix properties are not easily compromised. The concurrent RAP process, although not very common, has the advantages of reducing stockpiling and providing RAP with lower moisture content.

Method 2 Extended RAP

Method 2 Extended RAP also allows two methods of processing RAP. Processing is more substantial and results in better uniformity. What is significant about Method 2 is that added processing allows higher percentages of RAP, and as a result better economy.

Method 2 – Process 1

The first process under Method 2 requires fractionated and tested

stockpiles. Fractionation is the breaking down of RAP into two or more sizes by utilizing a sieving process, typically resulting in a fine fraction and a coarse fraction. Asphalt mixture manufacturers have found that fractionation provides high levels of uniformity that allows them to consistently meet mix proportioning requirements such as air voids and voids in the mineral aggregate, all the while running higher quantities of RAP. By ODOT specification, RAP that

has been fractionated and stockpiled in its various fractions can be directly introduced into the asphalt mixing plant’s raw material feed without additional screening.

Method 2 – Process 2

The second process allowed under Method 2 is similar to Method 1 – Process 1, in that stockpile uniformity must first be assured. Once assured, the RAP receives additional in-line processing as it is directed



The double-deck screen and associated conveyors between the RAP cold-feed bins and the drum.

into the asphalt mixing plant's raw material feed. The additional processing consists of processing by passing the RAP over a double-deck screen placed in-line between the RAP cold-feed bin and the mixing drum, using a 9/16 inch (14.3mm) screen for surface and intermediate mixes and a 1.5 inch screen for base mixes.

Binder Grade Change

An important consideration when using higher RAP contents in an asphalt mixture is the necessity to ensure sufficient mixture flexibility to avoid cracking. Asphalt binder reclaimed from RAP has high stiffness. There are different ways of accommodating for this stiffness. One method is to use a low enough RAP content that the new mix stiffness is not detrimentally affected. The other option is to use a softer virgin binder to accommodate for the stiffness of the much harder RAP binder. Blending charts are used for this purpose. The downside of blending in a soft virgin asphalt binder with the harder RAP binder is cost. Soft virgin binders are more expensive.

The need for softer virgin binder can be avoided for mixtures having RAP percentages between 26 and 40 percent if the mix is produced as foamed warm mix at 275 degrees F or less. When the mix is produced below this temperature, aging and oxidation are reduced and the virgin binder is not hardened or stiffened to the extent normal for hot mix production at higher temperatures. It then becomes unnecessary to substitute a softer grade of virgin binder to blend with the aged binder in the RAP. ODOT will be enforcing this temperature limitation in production, and will require a mixture to be redesigned if mix is produced at a higher temperature.

Stockpiling Requirements

Stockpiling requirements are similar under all methods and processes. At a minimum, a facility will need one or more receiving stockpiles for untested material being received from milling or other projects, and one or more processed and tested stockpiles for further processing into ODOT mix. There is a testing advantage for keeping RAP from ODOT projects separate from other sources; but, that requires separate receiving stockpiles. Creating fractionated stockpiles will also add to the number of stockpiles to be created and tested.

Common Specification Requirements

Other specification requirements common to both methods 1 and 2 are:

- The producer must provide enough space for meeting all RAP and Recycled Asphalt Shingles (RAS) handling requirements at their asphalt manufacturing facility
- A clean, graded base for stockpiles must be provided to ensure water does not collect
- Blended stockpiles of RAP and RAS, dubbed SHRAP (Shingles & RAP), must be tested to assure uniform gradation and asphalt binder content
- Assurance must be made that stockpile properties match the RAP

properties stated in the mixture formulation (i.e. JMF)

- All stockpiles on the grounds of the asphalt manufacturing plant are to be mapped; labeled according to material type and quantity; signature provided by the responsible manufacturer's employee; kept current; and posted in the asphalt manufacturing plant control room
- Tested stockpiles must not be co-mingled
- The asphalt manufacturer Quality Control Plan must document methods that will be employed to ensure the aforesaid specification requirements are met
- ODOT personnel monitoring asphalt manufacturing operations are instructed to note deficiencies in RAP housekeeping

Summary Comments

The four RAP processing options are:

Method 1 – Process 1

A simplified RAP process utilizing basic in-line screening for plants not desiring to use higher RAP amounts (for lower RAP amounts)

Method 1 – Process 2

A stream process for concurrent project RAP (for lower RAP amounts)

Method 2 – Process 1

A process ensuring a higher level of RAP uniformity through fractionation of RAP stockpiles (for higher RAP amounts)

Method 2 – Process 2

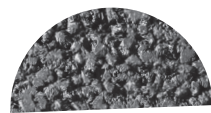
A process ensuring a higher level of RAP uniformity through introduction of in-line, double-deck RAP screening as a component of the raw material feed to the asphalt manufacturing process (for higher RAP amounts)

The four different processing methods described in the ODOT specifications (and above) are not all appropriate for higher levels of RAP usage. However, ODOT has structured the specification to allow and encourage asphalt manufacturers to use higher amounts of RAP. ODOT hopes contractors will weigh (as many have) the cost of additional processing against the savings attained through using higher amounts of RAP, and begin moving toward more RAP usage. ODOT expects that someday the specification with higher RAP allowances will become standard practice. In fact, ODOT notes that most contractors have already adopted the higher RAP standards.

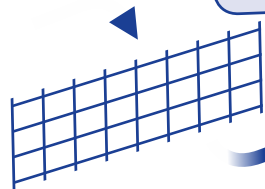
Significant progress has been made over the years to capitalize on the benefits of using reclaimed asphalt pavement. It is estimated that in Ohio the amount of RAP re-used into new asphalt mixtures produced in 2011 was 3.5 million tons. That is enough reclaimed asphalt to pave four lanes of pavement from Columbus to Los Angeles. The approximate value of that material is \$168 million. The use of recycling, and the associated cost savings, was essential in mitigating cost increases to asphalt customers during the crude oil fluctuations recently impacting the asphalt industry. The new ODOT RAP standards give promise to those benefits continuing and marking asphalt as a sustainable pavement construction material.

THE FOUR RAP PROCESSING OPTIONS

Method 1 – Process 1

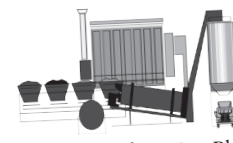


Coarse



Screening

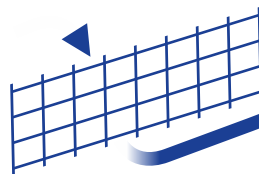
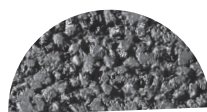
Surface courses: 0.75" screen
Other courses: 2" screen



Asphalt Manufacturing Plant

Method 1 – Process 2

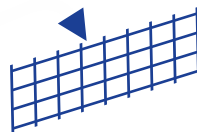
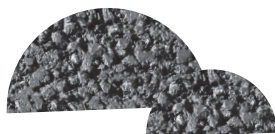
Concurrent RAP (Stream Process)



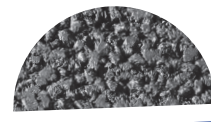
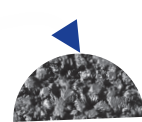
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When manufacturing asphalt mix concurrent with RAP procurement, reclaimed material composed of only one mix type is allowed in the stockpile, OR two mix types if taken concurrently in same milling operation. [Purpose is to ensure uniform RAP composition throughout HMA production.]

Method 2 – Process 1



Fractionated and Tested RAP Stockpiles



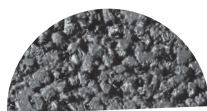
Fractionated RAP is proportioned into the asphalt mixing process.



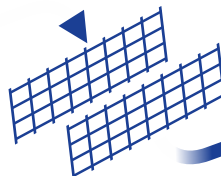
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Method 2 – Process 2

Screening: double-deck screening is used to ensure surface RAP is fractionated to 9/16 inch for surface and intermediate course mixes; 1.5 inch for base course mixes.



Processed and Tested Stockpile



Asphalt Manufacturing Plant