

## RECYCLED ASPHALT COLD MIXES

### PROCESS DESIGN OVERVIEW

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#### 1 SCOPE

Advances in asphalt emulsion technology make it possible for emulsion mixes to be used in a wide variety of pavement construction, rehabilitation, and maintenance applications. These mixes can be used as base and surface courses, stockpile mixes, upgrading gravel roads, and helping to reduce the total pavement thickness. One of these mixes is the recycled asphalt type which consists of a recycled asphalt pavement and an asphalt emulsion or in combination with a virgin aggregate. These mixes can be produced in a central plant, in a travel plant or road mixed. The emulsion should be designed for the mixing process to be used.

#### 1.1 DEFINITIONS

##### **Recycled Asphalt Mix:**

A Recycled Asphalt Mix is a mix similar in appearance to conventional hot mix. This mix can be reclaimed asphalt pavement mixed with an asphalt emulsion or the reclaimed asphalt pavement blended with virgin aggregate and emulsion. They include a wide variety of aggregate types and gradations and can be used for all types of pavement applications such base and surface courses, stockpile or maintenance mixes. The recycled asphalt mix normally require a thin surfacing (such as a chip seal) to protect the finished surface.

#### 2 MATERIALS

##### 2.1 Asphalt Emulsions:

Several factors have to be taken into account when choosing the emulsion to be used. The type and grade of emulsion is affected by the RAP material, virgin aggregate, the coating ability, the compatibility, the mixing method, the environmental conditions as well as the laying and compaction process. The most widely used grades of asphalt emulsion used in recycled asphalt mixes are SS-1, CSS-1, MS-2 and CMS-2, HF150 and HF150M. In recent years proprietary type emulsions including rejuvenator type emulsions have been developed for use in these recycled mixes.

##### 2.2 Mix Aggregate:

The virgin aggregate used in blended recycled asphalt mixes can be processed or semi-processed crusher, pit or bank run aggregates. Most are graded from a maximum size of 25 mm with material passing the 75 micron sieve. They should have very low clay content and not have an excessive amount of pass 75 micron material. The recycled asphalt material can be screened or unscreened RAP material from grinding projects or processed RAP piles.

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### 3 DESIGN CRITERIA

When designing a recycled asphalt mix a number of factors have to be examined and assessed to ensure a proper surface will be placed that will perform for its service life. The following factors can have a tremendous effect on the performance of a recycled asphalt mix; RAP material, virgin aggregate shape and type, mix workability, coating ability and residual asphalt content. If these factors are addressed the chances of a good recycled asphalt mix being placed are greatly increased.

#### **RAP Material:**

The RAP material is typically processed RAP taken from grinding operations. The material can split into coarse and fine RAP and blended back to make a better gradation. The physical properties of the recycled material (asphalt content, gradation of RAP, Gradation of extracted RAP, recovered penetration) should be determined.

#### **Virgin Aggregate Shape and Type:**

The overall shape of the virgin aggregate can influence the quantity of aggregate as well as the amount of asphalt emulsion to be used. The more graded the aggregate is the higher the emulsion quantity needed. The compatibility of the emulsion used with the aggregate is critical.

#### **Mix Workability:**

The emulsion used should give the finished mix enough workability to be laid placed in a homogeneous condition and be designed for the intended method of processing be it immediate placement or in a stockpile.

#### **Coating Ability:**

The asphalt emulsion should have the ability to coat the fine aggregate (pass 4.75 mm) without the fine aggregate balling up. With some emulsions the use of mixing water will aid in coating the fines. The use of emulsions containing solvent will aid in coating as well as the workability of the mix.

**Asphalt Residual in the Emulsion:** The quantity of asphalt residual in the emulsion can affect the quantity of asphalt emulsion needed to coat the aggregate. The lower the residual the higher the quantity of asphalt emulsion needed.

During the design process the two key factors that are needed is a well coated mix combined with adequate strength and stability which will be able to handle the traffic load and volume.

If these factors are taken into consideration in designing the dense graded mix then the chances of a successful mix are greatly improved. Typically a Recycled Asphalt mix would require an emulsion content of 1.0 – 4.0% (depending on design parameters), a minimum of 2500 Newtons stability at 25°C and air voids of 7 – 11%.



#### **McASPHALT INDUSTRIES LIMITED**

8800 Sheppard Avenue East T 416.281.8181 TF 1.800.268.4238  
Toronto, ON M1B 5R4 F 416.281.8842 E info@mcasphalt.com

mcasphalt.com  
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### 4 RECOMMENDED PERFORMANCE GUIDELINES

In order to construct a proper well recycled asphalt mix the following guidelines should be followed:

- Assure the existing pavement structure or base material are adequate to support expected traffic.
- Determine type of mixing process (central plant, blade mixing, travel plant) to be used.
- Determine emulsion grade and type to be used is well designed for chosen mixing process.
- Design a recycled asphalt mix with materials to be used on job.
- Use a clay free hard crushed aggregate having a well graded appearance if required.
- Ensure asphalt emulsion and aggregate are compatible.
- Ensure adequate emulsion is used.
- Ensure aggregate is moist but not saturated.
- Ensure the mix is workable and the fines are well coated.
- Calibrate and inspect all equipment.
- Use sufficient number and properly weighted pneumatic and steel rollers in static mode.
- Follow proper construction techniques.
- Use traffic control to protect mix.
- Work only in weather suitable for type and grade of emulsion being used.
- Once mix is cured it should be covered with a thin wearing surface such as a chip seal or sand seal.

### 5 RESOURCES

1. "Basic Asphalt Emulsion Manual", Fourth Edition, Asphalt Institute and Asphalt Emulsion Manufacturers Association, 2008
2. "Recommended Performance Guidelines", Second Edition, Asphalt Emulsion Manufacturers Association, Annapolis Maryland, 2006
3. "Asphalt Cold Mix Manual", MS-14, Asphalt Institute, Lexington Kentucky.



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