SECTION 13
COLD MIXED ASPHALT EMULSION MAINTENANCE MIXES

13.1 Scope
The recommended practice covers asphalt emulsion aggregate maintenance mixtures for stockpiling or immediate patching use made cold. It is written as a guide and should be used as such. Use specifications should then be adapted to conform to job, local user, and performance requirements.

13.2 Applicable Documents

13.2.1 ASTM Documents
- D140 Practice for Sampling Bituminous Materials
- D244 Test Methods for Emulsified Asphalts
- D692 Specification for Coarse Aggregate for Bituminous Paving Mixtures
- D977 Asphalt Emulsion
- D979 Practice for Sampling Bituminous Paving Mixtures
- D1073 Specification for Fine Aggregate for Bituminous Paving Mixtures
- D2172 Test for Quantitative Extraction of Bitumen from Bituminous Paving Mixtures
- D2397 Specification for Cationic Emulsified Asphalt
- D2489 Practice for Estimating Degree of Particle Coating of Bituminous Aggregate Mixtures
- D3515 Specification for Hot-Mixed, Hot-Laid Bituminous Paving Mixtures
- D3625 Effect of Water on Bituminous-Coated Aggregate Using Boiling Water
- D3628 Selection and Use of Emulsified Asphalts
- D4215 Specification for Cold-Mixed, Cold-Laid Bituminous Paving Mixtures
- D6704 Test Method for Determining the Workability of Asphalt Cold Mix Patching Material

13.2.2 AEMA Documents
- A Basic Asphalt Emulsion Manual (BAEM)

13.3 Asphalt Emulsion

13.3.1 Sampling and Testing
- The asphalt emulsion shall be sampled in accordance with procedures outlined in ASTM D140 and tested in accordance with ASTM D244.
- All samples shall be shipped and stored in clean airtight sealed plastic containers.
- Material shall be homogeneous, miscible with water and shall show no signs of separation after thorough mixing within 30 days after delivery.
• Selection of Asphalt Emulsion — In warmer climates or when material is to be used immediately, MS-2, HFMS-2 and CMS-2 are recommended.
• When prolonged stockpiling or low temperatures, -9° C (15° F) are anticipated, HFMS-2s is recommended. When specifically approved by the purchaser, other types of asphalt emulsion may be used if experience has proven that satisfactory performance will result. Other emulsions, which can be used, can be found listed in ASTM D3628.

13.4 Aggregate
The aggregates shall be crushed stone, crushed slag, crushed gravel, or sand conforming to the requirements of the appropriate ASTM specifications.

• Coarse Aggregate Specification D692
• Fine Aggregate Specification D1073.

Other mineral aggregates, such as uncrushed gravel and crushed shell, and other gradings, may be specified, provided that local experience or tests have demonstrated their ability to produce satisfactory asphalt emulsion aggregate maintenance mixtures.

13.5 Testing of Asphalt Paving Mixture
• Samples shall be obtained in accordance with ASTM D979. Stockpile samples shall be taken at least 100 mm (4 in.) below surface excluding any slight outer crust which may have formed.
• Adequate coating of the job aggregate by the asphalt emulsion shall be determined in accordance with ASTM D2489.
• Residual asphalt content shall be determined by extraction in accordance with ASTM D2172.
• Stripping of residual asphalt from aggregate shall be determined in accordance with ASTM D3625. Another popular method follows:

  When 50 g of the mixture, whether freshly prepared or taken from the stockpile, is heated at 121° C (260° F) in a laboratory oven for one hour and cooled with stirring to 93° C (200° F) in laboratory air, then is placed in 400 mL of boiling distilled water in a 600 mL glass beaker and stirred with a glass rod at the rate of one revolution per second for three minutes, the aggregate shall be at least 75% coated with an asphalt film. Visual observation of the coating shall be made by decanting the water and spreading the mix on an absorbent paper.

Workability of the stockpiled mixture can be determined by using ASTM D6704. Another method to determine workability is as follows:

Workability can be determined by placing the cool, loose mix in a metal pan at least 10 in. by 10 in. size and sufficiently deep to form an uncompacted layer 50 mm (2 in.) in depth. Place the pan containing the mixture in a cold room or freezer for a period of time such that the total mixture will be cooled below -9° C (15° F). Then remove the pan and mixture from the cold environment and record the temperature at which the mixture is determined to be workable. In a workable mixture, a 1 in. putty knife will enter the sample with reasonable ease and the material may be mixed with very little conglomeration.
13.6 General Requirements

- The proportions to be used in the production of the mixture shall be determined by the engineer or the supplier of the asphalt emulsion. The proportions so established shall be known as the Job Mix Formula and determined using ASTM 4215.
- The percentage of asphalt emulsion to be added to the aggregate shall be within the specified limits by weight of the dry aggregate. The exact percentages of aggregate and emulsion to be used shall be fixed by the engineer or the emulsion supplier on the basis of laboratory tests and analysis of the aggregate. The residual asphalt tolerance should be ±0.5% of the Job Mix Formula.
- The mixture shall be capable of being handled by the use of either hand shovels or power loading equipment, shall be workable for placing and compacting with hand tools or power equipment at the temperature of mixing or at temperatures as low as -9°C (15°F).
- The mixture shall be usable at once from the mixer or over a period of several months from a stockpile. The mixture shall remain in place when used to patch wet or dry pavements and shall be stable under normal traffic conditions.

NOTE
These suggested limits are meant to be flexible and used as a guide. However, there have been successful mixes which performed as desired whose characteristics were outside the limits shown.

13.7 Handling & Use

- Asphalt emulsion temperature should never exceed 85°C (185°F) prior to mixing with the aggregate.
- Mix aggregate and emulsion until best coating is obtained. Stripping may result if over-mixed.

13.8 Mixing

Asphalt emulsion and aggregate may be mixed in place or at a central plant pugmill. The choice of method depends on such factors as:

1. Equipment availability
2. Size of project
3. Aggregate source, type, and cost
4. Anticipated traffic volumes and loads
5. Climatic conditions

The best balance between these factors must be evaluated. Regardless of the mixing method, 100% coating of the coarse aggregate particles is not always achieved, nor is it necessary.

13.8.1 Mixing Moisture

Mixing procedures should aim at achieving a uniform dispersion of the emulsion with a complete coating of the finer aggregate fractions. Toward achieving this uniform dispersion of the asphalt emulsion, it is sometimes necessary to moisten the aggregate before application of the emulsion. The appropriate volume of water to be added...
should be determined by the mix design, and if required should be added prior to the incorporation of the emulsion.

Mixing of the emulsion should be done at as low a moisture content as possible, because the compaction moisture content is usually lower than the moisture content after mixing. Under poor drying conditions, the removal of surplus moisture could be a costly and time consuming operation.

13.8.2 Central Plant Mix

A central plant to produce the cold mix material is recommended for projects that involve close tolerances and high production. Generally, this type of mixing is done at the source of the aggregate.

The central cold mix plant consists of a mixer and certain auxiliary equipment for feeding the emulsion, water, aggregate and additives to the mixer. The asphalt emulsion central mixing plant generally has no screens other than a scalping screen to remove oversize aggregate. At the very least, the plant should consist of a pugmill, an emulsion storage tank, a metering pump, units for feeding water and additives, controls for adjusting and monitoring the various components, a conveyor, and a power source, a tachometer to aid in maintaining a constant speed on the conveyor belt, and one or more aggregate bins with belt feeders. The mixer should provide for variation in mixing times to ensure that the aggregate is properly coated but not over mixed. Mixing times can be varied in a continuous pugmill plant by changing the angle of the paddles, by varying the height of the endgate, or by changing the location of the asphalt spray bar.

Emulsion cold mixes require shorter mixing time than asphalt concrete mixes. The tendency is to overmix asphalt emulsion mixes, and this may have the effect of scrubbing the asphalt from the aggregate. It may also result in premature breaking of the emulsion, causing overly stiff mixtures.

13.8.3 Travel Mixers

Aggregates are placed into the hopper of the mixer where they are drawn into the mixing chamber. The emulsion-proportioning device is interlocked to ensure a constant blend. The emulsion is added by pumping through a spray bar mounted on the mixing chamber. This method permits the addition of all the emulsion in one application. The forward speed of the mixer should be adjusted so that the material being ejected has a uniform texture. Injecting the emulsion in one application through the mixing chamber can be done at a lower moisture content than with distributor application. The single application immediately brings the aggregate to optimum mixing moisture whereas the first application with a distributor adds only part of the moisture associated with the emulsion.

The travel plant places the mix on grade ready for consolidation into a stockpile.

13.8.4 Rotary Mixers

Rotary cross-shaft mixing employs a mobile mixing chamber which is self-propelled. The mixing chamber, usually 6 to 8 ft wide, and 2 to 3 ft high, open at the bottom, con-
tains one or more shafts, transverse to the roadbed, upon which mixing blades are mounted. As the shafts rotate rapidly, the mixing blades thoroughly agitate the material in the roadbed. The machine, moving forward, strikes off a uniform course of asphalt aggregate mixture. Self-propelled rotary mixers are designed to accurately and automatically control the predetermined mixing depth from existing surface grades.

Rotary mixers equipped with built-in spraying systems require that the emulsion application rates be matched accurately with the width and thickness of the course, forward speed of the mixer, and the density of the in-place aggregate. However, when utilizing a rotary mixer not equipped with spraybars, an emulsion distributor, operating ahead of the mixer, applies emulsion to the aggregate. Incremental applications of emulsion and passes of the mixer are usually necessary to achieve the specified mixture. Most rotary mixers are equipped with spray systems and when using this equipment, the following steps are recommended:

1. Spread the aggregate to uniform grade and cross section with motor graders.
2. Thoroughly mix the aggregate by one or more passes of the mixer.
3. Add emulsion in increments until the total required amount of emulsion is applied and mixed. If the mixer is not equipped with spraybars, the emulsion is to be applied with an emulsion distributor.
4. Make one or more passes of the mixer between applications of emulsion, as necessary for thorough mixing.

The total number of passes of the rotary mixer will depend on the method of adding the emulsion and on the amount of 0.075 mm (No. 200) material present.

13.8.5 Distributor & Motor Grader Mixing

Asphalt emulsion mixtures may be prepared by applying the asphalt emulsion by a distributor and blade mixing with a motor grader.

The first step in the operation is to shape the prepared aggregate into a uniform windrow of a known volume by means of a spreader box, windrow proportioner, or motor grader. The motor grader then lays out a uniform lift of aggregate from the windrow onto the mixing table. If mixing water is required, it is then added at a predetermined rate to the aggregate lift. Next the asphalt emulsion is applied at the predetermined rate by the distributor to the lift of aggregate.

The motor grader then folds the aggregate over the emulsion. The motor grader may work this lift back and forth to achieve mixing, or the mixture may be windrowed on the opposite side of the mixing table and another lift of aggregate processed as above. This procedure is repeated until the design quantity of asphalt emulsion has been added to the total windrow of aggregate.

The grading of the aggregate throughout the windrow may vary. Therefore, as asphalt mixing progresses, close attention should be paid to the appearance of the mix. It is very important that uniformity of grading and moisture content be achieved. Mixing should consist of as many passes with the motor grader as needed to fully spread the emulsion and coat the aggregate particles, and when completed the windrow should be moved to one side of the mixing table.
Blades are relatively inefficient mixing devices and the aeration is high. Therefore, a water content higher than that for rotary mixers will be required to assist dispersion of the emulsion and replace relatively high evaporation losses.

The mixing moisture will be well above the optimum compacting moisture so that the stabilized material will need drying before compacting.

13.8.6 Secondary Mixing
Sometimes further mixing of the windrowed material may be necessary after the addition of the emulsion. Unless the travel mixer can be used as a multiple pass mixer, this additional mixing usually is done with a motor grader. This ensures that all the windrowed material is incorporated into the mix. The number of passes with the motor grader required for this purpose varies with different job conditions. After the mixing operation is completed, the windrow should be moved to one side of the mixing table.

13.9 Stockpile Procedure
- To prevent excess moisture on the aggregate before mixing, the aggregate may have to be aerated.
- Place stockpile on a level grade in a conical shape to promote proper drainage of precipitation.
- Stockpiles shall be constructed in such a manner that no compaction other than the weight of the material itself will result. No equipment of any kind shall be run over the surface of the stockpile.

13.10 Construction Practice
- Equipment varies from only hand shovel to modern loaders and spreaders, from hand tempers to rollers.
- Prior to patching, the pavement should be properly prepared. The distressed section is removed extending into good pavement and as deep as necessary. Cut vertical edges with one pair of edges at right angles to the direction of traffic. If water is the cause of failure, install drainage. Clear out loose material and apply a tack coat to the vertical edges. Back fill with patch mix and compact.

13.11 Methods of Sampling And Testing
Sample all material and determine the properties enumerated in this guide in accordance with ASTM methods.