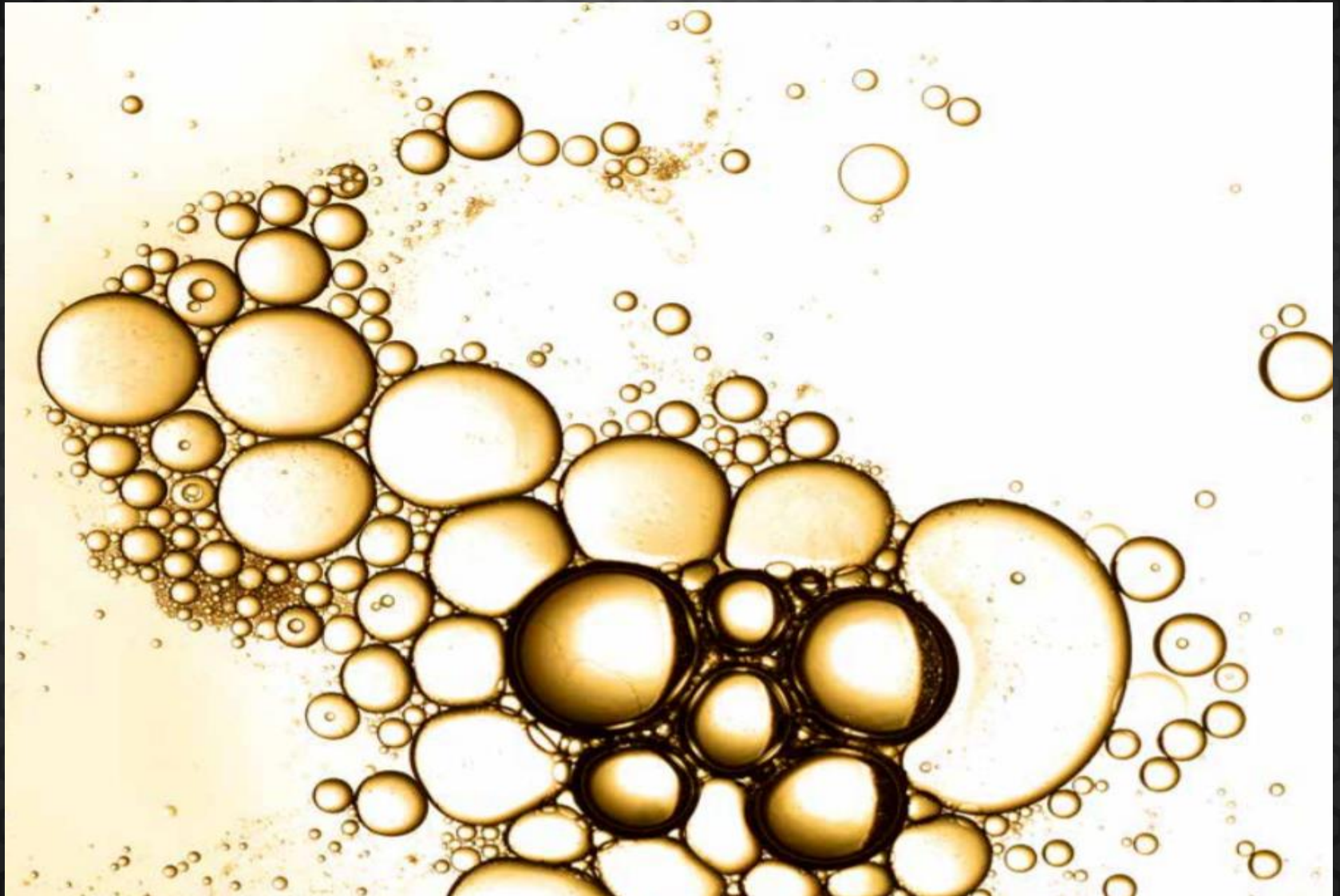




ASPHALT MAINTENANCE EQUIPMENT
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Asphalt Emulsions



First asphalt emulsion use 1900-1910 in U.S.

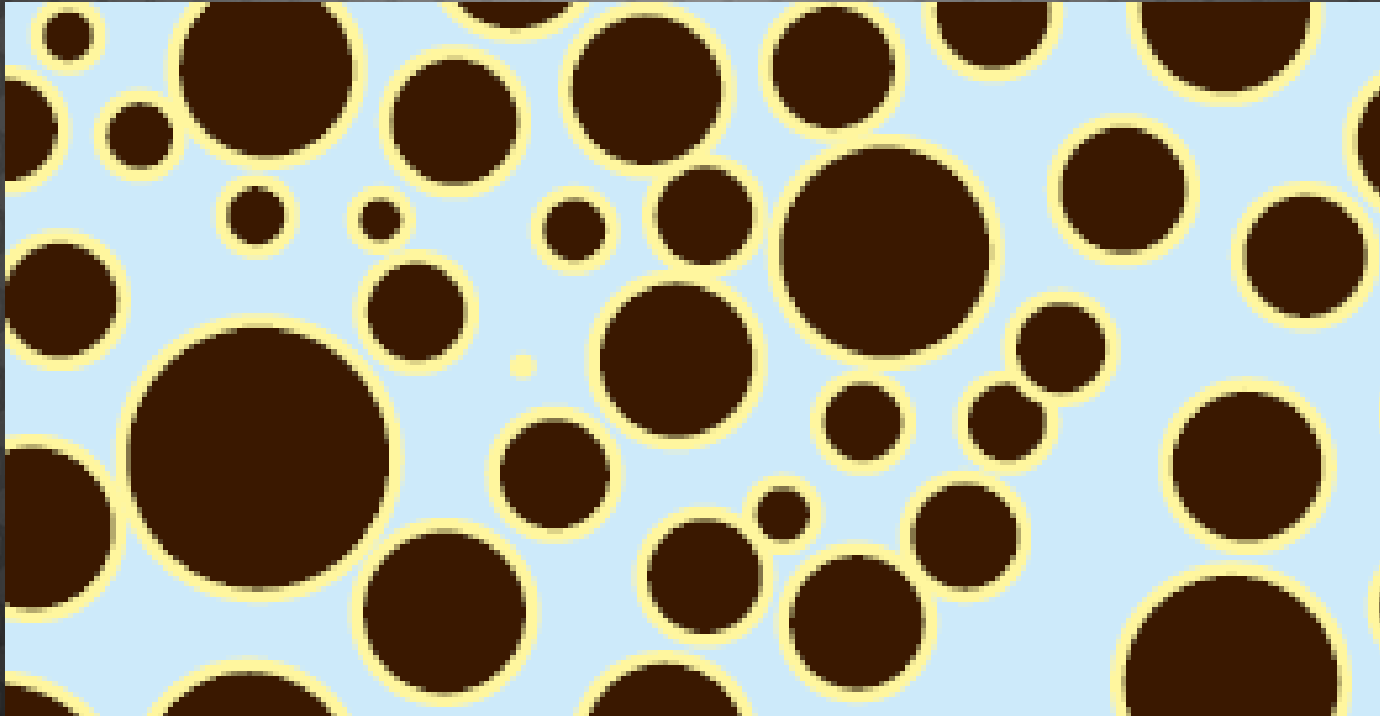
10 million tons of asphalt emulsion are used worldwide

2-3 million tons of asphalt emulsion in USA

The environmental movement in the 1970's prompted the increase in emulsion manufacturing due to concerns about pollution from cutback asphalts (VOC's)

What is an emulsion?

An emulsion is a dispersion of small droplets of one liquid in another liquid. Asphalt and Water



WHAT IS AN ASPHALT EMULSION?

Two liquids or components with one dispersed continuously through the other

The immiscible materials are held together in a stable suspension with the aid of a surfactant

Examples of common emulsions are shampoo, milk, mayonnaise and paint

Why Use Asphalt Emulsions?

- No petroleum solvent required to liquefy
- Little or no hydrocarbon emissions
- In most cases, used with no additional heat or very little heat.
- The ability to coat damp aggregate
- Can use cold materials at remote sites
- Wide variety of emulsion types available today.

Table 1-1 The Major Uses of Asphalt Emulsion

Surface Treatments	Asphalt Recycling	Other Applications
Fog sealing	Cold in-place	Stabilization (soil and base)
Sand sealing	Full depth	Maintenance patching
Slurry sealing	Hot in-place	Tack coats
Micro-surfacing	Central plant	Dust palliatives
Cape sealing	Cold in-place	Stabilization (soil and base)
		Prime coats
		Crack filling
		Protective coatings

Asphalt Emulsions - Composition

- Three basic ingredients
- Asphalt
- Water + Mechanical Mixing
- Emulsifying agent
- May contain other additives
- Polymers
- Stabilizers
- Coating improvers
- Antistrips
- Break control agents

Basic Emulsion Ingredients – Asphalt

- **Asphalt cement is basic ingredient**
- **Up to 50-75% of finished emulsion**
- **Hardness of base asphalt cement varies**
- **Climate may require harder or softer base**
- **Compatibility of emulsifier needed for stability**

Basic Emulsion Ingredients –Water

- **Second basic ingredient in an emulsion is water**
- **Contribution cannot be minimized**
- **Water may contain minerals or other matter**
- **Can affect the production of stable emulsions**
- **Water considered suitable for drinking, might NOT be suitable for emulsion production**

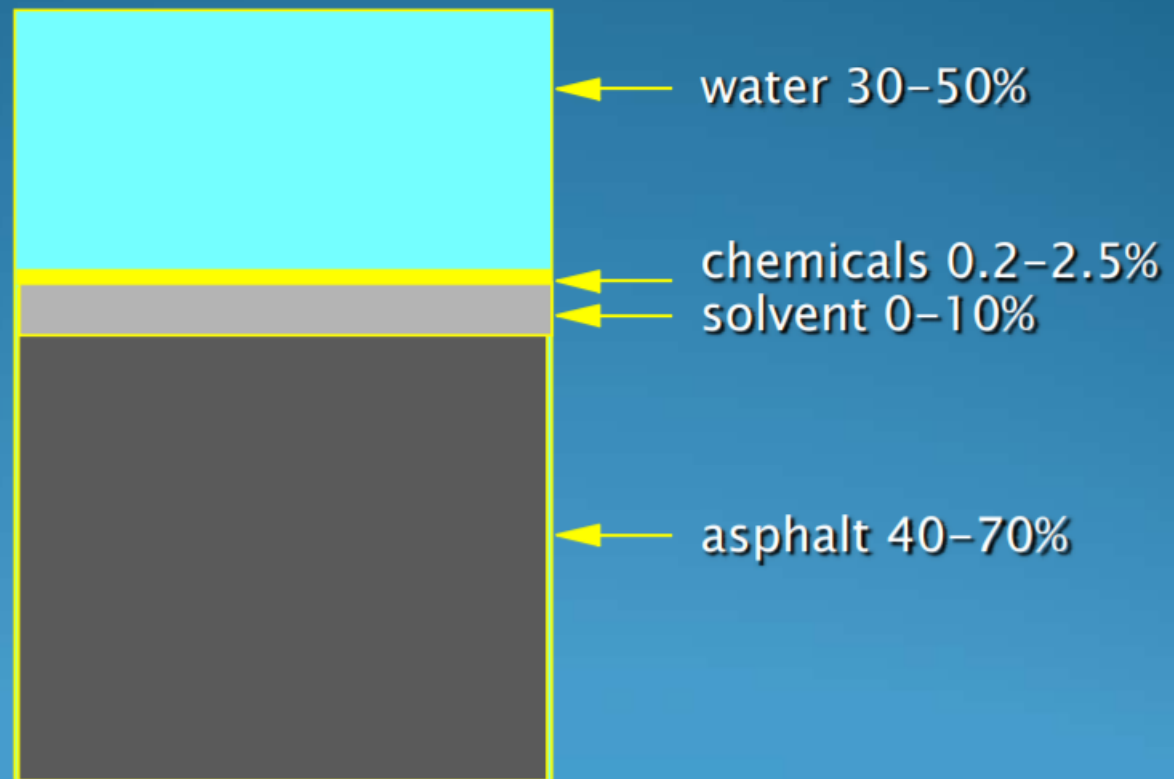
Basic Emulsion Ingredients – Emulsifying Agents

- **Surfactants**
- **Adsorbed at interface between liquids and solid**

Asphalt emulsion properties greatly depend on the chemical used as the emulsifier.

The emulsifier is a surface-active agent, or a surfactant. The emulsifier keeps the asphalt droplets in stable suspension and controls the breaking time. It is also the determining factor in the classification of the emulsion as anionic, cationic, or nonionic

Asphalt Emulsion composition



Asphalt Emulsions – Classification by Set Rate

- How quickly do asphalt droplets coalesce?

Two letter codes used to simplify + standardize

- RS – Rapid Setting
- MS – Medium Setting
- SS – Slow Setting
- QS – Quick Setting

Sub-Classifications - Typical Applications

▪ RS

- **Rapid Setting**
 - **Chip Seals**

▪ MS

- **Medium Setting**
 - **Plant Mixing**
 - **In-place Recycling**

▪ SS

- **Slow Setting**
 - **Cold Mixes**
 - **Tack Coats**

▪ QS

- **Quick Setting**
 - **Slurry Seals**
 - **Micro Surfacing**

NAMING THE EMULSIONS

- Prefix

RS = rapid set

SS = slow set

QS = quick set

MS = medium set

HFRS = high float rapid set

C = Cationic

AE = anionic emulsion

- Suffix

90,150, or 300 = penetration ranges

h = hard penetration

P,M or L = modified with polymer or latex

1 = low viscosity, stored @ cooler temps

2 = high viscosity, stored @ higher temps

Asphalt Emulsion Nomenclature

CRS-2P

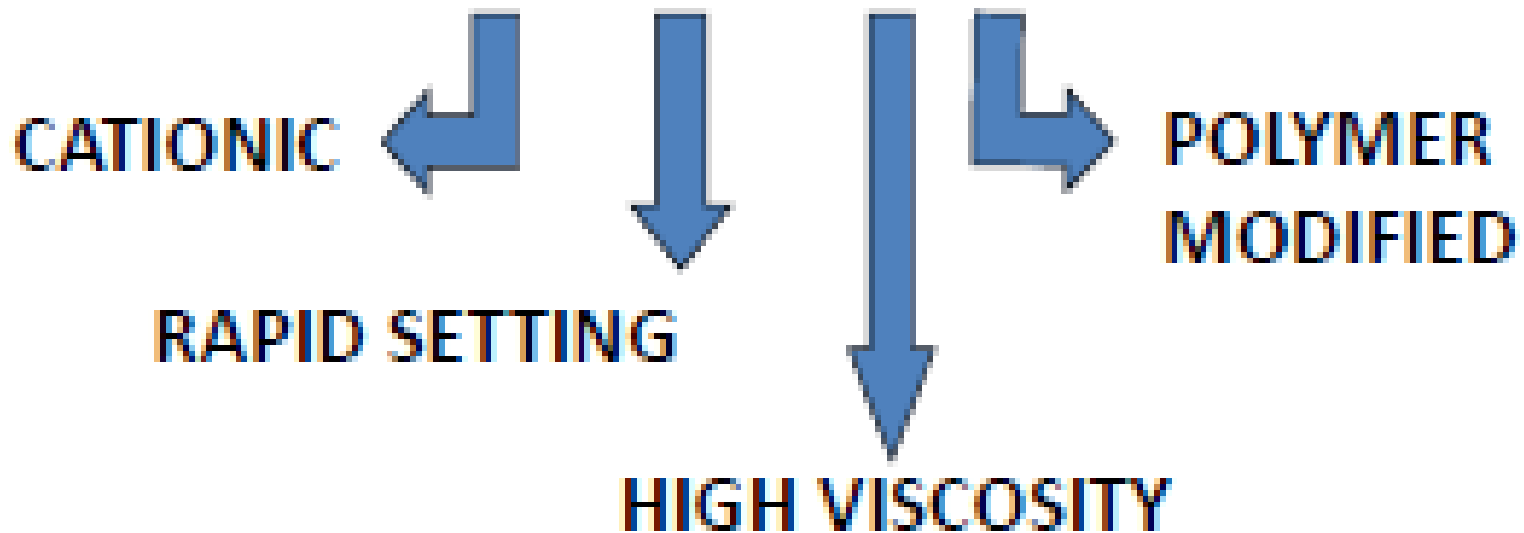


Table 2-1 Grades of Emulsion

Asphalt Emulsion	Cationic Asphalt Emulsion
(ASTM D977, AASHTO M140)	(ASTM D2397, AASHTO M208)
RS-1	CRS-1
RS-2	CRS-2
HFRS-2	—
MS-1	—
MS-2	CMS-2
MS-2h	CMS-2h
HFMS-1	—
HFMS-2	—
HFMS-2h	—
HFMS-2s	—
SS-1	CSS-1
SS-1h	CSS-1h

RAPID SETTING EMULSION

- Designed to react quickly with aggregate and revert from the emulsion to the asphalt.
- Primarily used for spray applications.
 - RS-2, HFRS-2, MWS-90, and CRS-2

MEDIUM SETTING EMULSION

- Designed for mixing with graded aggregate.
- Formulated not to break immediately upon contact with aggregate and will remain workable for a few minutes to several months depending upon the formulation.
- Primarily used in pugmills.
 - MS-2, CMS-2, HFMS-2, MWS-150 & 300

SLOW-SETTING EMULSION

- **Designed for mixing stability.**
- **Primarily used with high fine content aggregates, tack coats, fog seals and dust palliatives.**
 - **SS-1h, Dustlay, Dust Control**

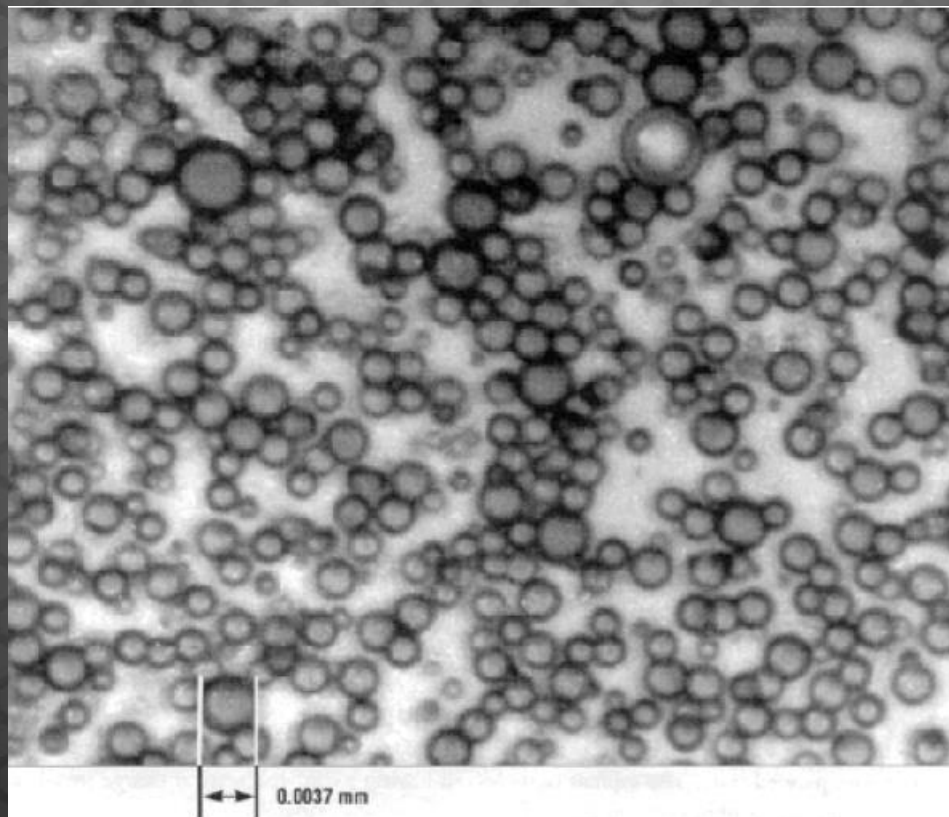
QUICK-SETTING & MICRO SURFACING

- Designed specifically for slurry and micro-surfacing emulsions.
- Allows quicker opening to traffic times.
- Micro-surfacing emulsions are polymer modified and allow mixes to be placed at greater thickness than slurry seals.
 - CSS-1h, CQS-1h and CQS-1hM

Asphalt emulsion droplets size

1-10 Microns in size

Human Hair 70-100 Microns in size



Storing Asphalt Emulsions

Storage tanks should be insulated for protection from freezing and most efficient use of heat. A skin of asphalt can form on the surface of emulsions when exposed to air.

Therefore, it is best to use tall, vertical tanks that expose the least amount of surface area to the air. Most fixed storage tanks are vertical but horizontal tanks are often used. for short-term field storage. Skinning can be reduced by keeping horizontal tanks full to minimize the area exposed to air.

Large diameter, slow-turning propellers are best and should be used to roll over the material. Over-mixing should be avoided .

Tanks may also be circulated top to bottom with a pump. Over-pumping is to be avoided.

DO store as you would fluid water — between 10°C (50°F) and 85°C (185°F), depending on the intended use and specific product.

DO store at the temperature specified for the particular grade and application.

DO NOT permit the asphalt emulsion to be heated above 85°C (185°F). Elevated temperatures evaporate the water, changing the characteristics of the asphalt emulsion.

DO NOT let the emulsion freeze. This breaks the emulsion, separating the asphalt from the water. The result will be two layers in the tank, neither of which will be suited for the intended use, and the tank will be difficult to empty.

DO NOT allow the temperature of the heating surface to exceed 100°C (212°F). This will cause premature breakdown of the emulsion on the heating surface.

DO NOT use forced air to agitate the emulsion. It may cause the emulsion to break

Grade	Temperature, 0°C (0°F)	
	Minimum	Maximum
RS-1	20° (70°)	60° (140°)
RS-2, CRS-1, CRS-2, HFRS-2	50° (125°)	85° (185°)
SS-1, SS-1h, CSS-1, CSS-1h, MS-1, HFMS-1	10° (50°)	60° (140°)
CMS-2, CMS-2h, MS-2, MS-2h, HFMS-2, HFMS-2h, HFMS-2s	50° (125°)	85° (185°)

Handling Emulsified Asphalts

- DO** when heating asphalt emulsion, agitate it gently to eliminate or reduce skin formation.
- DO** protect pumps, valves, and lines from freezing in winter. Drain pumps and service according to the manufacturer's recommendations.
- DO** blow out lines and leave drain plugs open when they are not in service.

- DO use pumps with proper clearances for handling emulsified asphalt.**
Tightly fitting pumps can bind and seize.
- DO warm the pump to about 65°C (150°F) to facilitate start-up.**
- DO when diluting asphalt emulsion, check the compatibility of the water with the emulsion by testing a small quantity.**
- DO if possible, use warm water for diluting, and always add the water slowly to the emulsion (not the emulsion to the water).**

- DO** avoid repeated pumping and recirculating, as the viscosity may drop and air may become entrained, causing the emulsion to be unstable.
- DO** place inlet pipes and return lines at the bottom of tanks to prevent foaming.
- DO** pump from the bottom of the tank to minimize contamination from skinning that may have formed.
- DO** remember that emulsions with the same grade designation can be very different chemically and in performance.

DO haul emulsion in truck transports with baffle plates to prevent sloshing.

DO agitate emulsions that have been in prolonged storage. This may be done by recirculation.

DO NOT mix different classes, types, and grades of emulsified asphalt in storage tanks, transports, and distributors.

DO NOT

apply severe heat to pump packing glands or pump casings. The pump may be damaged.

DO NOT

dilute rapid-setting grades of asphalt emulsion with water. Medium and slow setting grades may be diluted, but always add water slowly to the asphalt emulsion. Never add the asphalt emulsion to a tank of water when diluting.

DO NOT

load asphalt emulsion into storage tanks, tank cars, tank transports, or distributors containing remains of incompatible materials. See Table 3-3 Haulers and Hauling Vehicles,

DO NOT

subject emulsified asphalt or air above it to an open flame, heat, or strong oxidants. Adequate ventilation is required.

DO avoid breathing fumes, vapors, and mist.

DO obtain a copy of the supplier's material safety data sheet (MSDS). Read the MSDS carefully and follow it.

Table 3-2 Guide for Condition of Emptied Tanks Before Loading Asphalt Emulsions

Last Product In Tank						
Product To Be Loaded	Asphalt Cement (Includes Industrial Asphalt)	Cutback Asphalt and Residual Oils	Cationic Fuel Emulsion	Anionic Emulsion	Crude Petroleum	Any Product Not Listed
Cationic Emulsion	Empty ¹	Empty to no measurable quantity	OK to load	Empty to no measurable quantity	Empty to no measurable quantity	Tank must be cleaned
Anionic Emulsion	Empty ¹	Empty to no measurable quantity	Empty to no measurable quantity	OK to load	Empty to no measurable quantity	Tank must be cleaned

NOTES:

1. Any material remaining will produce dangerous conditions

Breaking

If the asphalt emulsion is to perform its ultimate function as a binder, the water must separate from the asphalt phase and evaporate. This separation is called “breaking.”

For surface treatments and seals, emulsions are formulated to break chemically upon contact with a foreign substance such as aggregate or a pavement surface.

When using anionic and cationic rapid-setting and medium-setting emulsions, the initial placement of the asphalt emulsion droplets on the aggregate develops through electrochemical phenomena.

For slow-setting emulsions, the mechanism is water evaporation. For dense mixtures, more time is needed to allow for mixing and placement. Therefore, emulsions used for mixtures are formulated for delayed breaking. A rapid-set emulsion will have a short breaking time (within one to five minutes after being applied), whereas a medium- or slow-set material may take considerably longer.

The setting (or 'breaking') process





**Table 6-2 Suggested Distributor Spraying Temperatures
for Various Grades of Asphalt Emulsions**

Type and Grade of Asphalt Spraying Temperatures			Type and Grade of Asphalt Spraying Temperatures		
Asphalt Emulsion ¹	(°C)	(°F)	Asphalt Emulsion ¹	(°C)	(°F)
RS-1	20-60	70-140	HFMS-2s	20-70	70-160
RS-2	50-85	125-185	SS-1	20-70	70-160
HFRS-2	50-85	125-185	SS-1h	20-70	70-160
MS-1	20-70	70-160	CRS-1	50-85	125-185
MS-2	20-70	70-160	CRS-2	50-85	125-185
MS-2h	20-70	70-160	CMS-2	20-70	70-160
HFMS-1	20-70	70-160	CMS-2h	20-70	70-160
HFMS-2	20-70	70-160	CSS-1	20-70	70-160
HFMS-2h	20-70	70-160	CSS-1h	20-70	70-160

NOTES:

1. Temperatures also apply to polymer-modified versions of these emulsions.

**Stepp Equipment that
Stores, Heats and
Applies Asphalt
Emulsions**

SBF
BOTTOM FIRED KETTLES

SBF BOTTOM FIRED KETTLE

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**Diesel Or LP Fired
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20 GPM Pump with Spray Wand**



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STRD TRAILER DISTRIBUTOR

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Asphalts**

**Available in 600,800, 1000,&1200 Gallon
Tanks**

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**600,800,1000,&1200 Gallon Insulated Tanks
100 or 150 GPM Hydraulic Pumping System**

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