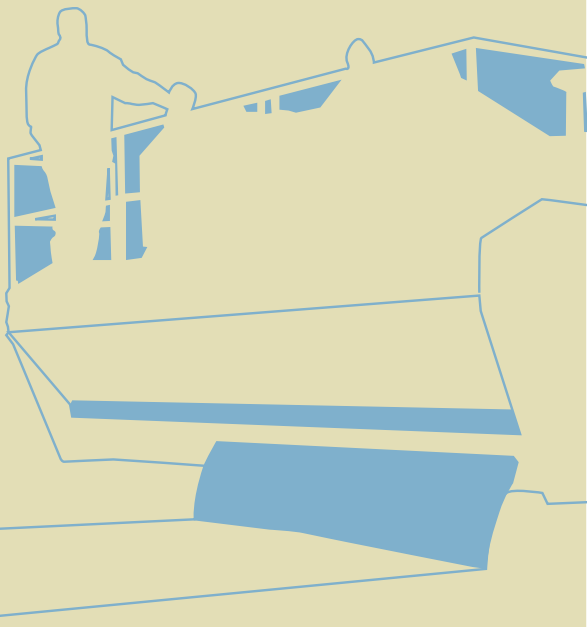


# THE ERGON FIELD GUIDE TO EMULSIONS



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## Preface

We at Ergon Asphalt & Emulsions hope you will find this handbook useful in your daily efforts in the areas of pavement preservation, maintenance, rehabilitation and construction. It is intended to be a simple guide and a quick reference to asphalt emulsions and their uses.

Asphalt emulsions have been used throughout the world for well over 50 years. In the early days, emulsions served as a solution to the problem of delivering asphalt at a usable temperature to remote locations. It was quickly recognized that the use of water as a carrier for asphalt had other distinct advantages. Emulsion expanded the types of materials that could be used and was much safer than hot or “cut back” products. Mixing asphalt with aggregates was easier, and the water phase carried the bitumen deep into cracks and crevices of a pavement surface that would have otherwise been left vulnerable to the elements.

As we move into the 21st century, the criterion of material selection is rapidly changing. The benefits and flexibility of asphalt emulsion products continue to emerge. A responsible awareness of the roadway construction and maintenance industry’s environmental impact, combined with the necessity of a healthy economy, demands we be less wasteful of our natural resources, more conscious of worker and user safety, and that we strive to efficiently manage limited taxpayer dollars.

Two important research documents are referenced in this handbook. An "Eco-efficiency Analysis," conducted by BASF Corporation, demonstrates the ecological advantage of using asphalt emulsion. "A Texas Chip Seal Study," written by Dr. Doug Gransberg of Oklahoma University, proves the economical benefit of emulsion products. The complete studies can be accessed through the website of the Asphalt Emulsion Manufacturers Association at [www.aema.org](http://www.aema.org).

If you are planning to use an asphalt emulsion product we encourage you to use this handbook. Consider it an introduction to the vast knowledge and technology available to you from our industry. In the following pages, the many different grades of emulsions and their uses are outlined, storage and handling issues are discussed and you will find various conversion tables as well as other useful information. We hope you find this handbook very helpful, but as always, we encourage you to contact your local sales representative to address your individual needs.

Best regards,  
R.M. "Myles" McKemie  
V.P. Sales  
Ergon Asphalt & Emulsions

## Eco-Efficiency Study

Asphalt emulsions are the most environmentally friendly products used in the paving industry. Several recent eco-efficiency studies provide data demonstrating the differences between asphalt emulsion technologies and other, more traditional paving methods. The studies focus on:

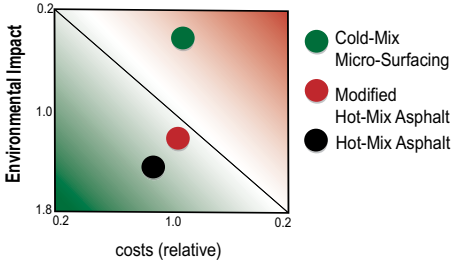
- Optimum Performance
- Raw Material and Energy Consumption
- Recycling and Disposal
- Ecological and Economic Advantages.

The charts on page 5 illustrate the balance between relative costs and the environmental impact for emulsion vs. hot applied chip seals and for emulsion micro-surfacing vs thin hot mix overlays, both with and without polymer modification. In both cases shown here, the emulsion applications had significantly higher eco-efficiency for similar relative costs.

The comprehensive analysis includes inputs of initial and life cycle costs, energy consumption, resource consumption, air emissions, water emissions, solid waste emissions, health effect potential, risk potential and land use. These categories were further broken down to such variables as global warming potential and photochemical ozone creation potential.

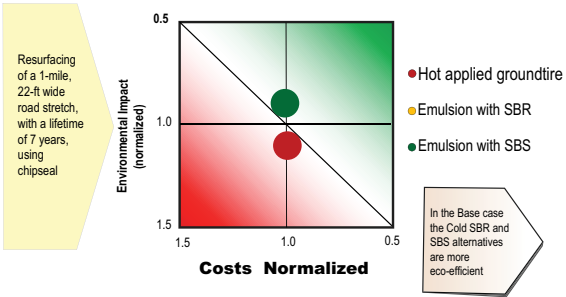
The goal of these analyses is to offer pavement engineers the best possible alternatives with the least environmental impact-at the best cost. More information on these studies is available on the AEMA website at [www.aema.org](http://www.aema.org).


### Thin Surfacing Eco-Efficiency



BASF Corporation

### Chip Seal Eco-Efficiency Portfolio-Base Case

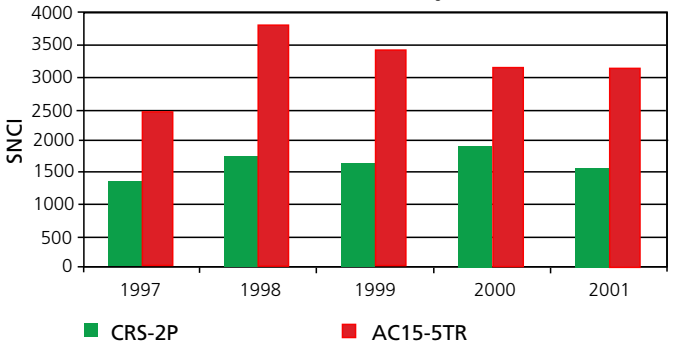


 Eco-efficiency

## Texas Chip Seal Study

The study collected both design and performance data on 342 chip seal projects worth nearly \$30 million that had been completed in the Texas Department of Transportation's Atlanta District since 1996. One hundred sixty five of these projects were emulsion projects utilizing CRS-2P as the binder and 177 were asphalt cement projects using AC15-5TR binders. The external variables were minimized as the Atlanta District had used the same seal coat contractor, Area Office, construction season, asphalt suppliers, and aggregate on all its districts chip seal projects for the past 12 years. The one difference in the aggregate was that the AC15-5TR used a lightweight aggregate that was pre-coated unlike the emulsion seals' lightweight aggregate that was not pre-coated. Thus, the comparison of the two binders can be made in a very direct manner, and the results can be viewed as specific to the engineering properties of the binders themselves without the need to qualify the conclusions based on independent parameters that could not be mathematically removed from the data. The study found that the emulsion chip seals performed as well as the hot asphalt cement seals and were the more cost effective of the two alternatives. Emulsion chip seals also furnished a better long-term friction course as measured by the skid number. The following graph indicates the cost savings related to friction resistance, the lower the SNCI the better.

### Skid Number Cost by Year



## **Asphalt Emulsion Defined**

### **What is an asphalt emulsion?**

Asphalt emulsion is a combination of three basic ingredients: asphalt, water, and a small amount of an emulsifying agent. These components are introduced into a colloid mill that shears the asphalt into very small droplets. The emulsifier, a surface-active agent, keeps the asphalt droplets in a stable suspension. The result is an asphalt based product with a consistency ranging from that of milk to that of heavy cream, which can be used in cold processes for road construction and maintenance.

### **Why use asphalt emulsions?**

Asphalt emulsion does not require a petroleum solvent to make it liquid, and in most cases, asphalt emulsions can be used without additional heat. Both of these factors contribute to energy savings. Additionally, asphalt emulsions offer great flexibility in their application since they offer the end-user a great variety of characteristics not found in other paving and maintenance materials. Asphalt emulsions are environmentally friendly. There are little or no hydrocarbon emissions created with their use.

### **Are asphalt emulsions new?**

Asphalt emulsions were first prepared in the early part of the 20th century, and today, they are used internationally. The use of asphalt emulsions is growing, and 10-20% of all asphalt is used in the form of asphalt emulsions.

### **How are asphalt emulsions classified?**

Asphalt emulsions are classified into three

categories: anionic, cationic, or nonionic. The anionic and cationic classes refer to the electrical charges surrounding the asphalt particles. The absence of the letter "C" denotes anionic emulsions. Asphalt emulsions are further classified on the basis of how quickly they coalesce; i.e., revert to asphalt cement. The terms RS (Rapid Set), MS (Medium Set), SS (Slow Set), and QS (Quick Set) have been adopted to simplify and standardize this classification. Additionally, trailing numbers are used to delineate the relative viscosity of the emulsion, and the letters "h" and "s" indicate whether hard or soft base asphalt is used to make the asphalt emulsions. Thus, a CSS-1h is a cationic slow set emulsion with a relatively low asphalt emulsion viscosity made with hard base asphalt.

### **Do asphalt emulsions have any uses around the home?**

Driveway sealers, roofing repair materials, caulks and mastics may contain specially formulated asphalt emulsions.

### **Where can I learn more about asphalt emulsions?**

You can order AEMA's Basic Asphalt Emulsion CD-ROM through the website at [www.aema.org](http://www.aema.org).

### **What chemicals are present in the emulsion?**

The main components of the emulsion are asphalt (bitumen) and water. Emulsions typically contain between 55 and 75% asphalt. In addition to the asphalt and water, asphalt emulsions contain 0.1-2% of an emulsifier, or "soap," which functions

to stabilize the emulsion. These soaps are similar in nature to the soaps and detergents used in household cleaning and personal care. The asphalt emulsions may also contain trace amounts of other ingredients such as pH (acidity) regulators and viscosity regulators.

### **Tell me more about the emulsifying agents.**

The most common products are fatty acids and lignin's derived from wood; these form soap by reaction with sodium hydroxide. The soaps become negatively charged in water and give "anionic" asphalt emulsions. Another class of emulsifiers, amines, are derived from wood acids (tall oils) or animal fats (tallow). These emulsifiers form soaps which become positively charged in water and give "cationic" asphalt emulsions.

### **How do they work?**

When asphalt emulsion is mixed with or exposed to the aggregates used in roadway applications, the emulsion is destabilized, and the droplets of asphalt fuse together providing a strong adhesive bond to "glue" the aggregates together. The water evaporates, but the emulsifiers remain in the asphalt where they provide a valuable function in helping the asphalt adhere to the aggregate.

## Chip Seal Defined

### **What is a chip seal?**

A chip seal, or single surface treatment, is the most widely used pavement preservation method today. Chip seals produce an all-weather surface that renews weathered pavements, improves skid resistance, aides in lane demarcation, and seals and protects the underlying road surface.

### **How is a chip seal applied?**

Potholes are sealed, and any large cracks in the road surface are repaired. Sufficient curing of these repairs is allowed before applying the chip seal. The road surface is then cleaned using a power sweeper or rotary broom. An asphalt emulsion is then uniformly spray-applied by an asphalt emulsion distributor, and aggregate (chips) are evenly applied with a self-propelled or a truck-attached mechanical spreader. A pneumatic tired roller is then used to embed the aggregate into the asphalt film. After initial cure, excess aggregate is removed by brooming. After the chip seal treatment has cured completely, the surface may be swept again and striping applied.

### **What types of asphalt emulsions are used for chip seals?**

Typical asphalt emulsions used in chip seals are CRS-2, RS-2, and HFRS-2. For higher volume traffic roadways, polymer modified versions of these asphalt emulsions, like CRS-2p, are used. Also see Section 10 on Product Application for more emulsion choices.

### **Is there any advantage in using an asphalt emulsion over hot asphalt in the chip seal application process?**

Asphalt emulsion is more environmentally friendly as it is applied at a much lower temperature. With lower storage and application temperatures, safety is vastly improved, and there is a significant energy savings. Asphalt emulsion does not require the use of pre-coated aggregates, and in fact, performs better with uncoated or bare aggregate. Asphalt emulsion fully penetrates and fills surface cracks and voids even in the presence of moisture; hot asphalt tends to bridge these areas. Asphalt emulsion is more forgiving and will work under a wider variety of field conditions than hot applied products.

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### **What are some keys to a successful chip seal surface treatment?**

- Coordinate construction to ensure continuous operation.
- Use hard, cubical, and clean aggregate.
- Properly calibrate application equipment.
- Maintain traffic control while chip seal application cures.

## Surfacing Types

### **What is slurry surfacing?**

Slurry surfacing is a thin, cold, mixed pavement preservation treatment comprised of asphalt emulsion, aggregate, water and mineral filler. There are two basic products, slurry seal and microsurfacing. Slurry seal is typically applied on residential streets, airports, sidewalks and parking lots. Microsurfacing is a premium product based on specially selected aggregates and polymer modified asphalt emulsion. Microsurfacing is designed to be applied in thicker lifts for high trafficked areas requiring heavier application rates and quick return to traffic. Microsurfacing is also used as a rut fill treatment.

### **How is a slurry seal or microsurfacing applied?**

The raw materials are combined in a mobile mix unit. The slurry surfacing is applied to an existing pavement surface by means of a spreader box linked to the mixing unit. The slurry is introduced into the spreader box and is “laid down” as the mixing unit is driven forward.

### **What type of asphalt emulsion is suitable?**

Slurry seal may use a variety of emulsions such as SS-1h or CQS-1h. Microsurfacing always uses a cationic polymer modified emulsion such as CSS-1hp. The emulsion type is selected on the basis of local specifications and through a laboratory mix design process, comprised of tests on the compatibility of the aggregate and the emulsion, and on the durability of the cured seals. See Section 10 on Product Application for more emulsion choices.

## Tack Coats and Primes

### What is tack coat?

Tack coat (also known as bond coat) is a light application of asphalt emulsion between hot mix asphalt layers designed to create a strong adhesive bond without slippage. Heavier applications may be used under porous layers or around patches where it also functions as a seal coat.

### Why use tack coat?

Without a tack coat, the asphalt layers in a roadway may separate, which reduces the structural integrity of the pavement and may allow water to penetrate the structure.

### What type of emulsion should be used for tack coats?

The type of emulsion used for tack coats varies from country to country. Normal practice in the USA is to use a slow-setting emulsion that is diluted with water before application. In many European countries, cationic rapid setting or specially designated low viscosity medium setting emulsions are used, and are applied undiluted. See Section 10 on Product Application for more emulsion choices.

### Why use prime coat?

Prime coats protect the integrity of the granular base during construction and help reduce dust. In the case of a base which is to be covered with a thin hot mix layer or a chip seal for a low volume roadway, priming ensures a good bond between the seal and the underlying surface which otherwise would have a tendency to delaminate.

### **Why use asphalt emulsion prime?**

Compared to cut back asphalt primes, emulsion primes are environmentally friendlier.

### **What type of emulsion is most suitable for emulsion prime?**

Slow-setting grades of asphalt emulsions (diluted with water before application) are suitable. To ensure good penetration on dense granular or stabilized bases, the surface may need to be scarafied and dampened before application of the emulsion. See Section 10 on Product Application for more emulsion choices.

## **Emulsion Recycling**

### **How are asphalt emulsions used in recycling applications?**

Cold in-place recycling (CIR) and full-depth reclamation (FDR) are two of the most common applications that use asphalt emulsion as the binder that mixes with the pulverized and reclaimed old pavement to create a new level base course.

### **What is the difference between cold in-place recycling and full-depth reclamation?**

Cold in-place recycling pulverizes the existing pavement to a depth of 50 to 100 mm (2 to 4 inches). Full-depth reclamation pulverizes to a greater depth below the existing pavement into the underlying material to produce a stabilized base course.

**What are the advantages of recycling?**

Energy is conserved as the construction is completed in-place/on-grade, and no fuel is required for heating. Reflective cracking can be reduced with CIR and eliminated by FDR. Additionally, the pavement crown and cross slope can be restored, and loss of curb height is reduced or eliminated.

**What type of asphalt emulsions are used in these recycling processes?**

Typically, cationic or anionic medium-setting grades, high-float medium setting grades, and cationic slow setting grades are used. Polymer modified versions of these grades are also used. See Section 10 on Product Application for more emulsion choices.

**After a pavement has been recycled, is a wearing course required to waterproof the recycled pavement?**

Yes. Depending on the traffic volume, a variety of surface treatments such as chip seals or slurry surfacing may be applied. For high volume traffic roadways, hot-mix asphalt is often applied.

**Emulsion Mixes****What is the difference between “dense-graded” and “open-graded” emulsion mixes?**

Dense-graded mixtures contain aggregate which have been selected to include fine material and filler; therefore, the compacted mixture has low air voids and is essentially impermeable to water. Open-graded mixtures contain aggregate without the fine fractions, and when compacted, have high voids and

are permeable to water. Because of its high fines content, the aggregate in dense-graded mixes is generally more reactive towards asphalt emulsion and demands a slower-setting grade than open-graded mixtures.

### **Why should I use cold emulsion mix rather than hot mix?**

Cold mixes use less energy and produce fewer emissions than hot mixes. Cold mix plants are lower cost, more simple and more mobile than hot mix plants, and emulsion mixes lend themselves to on-site and in-place manufacture. The ability to stockpile material for future use leads to less waste and reworking than with hot mix.

### **How should I select the emulsion for cold mix?**

Emulsion selection is on the basis of laboratory mix designs. Mix designs ensure that the emulsion is compatible with the aggregate and that the mixture is durable. Slow-setting emulsions are generally used for dense mixes, and medium-setting emulsions for open-graded mixes. Your emulsion supplier can adjust the emulsion formulation, if necessary, to best suit the aggregate and application. See Section 10 on Product Application for more emulsion choices.

### **What are the advantages of warm mix?**

Asphalt emulsion can be used in a conventional hot mix plant and requires much lower mix temperatures. The advantages are greatly reduced emissions, fuel savings, worker safety and less

hardening of the asphalt binder. The higher viscosity of the base binder at the mix temperature allows thicker films to be deposited on open-graded aggregate.

# Product Application

	CHIP SEAL - SINGLE	CHIP SEAL - MULTIPLE	SAND SEAL	SLURRY SEAL	MICROSURFACING	CRACK FILL	SANDWICH SEAL	DUST PALITIVE	FOG SEAL	TACK COAT	REJUVENATOR	MULCH TREATMENT	PENETRATING PRIME	RECYCLE MIX	AGG MIX	WARM MIX COLD LAY	BLADE MIX
AE-3																	
AE-P																	
AES-300																	
AES-300A																	
ARA-1																	
CHFRS-2HP																	
CHFRS-2P																	
CMS-1P (CR)																	
CMS-1P (QB)																	
CMS-2																	
CMS-2R																	
CMS-2S																	
Coherex																	
CQS-1H																	
CQS-1HLM																	
CRS-1P																	
CRS-2																	
CRS-2H																	
CRS-2HP																	
CRS-2HLM																	
CRS-2L																	
CRS-2P																	
CSS-1																	
CSS-1H																	
CSS-1P																	
CSS-1HP																	
CSS-1R																	
EA-1																	
ERA-25																	
HFRS-2																	
HFRS-2P																	
MS-2																	
Plastic Seal																	
Reclimite																	
RS-2																	
SS-1																	
SS-1H																	
SS-1HH (heavy)																	
SS-1HLM																	

- Emulsion is sprayed on the road and then covered with aggregate; can fill cracks.
- Emulsion is mixed with aggregate and then placed on road; can fill some cracks.
- Combination or specialty applications.
- Emulsion is applied to the roadway or surface without any cover material.
- Emulsion is mixed with aggregate and then the mix is stored or placed on the road.

## Sales & Plant Contact Information

### Birmingham

Plant Manager	Bob Walley
Plant Telephone	205-436-3413
Plant Fax	205-436-3404
Plant Address	7890 Birmingham Road Mulga, AL 35118

Area Sales Manager	Kyle Cook
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Sales Office Address	2100 Southbridge Parkway Suite 650 Birmingham, AL 35209

### Chandler

Plant Manager	Joel Shealey
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Area Sales Manager	Dave Troynek
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Sales Office Fax	480-940-9595
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### Memphis

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Area Sales Manager	Amy L. Walker
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Sales Office Address	1989 Channel Ave. Memphis, TN 38113

#### Las Vegas

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Sales Office Address	6400 West Richmar Ave. Las Vegas, NV 89139

#### Mt. Pleasant

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Plant Telephone	903-572-9839
Plant Fax	903-572-1408
Plant Address	209 Robert Nance Road Mt. Pleasant, TX 75445

Area Sales Manager	Tom O'Leary
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Sales Office Fax	903-596-7436
Sales Office Address	722 South Boisd-Arc Suite 6 Tyler, TX 75701

## Pleasanton

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Plant Fax	830-569-6043
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Regional Sales Manager	David Stroud
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## Snowflake

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Area Sales Manager	Dave Troynek
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Sales Office Address	420 N. Roosevelt Ave. Chandler, AZ 85226

## Vicksburg

Plant Manager	Bill Hoxie
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Plant Fax	601-630-8347
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Area Sales Manager	Jerry Walley
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Sales Office Fax	318-574-9790
Sales Office Address	P.O. Box 552 Tallulah, LA 71284

## Waco

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Regional Sales Manager	David Stroud
Sales Office Telephone	254-753-5885
Sales Office Fax	254-753-2404
Sales Office Address	1820 Hwy 6 East Waco, TX 76705

	1	2	3	4	5	6	7	8	9
AE-3				■					
AE-P				■	■	■		■	
AES-300				■	■				
AES-300A				■	■				
ARA-1				■					
CHFRS-2HP	■								
CHFRS-2P	■			■	■				■
CMS-1P (CR)			■	■	■				■
CMS-1P (QB)				■					■
CMS-2				■					■
CMS-2R			■						
CMS-2S									■
Coherex		■	■						
CQS-1H		■	■				■	■	■
CQS-1HLM		■	■				■		■
CRS-1P					■				■
CRS-2	■				■			■	■
CRS-2H	■	■	■		■	■			
CRS-2HP	■	■			■				
CRS-2HLM			■						
CRS-2L				■					
CRS-2P	■			■	■	■	■	■	■
CSS-1	■				■			■	■
CSS-1H	■		■		■			■	■
CSS-1P									■
CSS-1HP								■	
CSS-1R					■			■	
EA-1				■					
ERA-25		■							
HFRS-2						■			
HFRS-2P						■			
MS-2					■	■			
Plastic Seal		■							
Reclimite		■	■						
RS-2				■					
SS-1				■	■	■	■		
SS-1H		■	■		■				
SS-1HH (heavy)			■						
SS-1HLM						■			

## Product Production Locations

### PLANTS

- 1 Birmingham, AL
- 2 Chandler, AZ
- 3 Las Vegas, NV
- 4 Memphis, TN
- 5 Mt Pleasant, TX
- 6 Pleasanton, TX
- 7 Snowflake, AZ
- 8 Vicksburg, MS
- 9 Waco, TX

# Handling Asphalt Emulsions

## Do's & Don'ts of Storage & Handling of Asphalt Emulsions

### DO's

- Set the clearance on pumps for emulsions to prevent binding and to prevent breaking of the emulsion.
- Clear lines, valves, and pumps of emulsion.
- Drain pumps and remove plugs during freezing weather. No. 1 or No. 2 fuel oil may be used to keep pumps free.
- Warm the pump casings and packing glands to 150°F (65°C) to ease start-up.
- Store emulsions in vertical tanks to prevent excessive skin formation.
- Store emulsions at the temperature specified for the particular grade and application.
- Store emulsion in insulated tanks to protect from freezing and make most efficient use of heat.
- Use large, side mounted, slow moving propellers, mounted 3 feet (1 meter) from the bottom of the tank to "roll" the emulsion to prevent skin from forming if skin formation is an issue. Over-mixing should be avoided.
- Gently circulate emulsions when heating or after prolonged storage.
- Place inlet and return lines near the bottom of the tank to prevent foaming.
- Pump from the bottom of the tank to minimize contamination from skinning that may have formed.
- Check compatibility of water and emulsion in a flask prior to use on a larger volume.
- Dilute medium and slow-setting emulsions by adding warm water to the emulsion.

- Drain tanks to no measurable quantity before adding an emulsion of different type. Emulsions with the same designation may be very different in performance.
- Provide adequate ventilation.
- Heat only to reasonable temperatures.
- Haul emulsion in truck transports with baffle plates to prevent sloshing.

### **DON'TS**

- Use tight clearance pumps; they may seize.
- Leave emulsion in pumps, valves or lines during freezing weather.
- Hold emulsions in lines and pumps for extended periods.
- Apply severe heat to pump casings or packing glands. The pump may be damaged, and the emulsion may break.
- Allow heating surfaces to exceed 185°F (85°C). This will cause emulsion to break on the heating surface.
- Store emulsions in horizontal tanks.
- Circulate emulsions excessively. Emulsions tend to lose viscosity when pumped. Air may also become entrained and lead to an unstable emulsion. Excessive pumping may also lead to the emulsion breaking.
- Use forced air to agitate emulsions.
- Dilute rapid-setting emulsions with water. Never add emulsion to water.
- Dilute emulsions with non-potable water or cold water.
- Dilute emulsions with fuel oil, diesel fuel or kerosene.

- Put fuel oil, diesel fuel or kerosene on top of a tank of emulsion to prevent skin from forming.
- Pump emulsions into open air or have inlet lines near the top of the tank.
- Place outlet lines in mid tank.
- Mix emulsions of different chemical types, classes, grades or designations in storage tanks, trailers, transports or distributors. Anionic and cationic emulsions, may coagulate when mixed.
- Subject emulsion or the open air above it, to open flame or strong oxidants. Never heat the emulsion over 190°F (88°C).
- Load emulsion into storage tanks, tank cars, tank transporters or distributors containing remains of an incompatible material.
- Proceed if you have questions.

## **Asphalt Emulsions Storage**

### **Why are asphalt emulsion storage and handling requirements important?**

Asphalt emulsions are a dispersion of fine droplets of asphalt cement in water. Since water is the carrier, medium specific storage and handling procedures should be followed.

### **What is the proper storage temperature for storing asphalt emulsions?**

Store asphalt emulsion between 50°F (10°C) and 185°F (85°C). Do not permit the asphalt emulsion to be heated above 185°F (85°C). At elevated temperatures, the water will evaporate, changing the characteristics of the asphalt emulsion. The following chart outlines minimum and maximum temperatures for various grades of asphalt emulsion.

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

### **What will happen if the asphalt emulsion freezes?**

This will break the asphalt 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. Likewise, the tank will be difficult to empty.

### **What type of storage tank is best suited for storing asphalt emulsions?**

Vertical storage tanks are best suited to store emulsions. Vertical tanks expose the least amount of surface area to air, thus reducing the formation of an asphalt skin on the surface of the emulsion. Tanks must also be insulated with a weather resistant covering, to protect the asphalt emulsion from freezing and provide the most efficient use of heat. Additionally, side-entering propeller mixers can be used to gently agitate the asphalt emulsion. This eliminates any skin formation. Side entry mixer placement must be engineered to the size of the storage tank.

## Can a pump be used to mix and circulate a storage tank of asphalt emulsions?

Yes. However, over-pumping is to be avoided since some asphalt emulsions are shear sensitive. Over-pumping and over-mixing can significantly alter the characteristics of the asphalt emulsion. Tanks should be circulated from top to bottom.

## Can asphalt emulsions of different classes be mixed together?

Any amount of material remaining within a tank or tanker must be compatible with the added emulsion, and the amount remaining must be insufficient to cause the emulsion to fall out of specification. When asphalt emulsions of different classes are co-mingled in measurable quantities, the asphalt emulsion will become unstable and break. If in doubt, check with your asphalt emulsion supplier.

		Last Product in Tank				
		Asphalt Cement (Includes Industrial Asphalt)	Cut Back Asphalt and Residual Oils	Cationic Emulsion	Anionic Emulsion	Any Product Not Listed
Product to be Loaded	Cationic Emulsion	Empty to		Contact Supplier or Empty to No Measurable Quantity	Tank Should Be Cleaned	Tank Must Be Cleaned
	Anionic Emulsion	No Measurable		Tank Should Be Cleaned	Contact Supplier or Empty to No Measurable Quantity	
	Asphalt Cement	Quantity		Tank Must Be Empty - Dangerous Condition May Result	Tank Must Be Empty - Dangerous Condition May Result	

## Asphalt Emulsions and Health

### **Are there any health or safety precautions that should be exercised when using asphalt emulsions?**

Avoid breathing fumes, vapors, and mist. Obtain a copy of the supplier's material safety data sheet (MSDS). Read the MSDS carefully and follow it. For a copy of an MSDS, please visit the Ergon web site at [www.ergon.com](http://www.ergon.com) and follow the links to the MSDS page.

### **Molten Asphalt Cement Burn Treatment**

Completely submerge the affected area in ice or cold tap water, or place the affected area under running water.

**DO NOT DELAY TREATMENT. DO NOT ATTEMPT TO REMOVE THE ASPHALT CEMENT.**

For minor and serious asphalt cement burns—seek medical attention.

Treat the victim for shock, as appropriate. Keep the victim lying down and quiet. Keep the victim covered with a blanket or something similar to keep the body temperature normal. Keep the victim's head lower than the feet to promote blood supply to the head and chest.

### **SAMPLING**

*Goal: obtain samples that are truly representative of material, that are not contaminated, and that will resist deterioration during shipping and/or storage.*

*Above all, sampling should be done in a manner safe for the employee. More information can be found in AASHTO T40 or ASTM D140, Standard Practice for Sampling Bituminous Materials.*

- Before sampling, the Material Safety Data Sheet (MSDS) from the supplier should be carefully read and followed.
- Care should be taken to avoid breathing fumes, mists and/or vapors.
- To protect skin, gloves should be worn and long sleeves fastened over the gloves at the wrist.
- Face shields should be worn to protect against splashed material and any fumes.
- There shall be no smoking while sampling asphalt or emulsions.
- Sample containers must be new, clean and dry, and not be rinsed, washed or cleaned. Plastic gallon jugs are preferred for emulsions. Any containers that are not clean and dry should be discarded.
- The lid should fit tightly and properly on the sample container.
- Care should be taken to prevent any possible contamination.
- The sample container should not be submerged in solvent nor wiped with a cloth or rag containing solvent. If there is any material on the outside of the container, it should be wiped with a clean dry cloth immediately after the container is sealed and removed from the sampling device.

- During sealing and wiping, the container should be on a firm, level surface to prevent splashing, dropping or spilling.
- The sample must not be transferred to another container.
- The filled container should be tightly and positively sealed immediately after the sample is taken.
- The sample should be properly marked for identification with a permanent marker on the container itself, not the lid.
- The sample should be identified with the following at a minimum:

*Shipper's name and bill of lading or loading*

*Slip number*

*Date sampled*

*Sampler's name*

*Sample location (place sample taken)*

*Product grade*

*Project identification*

*Other information as necessary*

- Emulsion samples should be packaged, labeled, and protected from freezing during shipment. They should also be shipped to the laboratory the same day they are taken. To protect from shipping damage, the containers should be tightly sealed and carefully packed in protective material.

## **Crafco Pavement Maintenance Products**

Crafco, Inc.  
420 N. Roosevelt  
Chandler, Arizona 85226  
www.sales@crafco.com  
602-276-0406 ext 8023.

### **Crafco Pavement Preservation Products Sealants**

Crafco joint sealant extends the life of cement pavement. Joint sealant is designed to keep moisture out of the pavement sub-base, limit spills and prevent foreign objects (F.O.D.) from pavement surfaces.

RoadSaver 222 Sealant - 34222 Crafco RoadSaver 222 sealant is a single component, hot-applied petroleum based pavement crack and joint sealant which meets all requirements of ASTM D3405 and AASHTO M301. Packaging consists of individual boxes of sealant which are palletized into shipping units.

*Crafco Joint Adhesive* - Crafco's hot-applied modified asphalt composition effectively bonds paving passes together, creating a watertight seal during thermal movement resulting in improved long-term performance of the joint with no significant cracking. This product is also effective for waterproofing exposed edges of asphalt concrete pavement areas such as at the curb gutter and shoulder interfaces. Additionally, waterproofing can be assured where manhole covers and hand valves (gas, water, etc.) are installed in asphalt concrete pavement.

## Crafco Patching Products

*Crafco PolyPatch* is a versatile hot-applied, pourable, self-adhesive polymer modified asphalt binder containing selected aggregate to ensure good load bearing and skid resistant characteristics. PolyPatch is produced in several grades for various applications. PolyPatch is effectively used to level high manhole risers, drop inlets, bridge deck approaches, elevation discrepancies, utility cuts and more.

QPR is approved as a high performance patching material in most states and other user agencies within the United States. QPR is specifically formulated for the wide-ranging temperature and climate of our area. QPR is permanent and fully guaranteed against any failure.

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### Patching Systems

Patcher II is specifically designed to heat and mix PolyPatch and TechCrete for application. The Patcher II has two large openings for easy material loading. Advanced digital temperature controls maintain accurate material and oil temperatures and feature an auto flame shut down for safety. The products are thoroughly mixed by a horizontally mounted internal shaft with sweep paddles. To clean the Patcher for material type changeover, load the Patcher with clean aggregate, run the mixer, and then empty.

The Crafco Patcher Series Melter is available in two sizes. The Patcher II's large volume easily handles large production projects. The Patcher I is designed for smaller patching tasks.

**Spray Injection Patchers**—Crafco offers three models of Spray Injection Patchers. The equipment's integrated operation cleans the area to be repaired, applies a tack coat, coats the aggregate with asphalt emulsion, and then applies the mixture all in one easy continuous operation. Using high velocity air, the coated aggregate material is compacted during application, leaving virtually no voids in the final pavement repair, making a long lasting patch that is superior to conventional methods as proven by government studies. Also available are the Magnum Spray Patcher, the Air Stream and Air Stream™. The two most common products used are HFRS-2 and CRS-2.

### **Geo Composites**

*PavePrep* is a high-density mastic laminated with a tough woven polyester designed to withstand the loads encountered by highway traffic and stress concentrations at pavement joints and cracks. *PavePrep's* dense and flexible mastic reduces crack reflection through the overlay.

ISAC isolates the immense strain, impact loading and movement deflections that are created by airplane takeoffs and landings. Bridge decks and highways benefit from ISAC's geosynthetics and asphalt mastic composite, creating an effective, durable and long lasting barrier against water and de-icing salts.

*GeoTac* is a peel-and-stick waterproofing membrane designed specifically as a moisture

barrier. It prevents water permeation or penetration through pavement surfaces and the subsequent damage that moisture causes. GeoTac is high caliber with a full modified SBS asphalt mastic applied to a non-woven polyester geotextile.

*GeoFilm* is a peel-and-stick waterproofing membrane. It prevents water penetration and subsequent moisture damage. Applications include: box culverts, retaining walls, abutment back walls, concrete pipe joints, manholes, headwalls, median and paved shoulder inlets, catch basins, barrier median inlets, and foundations.

### **Pavement Preservation Equipment**

Crafco provides our customers with the most comprehensive line of Pavement Preservation Products available. Crafco's engineering and understanding of the industry sets the industry standards with quality performance products. Crafco Pavement Preservation Products are efficient, effective, long-lasting and cost effective.

*Super Shot Melter/Applicators* are designed to heat and apply sealant with efficiency and ease of use. Digital controls accurately regulate the heating temperature of the sealant and transfer oil. A patented internal pumping system eliminates clean out and features a hydraulic flow rate adjustment. There are no valves, no hose pressure build up, and fewer moving parts. Super Shot Melters will out-perform any comparable sized machine available.

*E-Z Pour Melter/Applicators* are the real workhorse of melter/applicators in the pavement preservation industry and are the industry standard. They feature one hour heat-up time, handle field mix or packaged material and heat and apply all hot pour sealant. Precision engineering and construction make the E-Z Pour trouble-free and safe to operate with the lowest operating cost in the industry. Safety features include a splash-proof lid, curb-side controls and a low profile for easy sealant loading. The E-Z Pour is a flush-free clean-up system requiring no solvents.

*Crafco Router* – Crafco Routers are designed to rout out and clean cracked side walls to prepare the crack for sealant. Routing and sealing pavement cracks with an overband can produce a 50% savings in sealing costs over a 10 year period. The Model 200, clutch operated pavement cutter will provide long lasting, safe and reliable service for many years. Different cutter blade configurations allow for cuts from 1/2 inch wide up to 1.3 inches wide. A selection of cutter blades are available for various applications.

# Conversion Charts

Pressure	atm	inches of water	cm of Hg	N/m <sup>2</sup>	lb/in <sup>2</sup> (psi)
1 atmosphere	1	$4.068 \times 10^2$	$7.6 \times 10^1$	$1.013 \times 10^5$	$1.470 \times 10^1$
1 inch of water	$2.458 \times 10^{-3}$	1	0.1868	$2.491 \times 10^2$	$3.613 \times 10^{-2}$
1 cm of water	$1.316 \times 10^{-2}$	5.353	1	$1.333 \times 10^3$	0.1934
1 newton/m <sup>2</sup>	$9.869 \times 10^{-6}$	$4.105 \times 10^{-3}$	$7.501 \times 10^{-4}$	1	$1.450 \times 10^{-4}$
1 lb/in <sup>2</sup>	$6.805 \times 10^{-2}$	$2.768 \times 10^1$	5.171	$6.895 \times 10^3$	1

Density	slug/ft <sup>3</sup>	lbm/ft <sup>3</sup>	lbm/in <sup>3</sup>	kg/m <sup>3</sup>	g/cm <sup>3</sup>
1 slug per ft <sup>3</sup>	1	$3.217 \times 10^1$	$1.862 \times 10^{-2}$	$5.154 \times 10^2$	0.5154
1 pound - mass per ft <sup>3</sup>	$3.108 \times 10^{-2}$	1	$5.787 \times 10^{-4}$	$1.602 \times 10^1$	$1.602 \times 10^{-2}$
1 pound - mass per inch <sup>3</sup>	$5.371 \times 10^1$	$1.728 \times 10^3$	1	$2.768 \times 10^4$	$2.768 \times 10^1$
1 kilogram per meter <sup>3</sup>	$1.940 \times 10^{-3}$	$6.243 \times 10^{-2}$	$3.613 \times 10^{-5}$	1	$1 \times 10^{-3}$
1 gram per centimeter <sup>3</sup>	1.940	$6.243 \times 10^1$	$3.613 \times 10^{-3}$	$1 \times 10^3$	1

Speed	ft/sec	km/hr	m/sec	mi/hr	knot
1 foot per second	1	1.097	0.348	0.6818	0.5925
1 kilometer per hour	0.9113	1	0.2778	0.6214	0.5400
1 meter per second	3.281	3.6	1	2.237	1.944
1 mile per hour	1.467	1.609	0.4470	1	0.8689
1 knot	1.688	1.852	0.5144	1.151	1

Length	meter	kilometer	inch	feet	miles
1 meter	1	$1 \times 10^{-3}$	39.37	3.281	$6.214 \times 10^{-4}$
1 kilometer	1000	1	$3.937 \times 10^4$	3281	0.6214
1 inch	0.00254	$2.54 \times 10^{-5}$	1	0.0833	$1.578 \times 10^{-5}$
1 foot	0.3048	$3.048 \times 10^{-4}$	12	1	$1.894 \times 10^{-4}$
1 mile	1609	1.609	$6.336 \times 10^4$	5280	1

## Conversion Charts

Area	m <sup>2</sup>	cm <sup>2</sup>	ft <sup>2</sup>	inch <sup>2</sup>
1 square meter	1	$1.0 \times 10^4$	10.76	1550
1 square centimeter	$1.0 \times 10^{-4}$	1	$1.076 \times 10^{-3}$	0.1550
1 square foot	$9.290 \times 10^{-2}$	929	1	144
1 square inch	$6.452 \times 10^{-4}$	6.452	$6.944 \times 10^{-3}$	1

Volume	m <sup>3</sup>	cm <sup>3</sup>	ft <sup>3</sup>	inch <sup>3</sup>
1 cubic meter	1	$1.0 \times 10^6$	35.31	$6.102 \times 10^4$
1 cubic centimeter	$1 \times 10^{-6}$	1	$3.531 \times 10^{-5}$	0.06102
1 cubic foot	$2.832 \times 10^{-2}$	28.320	1	1728
1 cubic inch	$1.639 \times 10^{-5}$	16.39	$5.787 \times 10^{-4}$	1

Mass	gram	kilogram	pound-mass (lbm)	slug	ton - mass
1 gram	1	$1.0 \times 10^{-3}$	$2.205 \times 10^{-3}$	$6.852 \times 10^{-5}$	$1.102 \times 10^{-6}$
1 kilogram	$1 \times 10^3$	1	2.205	$6.852 \times 10^{-2}$	$1.102 \times 10^{-3}$
1 pound-mass	$4.536 \times 10^2$	0.4536	1	$3.108 \times 10^{-2}$	$5.0 \times 10^{-4}$
1 slug	$1.459 \times 10^4$	$1.459 \times 10^1$	$3.217 \times 10^1$	1	$1.609 \times 10^{-2}$
1 ton - mass	$9.072 \times 10^5$	$9.07 \times 10^2$	$2.0 \times 10^3$	$6.216 \times 10^1$	1

Force	dyne	kgf	N	lb	pdf
1 dyne	1	$1.020 \times 10^{-6}$	$1.0 \times 10^{-5}$	$2.248 \times 10^{-5}$	
1 kilogram force	$9.807 \times 10^5$	1	9.807	2.205	7093
1 newton	$1.0 \times 10^5$	0.1020	1	0.2248	7.233
1 pound	$4.448 \times 10^5$	0.4536	4.448	1	32.17
1 poundal	$1.383 \times 10^4$	$1.410 \times 10^{-2}$	0.1383	$3.108 \times 10^{-2}$	1

# Conversion Charts

	Fahrenheit	Celsius
	20.00	-6.67
	25.00	-3.89
	30.00	-1.11
Freezing Temp.	<b>32.00</b>	<b>0.00</b>
	35.00	1.67
	40.00	4.44
	45.00	7.22
	50.00	10.00
	55.00	12.78
	60.00	15.56
	65.00	18.33
	70.00	21.11
	75.00	23.89
	80.00	26.67
	85.00	29.45
	90.00	32.22
	95.00	35.00
	100.00	37.78
	105.00	40.56
	110.00	43.34
	115.00	46.11
	120.00	48.89
	125.00	51.67
	130.00	54.45
	135.00	57.23
	140.00	60.00
	145.00	62.78
	150.00	65.56
	155.00	68.34
	160.00	71.12
	165.00	73.89
	170.00	76.67
	175.00	79.45
	180.00	82.23
	185.00	85.01
	190.00	87.78
	195.00	90.56
	200.00	93.34
	205.00	96.12
	210.00	98.90
Boiling Temp.	<b>212.00</b>	<b>100.00</b>

**General conversion formula**  
 where:  
 Tc = Temperature Celsius, and  
 Tf = Temperature Fahrenheit.

**Fahrenheit to Celsius**  
 $T_c = (5/9) \cdot (T_f - 32)$

**Celsius to Fahrenheit**  
 $T_f = ((9/5) \cdot T_c) + 32$



## Glossary

**Agg Mix**—A mixture of asphalt emulsion and mineral aggregate prepared in a central mixing plant and spread and compacted while the mixture is at or near ambient temperature.

**Blade Mix**—Application of a mixture of aggregate and asphalt emulsion to a roadway. The emulsion is applied by an asphalt distributor on a flattened wind-row of in-place or imported material. The blade of a motor grader mixes the materials through a series of tumbling and rolling actions and spreads the mix evenly over the pavement. The mix is then compacted.

**Chip Seal—Single**—A preventive maintenance surface treatment entailing a single application of asphalt emulsion by a distributor followed by a cover aggregate applied by a chip spreader. The surface is then rolled to seat the aggregate. The all-weather surface renews aging, weathered pavements; improves skid resistance and lane demarcation; and seals and protects the pavement.

**Chip Seal—Multiple**—A maintenance surface treatment composed of two or more successive applications of asphalt emulsion and cover aggregate. Successive chip applications typically use a smaller sized stone than the previous one.

**Cape Seal**—A multiple surface treatment consisting of an application of a chip seal which is allowed to cure and then broomed before the application of a slurry seal.

**Crack Fill**—A corrective maintenance technique in which asphalt emulsions are placed into non-working cracks (those with no horizontal movement) to substantially reduce the intrusion of incompressibles and infiltration of water, while also reinforcing the adjacent pavement. Typically there is little, if any, crack preparation prior to treatment.

**Crack Seal**—A preventive maintenance technique in which the crack is carefully prepared (routed, cleaned, dried, backer rod inserted) and a high quality sealant material is placed into working cracks to reduce the intrusion of incompressibles into the crack and to prevent infiltration of water into the underlying pavement layers.

**Dust Palliative**—A diluted emulsion sprayed directly on an unsurfaced road as a dust control agent.

**Fog Seal**—A light application of diluted emulsion sprayed on an existing asphalt surface to enrich aging, weathered surfaces and reduce raveling. Fog seals are also used to reduce chip loss on chip seals and as a color coating.

**MicroSurfacing**—A skid-resistant surface treatment composed of a mixture of polymer modified asphalt emulsion, well-graded aggregate, mineral filler, water and other additives, properly proportioned, mixed, and spread on a paved surface. Microsurfacing cures more quickly than slurry seal allowing thicker application, rut filling, and quick traffic return on high volume roadways. The maintenance treatment seals and protects the pavement surface.

**Mulch Treatment**—Spray application of an emulsion on soil, straw or seeded area, leaving a thin membrane to hold hay or straw mulch in place.

**Penetrating Prime**—An application of emulsion to an absorbent surface to prepare an untreated base for an asphalt surface. The prime penetrates or is mixed into the surface of the base and plugs the voids, hardens the top and helps bind it to the overlying asphalt course.

**Recycle Mix**—A mixture produced after processing reclaimed asphalt pavement (RAP) materials with an asphalt emulsion. The recycled mix may be produced by hot or cold mixing at a plant, or by processing the materials cold and in-place.

**Rejuvenator**—A light spray application of diluted recycling emulsion applied to an existing asphalt pavement to restore the chemical balance and desired physical properties of the surface asphalt.

**Slurry Seal**—A preventive or corrective maintenance surface treatment composed of a mixture of dense-graded aggregate, emulsified asphalt, mineral fillers, additives and water. The slurry seal improves surface texture and seals and protects the pavement.

**Sand Seal**—A preventive maintenance surface treatment consisting of a spray application of asphalt emulsion followed with a light covering of fine aggregate, such as clean sand or screenings. The sand seal seals and protects the pavement.

**Sandwich Seal**—A surface treatment that consists of application of asphalt emulsion and a large aggregate, followed by a second application of asphalt emulsion that is in turn covered with smaller aggregate and compacted. Sandwich seals are used to seal the surface and improve skid resistance, especially on asphalt pavement surfaces that are bleeding or flushing.

**Seal Coat**—A thin surface treatment to improve surface texture and protect an asphalt surface. Surface treatments include fog seals, sand seals, slurry seals, micro-surfacing, cape seals and sandwich seals. The terms “seal coat” and “chip seal” are sometimes used interchangeably.

**Tack Coat**—A light application of diluted asphalt emulsion used to ensure a bond between two pavement layers.

**Warm or Hot Emulsion Mix**—A mixture of asphalt emulsion and mineral aggregate usually prepared in a conventional hot mix asphalt plant at a temperature less than 125°C (260°F). It is typically spread and compacted at a temperature above 95°C (200°F).

## Key Websites

American Association of State Highway Transportation Officials - AASHTO  
[www.aashto.org](http://www.aashto.org)

American Highway Users Alliance—AHUA  
[www.highways.org](http://www.highways.org)

American Public Works Association—APWA  
[www.apwa.net](http://www.apwa.net)

American Road & Transportation Builders Association—ARTBA  
[www.artba.org](http://www.artba.org)

American Society for Civil Engineers—ASCE  
[www.asce.org](http://www.asce.org)

American Society for Testing and Material—ASTM  
[www.astm.org](http://www.astm.org)

Asphalt Education Partnership— AEP  
[www.beyondroads.com](http://www.beyondroads.com)

Asphalt Emulsion Manufacturers Association—AEMA  
[www.aema.org](http://www.aema.org)

Asphalt Institute—AI  
[www.asphaltinstitute.org](http://www.asphaltinstitute.org)

Asphalt Recycling & Reclaiming Association—ARRA  
[www.arra.org](http://www.arra.org)

Associated General Contractors—AGC  
[www.agc.org](http://www.agc.org)

Canadian Technical Asphalt Association–CTAA  
[www.ctaa.ca](http://www.ctaa.ca)

Federal Highway Administration–FHWA  
[www.fhwa.dot.gov](http://www.fhwa.dot.gov)

FHWA Construction & Maintenance–FHWA  
[www.fhwa.dot.gov/construction](http://www.fhwa.dot.gov/construction)

FHWA Pavement Technology–FHWA  
[www.fhwa.dot.gov/pavement](http://www.fhwa.dot.gov/pavement)

FHWA Tech Applications Program–FHWA  
[www.dot.gov/dotinfo/fhwa/hta/fhwahta.html](http://www.dot.gov/dotinfo/fhwa/hta/fhwahta.html)

FHWA Transportation System Preservation–FHWA  
[www.fhwa.dot.gov/preservation](http://www.fhwa.dot.gov/preservation)

Foundation for Pavement Preservation–FP2  
[www.Fp2.org](http://www.Fp2.org)

International Bitumen Emulsion Federation–IBEF  
[www.ibef.net](http://www.ibef.net)

International Road Federation–IRF  
[www.irfnet.org](http://www.irfnet.org)

International Slurry Surfacing Association–ISSA  
[www.slurry.org](http://www.slurry.org)

National Asphalt Pavement Association–NAPA  
[www.hotmix.org](http://www.hotmix.org)

National Association of County Engineers–NACE  
[www.countyengineers.org](http://www.countyengineers.org)

National Center for Pavement Preservation–NCP  
[www.pavementpreservation.org](http://www.pavementpreservation.org)

National Transportation Library–NTL  
<http://ntl.bts.gov/index.cfm>

Research In Progress–RIP  
<http://rip.trb.org/>

The Road Emulsion Association Ltd  
[www.rea.org.uk](http://www.rea.org.uk)

The Asphalt Contractor Online  
[www.asphalt.com](http://www.asphalt.com)

The Recycled Materials Resource Center–RMRC  
[www.rmrc.unh.edu](http://www.rmrc.unh.edu)

The Road Information Program–TRIP  
[www.tripnet.org](http://www.tripnet.org)

Transportation Research Board–TRB  
[www.nationalacademies.org/trb/](http://www.nationalacademies.org/trb/)

Transportation Research Information Service–TRIS  
<http://ntl.bts.gov/tris>

**Ergon, Inc.**  
**[www.ergon.com](http://www.ergon.com)**

**Ergon Asphalt & Emulsions**  
**[www.ergonasphalt.com](http://www.ergonasphalt.com)**

**Crafco, Inc.**  
**[www.crafco.com](http://www.crafco.com)**









1-800-824-2626  
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