Section IV: Dust Control and Stabilization

All gravel roads will give off dust under traffic. After all, they are unpaved roads that typically serve a low volume of traffic, and dust is usually an inherent problem. The amount of dust that a gravel road produces varies greatly. In areas of the country that receive a high amount of moisture, the problem is greatly reduced. Arid or semi-arid regions such as the desert southwest and much of the great plains region in the USA are prone to long periods of dry weather. Similar regions around the globe can have similar weather patterns. Dust can really bring complaints in these areas if there are residences located near the road and traffic is high.

The quality and type of gravel also has some effect on the amount of dust. Some limestone gravels can dust severely while some glacial deposits of gravel with a portion of highly plastic clay can take on a strong binding characteristic that will resist dusting remarkably well. Still, in prolonged dry weather, there will be dust! Whether to provide some type of dust control or not can be a hard decision to make. Virtually all methods of dust control require annual treatment.

The cost can be prohibitive if traffic volume is low. On the other hand, if traffic is high, the cost of dust control can more than pay for itself with the benefits of reduced material loss and reduced need for blade maintenance. (28) At this point, many agencies will face pressure to pave the road. It may actually be a good economic decision in the long run, especially if there is good indication that traffic will continue to increase in the future. However, never pave a road before it is ready! There is good information on making this decision in Appendix D.

Types of Stabilizers

Chlorides

These are the most commonly used products across the country. They fall into three categories: Calcium Chloride in flake or liquid form, Magnesium Chloride generally in liquid form, and Sodium Chloride (road salt). Sodium is seldom used and is the least effective. Calcium and Magnesium Chloride can be very effective if used properly. They are hygroscopic products which, in simplest terms, means they draw moisture from the air and keep the road surface constantly damp. They are reasonably simple to use.

Resins

These are products available under various commercial names. The basic composition is lignin sulfonate which is a by-product of the pulp milling industry. The product is sometimes called "tree sap" in the field. These products work best when incorporated into the surface gravel. They then provide cohesion to bind the soil particles together.

Natural Clays

Some regions of the country have excellent deposits of natural clay that

are highly plastic and provide strong cohesion when added in the right quantity to gravel.However, in prolonged dry weather, these roads will seldom be completely dust free. It can be difficult as well to haul the clay onto the road and mix it into the gravel. Because it is highly plastic,it tends to stick to the truck boxes and requires quite an effort to mix with the gravel.

Asphalts

The use of cut-back liquid asphalts to surface-treat gravel roads was once popular for dust control. However, because of the great amount of fuel oil or kerosene in these products, they have been banned in many places. Some emulsified asphalts may work for this purpose, but their use is very limited. The product must be applied with special asphalt application equipment.

Soybean Oil

This product is known technically as Acidulated Soybean Oil Soapstock. It is a by-product of the caustic refining process of soybean oil. It is a biodegradable material that has many of the characteristics of a light petroleum-based oil. It will penetrate a gravel surface and provide a light bonding of the gravel that effectively reduces dust when it is used properly.

Other Commercial Binders

There are too many of these to mention individually. They are marketed under various trade names across the country. It is always wise to try a test section of no more than 1000 feet in length to see how any of these products work with your gravel. One caution: do not use waste products such as crankcase drain oil from engines. This is harmful to the environment and is in violation of EPA rules.

Benefits of Stabilization

Once a road is stabilized there are several benefits. On high volume roads, these benefits can make stabilization very cost effective.

Reduced Dusting

It may be hard to justify the use of any of these products for dust control alone. However, when the products are working well, the added benefit of a stabilized surface that controls the loss of fines through dusting is a great economic benefit.When the fines are lost from a gravel surface, the stone and sand-sized particles that remain will tend to remain loose on the surface, leading to some distresses like washboarding and reduced skid resistance. It will become very hard to maintain. Fresh gravel with a higher percentage of fines needs to be hauled in. This becomes very expensive.

Reduced "Whip Off" of Aggregate

This is another economic bonus to dust control when it is working well. As mentioned earlier, when dust control products are working well, the fine material in the gravel cannot loosen and dust away. This also means that the stone portion of the gravel will tend to remain embedded in the surface and will not be lost to the edge of the road or even whipped off onto the inslope from heavy traffic. Studies have shown that as much as one ton of aggregate per mile is lost each year for each vehicle that passes over a road daily. This means that a road carrying 200 vehicles per day will experience the loss of 200 tons of aggregate per mile each year. (7) Obviously this will vary with the amount of rainfall received, the quality of the gravel and other factors. Retaining aggregate is a good added benefit to dust control.

Reduced Blade Maintenance

A road surface that remains tightly bound and stable will require much less blade maintenance. The manufacturers of some dust control products highly recommend that the surface should not be bladed at all after their products are applied.While extra blading, shaping and mixing is needed to prepare a road for dust control, the overall need for blade maintenance should be greatly reduced. This can be a great savings in equipment expense and labor. A county highway official once commented: "I don't react to dust complaints. All gravel roads have dust. But I do react to high maintenance costs. When we have to regravel a road frequently and do blade maintenance frequently, then it's time to look at stabilizing the surface with Magnesium Chloride. Reduced maintenance is what we're after. Dust control is just a bonus!"

Application Tips

There is not enough space to cover application tips for all products. Since the Chlorides are the most commonly used products, we will address the use of those. However, some or all of these tips would apply to the use of most other products as well.

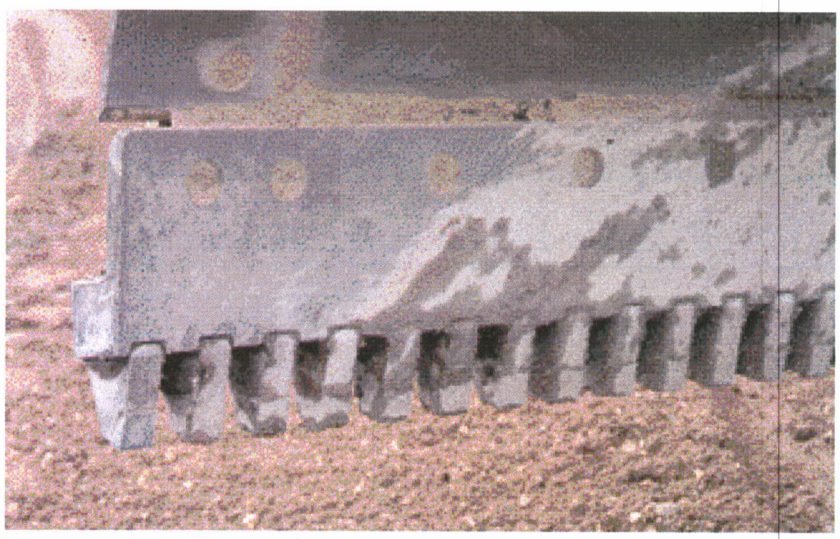
Need for Good Surface Gravel

Keep in mind the Chlorides are not binders. They simply draw moisture from the air. The gravel itself must have a good gradation — particularly a good percentage of fine material with some plasticity. This will give the gravel a natural binding char-acteristic. The Chlorides then will take over and keep the surface damp and it will remain tightly bound. It will not give up its fines in the form of dust. This point cannot be emphasized enough.If good gravel is not present on the road,it will be wise to haul in good fresh gravel prior to treatment. The cost of the Chloride treatment has been virtually wasted on some roads when the gravel was poor and very short-lived dust control resulted.

Road Preparation

This is another critical point in prepar-ing for dust control treatment.Make sure the road has a good crown in the driving surface. Also, make sure there is good shoulder drainage. Standing water anywhere in the roadway will cause the surface to soften and fail. It will leave a pothole in an otherwise good, stabilized roadway. These can be hard to correct afterwards with-out disturbing the stabilized surface around it.Another key to preparation is to loosen a minimum of one to two inches of the existing surface and leave it loose at a uniform depth across the roadway. This allows the Chloride to penetrate evenly and quickly into the gravel.

Do not compact the surface at all prior to applying chlorides.



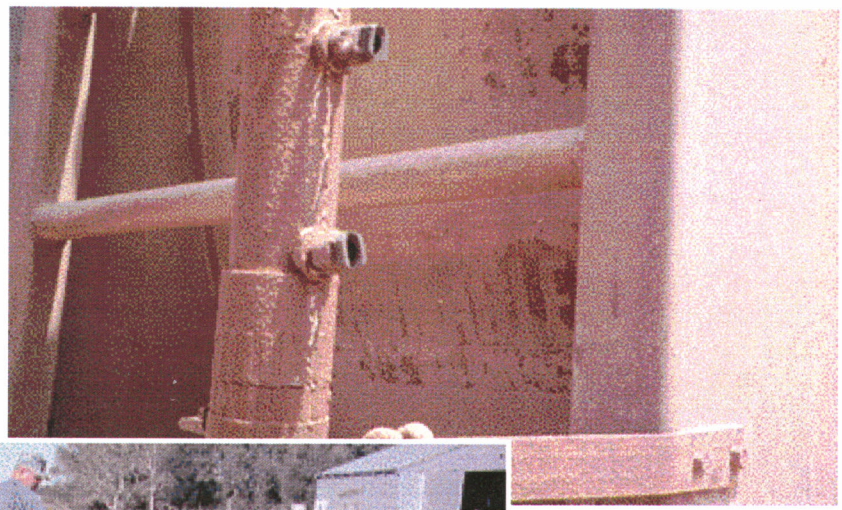
The carbide-tipped bits on a cutting edge can be a valuable tool in preparing a road for Chloride treatment.They penetrate the road and give a shallow scarifying effect to loosen and mix the existing gravel.This leaves a nice uniform loose layer of material on the surface.

This road has been prepared well for a liquid Magnesium Chloride treatment.Notice the uniform, loose and nicely crowned surface looking over the hilltop. There is also good shoulder drainage as well.This is an excel-lent example of road preparation.

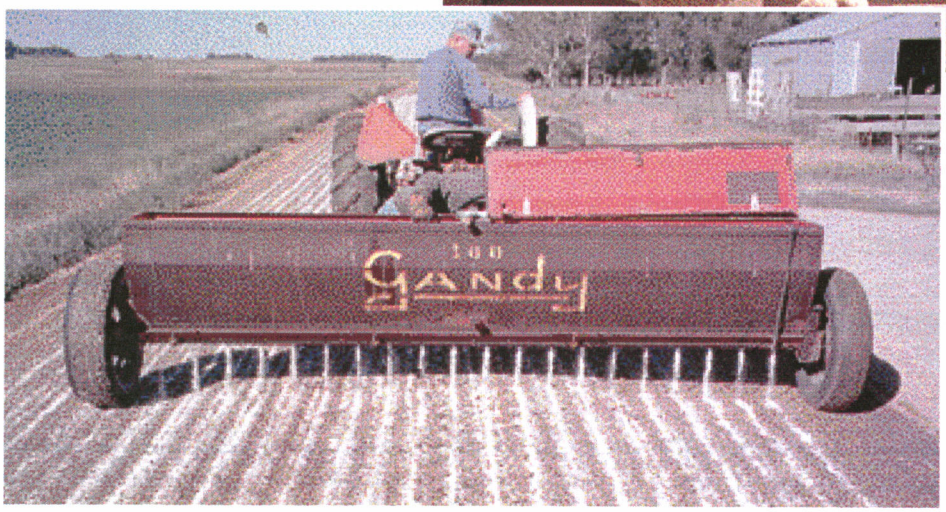
Applying the Product

The most important need here is for equipment that can be calibrated accurately and that will apply either the liquid or flakes evenly across the surface. Then a good application rate needs to be selected. This will vary with the type of gravel being treated and the length of time dust control is needed.Check with vendors and experts in your area to see what recommended rates are. Next, watch the weather! If rain is forecast or appears to be likely, don't take a chance. Rain on a freshly treated surface will leach out and dilute the Chloride and cause it to run off the road. It can temporarily harm grass on adjacent areas. But the bigger problem will be very poor performance afterwards. Also, it is ideal to keep traffic off of the road for up to two hours after application. This is not always possible, but it is very helpful. It is recommended that one side of the road be treated at a time. Rolling can be helpful, but is not essential. If rollers are used, pneumatic ones are best, and watch to see that the gravel does not start picking up from the surface. If that happens, wait until the surface cures a bit before finishing rolling.

Example of a good piece of application equipment.This truck has a pressurized spray bar with a computerized application system that meters the liquid Chloride with extreme accuracy.



This photo shows part of the spray bar with spraying nozzles.



A very effective, yet simple method of applying flake Chloride accurately with an old farm fertilizer spreader. These machines can be calibrated with great accuracy. Quick cleanup afterward is important since Chloride is corrosive to equipment.Once it is bound in the gravel, corrosive effect on vehicles is very low.

Optimum Moisture

It is important to have the gravel close to optimum moisture just before applying Chlorides. This will cause the product to be absorbed much more quickly and evenly into the gravel. Never apply the Chloride to dry gravel. It will not be evenly absorbed and may show failure in spots.

Test Sections

It is always wise to try a test section of dust control/stabilization treatment if this type of work has not been done before. If there is uncertainty about the suitability of the gravel being used or if there is doubt about the equipment, and/or other products being applied, the process can be tried on a 500-1000 foot road test section. If the process fails at the test section level, then only a small investment and time are lost. Also you have less public complaint.

The outcome from the failed test section will present an opportunity to analyze what may have gone wrong. Another test section can then be tried with a modified process and/or materials. If field performance proves satisfactory, the process can then be applied to larger jobs.

A water truck being used to prewet some very dry gravel just prior to treatment. This dramatically improves the success of the treatment.

Comparison of Calcium Chloride and Magnesium Chloride Application and Performance[1]

Source	Application	Functional Mechanism	Performance Advantages	Performance Restrictions
Calcium Chloride				
Three forms : ➢ Type I flake, at 77% to 80% purity. ➢ Type II flake, at 94% to 97% purity. ➢ Clear liquid at 35% to 38%.	➢ Usually one to two treatments per year. ➢ Follow-up: apply 1/2 to 1/3 initial dosage. Flakes: ➢ Initial application, flake: at 0.5 to 1.1 kg/m^2 Liquid: ➢ Typical application 0.9 kg/m^2. ➢ Typical application liquid: 35% to 38% solution at 0.9 to 1.6 l/m^2.	➢ Attracts and retains moisture at a relative humidity of 29% at 25°C and 20% humidity at 38°C. ➢ Assists compaction. ➢ Treated road can be regraded and recompacted with less concern for losing moisture and density.	➢ Retains moisture and attracts moisture from the air. ➢ Lowers freezing point of water minimizing frost heave and reducing freeze-thaw cycles. ➢ Increases compacted density of road material. ➢ Effectiveness retained after reblading.	➢ Slightly corrosive to metal, highly to aluminum and its alloys. ➢ Rainwater tends to leach out highly soluble chlorides. ➢ If high fines content in treated material, the surface may become slippery when wet.
Magnesium Chloride				
➢ Produced from natural salt brine. ➢ By-product of potash production.	➢ Usually one to two treatments per year. ➢ Initial application: 28-35% solution. ➢ Typical application: 1.4 to 2.3 l/m^2. ➢ Follow-up: apply 1/2 initial dosage.	➢ Attracts and retains moisture at a relative humidity equal to or greater than 32% independent of temperature. ➢ More effective than calcium chloride solutions for increasing surface tension, resulting in a very hard road surface when dry. Treated road can be regraded and recompacted with less concern for losing moisture and density.	➢ Reduces evaporation rate of moisture in the road. ➢ Lowers freezing point of water minimizing frost heave and reducing freeze-thaw cycles. ➢ Increases compacted density of road material more so than calcium chloride.	➢ Corrosive to steel, though inhibitors can be added. ➢ Solubility results in leaching during heavy precipitation.

[1] Table based upon the National Guide to Sustainable Municipal Infrastructure (InfraGuide), 2005. Dust Control for Unpaved Roads, version 1.0. October 2005. InfraGuide is a national network established by the National Research Council (NRC), the Federation of Canadian Municipalities (FCM), Infrastructure Canada and the Canadian Public Works Association. For update information, please visit www.infraguide.ca

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Dust Palliative Selection and Application Guide

DUST PALLIATIVE SELECTION AND APPLICATION GUIDE

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INTRODUCTION

The purpose of this publication is to help practitioners understand and correctly choose and apply the dust palliative that is appropriate for their particular site, traffic conditions, and climate. In addition, this publication describes the expected performance, limitations, and potential environmental impacts of various palliatives.

This guide examines most of the commonly available dust palliatives currently available and does not endorse any particular product. Since new products will become available and existing products will most likely change following publication of this report, it is recommended that this guide be used as a starting point for determining which palliative would be most appropriate for a given situation.

DUST ABATEMENT BASICS

Dust from unpaved roads is not only a nuisance but creates a safety hazard by reducing the driver's visibility. Dust also affects the health of road users and increases wear-and-tear on vehicles. Dust is always considered an intruder at campsites and picnic areas. In some areas there are regulations that limit the amount of particulate allowed in the atmosphere.

Fine particles, including dust, act to help hold the surface of unpaved roads together. With a loss of fine particles from the roadway, there is an increase in roadway surface raveling and maintenance costs. These fines are smaller than what the eye can see and pass through the 75 μm (No. 200) sieve.

How can dust emissions from the roadway be reduced or eliminated? Since the fines act as a binder that holds the surface of the unpaved road together, removing them is not a good option. Sealing the surface with an asphalt or concrete pavement or Bituminous Surface Treatment eliminates the dust problem; however, the low traffic on most Forest Service roads does not justify the cost of sealing the road with asphalt, concrete, or a surface treatment. Another alternative is to apply a dust suppressant product. These products are not a permanent solution and will require further applications as the effectiveness of the product decreases with time. Dust suppressants are one of many possible methods to control dust (Foley 1996; UMA 1987; Washington Dept. of Ecology 1996).

Dust suppressants work by either agglomerating the fine particles, adhering/binding the surface particles together, or increasing the density of the road surface material. They reduce the ability of the surface particles to be lifted and suspended by either vehicle tires or wind.

To properly select the appropriate palliative one must understand the primary factors that generate dust. They include the following:

- Vehicle speed
- Number of wheels per vehicle
- Number of vehicles
- Vehicle weight
- Particle size distribution (gradation) of the surface material
- Restraint of the surface fines (compaction, cohesiveness/bonding, durability)
- Surface moisture (humidity, amount of precipitation, amount of evaporation).

An excellent description of these factors that generate dust and how to analyze total long-term costs can be found in Foley et al. (1996) and UMA Engineering (1987).

Selection of the proper dust abatement program must include an understanding of not only the above factors, but the total long-term cost and environmental impacts of that program. Long-term costs include road improvement, road preparation, application of the suppressant in conjunction with the number of times the palliative needs to be applied, and expected change in maintenance practices. Environmental considerations typically

include impacts to the water quality, aquatic habitat, and plant community.

Besides controlling dust, a good dust abatement program may include reduced maintenance bladings and decreased aggregate loss (UMA 1987; Addo and Sanders 1995; Lund 1973).

DUST PALLIATIVE BASICS

There are a wide variety of dust suppressants available on the market today and there will continue to be more in the future. They can be divided into seven basic categories: water, water absorbing products, petroleum based products, organic nonpetroleum based products, electrochemical products, polymer products, and clay additive products. The categories are listed in order based on an estimate of past usage/ popularity.

Typical suppressants in each category are:

- Water
- Water Absorbing Products (deliquescent/ hydroscopic)
  - calcium chloride brine and flakes
  - magnesium chloride brine
  - sodium chloride (salt)
- Organic Petroleum Products
  - asphalt emulsions
  - cutback asphalt (liquid asphalt)
  - dust oils
  - modified asphalt emulsions
- Organic Nonpetroleum Products
  - animal fats
  - lignosulfonate
  - molasses/sugar beet
  - tall oil emulsions
  - vegetable oils
- Electrochemical Products
  - enzymes
  - ionic products
  - sulfonated oils
- Synthetic Polymer Products
  - polyvinyl acetate
  - vinyl acrylic
- Clay Additives
  - bentonite
  - montmorillonite

Table 1 gives an overview of these seven categories, listing their attributes, limitations, typical application rates, and common names based on Foley et al. (1996), UMA Engineering (1987), TTAO (1986), Bolander (1997), and Scholen (1992). Table 2 lists manufacturers and some distributors of the various dust palliatives.

SUPPRESSANT SELECTION TIPS

To determine the most cost-effective dust palliative, it is recommended that the flow diagram by UMA Engineering (1987) and Washington State Department of Ecology (1996) in figure 1 be followed. Important benefiting factors (Langdon 1980) of dust palliatives that should be considered when evaluating and selecting the proper dust palliative include:

- Cohering the dust particles to themselves or to larger particles
- Resisting wear by traffic
- Remaining on the road
- Resisting aging.

Based on the above characteristics, the product selection chart shown in table 3 should aid in selecting the most suitable dust palliative (Foley et al. 1996; UMA 1987; Bolander 1997; Bolander 1999; Scholen 1992; Langdon et al. 1980; Han 1992). When using the information in table 3, first perform a soils analysis to classify the surface material. Some palliatives require a clay component (plasticity index) or specific amount of fines to properly bind and/or agglomorate. Table 1 provides additional information about dust suppressant limitations, application methods, and environmental impact, which helps further in selecting the best dust palliative. The flow diagram in figure 1 leads the practitioner to figure 2, which is a guide for determining the overall cost of the dust abatement program including the yearly and possibly the multi-year cost of a dust abatement application. Figure 3 is a guide for summarizing the expected benefits of the selected dust control plan.

If a petroleum dust palliative is being considered, further suppressant selection information can be found in Langdon (1980) and Langdon, Hicks, and Williamson (1980).

Table 1—Road dust suppressants.

Dust Suppressant Category	Attributes	Limitations	Application	Origin	Environmental Impact
Water	• agglomerates the surface particles • normally, readily available	• evaporates readily • controls dust generally for less than a day • generally the most expensive and labor intensive of the inorganic suppressants	• frequency depends on temperature and humidity; typically only effective from 1/2 to 12 hours	• any potable water source	• none
Water Absorbing: Calcium Chloride (deliquescent)	• ability to absorb water from the air is a function of temperature and relative humidity; for example, at 25°C (77°F) it starts to absorb water at 29% relative humidity, and at 38°C (100°F) it starts to absorb water at 20% relative humidity • significantly increases surface tension of water film between particles, helping to slow evaporation and further tighten compacted soil as drying progresses • treated road can be regraded and recompacted with less concern for losing moisture and density	• requires minimum humidity level to absorb moisture from the air • doesn't perform as well as MgCl in long dry spells • performs better than MgCl when high humidity is present • slightly corrosive to metal, highly to aluminum and its alloys, attracts moisture, thereby prolonging active period for corrosion • rainwater tends to leach out highly soluble chlorides • if high fines content in treated material, the surface may become slippery when wet • effectiveness when less than 20% solution has performance similar to water	• generally 1 to 2 treatments per season • initial application: flake: @ 0.5 to 1.1 kg/m^2 (1.0 to 2.0 lb/y^2), typical application 0.9 kg/m^2 (1.7 lb/y^2) @ 77% purity liquid: 35 to 38% residual @ 0.9 to 1.6 L/m^2 (0.2 to 0.35 g/y^2), typical application is 38% residual concentrate applied undiluted @ 1.6 L/m^2 (0.35 g/y^2) • follow-up: apply @ 1/2 to 1/3 initial dosage	• by-product in the form of brine from manufacture of sodium carbonate by ammonia-soda process and of bromine from natural brines • three forms: flake, or Type I, @ 77 to 80% purity pellet, or Type II, @ 94 to 97% purity clear liquid @ 35 to 38% solids	• water quality impact: generally negligible if the proper buffer zone exists between treated area and water • fresh water aquatic impact: may develop at chloride concentrations as low as 400 ppm for trout, up to 10,000 ppm for other fish species • plant impact: some species susceptible, such as pine, hemlock, poplar, ash, spruce, and maple • potential concerns with spills of liquid concentrate

Table 1—Road dust suppressants (continued).

Dust Suppressant Category	Attributes	Limitations	Application	Origin	Environmental Impact
Water Absorbing: Magnesium Chloride (deliquescent)	• starts to absorb water from the air at 32% relative humidity independent of temperature • more effective than calcium chloride solutions for increasing surface tension, resulting in a very hard road surface when dry • treated road can be regraded and recompacted with less concern for losing moisture and density	• requires minimum humidity level to absorb moisture from the air • more suitable in drier climates • in concentrated solutions, very corrosive to steel (note: some products may contain a corrosive-inhibiting additive); attracts moisture, thereby prolonging active period for corrosion • rainwater tends to leach out highly soluble chlorides • if high fines content in treated material, the surface may become slippery when wet • effectiveness when less than 20% solution has performance similar to water	• generally 1 - 2 treatments per season • initial application: 28 to 35% residual @ 1.4 to 2.3 L/m^2 (0.30 to 0.5 g/y^2), typical application is 30% residual concentrate applied undiluted @ 2.3 L/m^2 (0.50 g/y^2) • follow-up: apply @ 1/2 initial dosage	• occurs naturally as brine (evaporated)	• water quality impact: generally negligible if the proper buffer zone exists between treated area and water • fresh water aquatic impact: may develop at chloride concentrations as low as 400 ppm for trout, up to 10,000 ppm for other fish species • plant impact: some species susceptible such as pine, hemlock, poplar, ash, spruce, and maple • potential concerns with spills
Water Absorbing: Sodium Chloride (hygroscopic)	• starts to absorb water from the air at 79% relative humidity independent of temperature • increases surface tension slightly less than calcium chloride	• requires minimum humidity level to absorb moisture from the air • moderately corrosive to steel in dilute solutions • tends not to hold up well as a surface application	• generally 1 - 2 treatments per season • higher dosages than calcium treatment	• occurs naturally as rock salt and brines	• same as calcium chloride

Table 1—Road dust suppressants (continued).

Dust Suppressant Category	Attributes	Limitations	Application	Origin	Environmental Impact
Organic Petroleum Products	• binds and/or agglomerates surface particles because of asphalt adhesive properties • serves to waterproof the road	• under dry conditions some products may not maintain resilience • if too many fines in surface and high in asphaltenes, it can form a crust and fragment under traffic and in wet weather • some products are difficult to maintain	• generally 1 to 2 treatments per season • 0.5 to 4.5 L/m^2 (0.1 to 1 g/y^2) depending on road surface condition, dilution, and product • the higher viscosity emulsions are used for the more open-graded surface materials • follow-up: apply at reduced initial dosages	• cutback asphalt: SC-70 • Asphalt emulsion: SS-1, SS-1h, CSS-1, or CSS-1h mixed with 5+ parts water by volume • modified asphalt emulsions • emulsified oils • mineral oils	• wide variety of ingredients in these products • "used" products are toxic • oil in products might be toxic • need product specific analysis • potential concerns with spills and leaching prior to the product "curing"
Organic Nonpetroleum: Lignin Derivatives	• binds surface particles together • greatly increases dry strength of material under dry conditions • retains effectiveness during long dry periods with low humidity • with high amounts of clay, it tends to remain slightly plastic permitting reshaping and additional traffic compaction	• may cause corrosion of aluminum and its alloys • surface binding action may be reduced or completely destroyed by heavy rain, due to solubility of solids in water • becomes slippery when wet, brittle when dry • difficult to maintain as a hard surface, but can be done under adequate moisture conditions	• generally 1 to 2 treatments per season • 10 to 25% residual @ 2.3 to 4.5 L/m^2 (0.5 to 1.0 g/y^2), typical application is 50% residual concentrate applied undiluted @ 2.3 L/m^2 (0.50 g/y^2) or 50% residual concentrate applied diluted 1:1 w/water @ 4.5 L/m^2 (1.0 g/y^2) • may be advantageous to apply in two applications • also comes in powdered form that is mixed 1 kg to 840 liters (1 lb to 100 gallons) of water and then sprayed	• water liquor product of sulfite paper making process, contains lignin in solution • composition depends on raw materials (mainly wood pulp) and chemicals used to extract cellulose; active constituent is neutralized lignin sulfuric acid containing sugar	• water quality impacts: none • fresh water aquatic impacts: BOD may be high upon leaching into a small stream • plant impacts: none • potential concern with spills

Table 1—Road dust suppressants (continued).

Dust Suppressant Category	Attributes	Limitations	Application	Origin	Environmental Impact
Organic Nonpetroleum: Molasses/Sugar Beet Extract	• provides temporary binding of the surface particles	• limited availability	• not researched	• by-product of the sugar beet processing industry	• water quality impact: unknown • fresh water aquatic impact: unknown • plant impact: unknown, none expected
Organic Nonpetroleum: Tall-Oil Derivatives	• adheres surface particles together • greatly increases dry strength of material under dry conditions	• surface binding action may be reduced or completely destroyed by long-term exposure to heavy rain, due to solubility of solids in water • difficult to maintain as a hard surface	• generally 1 treatment every few years • 10 to 20% residual solution @ 1.4 to 4.5 L/m^2 (0.3 to 1.0 g/y^2); typical application is 40 to 50% residual concentrate applied diluted 1:4 w/water @ 2.3 L/m^2 (0.5 gal/y^2)	• distilled product of the kraft (sulfate) paper making process	• water quality impact: unknown • fresh water aquatic impact: unknown • plant impact: unknown
Organic Nonpetroleum: Vegetable oils	• agglomerates the surface particles	• limited availability • oxidizes rapidly, then becomes brittle	• generally 1 treatment per season • application rate varies by product, typically 1.1 to 2.3 L/m^2 (0.25 to 0.50 g/y^2) • the warmer the product, the faster the penetration • follow-up: apply at reduced initial dosages	• some products: canola oil, soybean oil, cotton seed oil, and linseed oil	• water quality impact: unknown • fresh water aquatic impact: some products have been tested and have a low impact • plant impact: unknown, none expected

Table 1—Road dust suppressants (continued).

Dust Suppressant Category	Attributes	Limitations	Application	Origin	Environmental Impact
Electrochemical Derivatives	• changes characteristics of clay-sized particles • generally effective regardless of climatic conditions	• performance dependent on fine-clay mineralogy • needs time to "set-up," i.e. react with the clay fraction • difficult to maintain if full strengthening reaction occurs • limited life span	• generally diluted 1 part product to anywhere from 100 to 600 parts water • diluted product also used to compact the scarified surface	• typical products: sulfonated oils, ammonium chloride enzymes, ionic products	• need product specific analysis • some products are highly acidic in their undiluted form
Synthetic Polymer Derivatives	• binds surface particles because of polymer's adhesive properties	• difficult to maintain as a hard surface	• generally 1 treatment every few years • 5 to 15% residual solution @ 1.4 to 4.5 L/m^2 (0.3 to 1.0 g/y^2); typical application is 40 to 50% residual concentrate applied, diluted 1:9 w/water @ 2.3 L/m^2 (0.50 gal/y^2)	• by-product of the adhesive manufacturing process • typically 40 to 60% solids	• water quality impact: none • fresh water aquatic impact: generally low • plant impact: none • need product specific analysis
Clay Additives	• agglomerates with fine dust particles • generally increases dry strength of material under dry conditions	• if high fines content in treated material, the surface may become slippery when wet	• generally 1 treatment every 5 years • typical application rate is at 1 to 3% by dry weight	• mined natural clay deposits	• water quality impact: unknown • fresh water aquatic impact: none • plant impact: none

Table 2—Suppressant manufacturers.

Suppressant Category		Product Name	Manufacturer or Primary Distributor	Phone Number	Web Site
Water Absorbing	Calcium Chloride	Calcium Chloride Liquid	General Chemical	800-668-0433	www.genchem.com
		Calcium Chloride Flakes	General Chemical	800-668-0433	www.genchem.com
		Dowflake	Dow Chemical	800-447-4369	www.dowcalciumchloride.com
		Liquidow	Dow Chemical	800-447-4369	www.dowcalciumchloride.com
	Magnesium Chloride	DustGard	IMC Salt	913-344-9334	
		Dust-Off	Cargill Salt Division	800-553-7879	
		Chlor-tex	Soil-Tech	702-873-2023	www.soil-tech.com
	Blend of Calcium and Magnesium Chloride	Dust Fyghter	Midwestern Industrial Supply, Inc.	800-321-0699	www.midwestind.com
	Sodium Chloride	Morton Salt	Morton International	312-807-2000	
		IMC Salt	IMC Salt	800-323-1641	
Organic Petroleum	Asphalt Emulsion	CSS-1	Any major asphalt supplier		
	Cutback	MC-70	Any major asphalt supplier		
	Dust Oil/Dust Fluids	Fuel Oil	Pacific Northern Industrial Fuels	206-282-4421	
		Duo Prime Oil	Lyondell Petrochemical Co.	800-423-8434	(white mineral oil)
		EnviroKleen	Midwestern Industrial Supply, Inc.	800-321-0699	www.midwestind.com (synthetic iso-alkane)
	Modified Asphalt Emulsion	Asphotac	Actin	219-397-5020	
		Coherex	Witco Corp.	800-494-8287	www.witco.com
		DOPE-30	Morgan Emultech, Inc.	530-241-1364	
		PennzSuppress-D	Pennzoil-Quaker State Co.	713-546-4000	www.pennzsuppress.com
		Penetrating Emulsion Primer (PEP)	Koch Asphalt Co.	909-829-0505	www.kochmaterials.com
		Petro Tac	Syntech Products, Inc.	800-537-0288	www.syntechproducts.com
		Road Pro	Midwestern Industrial Supply, Inc.	800-321-0699	www.midwestind.com
		Sandstill	Energy Systems Associates, Inc.	703-503-7873	
Organic Nonpetroleum	Lignosulfonate	DC-22	Dallas Roadway Products, Inc.	800-317-1968	www.dallasroadway.com
		Dustac	Georgia Pacific West, Inc.	360-733-4410	(was Lignosite)
		Dustac-100	Georgia Pacific West, Inc.	360-733-4410	www.gp.com/chemical/lignosulfonate
		CalBinder	California-Fresno Oil Co.	209-486-0220	www.calfresno.com
		Polybinder	Jim Good Marketing	805-746-3783	
		RB Ultra Plus	Roadbind America Inc.	888-488-4273	www.roadbind.com

Table 2—Suppressant manufacturers (continued).

Suppressant Category		Product Name	Manufacturer or Primary Distributor	Phone Number	Web Site
	Molassas/Sugar Beet	Dust Down	Amalgamated Sugar Co.	208-733-4104	
	Tall Oil Emulsion	Dust Control E	Pacific Chemicals, Inc./ Lyman Dust Control	604-828-0218 or 800-952-6457	
		Dustrol EX	Pacific Chemicals, Inc / Lyman Dust Control	604-828-0218 or 800-952-6457	
		Road Oyl	Soil Stabilization Products Co., Inc.	800-523-9992	www.sspco.org
	Vegetable Oils	Soapstock	Kansas Soybean Association Indiana Soybean Association	800-328-7390 800-735-0195	
		Dust Control Agent SS	Greenland Corp.	888-682-6040	
Electro-chemical	Enzymes	Bio Cat 300-1	Soil Stabilization Products Co., Inc.	800-523-9992	www.sspco.org
		EMCSQUARED	Soil Stabilization Products Co., Inc.	800-523-9992	www.sspco.org
		Perma-Zyme 11X	The Charbon Group, Inc.	714-593-1034	www.natural-industrial.com
		UBIX No. 0010	Enzymes Plus, Div of Anderson Affiliates	800-444-7741	
	Ionic	Road Bond EN-1	C.S.S. Technology, Inc.	800-541-3348	www.csstech.com
		Terrastone	Moorhead Group	831-685-1148	www.terrastone.com
	Sulfonated Oils	CBR Plus	CBR Plus, Inc. (Canada)	604-684-8072	www.cbrplus.com
		Condor SS	Earth Sciences Products Corp.	503-678-1216	www.earthscienceproducts.com
		SA-44 System	Dallas Roadway Products, Inc.	800-317-1968	www.dallasroadway.com
		Settler	Mantex	800-527-9919	
		TerraBond Clay Stabilizer	Fluid Sciences, LLC	888-356-7847 or 318-264-9448	www.fluidsciences.com
Synthetic Polymer Emulsions	Polyvinyl Acetate	Aerospray 70A	Cytec Industries	800-835-9844	www.cytec.com
		Soil Master WR	Enviromental Soil Systems, Inc.	800-368-4115	
	Vinyl Acrylic	Earthbound L	Earth Chem Inc.	970-223-4998	www.earthchem.com
		ECO-110	Chem-crete	972-234-8565	www.chem-crete.com/ soilstabilizer.htm
		PolyPavement	PolyPavement Company	323-954-2240	www.polypavement.com
		Liquid Dust Control	Enviroseal Corp.	561-969-0400	www.enviroseal.com
		Marloc	Reclamare Co.	206-824-2385	
		Soiloc-D	Hercules Soiloc	800-815-7668	
		Soil Seal	Soil Stabilization Products Co., Inc.	800-523-9992	www.sspco.org
		Soil Sement	Midwestern Industrial Supply, Inc.	800-321-0699	www.midwestind.com
		TerraBond PolySeal	Fluid Sciences, LLC	888-356-7847	www.fluidsciences.com
	Combination of Polymers	Top Shield	Base Seal International, Inc.	800-729-6985	www.baseseal.com

Table 2—Suppressant manufacturers (continued).

Suppressant Category		Product Name	Manufacturer or Primary Distributor	Phone Number	Web Site
Clay Additives	Bentonite	Central Oregon Bentonite	Central Oregon Bentonite	541-477-3351	
		Pelbon	American Colloid Co.	800-426-5564 or 847-392-4600	www.colloid.com
		Volclay	American Colloid Co.	708-392-4600	www.colloid.com
	Montmorillonite	Stabilite	Soil Stabilization Products Co., Inc.	800-523-9992	www.sspco.org

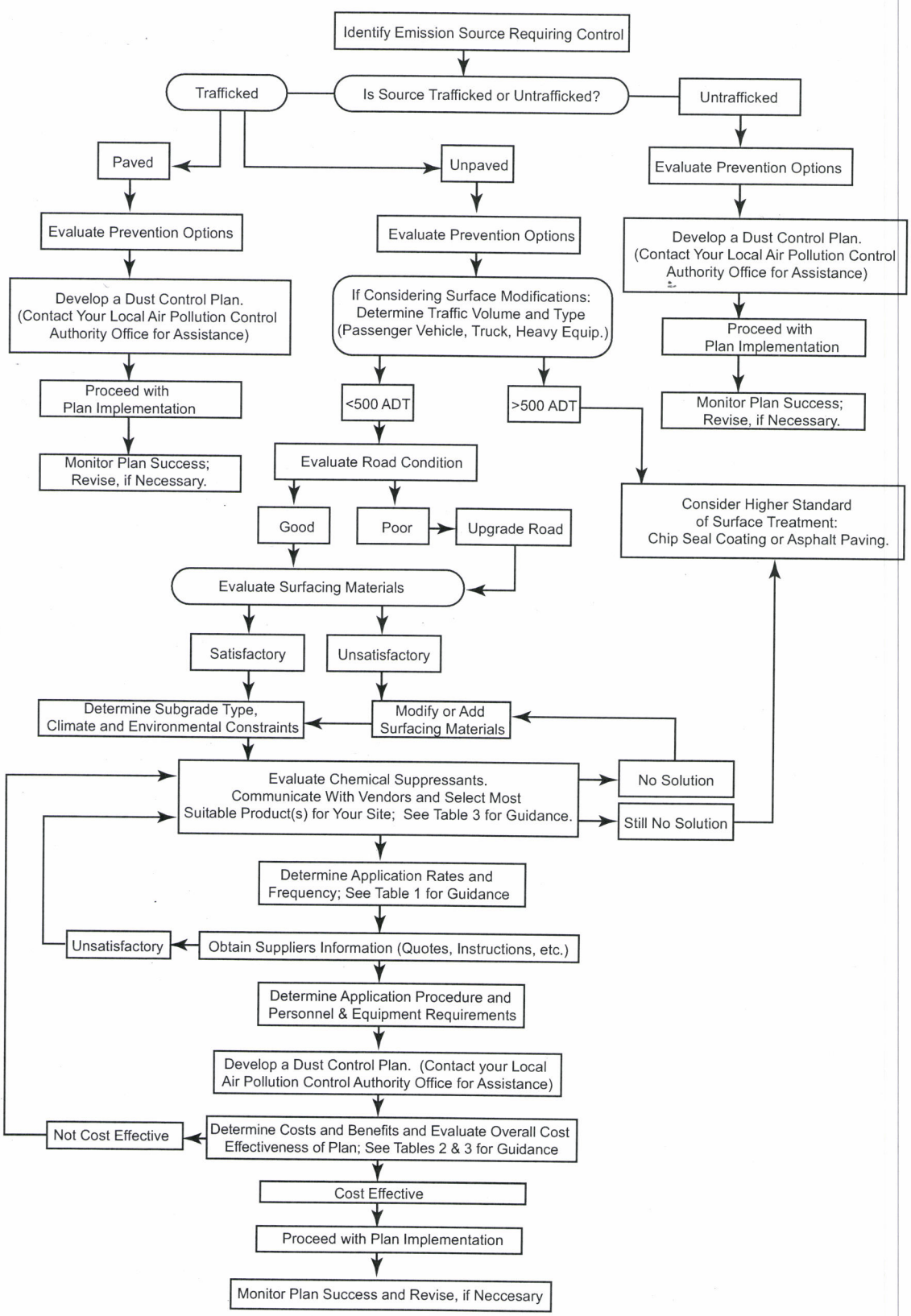

Figure 1—Guidelines for cost-effective selection and use of dust palliatives.

Table 3—Product selection chart.

Dust Palliative	Traffic Volumes, Average Daily Traffic			Surface Material								Climate During Traffic		
				Plasticity Index			Fines (Passing 75μm, No. 200, Sieve)							
	Light <100	Medium 100 to 250	Heavy >250 (1)	<3	3–8	>8	<5	5–10	10–20	20–30	>30	Wet &/or Rainy	Damp to Dry	Dry (2)
Calcium Chloride	✓✓	✓✓	✓	✗	✓	✓✓	✗	✓	✓✓	✓	✗ (3)	✗ (3,4)	✓✓	✗
Magnesium Chloride	✓✓	✓✓	✓	✗	✓	✓✓	✗	✓	✓✓	✓	✗ (3)	✗ (3,4)	✓✓	✓
Petroleum	✓	✓	✓	✓✓	✓	✗	✓ (5)	✓	✓ (6)	✗	✗	✓ (3)	✓✓	✓
Lignin	✓✓	✓✓	✓	✗	✓	✓✓ (6)	✗	✓	✓✓	✓✓	✓ (3,6)	✗ (4)	✓✓	✓✓
Tall Oil	✓✓	✓	✗	✓✓	✓	✗	✗	✓	✓✓ (6)	✓ (6)	✗	✓	✓✓	✓✓
Vegetable Oils	✓	✗	✗	✓	✓	✓	✗	✓	✓	✗	✗	✗	✓	✓
Electro-chemical	✓✓	✓	✓	✗	✓	✓✓	✗	✓	✓✓	✓✓	✓✓	✓ (3,4)	✓	✓
Synthetic Polymers	✓✓	✓	✗	✓✓	✓	✗	✗	✓✓	✓✓ (6)	✗	✗	✓	✓✓	✓✓
Clay Additives (6)	✓✓	✓	✗	✓✓	✓✓	✓	✓✓	✓	✓	✗	✗	✗ (3)	✓	✓✓

Legend

✓✓ = Good ✓ = Fair ✗ = Poor

Notes:

(1) May require higher or more frequent application rates, especially with high truck volumes
(2) Greater than 20 days with less than 40% relative humidity
(3) May become slippery in wet weather
(4) SS-1 or CSS-1 with only clean, open-graded aggregate
(6) Road mix for best results

Forest _____ Date _____

Road Name _____ Estimated ADT _____

Road Number _____ Average Road Width _____

Project Location From _____ To _____ Length _____

Dust Palliative Product _____ First Application Rate _____

Second Application Rate _____

Item	Total Cost	Cost/km
A. Road Improvement Costs • Drainage improvements • Geometric improvements • Repair of failed areas • Addition of gravel surfacing		
B. Surface Preparation Costs • Addition of select material (fines, etc.) • Break up and loosen, watering, shaping, compacting		
C. Product Supply and Application Cost • Material supply • Diluting with water (if necessary) • Transportation & application		
D. Miscellaneous Costs • Traffic control, detours • Inspection, supervision • Other costs		
TOTAL COST OF PROGRAM		
COST EXCLUDING ITEM "A" ABOVE		

Figure 2—Cost record for dust control programs.

Forest _____ Date _____

Road Name _____ Estimated ADT _____

Road Number _____ Average Road Width _____

Project Location From _____ To _____ Length _____

Dust Palliative Product _____ First Application Rate _____

Second Application Rate _____

Benefits	Estimated Savings per Year
A. Reduced Maintenance costs • Estimate 25 to 75% savings over previous blading costs. Use local figures, if available.	
B. Reduced Regravelling • Estimate based on traffic volume and climate. Use local figures, if available.	
C. Other (intangible) • Reduced vehicle accidents • Reduced vehicle damage • Higher quality of life and property values • Reduced cleaning costs • Reduced dust induced respiratory problems • Reduced sedimentation in water bodies • Reduced impact on dust sensitive vegetation • Reduced complaints from public	
TOTAL TANGIBLE BENEFITS OF PROGRAM	

Figure 3—Benefits of dust control programs.

SUPPRESSANT APPLICATION TIPS

Once a suitable product is selected, the next step is to determine the appropriate application rate and frequency. Table 1 lists broad ranges of application rates for various products and can be used as a guideline. Manufacturer's literature, past experience, and field or laboratory test plots over a square meter (1 square yard) can also be used to help determine the appropriate application rate.

Generally, higher application rates or increased frequency is required when the following conditions are present:

- High traffic volumes with high speeds and a larger percentage of truck traffic
- Low humidity conditions, especially when using calcium chloride
- Low fines content in road surface, typically when there is less than 10 percent passing through the 75 μm (No. 200) sieve
- Poorly bladed surface and/or loose wearing surface.

General Application Tips

The performance of any dust suppressant is related to many application factors. Application method, rate, frequency, and product concentration are a few of these factors. A stable, tight surface that readily sheds surface water is another. If properly applied and constructed, a longer life and higher level of service can be expected from the dust abatement efforts (Foley et al. 1996; UMA 1987; Washington Dept. of Ecology 1996; Giummarra, Foley, and Cropley 1997). Since dust suppression and road maintenance efforts are usually combined, it is prudent to include the following practices in the maintenance and rehabilitation of road surfaces prior to applying a dust palliative:

- Repair unstable surfacing and/or subgrade areas
- Adequately drain (crown and crossfall) the road surface
- Remove boney (poorly graded) surface material
- Grade sufficient depth of roadway to remove ruts, potholes, and erosion gullies
- Compact the roadway (depending on treatment and sequence of operations).

Maximum benefits can also be achieved by adequate penetration of the liquid dust suppressant. This penetration should be on the order of 10 to 20 millimeters (3/8 to 3/4 inches). Proper penetration mitigates loss of the palliative resulting from surface wear. Adequate penetration also resists leaching, imparts cohesion, and resists aging (Langdon 1980).

Application tips that apply to all liquid dust suppressant products include:

- Apply suppressants, especially salts, immediately following the wet season.
- If possible, apply after rain so materials are moister (aids mixing) and more workable. If applied just before a rain, the material may wash away.
- Adhere to manufacturers' recommendations on minimum application rate, compaction and curing time prior to allowing traffic.
- If the surface material is dry, dampen, except when using cut-back asphalt products.
- If a hard crust is present, break up and loosen the surface.
- Use a pressure distributor to uniformly distribute the dust suppressant.
- Ensure that the necessary "residual" of the product is obtained. The residual is the amount of product that remains after the evaporation of water from the concentrate, as well as that used to dilute the product prior to application. The residual (sometimes called solids or binder) is the portion of the product that is responsible for the binding and/or agglomeration of the particles.

Water Application Tips

Regular, light watering is more effective than less frequent, heavy watering.

Chloride Application Tips

Light compaction is recommended after a chloride brine application.

Petroleum Application Tips

Soil type and density greatly affect the rate and amount of penetration. In all instances, it is desirable to attain a 12 to 25 millimeter (1/2 to 1 inch) penetration. Most products (with the exception of SS- and CSS-1) will penetrate and coat most soils if they have been loosened by scarification. For surfaces which have not been scarified, only those products with low viscosities will penetrate.

Organic Nonpetroleum Application Tips

Remove loose material prior to application unless the road surface will be mixed and/or compacted after the spray application. When applying vegetable oils, the top 25 to 50 millimeter (1 to 2 inches) of the surface should be loose to improve penetration.

Electrochemical Application Tips

Typically these products are mixed into the road surface.

Polymer Application Tips

Light compaction is recommended after a polymer application, unless the polymer is mixed into the road surface.

Clay Additive Application Tips

Ensure that the clay and the associated water used for compaction is uniformly distributed throughout the surface material. This method requires a minimum of 8 passes with a motor-grader or use of a cross-shaft rotary mixer.

All dust suppressants have a limited lifespan and require regular applications to satisfactorily control dust on a long-term basis. Subsequent applications should be made if and when dust levels exceed acceptable levels. These subsequent applications may be lighter than the initial application.

ENVIRONMENTAL IMPACTS

Any suppressant ingredient may migrate due to carelessness in application, run-off, leaching, dust particle migration, or adhesion to vehicles. Carefully review the product literature, Material Safety Data Sheet, and manufacturer's instructions before purchase and use. Observe all safety precautions and follow manufacturer's directions when handling, mixing, and applying dust suppressants. Application of all dust suppressants must comply with federal, state, and local laws and regulations. These vary by locality and need to be checked prior to implementing the dust abatement program.

The primary environmental concern with dust palliatives is how they impact the groundwater quality, freshwater aquatic environment, and plant community. Take all necessary precautions to keep dust palliative material out of water drainages and roadway ditches leading to streams.

The impact of dust palliatives on groundwater quality is based on how the suppressant migrates to the local groundwater table in conjunction with the chemicals used in the suppressant. Chemical analysis of the suppressant will assist in determining if harmful constituents are present. Knowing the depth to groundwater and the permeability of the native soil will assist in determining how and if the chemicals will leach to the groundwater table. A direct way to evaluate the contamination of harmful constituents to the groundwater is to conduct water quality sampling of the surrounding area before and after dust palliative application.

The impact of dust palliatives on the freshwater aquatic environment is measured by both the toxicity to fish and the availability of oxygen. Each state sets its own standards and they may vary by watershed and the type and age of the fish population. The test to determine toxicity is the LC50 test and the test to determine available oxygen is the BOD (Biochemical Oxygen Demand) test. The LC50 test measures the lethal concentration (LC) of product, expressed in parts per million (ppm), that will produce a 50 percent mortality rate in the test group in 96 hours. The larger the concentration, the less toxic the material. Typically, less than 100 ppm is considered toxic, 1,000 ppm is considered practically nontoxic, and greater than 10,000 ppm is considered nontoxic. The BOD test measures the oxygen used by microbes as it digests (feeds on) the product in water. Typically, the products that are derived from organic nonpetroleum suppressants are the most likely to have high BOD results.

There are no standard tests for measuring how dust palliatives impact the plant community; however, some tests have been performed that simply observe the impact on plant life.

Addo and Sanders (1995) summarize a number of environmental impact studies on the use of various chlorides on water quality, plants, and animals. Heffner (1997) updates the work by Schwendeman (1981) concerning the environmental impacts of some of the most common dust palliatives used by the Forest Service. Based on their efforts, the following is recommended when using these palliatives once or twice a year at their typical application rates:

Lignosulfonate - Determine prior to application if significant migration (water drainage) might occur from the treated area into local streams, ponds, and lakes. Ensure that migration will not impact the oxygen needs of the aquatic community.

Calcium and Magnesium Chlorides - Restrict the use of chlorides within 8 meters (25 feet) of a body of water. In areas of shallow groundwater, determine if significant migration of the chloride would reach the groundwater table. Restrict the use of chlorides if low salt tolerant vegetation is within 8 meters (25 feet) of the treated area. Typical low-tolerant vegetation includes various varieties of alder, hemlock, larch, maple, ornamentals, and pine.

Evaluations of other dust palliatives have not been made. If there is concern regarding the impact of a dust palliative on the environment, then, as a minimum, the LC50 and BOD tests should be performed. Results can be used to estimate the potential impact of the dust palliative in question on the local aquatic and plant communities.

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Pete graduated from Michigan State University with a degree in civil engineering. He has a master's degree in soil mechanics and foundation engineering from Oregon State University. Pete began his career with the Forest Service as a geotechnical engineer on the Willamette NF. After 10 years on the Willamette, Pete moved to the Pacific Northwest Regional Office (Region 6) in Portland, OR as the Regional Pavement Engineer.

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Library Card
Bolander, Peter, ed. 1999. Dust palliative selection and application guide. Project Report. 9977-1207-SDTDC. San Dimas, CA: U.S. Department of Agriculture, Forest Service, San Dimas Technology and Development Center. 20 p.

This publication helps practitioners understand and correctly choose and apply the dust palliative that is appropriate for their particular site, traffic conditions, and climate. Describes the expected performance, limitations, and potential environmental impacts of various palliatives. It is recommended that this guide be used as a starting point for determining which palliative would be most appropriate for a given situation.

Keywords: dust abatement, palliatives, suppressants

Additional single copies of this document may be ordered from:
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Calcium Chloride – The Essential Element for Better Roads

Posted By webmaster On May 9, 2012 @ 2:18 pm In | No Comments

CALCIUM CHLORIDE – The essential element for better roads

ON THE ROAD: THE USES OF CALCIUM CHLORIDE

There are many ways in which calcium chloride can help your road.

Dust Control

Calcium chloride is one of the most effective dust control agents in the industry.

Base stabilization

A stable base requires maximum density, and moisture control is the key to density. Calcium chloride is an economical, dependable additive for obtaining optimum moisture during construction.

Full depth reclamation

When recycling roads through full depth reclamation, calcium chloride can provide a stabilized base that can withstand traffic even before the wearing surface is applied.

Whether you're stabilizing a road base or reclaiming a road, calcium chloride helps prevent costly maintenance problems. With a strong, structurally-uniform base that results from using calcium chloride, your road will be more resistant to problems like frost heave, uneven settlement, potholes and ruts.... So it will last longer and require less maintenance.

Each season brings new challenges to your road maintenance program. You can meet these challenges; improve the quality of your roads, and lower maintenance costs by using calcium chloride as part of your ongoing highway maintenance strategy.

ROAD-RESCUING PROPERTIES OF CALCIUM CHLORIDE

- **Hygroscopic:** calcium chloride absorbs moisture from air and surroundings.
- **Deliquescent:** calcium chloride dissolves in the moisture and forms a clear solution that is extremely resistant to evaporation.
- **High surface tension:** calcium chloride lubricates the aggregate, improving the interlocking action.

HOW CALCIUM CHLORIDE SAVES ROADS AND MONEY

- **Improved dust control:** Calcium chloride retains moisture for prolonged periods. This unique property helps to hold down dust and stabilize unpaved road surfaces, creating smooth-riding roads that last.
- **Reduced routine maintenance costs:**

Since calcium chloride treated roads need less maintenance than roads treated with other materials, you can save on labor, equipment and fuel costs. By maximizing compaction, calcium chloride also provides a longer-lasting road.

- **Reduce gravel replacement costs:** Up to 80% of the cost of aggregate replacement can be saved when calcium chloride is properly applied.
- **Reduced construction costs:** Because calcium chloride speeds compaction, less rolling is required to achieve greater density, which translates into greater labor savings. When used with full depth reclamation, calcium chloride can help reduce road reconstruction costs by as much as 50%.

CALCIUM CHLORIDE IN DUST CONTROL

Dust is a public nuisance on unpaved roads, and can affect visibility to such a degree that driving becomes hazardous. Uncontrolled dust can also lead to a break-down of the road itself.

Calcium chloride is highly effective as a dust control agent, because it resists evaporation. As a result, calcium chloride keeps dust down longer than other dust control agents.

CONTROLLING DUST FOR LESS

Calcium chloride is a cost-effective-and highly effective-agent for dust control, providing savings of up to 50%. Calcium chloride also:

- Reduces grading costs by as much as 50%
- Reduces replacement cost of gravel and other materials by up to 80%
- Reduces labor costs
- Poses minimal threat to the environment, because it resists leaching. In fact, calcium chloride is used in food processing, fertilizers and as a nutrient in some applications.

APPLYING CALCIUM CHLORIDE FOR DUST CONTROL

1. Blade and shape the surface to allow water to drain off properly.
2. Apply a 35% solution of calcium chloride using a tank truck with a rear-mounted distribution bar that spreads the liquid evenly over the road.
3. For proper road maintenance, apply a second time later in the summer.

APPLICATION TIPS FOR DUST CONTROL

- Calcium chloride works best when applied just before roads become dry and dusty, because it can then retain moisture already present in the road.
- Apply calcium chloride immediately after spring shaping, before the road has dried from the spring rains.
- Although liquid calcium chloride makes unpaved roads hard, it can make paved roads slick. Distributor trucks should reduce speed about 100 feet (30 meters) before paved areas and use extreme caution treating the remaining unpaved area.

CALCIUM CHLORIDE LEAVES OTHER AGENTS IN THE DUST

- **Water** can't resist evaporation like calcium chloride; that's why water can only *delay* dust instead of *control* it. Once the water evaporates, you will have to water the road again. And frequent road watering adds up to greater operating costs.
- **Oil** is messy, chokes roadside foliage, and causes a crusty, crumbling road surface when it dries. Oil also costs at least three times as much as calcium chloride.
- **Oil emulsions** are less expensive than oil alone, but as the water evaporates, the problems of the oil messiness and a crumbling surface remain.
- **Lignosulfonate,** a by-product of paper mills, is less expensive than calcium chloride, but it lasts a fraction of the time. Frequent reapplication is necessary due to wash-out caused by rain-which translates into extra costs and maintenance trips.

THE IMPORTANCE OF BASE STABILIZATION

To the public, the dust clouds trailing cars and trucks on unpaved roads are a nuisance, even a

driving hazard. To those who maintain these roads, the fines leaving the road as a dust threaten the road's very existence.

Fine particles in a road fill the spaces between coarser aggregates which bind them into a compact, dense surface. When the fines are lost, traffic will break down the road surface, scattering the aggregate and causing ruts, washboard, and other hazardous problems. One study estimates that a single car travelling on an untreated road once a day for a year would throw off a ton of gravel per mile. Such unchecked deterioration leads to costly road rebuilds and higher road maintenance costs...not to mention complaints by local citizens.

Proper application of calcium chloride will stop the damage before it starts by maintaining a clean, solid, smooth-riding surface.

CALCIUM CHLORIDE KEEPS IT TOGETHER...

A road is only as strong and durable as its base... and the integrity of the road base depends on proper interlocking of aggregate.

Calcium chloride absorbs moisture from the air to form a clear liquid. This liquid is extremely resistant to evaporation and is attracted to negatively-charged soil particles (clay), which decreases leaching. Because it resists evaporation, calcium chloride maintains optimal moisture levels (between 7-8%) during compaction to attain a high density.

The calcium chloride solution penetrates the road's material, coating tiny particles of dust and gravel, binding them together. This binding action stabilizes the unpaved road, keeping it dense and compacted. Aggregate particles also interlock faster, speeding the compaction of the base. That means calcium chloride treated road bases reach greater density with fewer rollings than bases using only plain water — which translates into labor savings. In fact, the cost of calcium chloride is often completely offset by the savings it provides in construction costs.

The calcium chloride solution moves deeper into the base during wet weather; during dry spells it rises towards the surface through capillary action to keep the surface moist. In this manner, moisture is maintained in the road to minimize the loss of fines. As a result, the road remains dense and compact under almost any level of traffic — even on the hottest, driest days.

...FOR LESS

Calcium chloride is a cost-effective alternate to paving, providing savings of up to 50%. Calcium chloride also:

- Reduces replacement cost of gravel and other materials by up to 80%
- Reduces compaction effort on loose granular surfaces by 60%
- Reduces labor costs
- Enables emergency and local traffic to use roads right after application, because it firms up almost immediately.

APPLYING CALCIUM CHLORIDE FOR BASE STABILIZATION

Use the following steps to stabilize the unpaved road:

1. Scarify the existing granular surface.
2. Select and add aggregate as needed.
3. Add 75% calcium chloride by weight of aggregate. Spray a 35% solution of liquid calcium chloride evenly over the road.
4. Mix all materials.
5. Create a 4% slope on either side of the crown.
6. Compact the surface uniformly.
7. Add 0.25% calcium chloride by weight of aggregate to seal the surface.

APPLICATION TIPS FOR BASE STABILIZATION

- Make sure roads have proper drainage so that water will not undermine the roads.

- Spray within a couple of days after grading to reduce the time that the roads are vulnerable to traffic.
- Spraying the liquid under pressure helps ensure the application is more uniform.
- Avoid very wet weather when spraying. If a heavy or steady rainfall occurs just after spraying a road, the runoff will take some of the calcium solution with it, especially on steep grades.

CALCIUM CHLORIDE STANDS UP TO OTHERS

- **Water** can't control the road's moisture content because it can't resist evaporation. Calcium chloride *is* resistant to evaporation, so it continues to attract and retain moisture which improves compaction. So calcium chloride can help reduce your maintenance trips, grading, rework, and man-hours. It can also reduce equipment, fuel, and repair costs. Water only works as long as long as it's around. As soon as water evaporates, so do your savings!
- **Oil** does not bind aggregate as well as calcium chloride, since it merely forms a thin crust on top of the aggregate. And when this crust breaks off during grading, potholes appear.
- **Oil emulsions** have the same effect as oil alone: they produce crumbly, crusty roads.
- **Lignosulfonate** requires more frequent applications than calcium chloride-which increases your labor and maintenance costs.

RECYCLING ROADS THROUGH FULL-DEPTH RECLAMATION

Full-depth reclamation is a straightforward process that uses pulverizing equipment to grind a road's existing asphalt and gravel base into a uniform aggregate composition. Liquid calcium chloride is then blended in, resulting in a stabilized base course.

CALCIUM CHLORIDE MAKES RECLAIMED ROADS BETTER...

Studies show that roads reclaimed with liquid calcium chloride can withstand stress and shock, and distribute load better than roads reclaimed without calcium chloride. Liquid calcium chloride lubricates the fines and allows them to adhere to each other and to the aggregate. So calcium chloride makes optimum compaction easy to achieve, which in turn keeps the road dense and compact under almost any level of traffic.

Because calcium chloride's fast firming-up action helps keep aggregates in place, traffic can usually continue using the roadway during construction. This fast, dependable action also makes stage construction possible. And because calcium chloride has a low freezing point, the full depth reclamation season can be extended from just after frost into late November.

...AT A BETTER PRICE

Using liquid calcium chloride for full depth reclamation can help you add structural value and cost savings to your own operations:

- Aggregate treated with calcium chloride reaches greater density and compaction with less rolling, thereby speeding the work. In addition, emergency and local traffic can still use the roadway during construction and before asphalt is applied because liquid calcium chloride sets up almost immediately.
- Calcium chloride extends road life and reduces the amount of patching and other maintenance needed. Many officials anticipate an average life expectancy of 15 years or more for roads reclaimed with calcium chloride, as opposed to 5-10 years for roads without calcium chloride.
- Full depth reclamation recycles existing materials, so disposal concerns (and costs) are eliminated, while natural resources and energy are preserved. Calcium chloride also reduces the threat to the environment.
- Because the reclamation process is accomplished in place, the heating, mixing and hauling costs of conventional reconstruction techniques can be eliminated.
- Calcium chloride reduces the effects of frost action by 50 to 60%. It has an antifreeze

effect which lowers the freezing point of the moisture in the base.

HOW TO RECLAIM ROADS WITH CALCIUM CHLORIDE

Full depth reclamation with calcium chloride only takes six steps:

1. Pulverize asphalt, mixing it with a predetermined amount of underlying base materials. The old surface becomes part of the new road base.
2. Apply calcium chloride at the rate of 0.75 gallons per sq. yd. (3.9 liters per sq. meter).
3. Pulverize a second time to thoroughly mix asphalt, base material and calcium chloride.
4. Grade the materials to establish the desired surface profile.
5. Roll the surface to consolidate the materials. Calcium chloride lubricates the materials, aiding compaction.
6. Seal the surface with a second application of calcium chloride, applied at the rate of 0.25 gallons per sq. yd. (1.3 liters per sq. meter).

CALCIUM CHLORIDE OUTSTRIPS ASPHALT EMULSIONS

In full depth reclamation, calcium chloride presents several advantages over asphalt emulsions:

- **Economical:** Calcium chloride costs half as much as asphalt emulsions. And calcium chloride's natural viscosity facilitates compaction, so you can achieve a more stable road base with less work–which translates into significant labor and equipment savings.
- **Improved bond:** Calcium chloride helps absorption of bituminous materials. Priming materials are readily absorbed and there is no blocking of bituminous materials due to dust film.
- **Frost protection:** Small percentages of calcium chloride are effective in reducing detrimental frost action. Work done at Perdue University concluded that calcium chloride, in a stabilized mixture, prevented detrimental frost heaving.
- **Versatile:** Calcium chloride can be used as an additive for reclaiming a wide range of road types.
- **Controlled curing for increased stability:** Results show that calcium chloride used in the mix assures a high structural stability, because it controls a high rate of drying in both the compaction and curing periods.

APPLICATION TIPS FOR FULL DEPTH RECLAMATION

- Use a vibratory roller. It can make a difference in road hardness because it offers greater compaction–especially with calcium chloride, which lubricates the particles so they move close together.
- Check drainage. The road should have adequate cross-fall, shoulders, ditching and other drainage features.
- The total amount of 35% liquid calcium chloride to be used is 1 gallon per sq. yd. (5.2 liters per sq. meter). To ensure that the liquid calcium does not run off, application by distributor truck might require multiple passes.
- The base course with liquid calcium chloride should be allowed to cure for several weeks prior to construction of the final wearing surfaces. The length of time necessary for proper curing will vary depending on weather and environmental conditions.
- Wearing surfaces may consist of a single or double seal coat, or varying thicknesses of cold mix or hot asphalt mix, depending on traffic load.

GENERAL NOTES ON USING CALCIUM CHLORIDE

Make your initial seasonal application of calcium chloride in the springtime, as soon as possible after roads have received their final shaping. Calcium chloride can be applied in either liquid or flake form.

Liquid calcium chloride

In liquid form, calcium chloride works best when applied just before roads become dry and

dusty. Liquid calcium chloride will always add moisture to the road, but it penetrates better and is more effective if used to retain moisture already present.

Liquid calcium chloride is generally sprayed as a 35% solution, using a tank truck with a rear-mounted distribution bar that spreads the liquid evenly over the road. Approximately 2200 gallons per mile (4663 liters per km.) will cover a 12-foot wide (3.75 meter) road.

Apply liquid calcium immediately after spring shaping, before the road has dried from spring rains. Liquid calcium chloride is normally applied at the rate of 0.4 gal. per sq. yd. (2 liters per sq. meter). For proper road treatment, apply a second time later in the summer, at the rate of 0.1 gal. per sq. yd. (0.5 liter per sq. meter).

Flake calcium chloride

In spring, flake calcium chloride should be applied while the road is still moist, before dust appears. Apply flake calcium chloride evenly and uniformly over the road's surface within one foot (½ meter) of either side. On previously treated roads, application rates range from low ½ lb. per sq. yd. (0.3kgs. per sq. meter), for a road having carry-over and light traffic, to 2 lbs. per sq. yd. (1.2 kg. per sq. meter). On new roads that have been previously treated, application rates vary from 1 ½ to 2 lbs. per sq. yd. (0.9-1.2kg. per sq. meter), depending on the type of composition of the surface and traffic count. An additional application of ½ to ¾ lb. of calcium chloride per sq. yd. (0.3-0.45 kg. per sq. meter) should be made later in the season when the surface shows signs of dusting.

During periods of hot, dry weather, the surfaces of dense, well-compacted roads should be sprinkled with water just before the application of the flake calcium chloride. This speeds the dissolving of flake calcium chloride, and prevents the flakes from being thrown off the road's surface by traffic before they dissolve.

Several varieties of spreading equipment are suitable for applying flake calcium chloride, including tailgate, spinner disk and drill-type spreaders. Peters Chemical will help you determine the right spreader for your application, taking into consideration the uniformity of coverage, ease of regulating the rate of spread, and width of spread required.

Aggregate requirements for optimum results

A stable unpaved road contains a naturally or mechanically balanced mixture of local materials compacted into a smooth, dustless surface with moisture obtained from the air and maintained by calcium chloride.

For the best results when stabilizing an unpaved road, incorporate calcium chloride into the base during a road rebuild. The optimum formula is to apply 1% calcium chloride by weight to selected gravel materials. For proper stabilization, a well graded crushed aggregate is recommended, with 80% of it having fractured faces and 3 to 12% by weight being able to pass through a #200 U.S. sieve. The road should also have adequate cross-fall, shoulders, ditching and other drainage features.

A typical unpaved road treated with calcium chloride contains surfacing materials ranging in size from coarse aggregate (two inch maximum) to the very finest particles of binder and soil. A two-inch top size aggregate is considered maximum for easy blade maintenance.

The smaller-sized particles must be present in sufficient quantities to fill the spaces between each of the larger sizes. The binder soil, kept moist by treatment with calcium chloride, remains plastic, keeping voids filled. Traffic will compact the graded particles into place, interlocking them to form a dense, smooth-riding surface with sufficient strength to carry normal wheel loads. The surface thus formed is sufficiently tight and compact to prevent penetration by water from rain or melting snow.

To achieve lasting stability, road surfaces of this kind should meet the surface course gradation recommendation of the American Association of Highway and Transportation Officials.

- Peters Chemical Company - http://www.peterschemical.com -

Holding the Road with Calcium Chloride Flake

Posted By webmaster On June 6, 2012 @ 4:13 pm In | No Comments

Holding the Road with Calcium Chloride Flake

Introduction

In its initial roadway applications nearly a century ago, the sole purpose of calcium chloride was to provide relief from dusty road conditions. Its use, however, has grown continuously for over 75 years, and calcium chloride is now an integral part of the plans and specifications of contractors and highway departments throughout the nation. Today, calcium chloride is used not only to maintain unpaved roads and streets but also to construct the shoulders and bases of modern superhighways and turnpikes.

Peters Chemical Company has had years of experience using calcium chloride for these highway applications. Our experience, along with the vast research conducted by various organizations, has helped us to gain a wealth of knowledge in this area. This knowledge assures predictable, controlled, economic results.

The following pages examine two current uses of calcium chloride:

1. Surface stabilization (including dust control and surface consolidation)
2. Graded aggregate mixes for bases and shoulders.

While these two uses are interrelated, each represents a specific phase of road work, and for this reason they are discussed separately. Although the formulations presented here are based on 83-87% flake calcium chloride, other forms of calcium chloride may be substituted by the use of appropriate adjustments for the product assay.

Surface Stabilization

Regular flake calcium chloride has two properties that make it particularly useful as a surface stabilization material:

1. It absorbs moisture from the air or surface and retains this moisture for an indefinite period of time. This property is referred to as hygroscopicity – the ability to absorb moisture from the atmosphere.
2. It dissolves in the moisture it absorbs, forming a clear, colorless liquid, which is extremely resistant to evaporation. This chemical action is known as deliquescence – the ability to become liquid by the absorption of moisture.

When flake calcium chloride is spread on an unpaved surface, it begins to absorb moisture from the air or surface and to dissolve in that moisture. As the resultant calcium chloride solutions penetrate the surface material, they coat the particles of dust and gravel and bind them together. This binding action stabilizes the surface and keeps unpaved roads dense and compacted. Because these same calcium chloride solutions resist evaporation, the surface remains damp, and the particles stay bound together, even on the hottest, driest days.

Dust Control with Calcium Chloride

Billowing clouds of dust are recognized by the general public as a nuisance and sometimes even

as a hazard. Yet every highway superintendent knows that the tiny particles, or "fines", serve a vital function in the roadway surface if they can be held there.

So long as they remain in the surface, the fine particles stabilize the unpaved roadway by acting as a binding agent for the coarser aggregates. But when those fines are lost in the air, the road surface begins to loosen, and traffic starts scattering the expensive roadway aggregate into ditches and culverts. If unchecked, this continuous deterioration of the roadway surface will result in the need for extensive road rebuilding and attendant high costs.

A proper application of calcium chloride helps stop the deterioration before it begins. When applied as a dust control agent, calcium chloride consolidates and stabilizes the roadway to provide a clean, smooth-riding surface.

Benefits of Calcium Chloride

Calcium chloride has a long history of use as a dust control agent for unpaved roadways, parking lots and other unpaved surfaces, and its use in this application is continually growing. The consistent increase in acceptance of calcium chloride can be attributed to the combination of the following benefits:

1. **Retention of Fines:**

   The loss of fines in the formation of dust is one of the basic reasons for the deterioration of a riding surface. Calcium chloride helps stop this surface deterioration by enhancing the binding the loss of fines in the formation of dust is one of the basic reasons for the deterioration of a riding surface. Calcium chloride helps stop this surface deterioration by enhancing the binding together of fines and aggregates and thus forming a stabilized surface.

2. **Reduced Material Replacement Costs:**

   The replacement cost of lost materials represents an actual loss of road dollars for many highway departments. Often an even more serious factor is the depletion of local deposits of gravel and other surfacing materials. When calcium chloride is applied to an unpaved surface, it coats the fines and aggregates, binding them together to help keep the original surface material in place and thus also to help reduce the need for replacement materials.

3. **Less Blading:**

   The amount of blading required to patch and reshape a road is directly related to the extent of the deterioration of the road's surface. A badly deteriorated road surface will require extensive, heavy blading; a stable, consolidated roadway surface will require a minimal light blading. As calcium chloride binds the fines and aggregates together, the treated road materials form a stable, compacted surface that remains intact and requires less blading.

4. **Elimination of Dust Complaints:**

   There is no other phase of highway maintenance that is more appreciated by the driving public and by taxpayers who live and work along unpaved roads than the elimination of dust.

   Soon after an application of calcium chloride for dust control, the telephone calls and letters expressing concern over dust are replaced by thanks for the smooth-riding, dust-free road surface.

5. **Adaptability to Surfaces:**

   Almost no two geographical areas have exactly the same composition of material in their road surfaces. However, with proper gradation, calcium chloride can be used on almost all unpaved surfaces (both large and small), including earth, cinders, gravel, sand,

bluestone, shale, limestone, clay, graded crushed stone, shell, and other similar local materials.

6. **Increased Safety:**

   Dust is not only a nuisance but can also be the cause of accidents on unpaved roads. As billowing clouds of dust reduce visibility, the temporarily "blinded" motorist must confront the dangers of unseen potholes, washboard, and other road hazards.

   Because of its ability to penetrate the road surface and bind fines and aggregates together, calcium chloride greatly reduces the formation of both dust and potholes. The end result is a cleaner, safer, smoother-riding surface.

Why Calcium Chloride

Over the years, a variety of materials including oil, oil emulsions, lignin sulfonate, and water have been used for dust control. A comparative examination of these materials clearly indicates why calcium chloride has proven to be the most effective dust control agent.

Lignin Sulfonate:

From the standpoint of material costs, lignin sulfonate, an impure by-product of sulfite wood pulping operations, may be less expensive than calcium chloride. Yet the use of this material for dust control and stabilization has been minimal because of its lack of availability and its lower effectiveness. To overcome the problem of lower effectiveness, more applications are needed. And more applications can mean only one thing: higher operating costs.

Water:

Water is undoubtedly the least expensive material used for dust control. Yet evaporation necessitates multiple applications. In addition, water has no aggregate binding ability. Therefore, soon after the application of water is followed by surface drying, the problems of dusty, deteriorating roads reappear.

Although water is inexpensive, the high operating costs associated with constant watering and patching make water an unattractive alternative for dust control.

Millions of miles of unpaved roads in this country are constructed of excellent surfacing material. A simple treatment with calcium chloride, combined with seasonal shaping, will provide clean, smooth-riding surfaces requiring little, if any, other maintenance. Frequently, the use of calcium chloride for stabilization through dust control more than pays for itself in savings in replacement materials and blading. And roads of this type are often so well accepted that demands for more expensive paving can be held off until the volume of traffic grows to a point where the cost of paving can be fully justified.

Spot Treatment:

Spot treatment with calcium chloride can be employed when local funds or traffic conditions do not permit full-scale dustlaying. Such spot treatment is practical at intersections, corners, detours, markets, in front of houses, on grade crossings, shoulders, breakups in blacktop pavements, and gravel roads adjacent to paved trunk lines.

Many communities handle the expenses of spot dustlaying on a share-the-cost basis whereby taxpayers who live along the road to be treated, or motorists who use the road, pay the local highway department for the calcium chloride plus a nominal charge for labor.

Surface Consolidation

Improvement of Unpaved Road Surfaces and Shoulders

A calcium chloride road is an unpaved road containing a naturally or mechanically balanced mixture of local materials compacted into a smooth, dustless surface with moisture absorbed from the air and maintained by calcium chloride.

The stability of this road results from combining local materials correctly either during the original construction or as part of planned maintenance operations.

In a road improvement program, the calcium chloride road is the intermediate type of improvement between the dusty unimproved road and the more expensive paved surface.

The experienced road man knows the performance of the gravel or stone roads in his system. Certain roads that stand up very well (after they have been shaped) during damp or even wet weather become dusty, ravel, and washboard during dry weather. Other roads are reasonably stable during dry weather but soften, become slippery, break up or pot-hole during periods of wet weather. Some roads may have sections where each of these conditions prevails. If these conditions are not severe, the roads can be converted to calcium chloride roads by shaping – securing of the proper crown – arranging for adequate ditching – and treating the surface with calcium chloride. In those cases, however, where periods of either dry or wet weather severely affect the stability of the road, it will be necessary to adjust materials in order to achieve a balanced mixture. Necessary adjustments can be made either in a single operation or through the addition of the required materials over a period of time as part of a regularly scheduled maintenance program.

Composition of the Calcium Chloride Road

Close examination of the surfacing materials of a typical calcium chloride road reveals that they range in size from coarse aggregate (one inch maximum) to the very finest particles of binder and soil. The smaller-sized particles are found in sufficient quantities to fill in the spaces between each of the larger sizes. Under traffic, these graded particles are compacted into place and interlock to form a dense, smooth-riding surface with sufficient strength to carry all normal wheel loads.

The binder soil, kept moist by treatment with calcium chloride, remains plastic, thereby keeping the voids filled. Thus there is formed a surface that is sufficiently tight and compact to prevent the penetration of water from rain or melting snow.

The surface of this kind of road usually meets the recommendation of the American Association of State Highway and Transportation Officials for surface course gradations. A one-inch top size aggregate is considered maximum for easy blade maintenance. Larger top sizes may be used as long as the other materials are proportionately graded.

Correcting Roads Lacking Proper Gradation

Some roads have unsuitable gradations as a result of either a lack of fines to compact or hold coarser aggregate or a lack of sufficient aggregate to give stability in wet weather. Correcting this deficiency requires either the addition of new material mixed with the present road material or the addition of sufficient graded aggregate to provide a new wearing surface.

Many types of aggregate can be used, including limestone, gravel, and crushed stone. It is essential that this material be graded (it should vary in size from coarse to fine) and not of a uniform size. If local graded material is not readily available, run-of-crusher stone or gravel can be used. In some cases, materials of different sizes can be selected, windrowed, and mixed on the road. This procedure is followed to insure that (1) all the aggregate will be incorporated into the surface, and that (2) no more aggregate is added than is necessary to accomplish the job. Where funds and equipment are available, the road may be corrected in one operation by scarifying the top inch, then adding and mixing the new aggregate with the scarified material.

Corrective Maintenance

If a road is compact and does not rut but becomes slippery in wet weather because of an excess

of binder soil, the application of sand, pea gravel, stone chips or similar small-sized material is recommended. This should be applied to the road surface during wet weather in very thin layers, either from trucks or by means of sand spreaders, in sufficient quantities to blot up the mud. And preferably this work should be done in the spring when the road surface is moist and before the calcium chloride has been applied.

Drainage, Shaping and Blading of the Calcium Chloride Road

The calcium chloride road, as any other type of road, produces the best results when it has good drainage and a proper crown. Thus, assuring good drainage and providing a proper crown are the first steps in converting a road to a calcium chloride road and the first items in any spring maintenance program. This work should be carried out as early as practical while there is still moisture in the ground and before the road dries out.

Drainage

Adequate drainage is vitally important. This requires the maintenance of a proper crown and the cleaning and shaping of ditches. A crown has been well described as the roof structure of the road. A good crown is essential to all calcium chloride roads. Standing water that results from a flat surface or high shoulder is, of course, the main cause of potholes.

Blading and Shaping

To restore the proper crown and shape the shoulders, a road should be bladed in the early spring when there is still moisture in the surface. A straight-line crown of ½" per foot has been found to be most satisfactory (3¼" to 4" on a 14' to 16' roadway).

It is important that care be taken not to cut into or otherwise disturb a hard, well-consolidated wearing surface by blading or maintenance when the road is dry. On roads of this type, the spring blading usually consists of pulling in a sufficient amount of loose material from the shoulders to restore the proper crown and cross section.

If, because of insufficient or improper maintenance, the road has developed potholes or poor cross section, heavier blading will be required. It may be necessary to cut into the surface to obtain sufficient material for reshaping. If any frost-boils have developed, it is necessary to remove the poor soil and replace it with granular material.

Summer and Fall Maintenance of Calcium Chloride Roads

During the summer and early fall seasons, the maintenance of calcium chloride roads is usually limited to light blading of the surface and the application of prescribed amounts of calcium chloride. It is recommended that patrolmen take advantage of rainy periods and start their maintenance either during or immediately following a rain. This maintenance consists of lightly blading from the edges toward the center of the road and then reversing the operation, feathering the material to the edges of the road. Care should be taken to limit the length of the sections to be maintained so that each section can be compacted before the road surface becomes too dry to bond under traffic. It is generally not advisable to blade the surface of consolidated roads during dry weather, as this tends to loosen the aggregate and dissipate the calcium chloride.

Application of Regular Flake Calcium Chloride

The initial seasonal application of calcium chloride should be made as soon as possible after roads have received their final shaping. In the spring, calcium chloride should be applied while the road is still moist – before it dries and dust appears. Calcium chloride should be evenly and uniformly applied over the surface of the road within one foot of either side. On roads that have been previously treated, the rate of initial or spring application of calcium chloride depends on

the amount of visible carry-over from previous applications, how well the surface is consolidated, and the amount of traffic being carried. This application will range from as low as ½ lb per square yard, on a compact road having carry-over and light traffic, to 1½ lbs per square yard.

On new roads which have not previously been treated, the quantity of calcium chloride to be used usually varies from 1 lb. to 1½ lbs. per square yard, depending on the type and composition of the surface and the traffic count. An additional application of ½ lb to ¾ lb of calcium chloride per square yard should then be made later in the season when the surface shows signs of dusting. Applications of calcium chloride should be made immediately following the blading, when the surface is still moist.

During periods of hot, dry weather, it is recommended that the surfaces of dense, well-compacted roads be sprinkled with water immediately preceding the application of flake calcium chloride. This will speed both the dissolving of the calcium chloride and the absorption of the solution into the surface of the road. This, in turn, prevents the dry flakes from being thrown from the road's surface by traffic before they dissolve.

Spreading Equipment

Many types and styles of spreaders can be used to apply calcium chloride, including the tailgate, spinner disk, and drill types. In choosing a spreader, important points to consider are the uniformity of the coverage and the ease of adjusting the controls to regulate the rate of application and width of the spread.

Graded Aggregate Bases

Engineered Bases for Modern Highways

Although the axiom "no surface is better than its base" has been familiar to highway engineers for many years, it is only in the comparatively recent past that special design and special construction of bases have been recognized as a practical necessity. It is now known that the quality of the base not only will affect the maintenance costs and riding qualities of rigid and flexible surfaces, but that the base is the factor that determines the life of the pavement itself.

In the past, inadequately drained bases and subgrades have caused millions of dollars worth of damage from heaving and frost boils. No type of pavement or surface was exempt from this trouble if the base was not properly constructed and drained.

Lack of uniformity in bases, uneven settlement, and poor compaction have also been responsible for such difficulties as settlement of slabs, waving, pot-holing, and longitudinal ruts.

It is generally acknowledged that, in order to allow for weakness in base structure, pavements have often been made thicker than would have been required to carry the anticipated traffic load. In designing primary roads, the engineer's problem is not whether to build a base but what type of base will be most suitable for a given project.

Advantages of the Calcium Chloride Graded Aggregate Base

The rapid increase in acceptance of the calcium chloride graded aggregate base in recent years is the result of the combination of the following advantages:

1. Dependability. In practical field experience it has proven the most dependable type.
2. Low cost.
3. Strength. It has high structural strength to carry the heaviest wheel loads.
4. Frost and moisture resistance. It is resistant to the detrimental action of excess moisture and frost.
5. Ease of field control.

In the calcium chloride graded aggregate base, the interlocking obtained from the gradation of the coarse aggregate provides the structural strength necessary to carry the load. The stability is the result of high densities (up to 150 lbs per cubic foot dry weight) which can be developed. Such densities prevent the main cause of base failures, either through softening or frost action, the existence of detrimental amounts of free water in the base.

Maintenance of Optimum Moisture

To achieve maximum density and stability, the careful control of moisture during the compacting period is essential, and calcium chloride produces the most economical and dependable means of controlling the optimum conditions of moisture accurately, which results in maximum density and stability.

Unless optimum moisture (approximately 7 to 8%) is uniformly maintained during the entire compaction period – despite periods of high temperature, low humidity, and drying winds – It is virtually impossible to achieve a uniform maximum density in all sections of the project. The continuous addition of water is both expensive and difficult to control accurately on the job, but the inclusion of calcium chloride in the mix provides a resistance to usual evaporation, reduces or eliminates the need for additional water, and maintains the necessary optimum moisture content.

The use of calcium chloride frequently adds nothing to the total cost of the completed base because the savings it affects during the construction period offset the cost of the calcium chloride. The addition of calcium chloride to graded aggregate mixes makes it possible to achieve maximum density with only a small fraction of the compactive effort required when plain water is used. In addition, graded aggregate containing calcium chloride reaches a greater density with fewer rollings than when plain water is used.

Preparation of Graded Aggregate Mixes

In the preparation of calcium chloride graded aggregate mixes, it is essential that the gradation and moisture be held to specified limits. This can be done by either of two methods: (1) combining measured amounts of specified materials at a central mixing plant and transporting the prepared mix to the job site; or (2) placing on the road for in-place mixing measured amounts of specified components, as called for in the specifications.

Plant Mix

A typical plant for producing graded aggregate mixes includes stocks of coarse and fine aggregates in bins or stockpiles and equipment for blending the proper proportions of these materials on a conveyor belt. Calcium chloride is usually added directly to the aggregate in the conveyor belt with a vibrator or similar type feeder. The correct amount of water is then added through spray bars located over the mixture.

There are a number of advantages to preparing specification mixes at a central mixing plant:

1. Maximum control assures a more uniform mix
2. Moisture content, so vital in attaining density and stability, is easily controlled and maintained.
3. Inspection is simplified since one worker at the plant can control gradation of material, moisture content, and amount of calcium chloride.
4. The possibility of segregation is eliminated.
5. There is accurate control of the amount and even distribution of calcium chloride throughout the mix.

Graded aggregate mixes containing calcium chloride, delivered from central batching and mixing plants are usually spread on the road by mechanical aggregate spreaders, so that rolling can start immediately before there is any moisture lost.

Road Mix

Although the value of plant-mixed materials is generally recognized, it may prove more practical for some projects to construct graded aggregate bases by road mix methods. This method requires more careful inspection and supervision to insure uniformity because the control of materials and moisture must be maintained in the field throughout the entire operation.

The subgrade and subbase must be in a thoroughly compacted condition and must be provided with adequate drainage prior to construction of the base.

To construct a satisfactory base by the road-mix method:

1. The coarse and fine material should be placed on the prepared surface, with care being taken to insure an even distribution of materials.
2. Binder-soils should b e in a dry and pulverized condition when placed.
3. All the material should then be bladed with a patrol grader by standard methods, from side to side or mixed with a travelling mixing machine until it is thoroughly and uniformly mixed.
4. Generally, lifts should not exceed 5 inches of compacted thickness.

Aggregates should be dry-mixed to some extent before the addition of the calcium chloride. Calcium chloride should then be added by means of a mechanical spreader.

Graded Aggregate Mixes for Wearing Courses and Shoulders

Calcium chloride graded aggregate mixes are also used for construction of wearing courses and for the shoulders of pavements on primary roads. Although the specifications for the mix for surfaces of this type differ slightly from those that are to be used in bases scheduled for immediate surfacing, the materials can be mixed and applied in the same manner. It is the practice of some highway departments to use a base course before paving as a riding surface for periods of up to one year to determine whether any weaknesses develop.

If the base is to be used as a surface for a period of time before placement of the finished pavement, particular care must be taken to allow for quick run-off by insuring that not less than 3/8 inch per foot (and preferably ½ inch) crown is permitted.

Materials and Specifications for Calcium Chloride Graded Aggregate Mixes

Although most of the specifications for graded aggregate mixes are similar, slight variations are made in different sections of the country to suit local weather and traffic conditions and/or the local availability of materials. The following is a typical specification for graded aggregate base material:

For use in the construction of stabilized wearing or base courses, graded aggregate shall consist of coarse aggregate composed of gravel, crushed stone or slag combined with soil mortar or stone fines, or any combination of these materials. The requirements are intended to cover only materials having normal or average specific gravity, absorption, and gradation characteristics. Where other materials are used, appropriate limits suitable to their use must be specified.

The aggregate shall be composed of hard durable particles and shall be free from injurious or deleterious substances.

Detailed Requirements of Gradation

Sieve Designation	Wearing Course*	Base Course*
1"	100	100
3/4"	85-100	70-100
3/8"	65-100	50-80

#4	55-85	35-65
#10	40-70	25-50
#40	25-45	15-30
#200	10-25	5-15

*The fraction passing the No. 200 sieve shall not be greater than two-thirds of the fraction passing the No. 40 sieve.

The fraction passing the No. 40 sieve shall have a plasticity of not less than 4 or more than 9. The liquid limit of the fraction passing the No. 40 sieve shall not exceed 35. If the wearing course is to be used as a base within a year, the plasticity index shall not exceed 6, and the liquid limit shall not be greater than 25.

**The fraction passing the No. 200 sieve shall not be greater than two-thirds of the fraction passing the No. 40 sieve.

The fraction passing the No. 40 sieve shall have a liquid limit not greater than 25 and a plasticity index not greater than 6.

Moisture Content: The materials herein specified shall contain sufficient moisture to insure compaction to design density. This specification is being followed by several state highway departments and the American Public Works Association.

The Use of Calcium Chloride for Graded Aggregate Mixes for Shoulders and Wearing Corners

Road Mix – Regular flake calcium chloride shall be uniformly spread at a rate of 0.5 pounds per square yard per inch of compacted thickness. The material shall be thoroughly mixed by alternately spreading and windrowing or by multiple blade maintainers, by rotary tillers or other travelling plant mixers, or by other approved methods.

Plant Mix – The finished plant-mixed material shall contain 10 pounds of regular flake calcium chloride per ton of mixture.

Surface Application – Where the course is to serve as a wearing surface, an application of one pound per square yard should be applied. This should be followed by one-half pound per square yard applications as required to keep down dust.

Handling Precautions

CAUTION! Regular and anhydrous flake calcium chloride is harmful if swallowed. Contact with the eyes, mucous membranes, or skin may cause irritation or burns. When using, work gloves should be worn, and dust should be avoided.

If swallowed, drink several glasses of water and then induce vomiting. Call a physician.

In case of contact: For eyes, promptly flush with plenty of water for at least 15 minutes, and call a physician. For skin, flush with plenty of water and wash thoroughly. Contaminated clothing should be removed as soon as possible and washed before being reused.

Regular and anhydrous flake calcium chloride acts by absorbing moisture which in turn liberates heat. This moisture-absorbing property can dry out leather and may damage clothing.

All ice-melting chemicals lower the freezing point of water and increase the number of freeze-thaw cycles. This situation may hasten the occurrence of flaking and scaling of concrete or mortar less than one-year old or of questionable quality. Mortar joints are particularly vulnerable.

Care must be used when applying near lawns or shrubs since damage to them may occur.

Keep out of reach of children.

Store in a cool, dry place.

- Peters Chemical Company - http://www.peterschemical.com -

DOWFLAKE™ XTRA – Calcium Chloride

Posted By webmaster On February 29, 2012 @ 4:42 pm In | No Comments

CALCIUM CHLORIDE – DOWFLAKE™ Xtra

Snow and Ice

DOWFLAKE™ Xtra Ice Melt Volume (at 20 degrees F):

- 33% faster than NaCl
- 27% faster than MgCl2 flake
- 2X faster than Urea
- 5X faster than KCl
- 9X faster than CMA
- Conventional 77-80 percent flake melts 7.7 pounds of ice per pound used. DOWFLAKE™ Xtra 83-87 melts 8.5 pounds of ice per pound used.

Dust Control

DOWFLAKE™ Xtra

DOWFLAKE™ Xtra 83-87 percent calcium chloride flake goes the extra mile for better dust control. With approximately 10 percent more calcium chloride than conventional 77 percent calcium chloride flake products, DOWFLAKE™ Xtra gives you greater pound-for-pound dust control than competing calcium chloride formulations and other materials.

DOWFLAKE XTRA is hygroscopic, drawing moisture from the air, eliminating the need to mix it with water.

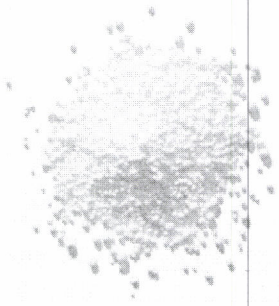
Oxy calcium chloride outperforms all other materials for dust control:

- Providing similar performance-but requires less than half the application rate-to magnesium chloride, thereby significantly reducing your costs.
- Doesn't form a crust or fragment under traffic like some oils and emulsions.
- Has greater, more predictable performance and less environmental impact than natural and processed brines.
- Has a slower evaporation rate than surfactants and water, which evaporate too quickly to be effective.

CALCIUM CHLORIDE ($CaCl_2$)

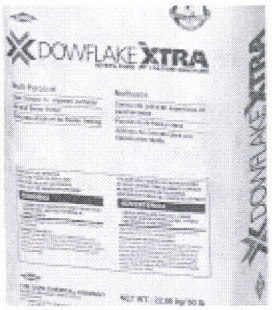
[1]

- Melts to -25° F
- Is the fastest, most effective ice melt available
- Premium-priced, similar to magnesium chloride, but pound-for-pound, melts twice as much ice
- Comes in pellet or flake form
- Is hygroscopic, drawing moisture from the air and creating heat to accelerate the melting process
- Vegetation, corrosion and concrete performance compares



favorably to competing ice-melt materials, including magnesium and potassium chloride.

DOWFLAKE™ Xtra 83-87 percent calcium chloride: "Xtra" Concentration for "Xtra" Ice-Melting Speed



[2]DOWFLAKE™ Xtra 83-87 Percent Calcium Chloride. has 10 percent more calcium chloride than conventional flake calcium chloride products. It's concentrated, so you can apply less.

Use DOWFLAKE™ Xtra calcium chloride by itself or mix it with rock salt and abrasives to give them extra power.
Calcium chloride's high-performance properties make it superior to plain salt and other ice-melting materials.

DOWFLAKE™ Xtra calcium chloride:

- Works across a wider range of temperatures than other ice melting materials.
- Works much faster than rock salt alone.
- Melts ice faster and at lower temperatures than urea and potassium chloride.
- Melts ice faster than magnesium chloride, which means that more magnesium chloride-at added cost-is needed to match the performance of DOWFLAKE™ Xtra calcium chloride.
- Here's the performance comparison. DOWFLAKE™ Xtra melts ice:
  - 33% faster than NaCl
  - 27% faster than MgCl2 flake
  - 2X faster than Urea
  - 5X faster than KCl
  - 9X faster than CMA

Conventional 77-80 percent flake melts 7.7 pounds of ice per pound used. DOWFLAKE™ Xtra 83-87 melts 8.5 pounds of ice per pound used.

DOWFLAKE™ Xtra calcium chloride provides additional benefits when it is mixed with other materials. It helps:

- Make rock salt work faster and at lower temperatures.
- Keep abrasives like sand and cinders manageable and free flowing at cold temperatures.
- Imbed abrasives in ice to prevent them from being bounced off the surface by traffic.
- Whether used by itself, with rock salt, or with abrasives, DOWFLAKE™ Xtra calcium chloride not only melts quicker, it also makes it easier for you to mechanically remove snow and ice by penetrating and loosening it.

Data Sheets

MSDS SHEET -Calcium Chloride – Dry [3]
SPECIFICATION SHEET – Calcium Chloride – Dry – Flake [4]

URLs in this post:

[1] Image: **http://www.peterschemical.com/wp-content/uploads/2008/11/peladow_pellets1.jpg**
[2] Image: **http://www.peterschemical.com/wp-content/uploads/2008/11/hidowflakextra50lbbag.jpg**

[3] **MSDS SHEET -Calcium Chloride – Dry: http://www.peterschemical.com/calcium-chloride-peladow-dowflake-and-liquid-calcium-chloride/msds-sheet-calcium-chloride-dry/**

[4] **SPECIFICATION SHEET – Calcium Chloride – Dry – Flake: http://www.peterschemical.com/calcium-chloride-peladow-dowflake-and-liquid-calcium-chloride/specification-sheet-calcium-chloride-dry-flake/**

- Peters Chemical Company - http://www.peterschemical.com -

LIQUIDOW™ – Liquid Calcium Chloride

Posted By webmaster On February 29, 2012 @ 4:42 pm In | No Comments

LIQUID CALCIUM CHLORIDE – LIQUIDOW™

Dust Control

LIQUIDOW™ Calcium Chloride Solution is produced from a naturally-occurring, underground brine that has been refined to remove impurities. LIQUIDOW™ outperforms alternative dust control materials.

- Doesn't form a crust or fragment under traffic like some oils and emulsions.
- Requires a lower application rate than magnesium chloride.
- Doesn't become slippery when wet or brittle when dry like lignin sulfonate.
- Has fewer impurities and more predictable performance than unprocessed brines.

The performance, residual stabilizing effects and cost effectiveness of LIQUIDOW™ calcium chloride solution provides substantial advantages over competing products in dust-control applications.

Data Sheets

SPECIFICATION SHEET – Calcium Chloride – Liquid [1]

Article printed from Peters Chemical Company: **http://www.peterschemical.com**

URL to article: **http://www.peterschemical.com/liquid-calcium-chloride-liquidow/**

URLs in this post:

[1] **SPECIFICATION SHEET – Calcium Chloride – Liquid**: **http://www.peterschemical.com/calcium-chloride-peladow-dowflake-and-liquid-calcium-chloride/specification-sheet-calcium-chloride-liquid/**

- Peters Chemical Company - http://www.peterschemical.com -

Specification Sheet – Calcium Chloride – Liquid

Posted By webmaster On August 16, 2006 @ 1:20 pm In | No Comments

PRODUCT DATA SHEET

LIQUID CALCIUM CHLORIDE

Calcium Chloride has varied uses: dust control and road base stabilization, ice and snow removal, a clear brine fluid in the oil field, an accelerator for concrete, and a brining agent for foods.

Description: Odorless, water white liquid in concentrations ranging from 28% to 42%.

This product meets ASTM Specification D98-95 and AASHTO M144

Physical Properties

32% Calcium Chloride Solution

- **Chemical Formula:** $CaCl_3$
- **Density:** White Pellet
- **Specific Gravity:** 1.322 at 60^oF
- **Crystallization Temperature:** -17^oF
- **pH:** 7 – 8
- **Total Alkali Chlorides:** < 0.2% (As $MgCl_2$)
- **Magnesium:** < 0.2% (As $MgCl_2$)
- **Other Impurities:** < 2% (excluding H_2O)

- Peters Chemical Company - http://www.peterschemical.com -

MAGNESIUM CHLORIDE (MAG) – Flake & Pellet

Posted By webmaster On August 16, 2006 @ 1:22 pm In | 1 Comment

MAGNESIUM CHLORIDE

Magnesium Chloride is considered (by some) as the best total ice-melter that is less corrosive on metal surfaces, protects concrete from spalling, is less toxic and environmentally as safe as Calcium Chloride and much less corrosive than Sodium Chloride (rock salt).

Benefits

- MAG is less irritating to the skin.
- MAG corrodes metal surfaces less.
- MAG is safer around vegetation.
- MAG is safer on concrete.
- MAG is safer for use around animals and humans.
- MAG is environmentally friendlier.
- MAG is safer and tracks less than Calcium Chloride.
- MAG Brine is an effective road salt prewetting agent.

- MAG is an effective tennis court conditioner.
- MAG can be used for tire ballasting.

MAGNESIUM CHLORIDE (Flake)

Description: Large, flat, clear to off-white flakes containing over 51% water of hydration.

Relative deicing speed: Starts about as fast as calcium chloride, but may become diluted and ineffective.

Lowest practical temperature: Down to 5° F.

Effect on concrete: Chemical attacks concrete at a "slow rate". Can cause damage from freeze-induced expansion pressures by increasing number of freeze/thaw cycles.

Effect on vegetation: Used as recommended, will not harm vegetation. However, magnesium chloride, on a percentage basis, contains 17-56% more chloride ions that other "salt" type deicers.

Residue: Leaves no powdery residue.

Manufacturer's recommended application rate: Below.

Comments: Flake magnesium chloride contains over 51% water. It starts deicing almost as fast as calcium chloride but may become diluted and ineffective. *"Slowly" attacks concrete chemically.

**Reference for "slow" rate of concrete attack per American Concrete Institute, ACI 201 2R-92, Guide to Durable Concrete.*

DUST CONTROL – HOW TO APPLY:

On unpaved roads, construction sites and parking lots:

MAG should be applied on the basis of up to 2 lb/sq. yard, and reapplied at 50% of this rate when the surface appears dry. Road surfaces should be graded prior to MAG® application.

On tennis courts or recreation fields:

MAG should be applied on the basis of up to 1 lb/sq. yard, and reapplied at 50% of this rate when the surface appears dry:

Data Sheets:

MSDS SHEET- Magnesium Chloride (Pellets & Flake) [1]

SPECIFICATION SHEET – Magnesium Chloride Flake [2]

SPECIFICATION SHEET – Magnesium Chloride Pellets [3]

URLs in this post:

[1] **MSDS SHEET- Magnesium Chloride (Pellets & Flake)**:
http://www.peterschemical.com/magnesium-chloride/msds-sheet-magnesium-chloride-pellets-flake/
[2] **SPECIFICATION SHEET – Magnesium Chloride Flake**:
http://www.peterschemical.com/magnesium-chloride/specification-sheet-

magnesium-chloride-flake/
[3] SPECIFICATION SHEET – Magnesium Chloride Pellets: **http://www.peterschemical.com /magnesium-chloride/specification-sheet-magnesium-chloride-pellets/**