Dust Control Field Handbook

Standard Practices for Mitigating Dust on Helipads, Lines of Communication, Airfields, and Base Camps

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Final report

Prepared for U.S. Marine Corps Systems Command
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ABSTRACT: The U.S. Army Engineer Research and Development Center has evaluated potential chemical dust palliatives for mitigating fugitive dust in military operations. The products were compared in laboratory testing and several field trials. The results of these efforts are compiled in this document to provide assistance for selecting and applying chemical dust palliatives for use on helipads, roads, airfields, and base camps. This document summarizes recommendations and conclusions derived from individual research projects. The information is intended to serve as a guide for acceptable dust mitigation. Variations of the procedures documented may be necessary to meet specific requirements.

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PREFACE

This handbook was developed as part of a dust control program funded by the U.S. Marine Corps Systems Command, Quantico, VA. The information presented herein is for use in selecting, procuring, and applying dust palliatives for helipads, lines of communication, airfields, and base camps. Recommendations are based upon field testing conducted at Yuma, AZ, Douglas, AZ, and Fort Leonard Wood, MO, during the period 2003 to 2005.

The report was prepared by John F. Rushing and Jeb S. Tingle of the Airfields and Pavements Branch (APB) of the U.S. Army Engineer Research and Development Center (ERDC), Vicksburg, MS.

Work was conducted under the general supervision of Don R. Alexander, Chief, APB; Dr. Albert J. Bush III, Chief, Engineering Systems and Materials Division; Dr. William P. Grogan, Deputy Director, Geotechnical and Structures Laboratory (GSL); and Dr. David W. Pittman, Director, GSL.

COL Richard B. Jenkins was Commander and Executive Director of ERDC. Dr. James R. Houston was Director.

PROCEDURE FOR USING DUST CONTROL FIELD HANDBOOK

(1) Use Table 1 (at tab ***Recommended Applications***) to select recommended product category for military applications.

(2) Review **Detailed Dust Palliative Descriptions** (tab ***Dust Palliatives***).

(3) Select product from recommended product category (Table 2, tab ***Vendors***).

(4) Review recommended product application equipment (Table 3 at tab ***Equipment*** and tabs ***Easy Lawn® Hydroseeder*** and ***Finn® Hydroseeder***).

(5) Review product application guidance (tabs ***Application Techniques*** and ***Helipads***, ***Roads***, and ***Base Camps***).

Table 1
Recommended Product Applications

Application	Primary Solution				Secondary Solution(s)			
	Product Category	***Application Rate***	***Dilution Ratio***	***Application Type***	***Product Category***	***Application Rate***	***Dilution Ratio***	***Application Type***
Airfields	Synthetic fluid	0.4 gsy	n/a	Topical	Polymer emulsion	1.2 gsy	3:1	Admix[#]
Lines of Communication	Polymer emulsion	0.8 gsy	3:1	Admix	Synthetic fluid	0.6 gsy	n/a	Topical
					Chloride salt*	0.8 gsy	n/a	Topical
Helipads	Synthetic fluid	0.4 gsy	n/a	Topical	Polymer emulsion	1.2 gsy	3:1	Topical
					Powdered polymer	1.2 gsy	1.3 lb/gal	Topical
Base Camps	Synthetic fluid	0.4 gsy	n/a	Topical	Polymer emulsion	0.6 gsy	3:1	Topical
					Powdered polymer	0.6 gsy	1.3 lb/gal	Topical
					Polysaccharide	0.6 gsy	3:1	Topical

* Should not be used in excessively dry or excessively wet conditions.
[#] Depth of mixing should be minimum 4 in.

Recommended Applications

DETAILED DUST PALLIATIVE DESCRIPTIONS

Chloride Salts

Calcium, magnesium, and sodium chlorides are commonly used chemicals for dust control. They absorb moisture from the air and maintain a “wet” appearance in soil. These materials can be purchased as a powder, pellet, flake, or a solution in water. They do not work well in excessively wet or dry climates. In wet regions, they will dissolve in water and leach from the soil. In arid regions, there is not sufficient humidity in the air for them to be effective. Both calcium chloride and magnesium chloride require relative humidity levels to be in excess of 30 percent for adequate results. Sodium chloride requires humidity levels even greater and is much less frequently used.

Chloride Salts				
Product Description	**Vendor Information**	**Effective Uses**	**Limitations**	**Shipping**
Calcium, magnesium, or sodium chlorides dissolved in water. They absorb moisture from air and lock down dust.		Lines of communication	Corrosive, may leach from soil during rain	275-gal containers (2,900 lb)

Lignosulfonates

Lignosulfonates are derived from tree rosins and are a by-product of pulpwood processing. They provide dust control by physically binding soil particles. Lignosulfonates are usually sold diluted in water, but they can be purchased in powder form. They are characterized by a distinct odor and dark color. They are susceptible to leaching from the soil in areas of high moisture or precipitation. Lignosulfonates should not be mixed with gray or salt water for dilution.

Lignosulfonates				
Product Description	**Vendor Information**	**Effective Uses**	**Limitations**	**Shipping**
Tree rosins suspended in water by surfactants. They bind soil grains.		Lines of communication	May leach from soil with precipitation Lower strength than polymer products	275-gal containers (2,500 lb)

Petroleum Products

Petroleum products are very effective for dust control but are often viewed as being detrimental to the environment. Diesel fuel, cutback asphalts, motor oil, and others have virtually been eliminated from use. Asphalt emulsions are one of the only remaining petroleum products currently used. They provide excellent dust mitigation by binding surface particles. They do not lose effectiveness through typical climatic variations. However, asphalt emulsions require special application equipment and must be delivered in a **heated tanker at around 180 ^{o}F**. Typical asphalt emulsions used for dust control are cationic slow setting (CSS) emulsions.

Asphalt Emulsion				
Product Description	**Vendor Information**	**Effective Uses**	**Limitations**	**Shipping**
Asphalt cement suspended in water by surfactants. Binds soil grains.		Lines of communication	Requires specialized application equipment	Delivered in heated tankers

Polyacrylamides

Polyacrylamides are water-soluble polymers that provide dust control through moisture retention. These materials are used as super-absorbents in baby diapers, chemical spill containment, and other applications. They are generally applied in powder or granular form because polyacrylamides cause very large increases in viscosity when dissolved in water. The solution has a consistency of mayonnaise and is difficult to apply to the soil. Polyacrylamides swell when they come in contact with water and may cause volume changes in the soil. For this reason, they are not recommended for use on roads.

Polyacrylamides				
Product Description	**Vendor Information**	**Effective Uses**	**Limitations**	**Shipping**
Super-absorbent polymer. Absorbs moisture from air to lock down dust. May be known as TRI-PAM.		Helipads	Cannot be mixed with water. Must be applied as powder. Requires incorporating into soil.	Sold in desired quantities of powder.

Polymer Emulsions

Polymer emulsions used for dust control are generally vinyl acetate or acrylic-based copolymers suspended in an aqueous phase by surfactants. They typically consist of 40 to 50 percent solid particles by weight of emulsion. Once they are applied, the polymer particles begin to coalesce as the water evaporates from the system, leaving a soil-polymer matrix that prevents small dust particles from escaping the surface. The polymers used for dust control typically have excellent tensile and flexural strength, adhesion to soil particles, and resistance to water. These materials are often limited by a short shelf life (less than 2 years). Polymer emulsions should not be mixed with gray or salt water for dilution.

Polymer Emulsion

Product Description	Effective Uses	Limitations	Shipping
Acrylic polymer suspended in water by surfactants. Water evaporates when placed on soil and leaves a bonded soil-polymer matrix. Prevents dust by binding soil grains.	Helipads Lines of communication Base camps Airfields	May require mixing with soil for lines of communication and airfields Potential for FOD damage on helipads and airfields, especially when light applications are used or thin crusts (<1 in.) are produced	275-gal containers (2,500 lb)

Product	Vendor	POC	Telephone Number	Email
Soiltac	Soilworks, LLC	Chad Falkenberg	1-800-545-5420	info@soilworks.com

Polysaccharides

Polysaccharides are solutions or suspensions of sugars, starches, and surfactants in an aqueous medium. They may be diluted with water depending on the intended use. Polysaccharides provide dust abatement by encapsulating soil grains and providing a binding network in the ground. They are considered to be biodegradable materials, and may leach from the soil with exposure to precipitation.

Polysaccharide				
Product Description	**Vendor Information**	**Effective Uses**	**Limitations**	**Shipping**
Mixture of sugar and starches designed to bind soil grains. Product is water soluble, biodegradable, and capable of dilution with water	*Surtac* Soilworks, LLC Chad Falkenberg 1-800-545-5420 info@soilworks.com	Helipads Base camps	Limited effective lifespan Lower strength than polymer emulsions May settle from solution during storage	275-gal containers (2,500 lb)

Powdered Polymer

The powdered polymer discussed in this document is in the form of a water-soluble powder. It can be added to water at a rate of 1.3 lb per gallon. The polymer undergoes a chemical reaction upon curing and forms a water-resistant film that binds soil grains.

Powdered Polymer				
Product Description	**Vendor Information**	**Effective Uses**	**Limitations**	**Shipping**
Water-soluble polymer designed to bind soil grains. Product is mixed at a rate of 1.3 lb per gallon water.	*Powdered Soiltac* Soilworks, LLC Chad Falkenberg 1-800-545-5420 info@soilworks.com	Helipads Lines of communication Base camps	Poor penetration when applied topically Lower strength than polymer emulsions	Sold in 50-lb bags. Requires 350 lb for equivalent mixture.

Synthetic Fluids

Synthetic organic fluids are applied to a soil "as received." These fluids are not miscible with water and therefore are unable to be diluted. They consist of isoalkanes that do not dry or cure with time. The reworkable binder is ready for immediate use upon application and maintains effectiveness over extended periods of time.

Synthetic Fluid				
Product Description	**Vendor Information**	**Effective Uses**	**Limitations**	**Shipping**
Blend of isoalkanes that forms a reworkable binder in soil. Will not mix with water. Effective for long-term use.	*Durasoil* Soilworks, LLC Chad Falkenberg 1-800-545-5420 info@soilworks.com	Helipads Lines of communication Base camps Airfields	More expensive than most products	275-gal containers (2,000 lb)

Table 2
Product and Vendor Information

Product Category	Dust Palliative	Vendor	POC	Telephone	Email
Polymer emulsion					
	Soiltac	Soilworks	Chad Falkenberg	1-800-545-5420	chad@soilworks.com
Polysaccharide	Surtac	Soilworks	Chad Falkenberg	1-800-545-5420	chad@soilworks.com
Powdered polymer	Powdered Surtac	Soilworks	Chad Falkenberg	1-800-545-5420	chad@soilworks.com
Synthetic fluid	Durasoil	Soilworks	Chad Falkenberg	1-800-545-5420	chad@soilworks.com

Vendors

Application Techniques

Soil Type

The soil type will have some effect on the performance of dust palliatives. Of course, finer grained soils present a larger problem with dust generation, but they also may be more difficult to control. The higher specific surface of the soil will require greater quantities of product to treat. Penetration may also be hindered by the small pore sizes between soil grains. Multiple light application rates may be required to treat fine-grained soils (silts and clays) to prevent ponding or surface runoff. Coarse-grained soils (sands and gravels) typically have higher infiltration rates to minimize ponding or runoff.

Intended Use

Choosing a dust palliative will ultimately be governed by the need for dust control that exists. Some products will work better for helipads, while others will be more effective on roads or airfields. Each type of chemical has benefits and limitations that should be considered before selecting a product. Table 1 lists some of the recommended products for different dust control needs.

Application Rates

Application rates should be chosen according to the soil type, the intended use of the treated area, and the necessary duration of use. In general, dust palliatives should be applied at a rate of 0.8 gsy. This should be sufficient for most applications. Synthetic fluids may be applied a lower rates for most projects because they contain 100 percent active ingredients. Polymeric materials may require application rates of greater than

1.0 gsy in areas of heavy traffic. For example, using polymer emulsions on helipads will require an application rate of near 1.5 gsy in order to produce thicker surface crusts to reduce foreign object damage (FOD) potential. Refer to Table 1 for detailed guidance on selecting application rates.

Dilution Ratios

Some products may require dilution with water. These are typically any emulsified products (polymers, lignosulfonates, etc.). Diluting the emulsion will reduce the viscosity and improve penetration. In general, 3 parts water should be added for each part product. Adding additional water will not have much impact on the depth of penetration. Products such as the synthetic fluids and chloride salts are intended for use “as received” and should be applied in their concentrated form.

Topical Method

Topical applications are the most commonly used technique for dust control. Spraying the surface of the soil with a dust palliative will effectively solve most dust problems. Alternative methods should be used when the area to be treated is structurally deficient for the anticipated traffic or when greater durability is needed.

Topical applications are accomplished by simply spraying the liquid dust palliative onto the native or prepared soil surface. It is imperative to maintain the greatest level of uniformity while dispersing the liquid. Application quantities are determined by estimating the area of ground surface to be treated and multiplying that area by the application rate suggested.

Admix Method

Admix methods are designed to incorporate dust palliatives deeper into the soil and to provide longer lasting dust abatement. These methods are usually necessary when heavy repetitive loading will be introduced to the soil. Roads and airfields (runways, taxiways, or parking aprons) generally require admix applications to achieve the desired results. Admix depths should be at least 3 in. for roads and 4 in. for airfields.

The following procedure (illustrated in Photos 10-13) is recommended for incorporating the dust palliative into the soil:

(1) Grade the soil, if necessary, using a motor grader.
(2) Spray half of total palliative application rate onto the soil surface.
(3) Blend into top 3 in. of soil using rotary mixer (Photos 11 and 29).
(4) Compact using steel-wheeled vibratory roller (for granular materials).
(5) Spray remaining product onto compacted surface.

This method will provide optimal performance of most palliatives. Alternative construction methods may not provide sufficient durability.

Table 3
Distribution Equipment and Vendor Information

Equipment Type	Model*	Vendor	POC	Telephone	Email
Hydroseeder	T 90	Finn Corp.	Mel Love	1-800-543-7166	mlove@finncorp.com
	C 95	Easy Lawn, Inc.	Bob Lisle	1-800-638-1769	sales@easylawn.com

* Model listed was evaluated by ERDC researchers. Other models are also available that may meet project needs. However, modifications to the commercial version were made, and the military version should be requested for theater applications.

Equipment

MITIGATING DUST ON HELIPADS – CH-53 and CH-46

Apply 900 gal synthetic fluid topically to 150- by 150-ft helipad

What you will need:

1. MTVR (medium tactical vehicle replacement)
2. Hydroseeder
3. (4) 275-gal totes dust palliative (synthetic fluid)
4. (3) Marines/soldiers

Procedure:

a. Survey and visibly establish area to be treated.
b. Place 900 gal of synthetic fluid into hydroseeder (Photo 1).
c. Position the MTVR and hydroseeder on edge of helipad.
d. Use the tower gun and a long-distance nozzle to spray half of product to half of helipad (Photo 2).
e. Drive the MTVR to opposite side of helipad.
f. Spray the remaining product.
g. Helicopters can land immediately (best results may occur after 1 day, Photo 4).

MITIGATING DUST ON HELIPADS – UH-1 and AH-1

Apply 450 gal synthetic fluid topically to 100- by 100-ft helipad

What you will need:

1. MTVR
2. Hydroseeder
3. (2) 275-gal totes dust palliative (synthetic fluid)
4. (3) Marines/soldiers

Procedure:

a. Survey and visibly establish the area to be treated.
b. Place 450 gal of synthetic fluid into the hydroseeder (Photo 1).
c. Position the MTVR and hydroseeder on edge of helipad.
d. Use the tower gun and a long-distance nozzle to spray half of product to one-half of helipad (Photo 2).
e. Drive the MTVR to the opposite side of helipad.
f. Spray the remaining product.
g. Helicopters can land immediately (best results may occur after 1 day, Photo 4).

Photo 1. Filling hydroseeder with product (step *b*)


Photo 2. Spraying helipad using tower gun (step *d*)


Photo 3. Spraying helipad using hand-held hose


Photo 4. UH-1 landing on helipad treated with synthetic fluid

ALTERNATIVE METHOD FOR MITIGATING DUST ON HELIPADS – CH-53 and CH-46

Apply 3,000 gal diluted polymer emulsion topically to 150- by 150-ft helipad

What you will need:

1. MTVR
2. Hydroseeder
3. (3) 275-gal totes dust palliative (polymer emulsion)
4. 2,250 gal water
5. (3) Marines/soldiers

Procedure:

a. Survey and visibly establish the area to be treated.
b. Place 675 gal of water into the hydroseeder.
c. Add 225 gal of polymer emulsion (Photo 1).
d. Mix for 5 minutes using mechanical agitation.
e. Position the MTVR and hydroseeder on the edge of the helipad.
f. Use tower gun and long-distance nozzle to spray the product on one-third of helipad (Photo 2).
g. Refill hydroseeder using steps *b–d.*
h. Spray product over the middle third of helipad.
i. Repeat step *g*.
j. Spray product on final third of helipad.
k. Use remaining polymer and water near center of helipad.
l. Allow **1-day** cure before use (sooner, if hard surface is achieved).

ALTERNATIVE METHOD FOR MITIGATING DUST ON HELIPADS – UH-1 and AH-1

Apply 1,350 gal diluted polymer emulsion topically to 100- by 100-ft helipad

What you will need:

1. MTVR
2. Hydroseeder
3. (2) 275-gal totes dust palliative (polymer emulsion)
4. 1,000 gal water
5. (3) Marines/soldiers

Procedure:

a. Survey and visibly establish the area to be treated.
b. Place 500 gal of water into the hydroseeder.
c. Add 175 gal of polymer emulsion (Photo 1).
d. Mix for 5 minutes using mechanical agitation.
e. Position the MTVR and hydroseeder on the edge of the helipad.
f. Use the tower gun and a long-distance nozzle to spray product on one-half of helipad (Photo 2).
g. Refill hydroseeder using steps *b–d.*
h. Spray product over remaining one-half of helipad.
i. Allow **1-day** cure before use (sooner, if hard surface is achieved).

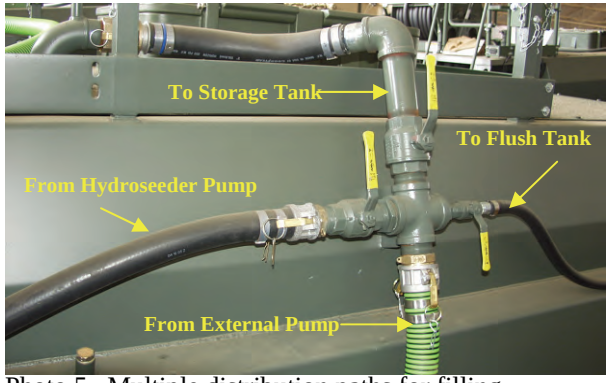

Photo 5. Multiple distribution paths for filling hydroseeder

Photo 6. Distributing emulsion onto helipad using tower gun


Photo 7. Spraying emulsion with hand-held hose

Photo 8. Desired crust thickness for emulsions to prevent FOD

MITIGATING DUST ON LINES OF COMMUNICATION AND MANEUVER SUPPLY ROUTES

Apply 0.8 gal per square yard polymer emulsion using <u>admix</u> construction procedure

What you will need:

1. MTVR/HMMWV (high mobility multipurpose wheeled vehicle)
2. Hydroseeder
3. Polymer emulsion*
4. Water*
5. Rotary mixer
6. Steel-wheeled vibratory compactor
7. (5) Marines/soldiers

* Quantities must be calculated based upon length and width of road.

Procedure:

a. Determine the length of road that can be treated per tank (hydroseeder capacity).
Length (yd) = Hydroseeder capacity (gal) / [Application rate (0.4) * Road width (yd)]
b. Place 675 gal of water into hydroseeder.
c. Add 225 gal of polymer emulsion (Photo 1).
d. Mix for 5 minutes using mechanical agitation.
e. Apply to road surface using distribution bar or wide-fan nozzle on tower gun.
f. Immediately till road surface to 3-in. depth using rotary mixer (Photo 10).

g. Compact soil until desired density is achieved (Photo 11).
h. Repeat steps *b–d.*
i. Spray over compacted road surface (Photo 12).
j. Repeat steps *a–i* for subsequent road lengths to be treated.

Photo 9. Grading road surface prior to treatment (if needed)

Photo 10. Applying product to road surface and distributing with rotary mixer (steps *e*–,*f*)

Photo 11. Compacting road surface after tilling (step *g*)

Photo 12. Applying final spray to road surface (step *i*)

ALTERNATIVE METHOD FOR MITIGATING DUST ON LINES OF COMMUNICATION

Apply 0.6 gal per square yard synthetic fluid <u>topically</u> to road surface

What you will need:

1. MTVR/HMMWV
2. Hydroseeder
3. Synthetic fluid*
4. (3) Marines/soldiers

* Quantities must be calculated based upon length and width of road.

Procedure:

a. Determine the length of road that can be treated per tank (hydroseeder capacity).
Length (yd) = Hydroseeder capacity (gal) / [Application rate (0.6) * Road width (yd)]

b. Place 900 gal of synthetic fluid into hydroseeder (Photo 1).

c. Apply to road surface using distribution bar or wide-fan nozzle on tower gun (Photos 13 and 14).

d. Repeat steps *a–c* for subsequent road lengths to be treated.

Photo 13. Applying synthetic fluid to road surface using wide-fan nozzle on tower hydroseeder

Photo 14. Applying synthetic fluid to road surface using distribution bar on rear of hydroseeder

MITIGATING DUST IN BASE CAMPS AND NON-TRAFFIC AREAS

Apply 0.4 gsy synthetic fluid <u>topically</u>

What you will need:

1. MTVR/HMMWV
2. Hydroseeder
3. Synthetic fluid*
4. (3) Marines/soldiers

Example			
Length ft (yd)	**Width ft (yd)**	**Area ft^2 (yd^2)**	**Product gal**
300 (100)	300 (100)	90,000 (10,000)	4,000
30 (10)	300 (100)	9,000 (1,000)	400

* Quantities must be calculated based upon area.

Procedure:

a. Determine the area to be treated in square yards. One 900-gal tank will mitigate dust on 2,250 sq yd soil (3,000 sq yd for 1,200 gal tank).
b. Calculate the necessary quantity of synthetic fluid.
c. Product (gal) = area (sq yd) * application rate (0.4 gal/sq yd).
d. Place 900 gal of synthetic fluid into hydroseeder.
e. Apply to soil surface using the tower gun or hand-held hose.
f. Repeat as necessary.

EASY LAWN® HYDROSEEDER OPERATION

Machine Specifications

Engine	54 HP Isuzu Diesel
Pump	4 in. × 3 in. centrifugal HPV7H pump – 110 psi, 620 gpm max 100 psi operating pressure
Dimensions	
Height*	111 in. (trailer) / 99 in. (skid)
Length	163 in. (trailer) / 178 in. (skid)
Width	91.5 in. (trailer) / 81 in. (skid)
Empty Weight	5,180 lb (trailer) / 5,050 lb (skid)
Working Weight	14,300 lb (trailer) / 16,580 lb (skid)
Tank Capacity	900 gal (trailer) / 1,200 gal (skid)
Fuel Capacity	28 gal
Distribution System	Hose, tower gun, or distribution bar

* Height can be reduced by disassembling tower gun

Machine Assembly

The safety railing and spray gun on the Easy Lawn hydroseeder must be assembled prior to use. The following text describes the proper procedure.

1. Remove the securing pin on the hydraulic hoses and control valve.
2. Remove the corner railing from the front of hydroseeder and position it correctly on posts.
3. Secure control valve onto the railing.
4. Remove the tower gun from storage position and secure on upper left corner (including U-bolts).
5. Install the center railing.
6. Remove the corner railing from the rear of hydroseeder and position it correctly on posts.
7. Ensure all connection pins are properly inserted and secure.

Filling Machine with Product

Two methods are available for filling the hydroseeder with liquid. The hydroseeder is capable of using its pump to transfer liquids into the tank, or an external pump can be used to deliver product. When using an external pump, a 2-in. hose can be connected to the delivery port emptying into the top of the tank (Photo 15). The tank lid can also be used as a location for overhead water supply filling. The hydroseeder is capable of pumping product from 275-gal containers into the tank without the use of an external pump. This can be accomplished by connecting a 2-in. hose from the product container to the suction valve on the hydroseeder pump. The gate valve (Photo 19) leading to the hydroseeder tank and the ball valve on the spraying hose should be in the “off” position during transferring. In addition to product, water should be placed into the flush tank for rinsing after applying dust palliatives. The flush tank is filled by changing valve positions on the delivery port that empties into the top of the tank. Filling is accomplished by closing the valve going to the

tank and opening the valve leading to the flush tank. **All transfer hoses should be rinsed with water immediately after filling.**

Machine Operation

The Easy Lawn hydroseeder is powered by a 54-hp Isuzu diesel engine and a variable-speed, hydraulically controlled pump. Variable-speed mechanical agitation is also available for mixing dust palliatives. In-line ball valves direct fluid through multiple paths for distribution and transfer. It is important to check all valves and ensure the intended path will be followed.

The following text details machine operation and palliative application:

Starting the engine

1. Check oil in engine.
2. Check fluid level in diesel fuel tank.
3. Check level of hydraulic oil in tank, and ensure the level is showing in the sight glass.
4. Check all ball valves to make sure they are closed.
5. Make sure the throttle switch is in the mix position and the agitation lever is in the center position.
6. Turn the key to preheat. When the heater light glows, turn the key to the start position. Allow the engine to warm up before starting the agitator or spraying.

Agitation

The hydroseeder is agitated by hydraulically powered paddles that keep fluids mixed inside the tank. The speed can be adjusted by the control valve mounted on the operation panel. Products that will be diluted with water should be agitated for approximately **5 minutes** prior to spraying. Rapid agitation may cause foaming within the tank.

Hose application

The Easy Lawn hydroseeder is equipped with a 200-ft hose for applying dust palliatives to various areas, including helipads and base camps. Ensure that the spray nozzle is inserted into the spray gun and that the ball valve is closed. Release the pin in the hose reel and pull out the desired length of hose. One to five people may be needed to carry the hose as the product is applied, being careful not to drag the hose through recently treated areas. Open the valves leading from the pump to the hose, make sure the alternate paths are closed, and open the valve on the spray tip. Slowly engage the pump and begin spraying from side to side with the fan nozzle perpendicular to the ground (Photo 16). When the desired product has been applied, turn off the pump, close the valves, and press the orange button on the side of the hose reel to electrically retrieve the hose. Replace the pin to lock the hose reel.

Tower gun application

The tower gun can be used to spray road shoulders, embankments, helipads, or most other areas where overspray will not interfere with equipment, structures, or personnel. This method is used to rapidly treat problematic areas. Two long-distance and two wide-fan nozzles are available depending on the desired spray pattern. The long-distance nozzles can spray approximately 130 ft. Ball valves should be open to direct fluid only to the tower gun. Insert the appropriate nozzle and aim the tower gun in the desired direction. Be careful to observe prevailing wind direction to prevent spraying unintended objects. Slowly engage the pump using the control valve located near the tower gun (Photo 18). Increase pressure to achieve the desired spray distance and pattern (Photo 17). When finished applying dust palliative, turn off the pump and close the ball valves located on the tower gun and at the pump.

Distribution bar application

The distribution bar on the hydroseeder allows for continual application of dust palliative on roads or other traffic areas as the transport vehicle travels. Five wide-fan spray nozzles on the distribution bar spray a total of

50 gal/min. Travel speed should be adjusted according to the desired application rate. The distribution bar is operated from the hydraulic pump control valve on top of the hydroseeder by the tower gun. First, make sure only the fluid lines directing product to the distribution bar are open. Begin forward movement of the vehicle and begin spraying at the desired location. Turn pump off before indicating for the vehicle driver to stop.

Cleaning and Maintenance

The hydroseeder should undergo routine maintenance and inspection at intervals indicated by the owner's manual. All fluid levels and filters should be checked prior to use. Replacement parts should be ordered from the manufacturer according to the owner's manual. Proper storage procedures should be followed when exposing the hydroseeder to cold temperatures to prevent damage from freezing water within the distribution lines.

The hydroseeder should be properly cleaned after each application. The flush tank should be kept full to immediately clean the distribution system after spraying **polymers** or other **crust-forming products**. Water should be sprayed until no visual evidence of product remains. The addition of soap may be necessary to clean **synthetic fluids** from the tank; however, they can remain in the system for prolonged periods of time without concern.

Improperly cleaned systems may develop clogs or films of plastic when using polymer emulsions for dust mitigation. The dried material must be removed by mechanical means (i.e., pressure-washing, scraping) or by chemical solvents such as paint strippers or JP8 fuel. Proper safety precautions should be taken when using any chemical solvents.

Photo 15. Filling Easy Lawn hydroseeder using external pump

Photo 16. Treating helipad using hand-held hose on Easy Lawn hydroseeder

Photo 17. Spraying helipad with dust palliative using tower gun on Easy Lawn hydroseeder

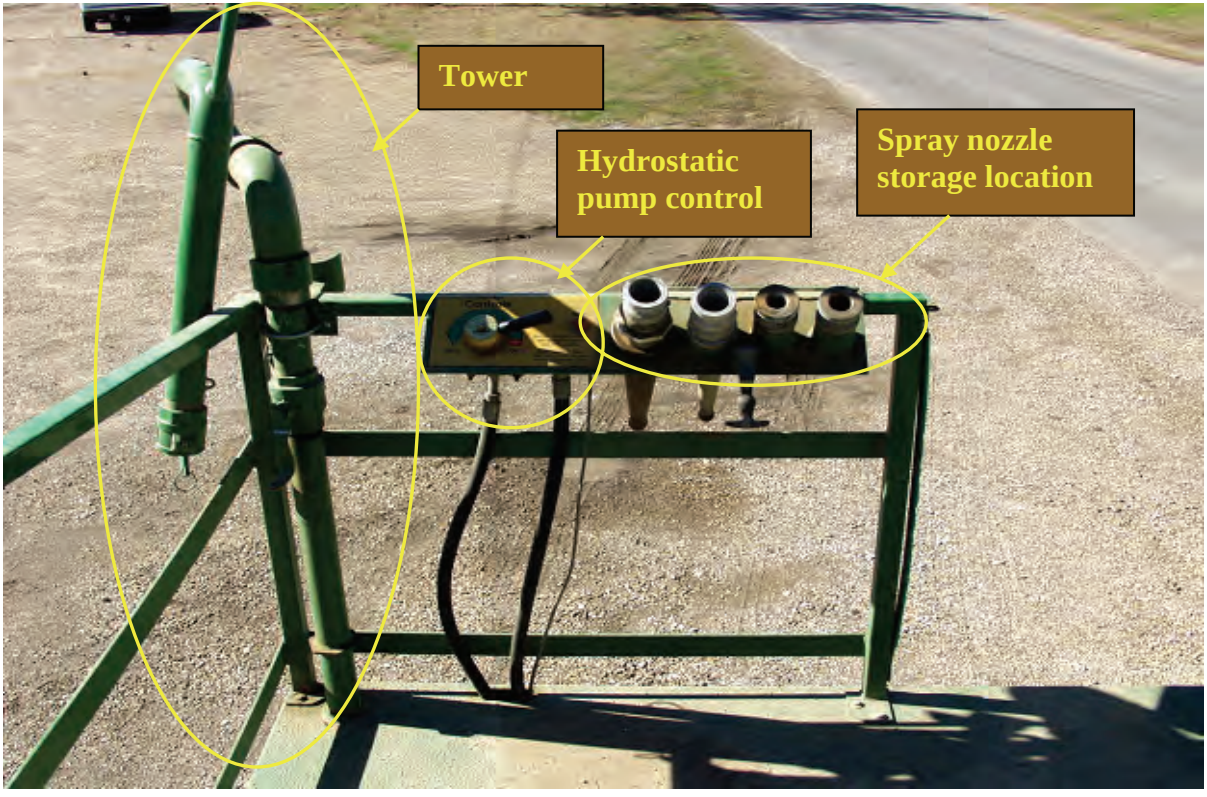

Photo 18. Control deck on Easy Lawn hydroseeder

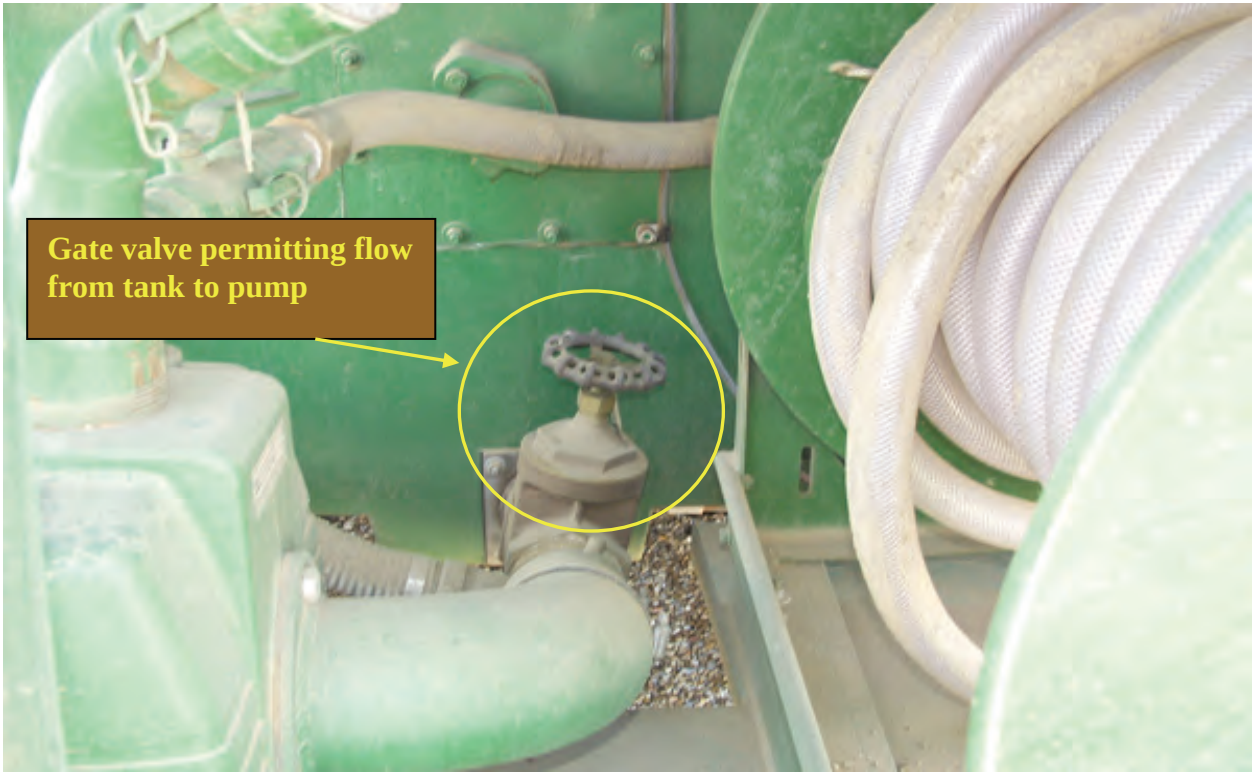

Photo 19. Gate valve on Easy Lawn hydroseeder (must be closed when transferring liquids using onboard pump)

FINN® HYDROSEEDER OPERATION

Machine Specifications

Engine	33.5-hp Kubota V1505
Pump	4 in. × 2 in. centrifugal pump – 170 gpm @ 100 psi
Dimensions	
Height*	108 in. (trailer) / 101 in. (skid)
Length	194 in. (trailer) / 154 in. (skid)
Width	85 in. (trailer) / 80 in. (skid)
Empty Weight	5,420 lb (trailer) / 4,480 lb (skid)
Working Weight	14,670 lb (trailer) / 16,080 lb (skid)
Tank Capacity	920 gal (trailer) / 1,180 gal (skid)
Fuel Capacity	14 gal (trailer) / 15 gal (skid)
Distribution System	Hose, tower gun, or distribution bar

* Height can be reduced by disassembling tower gun

Filling Machine with Product

Two methods are available for filling the hydroseeder with liquid. The hydroseeder is capable of using its pump to transfer liquids into the tank, or an external pump can be used to deliver product. When using an external pump, a 2-in. hose can be connected to the delivery port emptying into the top of the tank (Photo 20). Ensure valves are positioned to direct fluid into the tank before filling. The hydroseeder is capable of pumping product from 275-gal containers into the tank without the use of an external pump. This can be accomplished by connecting a 2-in. hose from the product container to the suction valve on the hydroseeder pump (Photo 21). The pump is engaged by turning the lever on the pump toward the “down” position (Photo 22). In addition to product, water should be placed into the flush tank for rinsing after applying dust palliatives. The flush tank is filled by changing valve positions on the delivery port that empties into the top of the tank. Filling is accomplished by closing the valve going to the tank and opening the valve leading to the flush tank (Photo 23). All transfer hoses should be rinsed with water immediately after filling.

Machine Operation

The Finn hydroseeder is powered by a 33.5-hp Kubota diesel engine with a centrifugal pump. Variable-speed mechanical agitation is also available for mixing dust palliatives. In-line ball valves direct fluid through multiple paths for distribution and transfer. It is important to check all valves and ensure the intended path will be followed.

The following text details machine operation and palliative application:

Before starting the engine

1. Check oil in engine.
2. Check fluid level in diesel fuel tank.
3. Check level of hydraulic oil in tank, and ensure the level is showing in the sight glass.
4. Inspect air cleaner; clean if necessary.
5. Check all ball valves to make sure they are closed.
6. Make sure drain plug is in place and secure.
7. Turn the key to preheat. When the glow plug indicator light goes off, hold the safety switch and turn the key to the start position. Continue to hold safety switch for 10 sec after engine starts. Allow the engine to warm up before starting the agitator or spraying.

Agitation

The hydroseeder is agitated by mechanical paddles that keep fluids mixed inside the tank. The speed can be adjusted by the control lever mounted on the front of the hydroseeder (Photo 24). Products that will be diluted with water should be agitated for approximately 5 minutes prior to spraying. Rapid agitation may cause foaming within the tank.

Hose application

The hydroseeder is equipped with a 200-ft hose for applying dust palliatives to various areas, including helipads and base camps. Ensure that the spray nozzle is inserted into the hose and that the ball valve is closed (Photo 25). Release the pin in the hose reel and pull out the desired length of hose. One to five people may be needed to carry the hose as the product is applied. Open the valves leading from the pump to the hose, make sure the alternate paths are closed, and open the valve on the spray tip. Engage the pump clutch

(Photo 26) and begin spraying from side to side with the fan nozzle perpendicular to the ground. Adjust the pressure by changing the throttle position (Photo 27).

When the desired product has been applied, slow the engine to idle speed, disengage the pump clutch, close the valves, and press the button located below the hose reel to electrically retrieve the hose. Replace the pin to lock the hose reel.

Tower gun application

The tower gun can be used to spray road shoulders, embankments, helipads, or most other areas where overspray will not interfere with equipment, structures, or personnel. This method is used to rapidly treat problematic areas. Two long-distance and two wide-fan nozzles (Photo 28) are available, depending on the desired spray pattern. The long-distance nozzles can spray approximately 130 ft. Ball valves (foot pedal) should be open to direct fluid only to the tower gun. Insert the appropriate nozzle and aim the tower gun in the desired direction. Be careful to note prevailing wind direction when spraying dust palliatives with the tower gun. Engage the pump clutch to begin spraying. Increase pressure to achieve the desired spray distance and pattern by adjusting the throttle. When finished applying dust palliative, slow the engine to idle speed, disengage the pump clutch, and close the ball valve controlled by the foot pedal on the tower gun.

Distribution bar application

The distribution bar on the hydroseeder allows for continual application of dust palliative on roads or other traffic areas as the transport vehicle travels. Five wide-fan spray nozzles on the distribution bar spray a total of 50 gal/min (Photo 29). Travel speed should be adjusted according to the desired application rate. The height of the distribution bar should be adjusted to achieve overlapping spray through the fan nozzles. The rubber 2-in. hose in the storage compartment connects the distribution bar to the pump. First, make sure only the fluid lines directing product to the distribution bar are open. Begin forward movement of the vehicle and begin spraying by engaging the pump clutch. Adjust the spray pattern by increasing the engine speed with the throttle. When

finished, slow the engine to idle speed, disengage the pump clutch, and close the ball valve leading to the distribution bar. Be sure to turn pump off before indicating for the vehicle driver to stop.

Cleaning and Maintenance

The hydroseeder should undergo routine maintenance and inspection at intervals indicated by the owner's manual. All fluid levels and filters should be checked prior to use. Replacement parts should be ordered from the manufacturer according to the owner's manual. Proper storage procedures should be followed when exposing the hydroseeder to cold temperatures to prevent damage from freezing water within the distribution lines.

The hydroseeder should be properly cleaned after each application. The flush tank should be kept full to immediately clean the distribution system after spraying **polymers** or other **crust-forming products**. Water should be sprayed until no visual evidence of product remains. The addition of soap may be necessary to clean **synthetic fluids** from the tank; however, they can remain in the system for prolonged periods of time without concern.

Improperly cleaned systems may develop clogs or films of plastic when using polymer emulsions for dust mitigation. The dried material must be removed by mechanical means (i.e., pressure-washing, scraping) or by chemical solvents such as paint strippers or JP8 fuel. Proper safety precautions should be taken when using any chemical solvents.

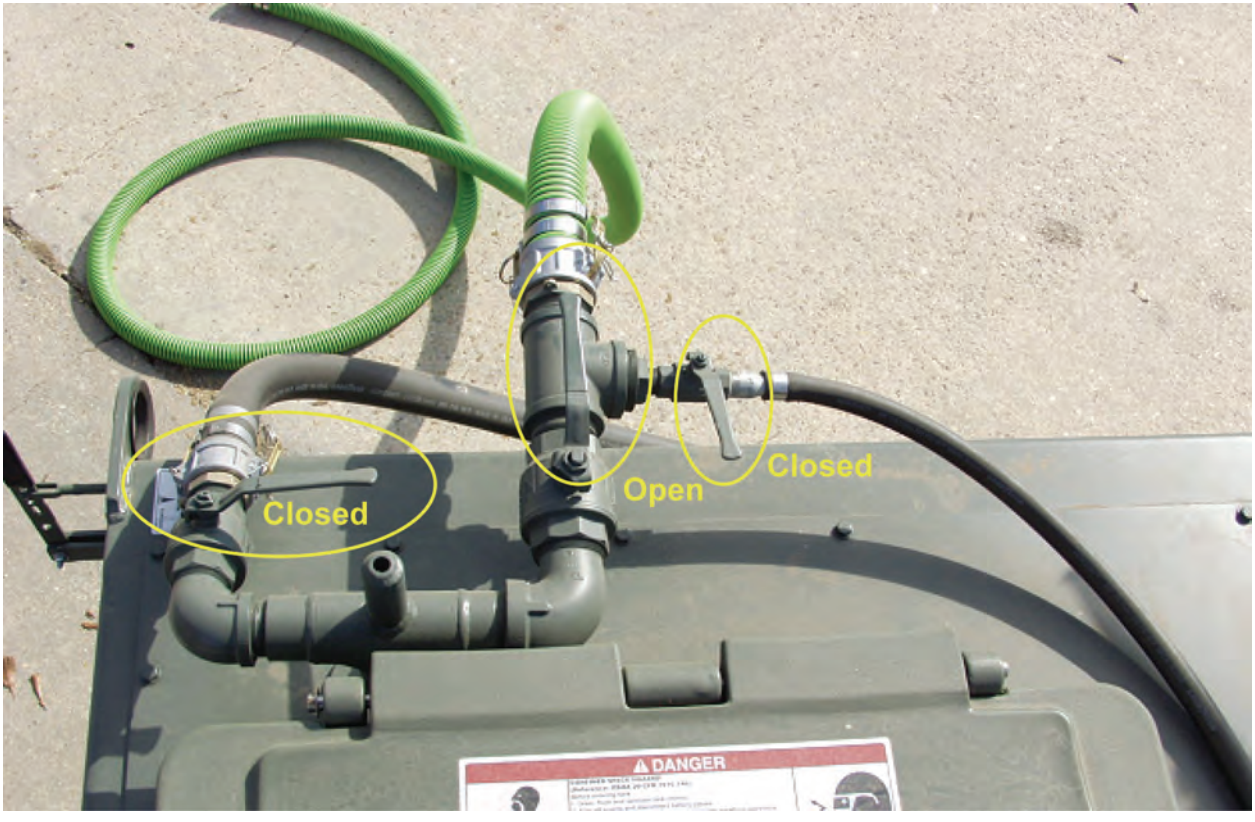

Photo 20. Filling hydroseeder from external pump or water source

Photo 21. Filling hydroseeder from storage container using onboard hydrostatic pump

Photo 22. Hydraulic suction pump engagement lever on Finn hydroseeder

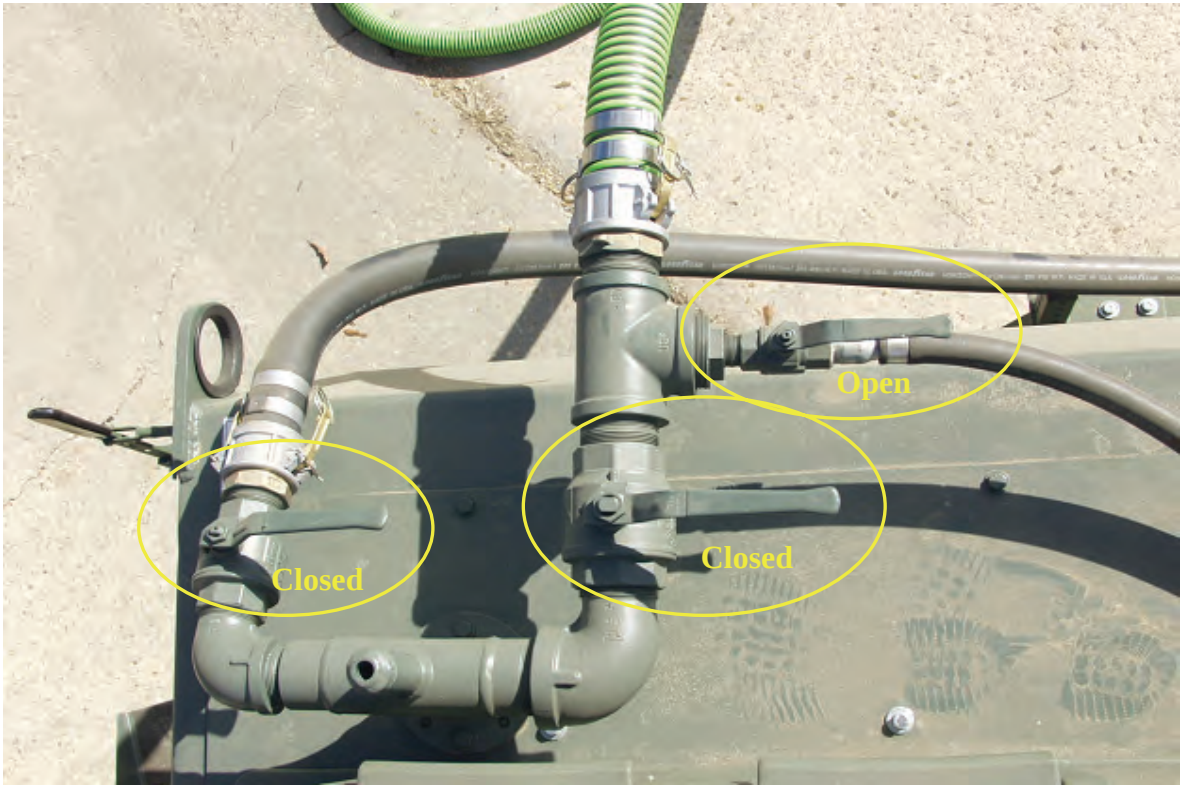

Photo 23. Filling flush tank from external water source

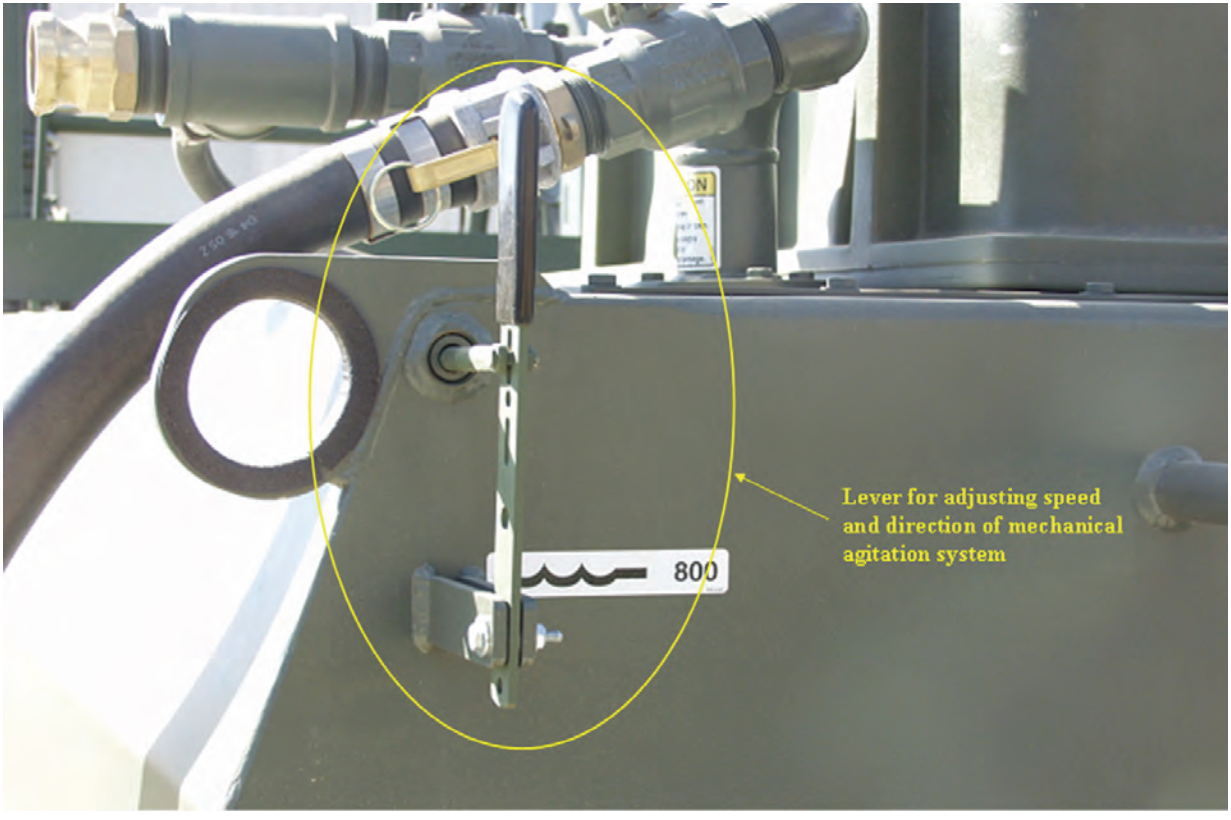

Photo 24. Lever for controlling mechanical agitation system

Photo 25. 200-ft hose with electric reel for multiple-use palliative distribution

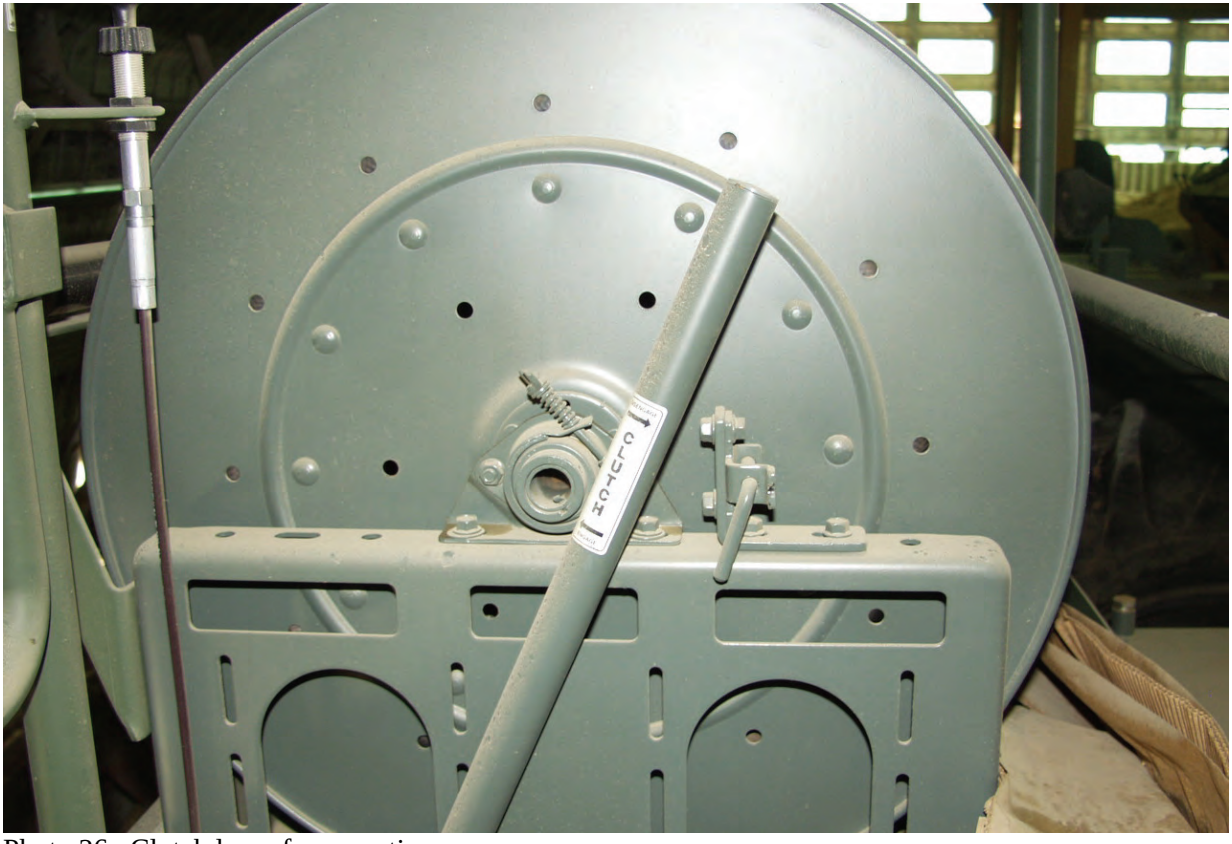
Photo 26. Clutch lever for operating pump

Photo 27. Engine throttle for Finn hydroseeder located by tower gun

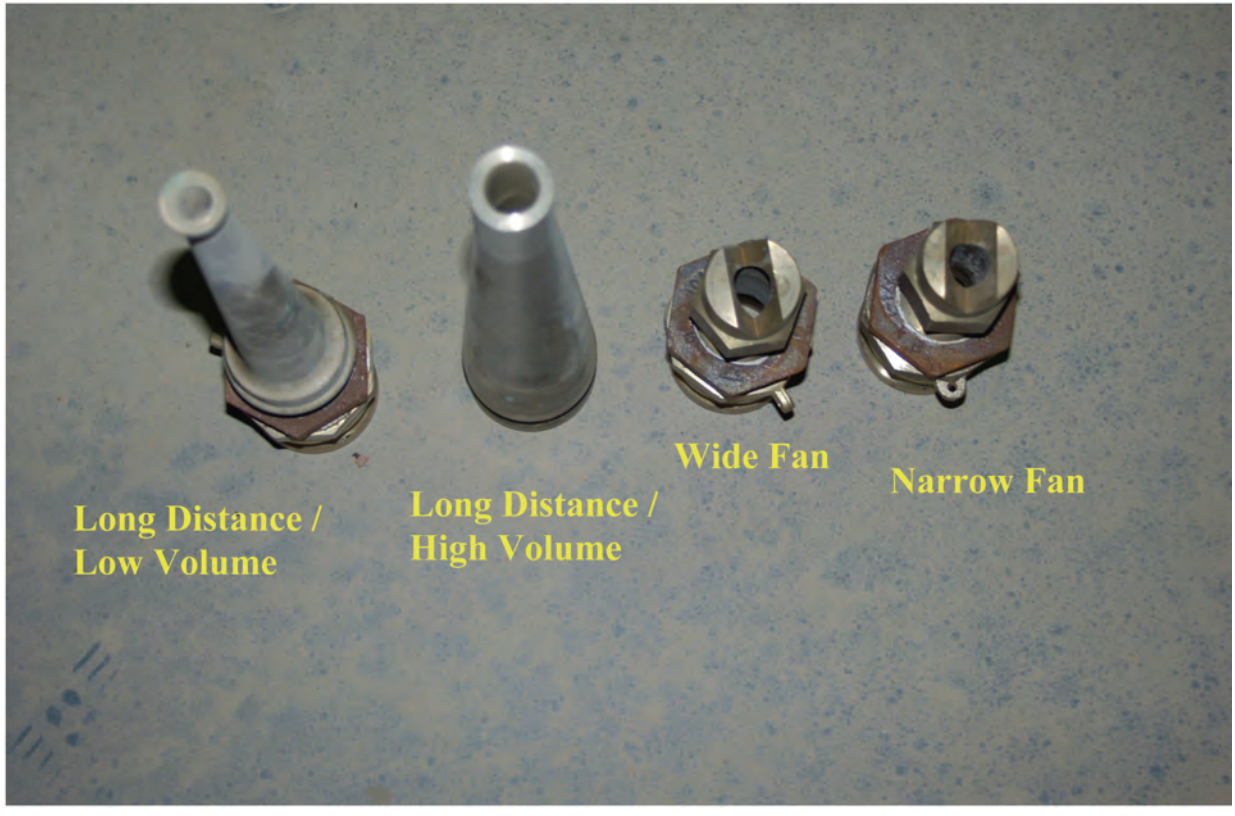

Photo 28. Spray nozzles for various spray patterns

Photo 29. Distribution bar on rear of hydroseeder

Tips for Selecting Dust Palliatives

Many vendors offer chemicals that they claim will eliminate dust in any circumstance. Most of the claims mentioned are partially true at best. It is important to rely on experience and product reputation when choosing a product to use. The list of product names included in this document is only a fraction of those available. The task of choosing the best product is not easy.

The first decision should be which chemical type will best suit the project needs. This may be governed by funding, logistics (shipping volumes), performance, or other considerations. Table 1 (tab *Recommended Applications*) lists recommended products for different applications based upon field test results from the ERDC. The list is not necessarily inclusive, and other chemical types may be equally effective in certain conditions. It is merely a guide in the decision-making process.

Logistical considerations should be made when choosing liquid chemicals for dust control. It is important to consider the specific gravity of the product and the volume that is required. For example, synthetic fluids weigh around 7.4 lb/gal. Polymer emulsions weigh over 9 lb/gal. Chloride salt solutions weigh over 10 lb/gal. These differences can have a large impact on the shipping weights for a given volume of product. The chemicals will typically be shipped in 275-gal containers. This brings the total weight for one container to approximately 2,000 lb for synthetic fluids, 2,500 lb for polymer emulsions, and 2,900 lb for chloride salts. An additional consideration is the volume of product needed. Synthetic fluids and chloride salts will be used in their concentrated form. Emulsions will be diluted using 3 parts water to 1 part product. If water is not available onsite, it will also have to be shipped.

The difference in products within chemical classes is generally indiscernible, but could be quite significant. The most important aspect for many of the products is the concentration of active ingredients. For example, chloride salts should contain around 38 percent salt (percentage may be less for magnesium chloride). Polymer emulsions generally contain 40 to 50 percent solid polymer. Requesting product specifications can ensure that pre-diluted materials are not being sold for full market value. Other considerations, such as viscosity differences and chemical composition, have been shown by ERDC research to represent only minor variations. Ultimately, the decision-making process will rely on the cost of the material unless relevant objections can be raised to eliminate a particular vendor from consideration.

It is important to realize that emulsified products have limited shelf lives. They consist of finely dispersed hydrophobic particles suspended in water. The dispersion is relatively unstable and may result in settling of the solid particles. Normal mixing procedures will not allow these particles to go back into a solution, and the product will not perform to its original properties. Emulsions should be kept away from extreme heat, ultraviolet light, and freezing temperatures. Chloride salts, polyacrylamides, powdered polymers, and synthetic fluids do not have limitations on shelf life.

Tips for Selecting Application Equipment

Application equipment should be selected based upon the types available for the project. Projects occurring on or near military installations are more likely to have a broader range of choices for equipment types. Expeditionary missions in active theaters may preclude the use of many types of machinery. The ultimate goal is to use equipment that will allow the most efficient progress for placing dust palliatives. Larger areas will need dispersions systems with large capacities. Liquid discharge is usually not the most time-consuming process. A hydroseeder can be used to spray over 100 gal per minute. Other systems using a distribution bar may spray around 50 gal per mininute. The time required to empty any tank at this rate will be relatively small. The process dominating the construction time (for topical applications) is transporting and filling the equipment. For large jobs, it is important to use methods that can reduce these steps. For treating small areas, time may not be as critical a factor.

Tips for Applying Dust Palliatives

Dust palliatives are commonly applied topically to a soil. This technique is a rapid solution to typical dust problems. The distribution equipment available will dictate the method that is used for applying the product. Equipment with distribution bars should be calibrated by adjusting the speed to obtain the desired application rate (Equation 1). Distributing dust palliatives via hose or other spray systems requires the operator to monitor the fluid level of the product in the holding tank to estimate the coverage. These adjustments are relatively easy to regulate.

$$\text{Vehicle\_Speed}\left(\frac{\text{ft}}{\text{min}}\right) = \frac{9 \cdot \text{Pump\_Outlet}\left(\frac{\text{gal}}{\text{min}}\right)}{\text{Application\_Rate}\left(\frac{\text{gal}}{\text{yd}^2}\right) \cdot \text{Spray\_Bar\_Width (ft)}} \qquad \text{(Eq. 1)}$$

Distribution equipment may have mechanisms that enable the operator to pump dust palliatives directly from their shipping containers to the holding tank. If this is not possible, the ERDC recommends transferring palliatives using a small, multipurpose centrifugal pump with approximately a 5.5-hp engine and 200 gal/min discharge capacity through a 2-in. hose (Photo 30). These types of pumps should be sufficient to transfer palliatives and provide adequate durability. The pump should be equipped with a rigid 2-in. hose and quick-connect fittings for rapid hookup/disassembly.

Dust palliatives are generally shipped in 275-gal plastic containers (Photo 31) with a discharge valve on the bottom. It is recommended that the procurement contract mandate that these containers be equipped with quick-connect fittings to easily link to suction hoses.

It is generally recommended that dust palliatives that consist of emulsified products be added to the container after the necessary dilution water is placed into the tank. If the emulsion is added first, excessive foaming may occur during the addition of dilution water (Photo 32).

All equipment should be thoroughly rinsed with water after transferring dust palliatives. Additionally, it is important to flush all distribution systems with water after applying dust palliatives. Film-forming products (polymers, lignosulfonates) will coagulate within the distribution system and clog equipment. Cleaning the equipment after this occurs may require significant disassembly. Organic solvents may also be required to completely remove remaining polymer. It is important to rinse equipment after spraying chloride salts because of their tendency to corrode metal and initiate rust formation. Rinsing may be optional when using synthetic fluids for dust control. They tend to lubricate equipment and have not been found to generate problems. Cleaning will be necessary if other types of liquids are to be placed into the equipment for other purposes.

Reapplication of dust palliatives may be necessary, as the effectiveness of the products diminishes over time. Areas treated with chloride salts or synthetic fluids may be rejuvenated by applying more palliative at approximately half the original application rate. Additionally, any troublesome area or exposed untreated soil may be fixed by coating that particular region with small quantities of product. Reapplication on polymer-treated soil may require some site preparatory work prior to spraying. The existing polymer film, if undisturbed in some areas, will tend to repel the emulsion and prevent penetration of the new product. Using methods to pulverize or scarify the soil may improve reapplication.

Dust mitigation, particularly on lines of communication, may require using the admix method to incorporate the dust palliatives into the soil for better performance. If a rotary mixer is not available, it may be best to simply compact the soil and topically apply the dust palliative. If the surface is hard and palliative ponding or

runoff becomes a problem, try applying in successive treatments of lighter application rates until the total recommended rate is achieved. This is particularly true when using polymer emulsions. They have some adhesive properties and are difficult to mix using other techniques such as windrowing with a motor grader. Applying polymer emulsions to the soil prior to compaction may cause the soil/product to stick to the roller of the compactor.

Photo 30. Mixing dust palliative in soil with rotary mixer

Photo 31. Transferring dust palliative from container to hydroseeder with centrifugal pump

Photo 32. Transferring dust palliative from 275-gal shipping container

Photo 33. Excessive foaming in hydroseeder as dilution water is added to

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14. ABSTRACT

The U.S. Army Engineer Research and Development Center has evaluated potential chemical dust palliatives for mitigating fugitive dust in military operations. The products were compared in laboratory testing and several field trials. The results of these efforts are compiled in this document to provide assistance for selecting and applying chemical dust palliatives for use on helipads, roads, airfields, and base camps. This document summarizes recommendations and conclusions derived from individual research projects. The information is intended to serve as a guide for acceptable dust mitigation. Variations of the procedures documented may be necessary to meet specific requirements.

15. SUBJECT TERMS

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Dust
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Dust control
Dust mitigation
Helipads
Roads

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