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FROM: AFCESA/CES
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SUBJECT: **Engineering Technical Letter (ETL) 08-XX: Chemical Dust Control for Contingency Roads, Base Camps, Helipads, and Airfields**

1. Purpose. This ETL provides guidance for the mitigation of dust for contingency roads, base camps, helipads, and airfields. This document includes detailed guidance for the selection and application of chemical dust palliatives within contingency environments.

2. Application. All Department of Defense organizations responsible for airfield maintenance and repair. The implementation of dust mitigation technology is necessary to reduce foreign object debris (FOD) potential, improve the safety of military operations, and reduce the operational hazards to military personnel.

2.1. Authority: Air Policy Directive 32-10, *Air Force Installations and Facilities.*

2.2. Coordination: Major command (MAJCOM) pavement engineers.

2.3. Effective Date: Immediately. This ETL will remain in effect until these findings are incorporated into Joint Service doctrine.

2.4. Ultimate Recipients*:*

- Air Force Prime BEEF Civil Engineers and RED HORSE Units,
- Army Corps of Engineers,
- Navy and Marine Corps,
- Construction contractors performing DOD airfield repairs,
- And other organizations responsible for airfield maintenance.

3. Acronyms and Terms:

AFCESA – Air Force Civil Engineer Support Agency
ASTM – American Society for Testing and Materials
BCE – base civil engineer
BEEF – base engineer emergency force
DOD – Department of Defense
ERDC – U.S. Army Engineer Research and Development Center
ETL – engineering technical letter
FAARP – Forward Area Arming and Refueling Point
FOD – foreign object debris
In. – inches
lb – pounds

gal – gallons
gsy – gallons per square yard
hr – hours
MAJCOM - major command
OPC – ordinary portland cement
PCC – portland cement concrete
psi – pounds per square inch
RED HORSE – Rapid Engineers Deployable - Heavy Operations Repair Squadron
USAF – United States Air Force

4. Preface. The U.S. military was plagued by fugitive dust during Operations Enduring Freedom and Iraqi Freedom. The generation of airborne dust during air and ground operations significantly impacted ground maneuver, fixed-wing and rotary-wing aircraft missions. Ground vehicles experienced safety hazards during convoy activities and exposed personnel to potential health hazards due to exposure to fine particulate matter. In addition, the widespread accumulation of dust during ground vehicle operations and in base camps adversely impacted the ability of military personnel to effectively conduct combat operations. Rotary-wing aircraft often experienced "Brown Out" conditions in which the density of airborne dust was such that the pilots lost site of the ground resulting in hazardous operating conditions. Aircraft and personnel were lost due to accidents resulting from "Brown Out" conditions. Fixed-wing aircraft operations in contingency environments generated significant dust from operating on semi-prepared surfaces and unusually narrow taxiways and runways. The dust generated resulted in increased aircraft maintenance, airfield maintenance (particularly sweeping operations), and reduced operations tempo while waiting for dissipation of dust clouds generated during aircraft landings and departures.

The U.S. Army Engineer Research and Development Center (ERDC) was tasked by the U.S. Air Force Civil Engineer Support Agency (AFCESA) to develop dust control guidance to address these concerns. The ERDC recently concluded research and development of chemical dust palliatives for the U.S. Marine Corps Systems Command for mitigating dust for two distinct applications, one for expeditionary use on Forward Area Arming and Refueling Points (FARPs) and one for sustainment use on roads and other large area applications. The technology developed under the Marine Corps' program was leveraged and applied to fixed-wing aircraft operations including field tests at two semi-prepared runway test sites sustaining C-17 aircraft operations. The results of these experiments were used to develop the guidance reported herein.

5. Relevant Standard Test Methods.

5.1. American Society for Testing and Materials (ASTM), Annual Book of ASTM Standards, 100 Barr Harbor Drive, West Conshohocken, PA:

5.1.1. ASTM D 2487, "Standard Classification of Soils for Engineering Purposes (Unified Soil Classification System)."

5.1.2. ASTM D 2834, "Standard Test Method for Nonvolatile Matter (Total Solids) in Water-Emulsion Floor Polishes, Solvent-Based Floor Polishes, and Polymer-Emulsion Floor Polishes."

6. Summary of Recommended Product Applications.

6.1. General Application Guidance. This section provides a quick reference tool for rapidly selecting the type of dust palliative, the target palliative application rate, and method of applying the product for a variety of dust abatement missions. The recommended use of this ETL is summarized in the following steps:

1. Use Table 6.1.1 to select the recommended type of product.
2. Review the *Detailed Dust Palliative Description* in Section 6.2.
3. Select product from recommended product category (Table 6.2.4.1).
4. Review the *General Application Information* in Section 6.3.
5. Review the *Detailed Application Guidance* in Section 6.4.

Table 6.1.1 provides a summary table for selecting the type or category of dust palliative recommended for a particular application. The table provides general guidance concerning the recommended application rate or quantity of product to be used as well as information on whether the product should be diluted with water prior to use. Table 6.1.1 also indicates whether the material should be applied topically or admixed into the soil to achieve the desired dust control results. Table 6.1.1 includes the primary solution recommendations on the left side and a secondary solution on the right side of the table if site conditions or the mission scenario preclude the use of the primary solutions.

Table 6.1.1
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[#]
Roads	Polymer Emulsion	0.8 gsy	3:1	admix	Synthetic Fluid	0.6 gsy	n/a	topical
Helipads	Synthetic Fluid	0.4 gsy	n/a	topical	Polymer Emulsion	1.2 gsy	3:1	topical
Base Camps	Synthetic Fluid	0.4 gsy	n/a	topical	Polymer Emulsion	0.6 gsy	3:1	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 inches.

6.2. Detailed Dust Palliative Description. This section describes the different categories of chemical dust palliatives that are recommended. The selection of the

correct type of dust palliative is critical to ensure that the method of dust abatement employed by the chemical is compatible with the mission.

6.2.1. 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). Due to some vendors having diluted polymer emulsion products in the past, it is recommended that random samples of the bulk product be taken to ensure that the bulk product includes at least 40 percent solids according to ASTM D 2834. Polymer emulsions should not be mixed with gray or salt water for dilution.

Table 6.2.1.1. Polymer Emulsions

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 Roads Base Camps Airfields	May require mixing with soil for roads 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, Inc	Chad Falkenberg	1-800-545-5420	info@soilworks.com

6.2.2. 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.

Table 6.2.2.1. 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, Inc. 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)

6.2.3. 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. Follow-on applications have a cumulative effect.

Table 6.2.3.1. Synthetic Fluids

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, Inc. Chad Falkenberg 1-800-545-5420 info@soilworks.com	Helipads Roads Base Camps Airfields	more expensive than most products	275-gal containers (2,000 lb)

6.2.4. Vendor Summary. As of 2008, a list of potential vendors is summarized in Table 6.2.4.1 below to assist in the procurement of products.

Table 6.2.4.1. Product and Vendor Information

Product Category	Dust Palliative	Vendor	POC	Telephone	Email
Polymer Emulsion	Soiltac	Soilworks	Chad Falkenberg	1-800-545-5420	info@soilworks.com
Polysaccharide	Surtac	Soilworks	Chad Falkenberg	1-800-545-5420	info@soilworks.com
Synthetic Fluid	Durasoil	Soilworks	Chad Falkenberg	1-800-545-5420	info@soilworks.com

6.3. General Application Information. The following section briefly describes the primary considerations and methods for applying the recommended dust palliatives.

6.3.1. 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. The soil type should be classified according to ASTM D 2487.

6.3.2. 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 6.1.1 lists some of the recommended products for different dust control needs.

6.3.3. 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 1.2 gsy in order to produce thicker surface crusts to reduce FOD potential. Refer to Table 6.1.1 for detailed guidance on selecting application rates. Note that higher application rates may be required if the polymer emulsions/polysaccharides are pre-diluted by the vendor as evidenced by less than 40 percent solids according to ASTM D 2834.

6.3.4. Dilution Ratios. Some products may require dilution with water. These are typically any emulsified products (polymers, polysaccharide). Diluting the emulsion will reduce the viscosity and improve penetration. In general, 3 parts water should be added for each part product. Note that the recommended dilution ratio may need to be reduced if the palliatives have been pre-diluted by the vendor to less than 40 percent solids according to ASTM D 2834. Synthetic fluids are intended for use “as received” and should be applied in their concentrated form.

6.3.5. 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 spraying the 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.

6.3.6. 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 for roads should be at least 3 in. and 4 in. for airfields. The following procedure (Photos 1 through 4) is recommended for incorporating the dust palliative into the soil:

(1) Grade the soil if necessary using a motor grader (Photo 6.3.6.1).
(2) Spray half of total palliative application rate onto the soil surface.
(3) Blend into top 3 in. of soil using rotary mixer (Photo 6.3.6.2).
(4) Compact using steel-wheeled vibratory roller (Photo 6.3.6.3).
(5) Spray remaining product onto compacted surface (Photo 6.3.6.4).

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

Photo 6.3.6.1. Grading road surface prior to treatment.

Photo 6.3.6.2. Applying product with hydroseeder and mixing into the road surface with a rotary mixer.

Photo 6.3.6.3. Compacting road surface after mixing.

Photo 6.3.6.4. Applying final spray to seal road surface after compaction.

6.3.7. Distribution Equipment. A variety of distribution equipment can be used to spray apply the palliatives. Table 6.3.7.1. includes some equipment used by the ERDC.

Table 6.3.7.1. Distribution Equipment and Vendor Information

Equipment Type	Model*	Vendor	POC#	Telephone	Email
Hydroseeder	T 90 T120	Finn Corp	Robert Portney	513-874-2818 800-543-7166	Sales@finncorp.com
Water Distributor	613CWD	Caterpillar	Brent Bargfrede	309-578-6378	Bargefrede_c@cat.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.
# Subject to change

6.4 Detailed Application Guidance. This section provides detailed guidance for treating helipads, roads, large open areas, base camps, and fixed-wing airfield facilities.

6.4.1. Dust Abatement on Helipads. This paragraph provides guidance for mitigating dust on unsurfaced helipads. The equipment requirements may be modified depending upon availability and mission requirements. However, the general types of equipment and process should be similar.

6.4.1.1. Supplies. The necessary supplies include the following:

1. Truck to haul the Chemical Totes, pumps, etc. and to tow the distribution equipment if necessary.
2. Hydroseeder or other spray distribution system compatible with the chemical selected.
3. (2-4) 275-gal totes dust palliative (synthetic fluid – primary option).
4. (1) trash pump and hoses with quick-connect ends to transfer the material from the tote to the distributor if the distributor does not include a pump.
5. (3) Airmen.

6.4.1.2. General Procedures. The general application procedures are as follows:

1. Survey and visibly establish area to be treated.
2. Place synthetic fluid into Hydroseeder/Distributor (Photo 6.4.1.2.1).

a. 450 gallons for 100-ft by 100-ft helipad for smaller rotary-wing aircraft.
b. 900 gallons for 150-ft by 150-ft helipad for larger rotary-wing aircraft.
c. Quantities will be larger for treating with a polymer emulsion as an alternative solution. Follow dilution/application guidance in Table 6.1.1.
d. If a polymer emulsion is used as the secondary solution, the material must be diluted 3:1 with water and agitated for a minimum of 5 minutes prior to application.

3. Position the Hydroseeder/Distributor on edge of helipad.
4. Use the tower gun and a long distance nozzle to spray half of product to half of helipad (Photo 6.4.1.2.2).
5. Move to the opposite side of helipad and spray the remaining product.
6. If the distributor does not have standoff spray capability, it may be necessary to traverse the helipad ensuring spray overlap. Note: if the helipad ruts significantly under the distributor, an attempt to smooth the ruts should be made and the ruts retreated by a hand wand to keep the ruts from acting as erosion focal points during aircraft operations.
7. Helicopters can land immediately for areas treated with synthetic fluids; however, best results may occur after one day (Photo 6.4.1.2.3). If a polymer emulsion is used as the alternative solution, the material must be allowed to cure for 24 hours prior to allowing traffic on the helipad.

Photo 6.4.1.2.1. Filling hydroseeder from material tote.

Photo 6.4.1.2.2. Topical application from hydroseeder tower gun.

Photo 6.4.1.2.3. UH-1 rotary-wing aircraft operating on treated helipad.

6.4.2. Dust Abatement on Roads. This paragraph provides guidance for mitigating dust on unsurfaced roads. The equipment requirements may be modified depending upon availability and mission requirements. However, the general types of equipment and process should be similar.

6.4.2.1. Supplies. The necessary supplies include the following:

1. Motor grader for initial grading if necessary.
2. Truck and or HMMWV to haul the chemical totes, pumps, etc. and to tow the distribution equipment if necessary.
3. Hydroseeder or other chemical distributor compatible with products.
4. Polymer emulsion and water*
5. Rotary mixer for admixing

6. Steel-wheeled vibratory compactor
7. (3) Airmen and (2) Equipment Operators

* quantities must be calculated based upon length and width of road

6.4.2.2. General Procedures. The general application procedures are as follows:

1. Grade road to establish general grade requirements and correct distresses as shown in Photo 6.3.6.1.
2. Determine the length of road that can be treated per tank (Hydroseeder/Distributor capacity):

   Length (yd) = tank capacity (gal) / [application rate (0.4 gsy) * road width (yd)]

3. Place 675 gallons of water into Hydroseeder/Distributor (Minimum 900-gallon capacity). For smaller distribution equipment recomputed quantities to match the recommended dilution ratio.
4. Add 225 gallons of polymer emulsion.
5. Mix for 5 minutes using mechanical agitation.
6. Apply to road surface using distribution bar or wide fan nozzle on tower gun.
7. Immediately till road surface to 3-in. depth using rotary mixer (Photo 6.3.6.2).
8. Compact soil until desired density is achieved (Photo 6.3.6.3).
9. Repeat steps *2-7* as needed.
10. Spray light application 0.2 gsy over compacted road surface (Photo 6.3.6.4).
11. Repeat steps 1-9 for subsequent road lengths to be treated.

6.4.3. Dust Abatement in Base Camps and Other Non-Traffic Areas. This paragraph provides guidance for mitigating dust in general base camp areas and other non-traffic areas. The application guidance for these areas is less robust and more cost effective since the surface is subjected to reduced loading requirements. Thus, this guidance should not be used for areas directly exposed to vehicle traffic. The equipment requirements may be modified depending upon availability and mission requirements. However, the general types of equipment and process should be similar.

6.4.3.1. Supplies. The necessary supplies include the following:

1. Truck and or HMMWV to haul the Chemical Totes, pumps, etc. and to tow the distribution equipment if necessary.
2. Hydroseeder or other chemical distributor compatible with products.
3. Synthetic fluid*.
4. (3) Airmen.

* Quantities must be calculated based upon recommended application rate of 0.4 gsy and the length and width of the area to be treated.

6.4.3.2. General Procedures. The general application procedures are as follows:

1. Determine the area of road that can be treated per tank (Hydroseeder/Distributor capacity):

   Area (sq yd) = Product (gal)/Application Rate (0.4 gal/sq yd)

2. Fill the distribution equipment with synthetic fluid. It is not diluted.
3. Apply to road surface using distribution bar, wide fan nozzle on tower gun, or hand wand/hose.
4. Repeat steps 1-3 as needed.

6.4.4. Dust Abatement Around Fixed-Wing Airfields. This paragraph provides guidance for mitigating dust around fixed-wing airfields. Due to safety concerns associated with surface friction requirements, dust palliatives are not recommended for use on any primary operating surface of the airfield. The exception is when the palliative is used as a soil stabilization agent and effectively admixed into the soil at depths greater than 4 inches and at higher rates typical of soil stabilization. Additionally, since the shoulders of unsurfaced airfields are designed to support occasional aircraft loading, it is also not recommended that the products be used on the shoulders of unsurfaced airfields. Thus, the use of chemical dust palliatives is limited to the graded areas of unsurfaced airfields. For paved airfields, chemical dust palliatives may be used on any unpaved area around the perimeter of the pavement including unpaved shoulders and graded areas. Due to potential foreign object debris (FOD) concerns, it is highly recommended that the synthetic fluids be used for this application. If the alternative polymer emulsion solution is used, the material MUST be admixed into the soil to minimize FOD potential. Polymer emulsions or other stabilization additives cannot be topically applied around fixed-wing airfields due to the potential to form thin crusts capable of generating FOD. The equipment requirements may be modified depending upon availability and mission requirements. However, the general types of equipment and process should be similar.

6.4.4.1. Supplies. The necessary supplies include the following:

1. Truck and or HMMWV to haul the chemical totes, pumps, etc. and to tow the distribution equipment if necessary.
2. Hydroseeder or other chemical distributor compatible with products.
3. Synthetic fluid*.
4. (3) Airmen.

* Quantities must be calculated based upon recommended application rate of 0.4 gsy and the length and width of the area to be treated.

6.4.4.2. General Procedures. The general application procedures are as follows:

1. Determine the area of road that can be treated per tank (hydroseeder/distributor capacity):

Area (sq yd) = Product (gal)/Application Rate (0.4 gal/sq yd)

2. Fill the distribution equipment with synthetic fluid. It is not diluted.
3. Apply to road surface using distribution bar or wide fan nozzle on tower gun.
4. Repeat steps 1-3 as needed.

6.4.4.3 Application Areas for Fixed-Wing Facilities. A major consideration in the treatment of areas around fixed facilities is the size of the area. The width of treatment

along the perimeter is generally reasonable; however, the length of treatment for airfields can range from 1-3 miles per side of the runway. The resulting treatment area can accumulate quickly. An analysis of the propeller/jet wakes was performed for the C-130 and C-17, respectively, to develop recommendations for the width of the treated area. The minimum treatment width is based upon the wingspan of the aircraft and the highest intensity plume, while the optimum treatment width is based upon the distance required to reduce the exhaust plume to a maximum velocity of 50 ft/sec or 35 mph. As general guidance, the treatment width along each side of the runway and around any turnarounds or aprons should be:

1. C-130 Minimum Treatment Width – 27 feet
2. C-130 Optimum Treatment Width - 50 feet
3. C-17 Minimum Treatment Width – 50 feet
4. C-17 Optimum Treatment Width - 100 feet

For unsurfaced fixed-wing facilities the treatment should begin at the edge of the shoulder and applied outward into the graded area and transition area. For paved fixed-wing facilities, the treatment should begin at the edge of the paved surface and extend outward to the recommended width.

7. Point of Contact. Recommendations for improvements to this ETL are encouraged and should be furnished to the Pavements Engineer, HQ AFCESA/CESC, 139 Barnes Drive, Suite 1, Tyndall AFB, FL 32408-5319, DSN 523-6334, commercial (850) 283-6334, e-mail AFCESAReachbackCenter@tyndall.af.mil

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