DUST CONTROL AND THE UNITED STATES MILITARY

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Abstract

This paper addresses experiences and concerns with dust mitigation procedures used by the U.S. military. The paper describes the current criteria published for the military on dust mitigation and details a research program established to provide updated guidance for the U.S. Marine Corps to address specific requirements in recent combat operations. This criteria was recently extended to include applications for the U.S. Army and U.S. Air Force. The paper also points out future areas of research that are needed, including addressing environmental concerns, providing guidance for dust mitigation in non-traffic areas, developing environmental and performance approval procedures, erosion control, and updating military criteria.

Introduction

The United States military often operates in austere environments with little or no improved infrastructure. These types of battlefields are tactically desirable to minimize collateral damage during warfare. However, this scenario requires transport vehicles that maintain high mobility in complex terrains and environmental conditions. By their aggressive nature, these vehicles are often prone to dust generation during movement.

Dust generation has been a problem for the military for many years. Since the period of World War I and II, aggressive tank treads have caused heavy dust generation on unpaved surfaces. In Vietnam, heavy dust clouds were often a problem with the increased use of rotary wing aircraft. More recently, dirt airstrips for landing C-130 and C-17 cargo planes produce unmistakable dust signatures during takeoff and landing events. The dust generated during all of these maneuvers impacts operational requirements, produces safety hazards, increases maintenance requirements, and creates an additional threat during missions.

Dust Mitigation Practices

The current criterion for dust mitigation for the U.S. military is given in UFC 3-260-17 (1). This document was accepted for criteria in 2004 but contains the body of Army TM 5-830-3 dated 1987. The recommendations made in this document do not reflect recent advances in technology and current industry practices. The information appears to be dated well beyond the 1987 publication date. This observation is especially evident by photos below (Figure 1) that describe particular causes of dust. The U.S. military is operating more sophisticated equipment today that requires special considerations for dust mitigation treatments.

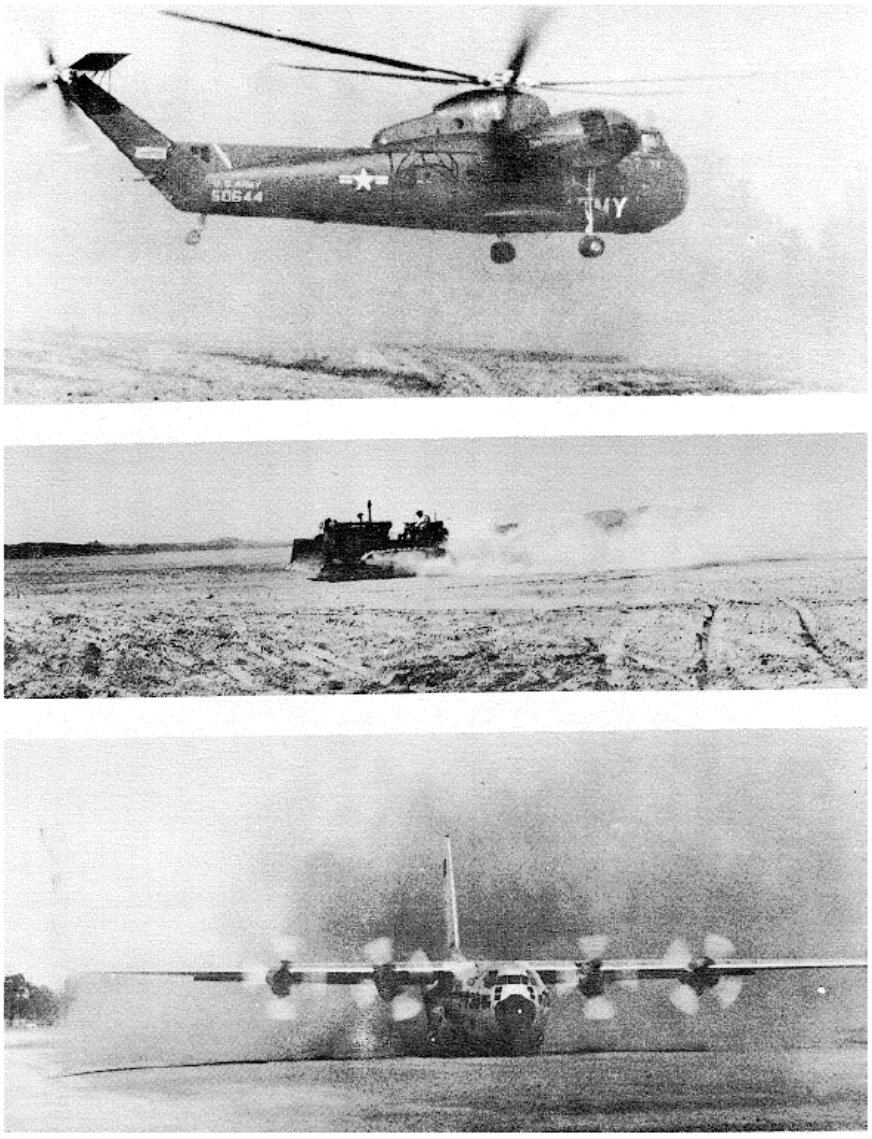

Figure 1. Excerpt from UFC dust control manual

The lack of relevant criteria for mitigating dust subsequently translates into inadequate practices by personnel in the field. Dust has been a significant obstacle during current operations in Iraq and Afghanistan, and many materials and techniques to combat the problem have been attempted with varying degrees of success. The lack of proper guidance for these techniques has led to two often occurring results.

First, products have been purchased to solve a dust problem that they are not capable of solving. For example, using a chloride salt in the extreme desert conditions in Iraq where humidity is low will lead to poor performance because the salt cannot absorb enough moisture from the air to function properly. This type of improper application wastes time and resources and causes frustration on the part of the user.

The other common occurrence is the improper application of an acceptable product, leading to product distrust and abandonment. For example, a user may spray a surface treatment of a diluted polymer emulsion on very soft, loose sand and then operate heavy equipment in the area. The equipment will break the crust of physically bound soil and expose loose material that becomes airborne. The user experiences distrust in the product because it did not perform as expected, but the problem was that a useful material was placed in an ineffective manner.

These types of situations were commonly experienced by military personnel in Iraq and Afghanistan. Military personnel often relied on innovative solutions executed with makeshift equipment to provide adequate results. While some units were able to meet requirements, the lack of proper guidance created great inefficiency for the military as a whole.

Recent Research Activities

The U.S. Marine Corps recognized complications caused by dust during the early stages of operations in Iraq and Afghanistan. They also recognized the fact that they did not

possess the capability to combat the problem. This realization led to expedited funding to develop a system that could fill immediate and future dust mitigation needs. The U.S. Army Engineer Research and Development Center embarked on a three-year developmental research program to provide products, equipment and application recommendations for the Marines. The multifaceted research program addressed several specific concerns.

First, the Marines had no capabilities for distributing chemical dust palliatives. The construction inventory of the Marines is very limited and relies on assets of the Navy Seabees and other units to provide engineering and construction support. A distribution system had to be developed and fielded if the Marines were going to provide their own dust mitigation capability. The development process involved down-selecting candidates from commercially available distribution equipment for other industries and subjecting selected equipment alternatives to field evaluations under predetermined criteria. Recommendations were made for the modification of the equipment for specific Marine requirements during the acquisition phase. The final systems, a skid-mounted hydroseeder and a tow-behind hydroseeder, were delivered to the units responsible for dust mitigation along with a comprehensive training program on the equipment use.

Product recommendations and application guidance were simultaneously being developed through a series of field evaluations. These trials addressed specific needs for dust mitigation on unpaved roads and helicopter landing pads. Results from these tests were used to provide guidance on selecting chemical dust palliatives and for determining effective application procedures.

Field trials for selecting chemical dust palliatives for helipads took place at the U.S. Marine Corps Air Station, Yuma, AZ (2,3). The site for these tests is physiographically located in southwest Arizona in an arid environment. The soil consisted of a poorly graded sand with silt according to the Unified Soil Classification System. After removing vegetation from the testing site, the soil was very loose to a depth of approximately one foot. Twenty helipad locations were surveyed for treatment with a

variety of products at multiple application rates. Treated areas were subjected to landings with multiple types of rotary wing aircraft and analyzed for product effectiveness (Figure 2). Results were compared to an untreated control section. Two different sequences of tests were performed at this site. Data were used to determine appropriate products and minimal application rates for providing adequate dust mitigation under both small attack/utility helicopters and their larger, heavier cargo counterparts.

Figure 2. CH-46 Helicopter landing on treated helipad.

Other field evaluations were designed to provide guidance for mitigating dust on unpaved roads. One study took place in Douglas, AZ on a 3.2-mile section of road paralleling the border between the U.S. and Mexico used by the U.S. Border Patrol for surveillance (4). This particular climatic region was also considered arid. Traffic on the road consisted of lightweight trucks at a frequency of approximately 60 per day. Road test sections of 500 feet in length were treated with a variety of products (Figure 3). The evaluation also included a comprehensive evaluation of application procedures for identifying the most durable treatment option. Test sections were monitored at 30, 60, 90, and 180 days to provide data for making recommendations on desirable products and application procedures on unpaved roads in arid environments.

Figure 3. Treating road section in Douglas, AZ with chemical dust palliative.

An additional test of dust palliatives on unpaved roads was executed on training routes at Fort Leonard Wood, MO (5). This facility represented a temperate climate and is used to train U.S. Army personnel to operate large wheeled vehicles in convoys (Figure 4). Heavy dust concentrations are generated by these large vehicle movements. Again, multiple 600-foot long test sections were marked and treated with a variety of products to monitor the long term performance for each material. Data collections at 1, 3, and 8 months were performed to evaluate the products. Knowledge gained from these test sections was used to support previous research results and determine climatic considerations for product use.

Figure 4. Dust generation caused by military convoys operating on unpaved road.

Additional dust mitigation tests were performed to minimize dust during aircraft operations on semi-prepared airfields. Three airfields were treated with select dust palliatives to mitigate dust along the runway edges during aircraft operations. These data were used to supplement guidance for roads and helipads.

The field evaluation portion of the U.S. Marine Corps research program provided the data for complete operational dust mitigation guidance. The procedures and recommendation were compiled in a dust mitigation handbook that was published and distributed to the Marine units along with the distribution equipment (6). The initial field handbook was specifically tailored to meet the needs of the Marines, and a second edition was published that provide a more comprehensive guide for the other services (7).

Knowledge Gaps and Future Needs

The research program executed for the U.S. Marine Corps addressed many operational concerns for dust problems within the military. However, the program specifically identified solutions for Marine Corps problems. Additional needs of the other services should be addressed to provide comprehensive solutions for the military as a whole. Many of these needs could be addressed without significant effort by utilizing the knowledge base from the work that has been accomplished.

While the research described previously made great strides to combat dust in operational environments, areas of additional concern have been identified. First, even in the operational environment, adequate research has not been performed to address dust control in non-traffic areas. These areas are also prone to dust generation from loose surface soil that can be picked up and transported by wind. These areas were a nuisance at large base camps in Iraq and Afghanistan. Product application quantities required for adequate treatment would be significantly reduced from those recommended for traffic areas. These reductions need to be quantified through research.

Additionally, research performed under the Marine Corps program did not address compliance with air quality standards set by the U.S. Environmental Protection Agency (EPA). The work considered all dust to be the same. Any dust was assumed to be detrimental to military operations. Further research should characterize the dust by the size and how it is classified in EPA guidance. This work would be required to provide better recommendations to military installations in the U.S. on how to control dust for meeting air quality regulations. Further, a study focused on air quality compliance issues would be more beneficial to personnel tasked with routine dust mitigation efforts on these installations where no external threats exist. These installations often only need to address the environmental and safety concerns posed by dust generation, while current recommendations focus on sustaining adequate maneuverability.

Furthermore, many of these dust palliatives may be effective in minimizing surface soil erosion by binding near surface particles until the area can be re-vegetated using conventional means. Research is needed to define the erosion resistance requirement, test products for suitability, and provide cost-effective application guidance.

Limited work was performed on the individual dust palliatives to determine their impact on the environment. The ERDC research focused on the environmental assessment of a few select products identified during the program described above (8). The suppliers of these products are often not intimately aware of chemical composition of the product and any precautions that should be considered with their use in different environments. Any use of dust palliatives should be preceded with environmental approval, but the approval is generally left to the specific governing body where dust mitigation is required. A central authority should assess all market products and clear those that are deemed environmentally friendly. This approval could then be passed along at the local level to expedite projects.

Along with the environmental approval, an approved product list should be established for military use. A set of criteria needs to be developed that allows interested vendors to submit materials for testing. Acceptance to the list would need to be followed with

periodic conformance checking to ensure quality control of the manufacturing process. The products approved for use should be awarded national stock numbers for easy procurement by military personnel through the Defense Logistics Agency and GSA schedule for other government agencies.

Finally, results from recent and future research programs should be incorporated into the UFC manuals to update the criteria. This step is essential for providing users in the military with current best practices knowledge. Periodic updates should be performed to ensure that criteria does not become out of date and includes any recent advances in technologies.

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