Engineer Research and Development Center

Dust Control Program

Sponsored by

USMC SYSCOM

Outline

- Background
- Types of Dust Palliatives
- Field Testing in Yuma, AZ
- Field Testing in Douglas, AZ
- Field Testing in Fort Leonard Wood, MO
- Final Recommendations

Types of Dust Palliatives

- Chloride Salts
- Lignosulfonates
- Petroleum Products
- Polyacrylamides
- Polymer Emulsions
- Powdered Polymer
- Synthetic Fluids

Chloride Salts

Chloride Salt		
Product Description	**Effective Uses**	**Limitations**
Calcium, magnesium, or sodium chlorides dissolved in water. Absorbs moisture from air and locks down dust.	Lines-of-Communication	Corrosive, May leach from soil during rain, Limitations on Environmental Conditions

Lignosulfonates

Lignosulfonate		
Product Description	**Effective Uses**	**Limitations**
Tree rosins suspended in water by surfactants. Binds soil grains.	Lines-of-Communication	May leach from soil with precipitation Lower strength than polymer products

Petroleum Products

Asphalt Emulsion		
Product Description	**Effective Uses**	**Limitations**
Asphalt cement suspended in water by surfactants. Binds soil grains.	Lines-of-Communication	Requires specialized application equipment

Polyacrylamides

Polyacrylamide		
Product Description	**Effective Uses**	**Limitations**
Super-absorbent polymer. Absorbs moisture from air to lock down dust.	Helipads	Cannot be mixed with water. Must be applied as powder. Requires incorporating into soil.

Polysaccharides

Polysaccharide		
Product Description	**Effective Uses**	**Limitations**
Sugar/Starch solution Binds soil grains with biodegradable polymer	Base Camps	May leach from soil with rainfall Limited effective lifespan

Polymer Emulsions

Polymer Emulsion		
Product Description	**Effective Uses**	**Limitations**
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

Powdered Polymers

Powdered Polymer		
Product Description	**Effective Uses**	**Limitations**
Water-soluble polymer designed to bind soil grains. Product is mixed at a rate of 1.3 pounds per gallon water.	Helipads Lines-of Communication Base Camps	Poor penetration when applied topically Lower strength than polymer emulsions

Synthetic Fluids

Synthetic Fluid		
Product Description	**Effective Uses**	**Limitations**
Blend of isoalkanes that forms a reworkable binder in soil. Will not mix with water. Effective for long term use.	Helipads Lines-of Communication Base Camps Airfields	Cost

EXPEDITIONARY PALLIATIVE DISTRIBUTION SYSTEM

- **Helicopter Application: (Ruled Out)**
  - Uncontrollable
  - Maximum Waste
  - Dedicated Airframe

- **ATV Application: (Ruled Out)**
  - Reduced Logistics Footprint
  - No Productivity
  - Many Refillings to Complete Helipad

- **Emulsion Distributor Application: (Considered)**
  - Very Accurate Distribution Control (No Waste)
  - Large Capacity to Complete Helipad Without Refilling
  - Dedicated Equipment
  - Must Traverse Helipad to Apply – Disturbs Surface
  - Slower Than Other Methods

EXPEDITIONARY PALLIATIVE DISTRIBUTION SYSTEM

➢ Hydroseeder: (Considering)

- Moderate Distribution Control (Some Waste)
- Large Capacity to Complete Helipad Without Refilling
- Dedicated Equipment But Adaptable to Multiple Tow Vehicles
- Standoff Application for Undisturbed Surface
- Fastest Application Method for Liquids

➢ Overseeder Application: (Dry Application)

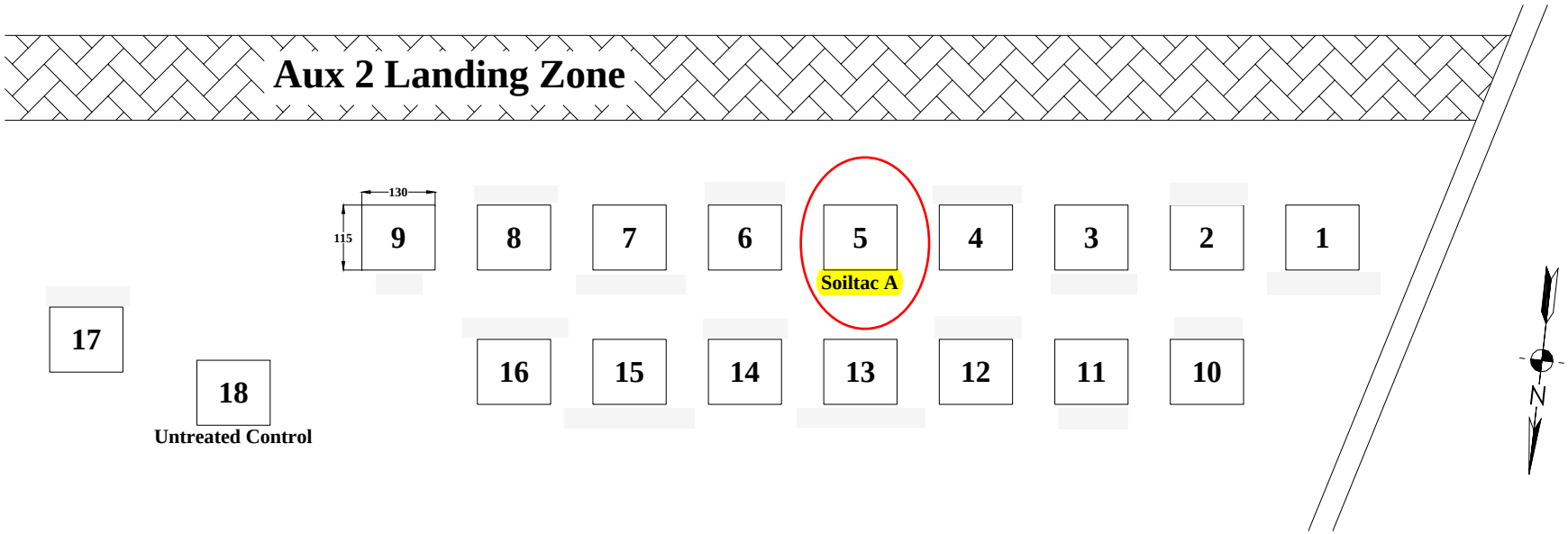
- Reduced Logistics Footprint
- Distribution, Mixing, and Sealing in One-Pass
- Many Require PTOs
- Modification Required for USMC Use

➢ HMMWV Application: (Dry/Liquid Application)

- MWSS 27 Modifying Equipment
- Capable of Dry/Liquid Application
- Limited Product Distribution Requires Refilling
- Must Traverse Site – Disturbs Surface
- Dedicated Vehicle

DEMONSTRATION OF APPLICATION TECHNOLOGIES

EXPEDITIONARY PALLIATIVE DISTRIBUTION SYSTEM
Yuma, AZ, Feb-Mar 2004



YUMA, AZ

- **Evaluation**
  - **Controlled Helicopter Landings**
  - **Pilot Feedback**
  - **Visual Ground Crew**
  - **Dust Collectors**
  - **Surface Evaluation Tests**

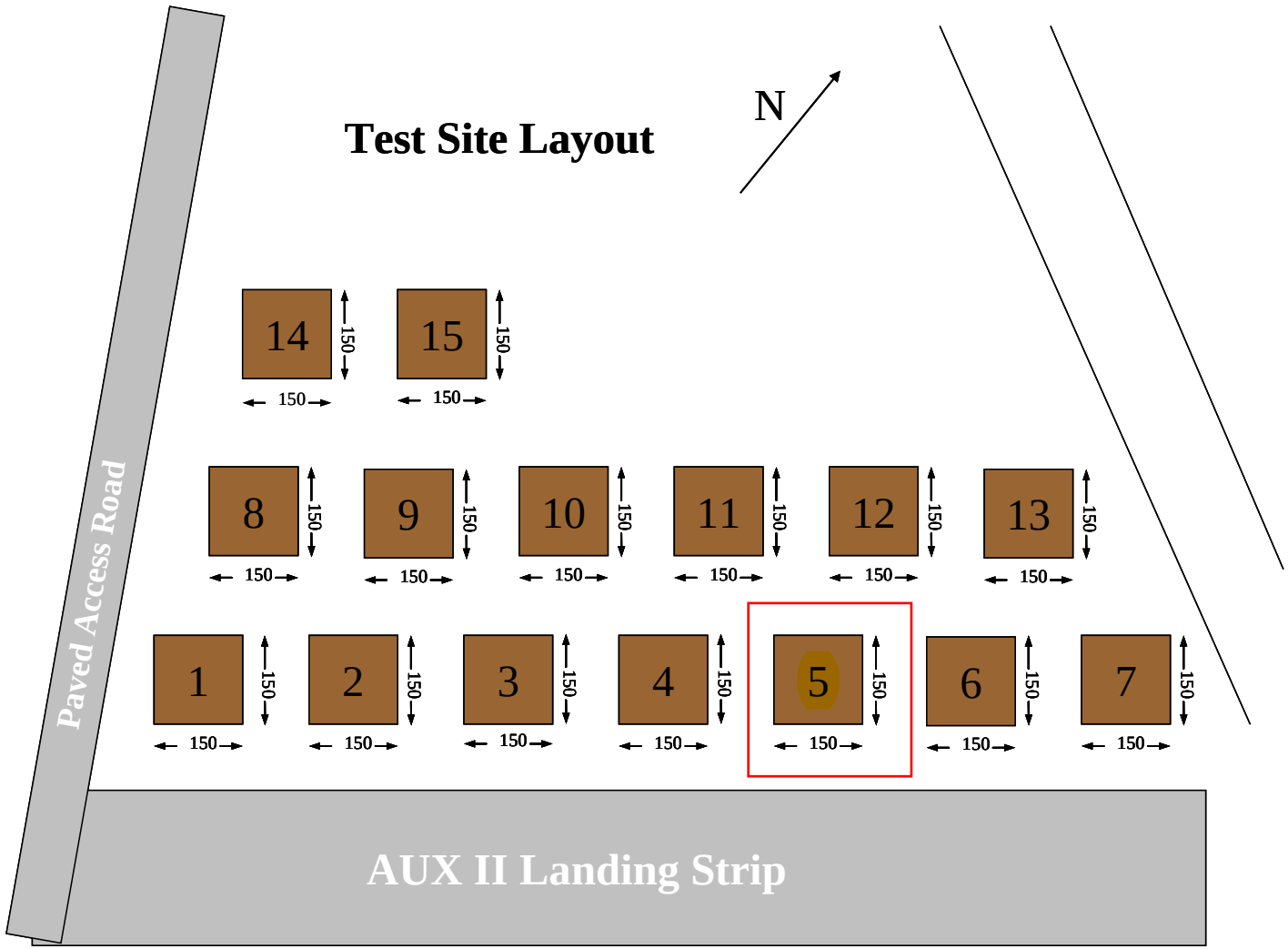
RECOMMENDED PALLIATIVES FOR HELIPADS

Table14. Weighted Palliative Ratings[1]

Helipad	Palliative	Rating Factors				Weighted Rating (Up to 100)
		Rotor Wash Resistance (Rating x 5)	Palliative Durability (Rating X 2)	FOD Potential (Rating X 2)	Surface Condition (Rating X 1)	
15		50	20	20	10	100
13		45	15	20	10	90
4		40	20	15	10	85
5	Soiltac A	40	20	15	10	85
7		40	20	15	10	85
9		40	20	15	10	85
1		35	20	15	7	77
2		35	20	15	7	77
16		40	20	10	7	77
8		30	20	15	10	75
6		30	15	10	7	62
3		20	20	10	7	57
12		20	10	5	5	40
10		5	5	5	7	22
11		5	5	5	7	22
17		0	0	0	3	3
14		0	0	0	2	2
18	Untreated	0	0	0	0	0

[1]Ratings are based on CH-46 and CH-53 flight tests conducted on 18-19 February 2004 with a cure time of 29 to 31 days. Original CH-46 flight tests conducted on 21January were incomplete, but indicated better performance of NRL helipads and Soiltac after short cure time of 3 days and before rainfall event.

YUMA, AZ, SEPT 2005



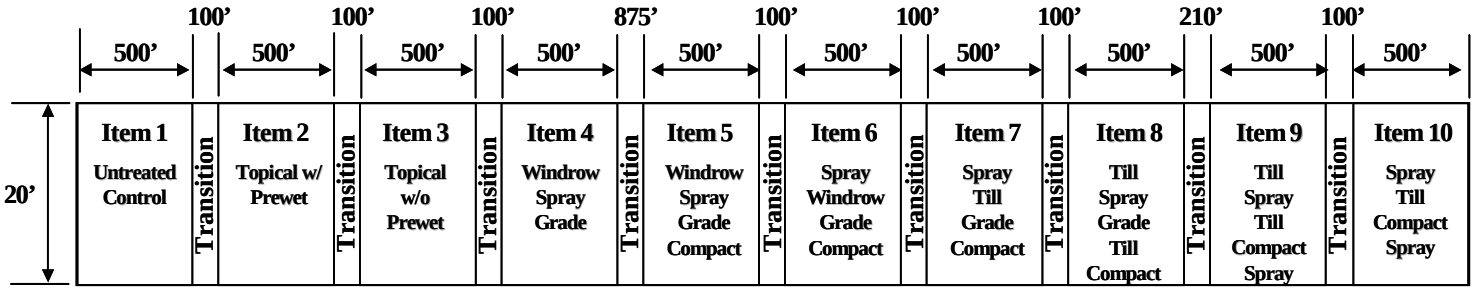
PRODUCT EVALUATION

PRODUCT PERFORMANCE

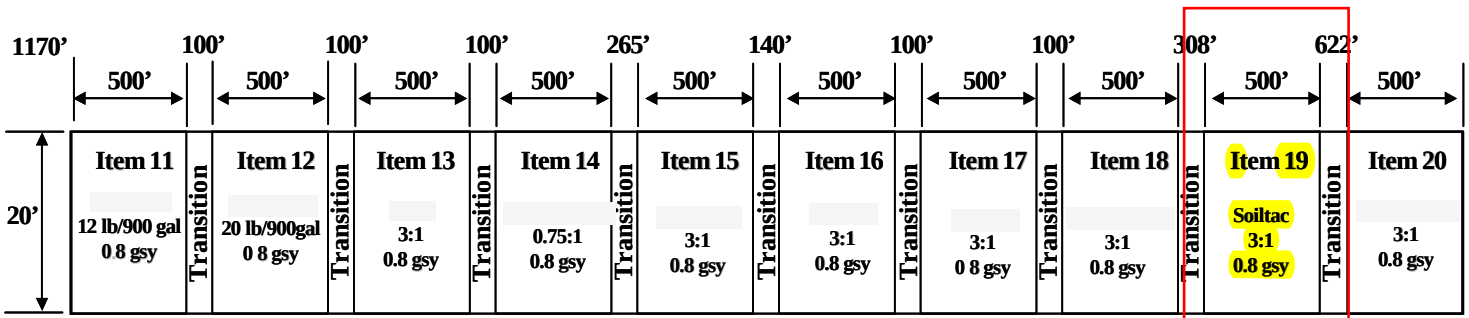
Summary of Pilot's Ranking					
Helipad	**Product**	**UH-1**	**CH-53**	**CH-46**	**AH-1**
13	**Durasoil**		1	1	1
7	**(0.4)**		2	2	2
6	**(0.6)**	1	3	3	3
5	**Surtac (0.6)**	3		4	4
14	**Surtac (0.4)**				5
12		2	4	5	
3		4			
2	**Powdered Soiltac**	5			
4	**Soiltac**	6			
10				6	
17	**Control**	7	5	7	6

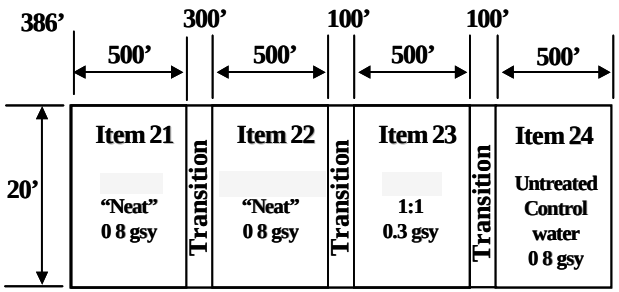
DUST CONTROL ON UNSURFACED ROADS

Douglas, AZ, March - 2004



CONSTRUCTION PROCESSES PLAN





PALLIATIVE EVALUATION PLAN

Not To Scale

TEST LOCATION CHARACTERISTICS

- U.S. Border Patrol road
- 3.2 miles of road paralleling U.S.-Mexico border
- 30 – 60 vehicles per day
- 15-in. per year average rainfall

- 500-ft x 20-ft test sections
- Marked with traffic delineators for identification
- Untreated transition areas separating test sections

EVALUATION OF CONSTRUCTION PROCEDURES

Section	Palliative	Method	Manpower	Time (min)
1	Water	Spray/Compact	4	60
2		Prewet/Spray/Compact	4	180
3		Spray/Compact	4	105
4		Windrow/Spray/Grade	4	42
5		Windrow/Spray/Grade/Compact	5	48
6		Spray/Windrow/Grade/Compact	5	48
7		Spray/Till/Grade/Compact	6	78
8		Till/Spray/Grade/Till/Compact	6	136
9		Till/Spray/Till/Compact/Spray	5	125
10		Spray/Till/Compact/Spray	5	46
		Range of Values:	**4 to 6**	**42 to 180**

RECOMMENDED CONSTRUCTION PROCESS

- Spray half of product onto surface

- Immediately till to a depth of 3 in. with a rotary mixer

- Follow with compactor

- Spray remaining product

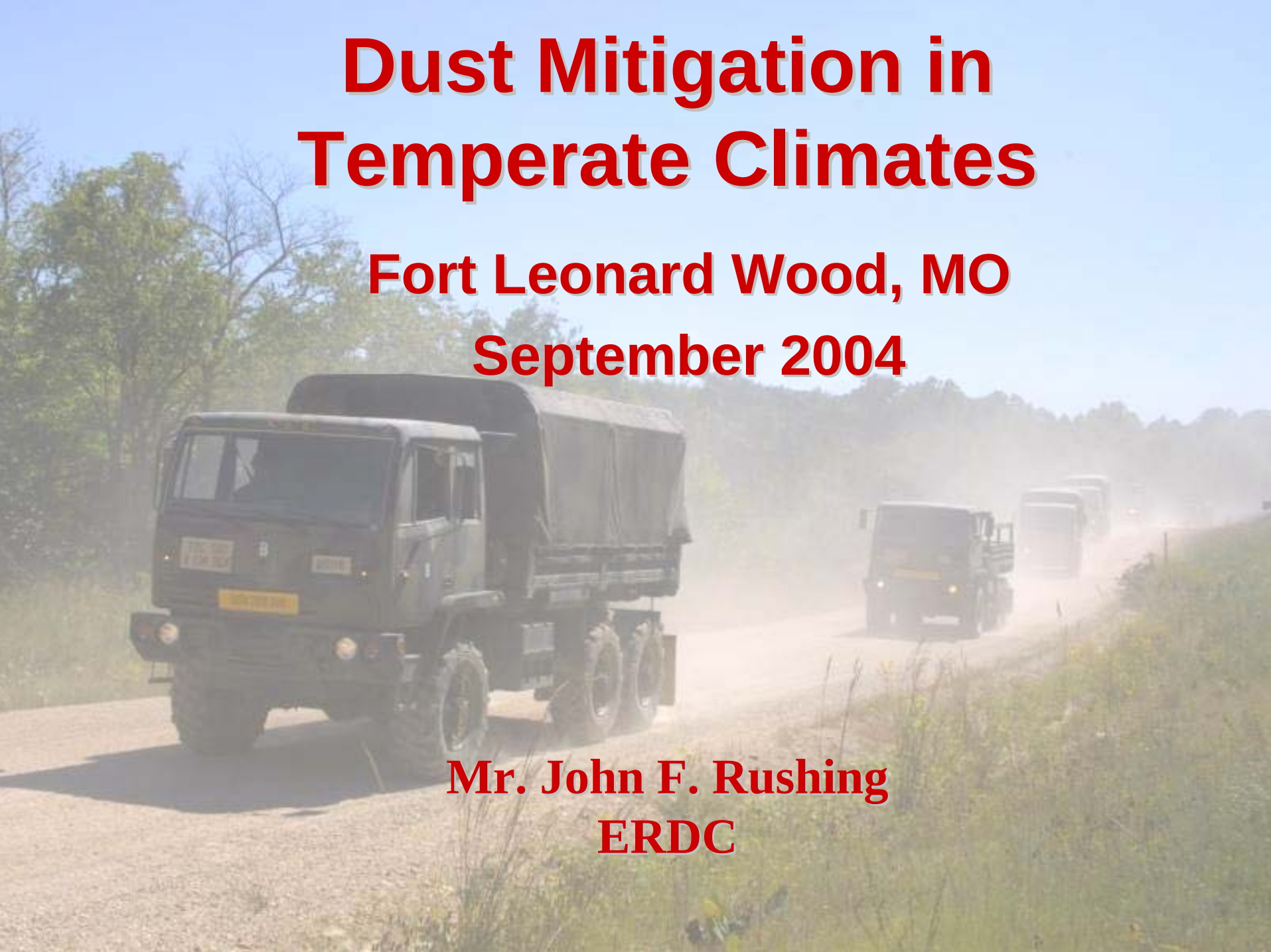
RELATIVE PRODUCT EFFECTIVENESS

Control

Surtac

DUST PALLIATIVE EFFECTIVENESS RATING

Product	Surface Ravelling (20%)	Visual Dust Rating (30%)	ERDC Dust Reduction (25%)	MRI Dust Reduction (25%)	Total
	9	10	10	10	**98**
Soiltac	5	8	9	9	**79**
	5	8	8	9	**77**
Surtac	4	7	9	9	**74**
	2	8	7	9	**68**
	0	6	3	7	**43**
	1	5	4	6	**42**
	1	4	5	5	**39**
	2	4	4	4	**36**
	1	5	3	4	**35**
	0	4	0	4	**22**
	0	2	6	0	**21**
	0	3	0	0	**9**
Control	0	2	0	0	**6**



Dust Mitigation in Temperate Climates

Fort Leonard Wood, MO

September 2004

Mr. John F. Rushing
ERDC

TEST SECTION LAYOUT

- Twenty-Five Sections Constructed on Straight, Level Locations Along Convoy Routes
- Sections 600 ft Long by 25 ft Wide
- Marked with Traffic Delineators for Identification

PRODUCT APPLICATION QUANTITIES

Section	Palliative	Additive Amounts (Gallons)			Application Rate (gsy)	Application Procedure
		Product	Water	Total[1]		
1		350	1000	1350	0.8	Admix
2	Soiltac	350	1000	1350	0.8	Admix
3		275	1075	1350	0.8	Admix
4		350	1000	1350	0.8	Admix
5	Surtac	350	1000	1350	0.8	Admix
6		1350	0	1350	0.8	Admix
7	Durasoil	1350	0	1350	0.8	Admix
8		1350	0	1350	0.8	Admix
9	Water	0	1350	1350	0.8	Admix
10	Soiltac	175	525	700	0.4	Admix
11		175	525	700	0.4	Admix
12	Surtac	175	525	700	0.4	Admix
13		675	0	675	0.4	Topical
14	Durasoil	675	0	675	0.4	Topical
15		175	525	700	0.4	Topical
16	Water	0	675	675	0.4	Topical
17	Soiltac	175	525	700	0.4	Topical
18	Surtac	350	1000	1350	0.8	Admix
19	Durasoil	1350	0	1350	0.8	Admix
20		350	1000	1350	0.8	Admix
21		675	0	675	0.4	Topical
22	Durasoil	675	0	675	0.4	Topical
23	Surtac	175	525	700	0.4	Topical
24	Water	0	1350	1350	0.8	Admix
25		175	525	700	0.4	Topical

1 Total product amount placed in distributor. Approximately 650 gal was used for 0.4 gsy application rate and 1300 gal for 0.8 gsy application rate

PALLIATIVE RANKING

Section	Palliative	Application Method	Stationary Dust Collection Data		Mobile Dust Collection Data		Visual Rating
			Dust Collected (g)	Reduction from Pretreatment Data (%)	Dust Collected (g)	Reduction from Pretreatment Data (%)	
6		Admix	0.033	97	0.034	86	10
21		Topical	0.047	95	0.027	89	10
19	Durasoil	Admix	0.055	95	0.020	92	10
11		Admix	0.079	92	0.052	78	9
2	Soiltac	Admix	0.100	90	0.048	80	9
23	Surtac	Topical	0.143	86	0.047	80	9
18	Surtac	Admix	0.151	85	0.084	65	9
8		Admix	0.161	84	0.031	87	9
14	Durasoil	Topical	0.165	84	0.052	78	9
22	Durasoil	Topical	0.181	82	0.055	77	9
12	Surtac	Admix	0.187	82	0.055	77	9
7	Durasoil	Admix	0.198	81	0.038	84	9
5	Surtac	Admix	0.159	85	0.039	84	8
4		Admix	0.319	69	0.066	73	7
13		Topical	0.326	68	0.148	39	7
10	Soiltac	Admix	0.456	56	0.055	77	7
1		Admix	0.580	44	0.102	58	7
20		Topical	0.409	60	0.092	62	6
17	Soiltac	Topical	0.431	58	0.121	50	6
3		Admix	0.732	29	0.076	68	6
16	Water	Topical	0.724	30	0.085	65	5
15		Topical	0.764	26	0.066	73	5
25		Topical	0.486	53	0.092	62	4
24	Water	Topical	0.634	38	0.175	27	3

Questions?