DOWFLAKE Calcium Chloride

Flake calcium chloride reduces maintenance costs and helps prevent runoff on unpaved Forest Service Roads

The Copper Creek Forest Service Road is a 20-foot wide, unpaved road located in the Helena National Forest in western Montana. Like other unpaved roads, it has a history of dusting up in the summer and washboarding. In fact, severe washboarding occurs even though the road is bladed, watered, and recompacted three times each year.

Due to concerns about ongoing requirements for road maintenance needed to maintain acceptable ride quality and to eliminate excessive sediment runoff from the road into nearby streams, the U.S. Department of Agriculture Forest Service (Region 1 Materials Engineering Section, Missoula, MT) conducted an evaluation of alternate chemical stabilization treatments on the road. Their goal was to identify a method to improve ride quality, reduce dusting and sediment runoff, reduce aggregate loss, and minimize ongoing maintenance.

The Copper Creek road consists of good quality, well-graded, crushed aggregate. Traffic volumes range from 20 to 50 light vehicles per day from mid-May through November. Vehicle speeds are typically greater than 35 miles per hour.

In June 1998, the Forest Service constructed 17 test sections using seven different maintenance techniques (Table 1). Grades in the test sections were approximately 2 percent. Bentonite clay and 77% flake calcium chloride were used as stabilizing agents on eight of the test sections. The treatment methods included traditional blading, watering, and compaction as well as mixing the stabilization agents with the aggregate to a depth of 2.5 inches. The stabilization agents were applied and blended into the aggregate with the use of an in-place processor operated by Triple Tree Inc., Missoula, MT. The processor is designed to grind native road surfaces to a specified depth and is essential to ensure the product is adequately mixed. Use of dry calcium chloride flake, such as DOWFLAKE* calcium chloride, ensures even blending at high application rates of product with one pass of the processor.

Table 1. Surface Treatment Methods and Results

Treatment Description[1]	Additional Blade Maintenance Required[2]	Road Serviceability/Quality	
		# of Good Weeks	# of Poor Weeks
Traditional blading, watering, & compaction	5	10	44
Mixing 2.5" deep with in-place processor	5	12	42
Bentonite clay mixed 2.5" deep with in-place processor	4	16	38
1.6 lbs/sq yd flake $CaCl_2$ on surface for dust abatement	3	19	35
Bentonite clay mixed 2.5" deep with in-place processor plus 1.6 lbs/sq yd flake $CaCl_2$ on surface	3	20	34
2.2 lbs/sq yd flake $CaCl_2$ mixed 2.5" deep with in-place processor	2	40	14
4.2 lbs/sq yd flake $CaCl_2$ mixed 2.5" deep with in-place processor	0	>54	0

1 All sections were bladed, watered and compacted.
2 During a 54-week period (1998 and 1999 seasons)

Of the treatment methods evaluated, the best performing was the 77% flake calcium chloride applied at a rate of 4.2 lbs/square yard and blended with the in-place processor to a depth of 2.5 inches. This application rate is designed to provide a calcium chloride concentration (100% basis) in the aggregate of approximately 1.3% by weight. After 54 weeks, the section stabilized with calcium chloride still had not required reblading. The other sections all required grading at least twice due to road surface deterioration. When incorporated as a road base stabilizer, calcium chloride has a characteristic ability to attract and hold moisture at low humidity and high temperatures. This property enables calcium chloride to keep unpaved road surfaces damp and minimize the loss of fines under severe summer conditions. With its strong moisture film and high surface tension, calcium chloride helps bind aggregate particles together. Consequently, unpaved road surfaces remain compact and stable.

Cost Comparison

Although the initial cost per mile of applying calcium chloride at the 4.2 lbs/square yard rate is higher than most of the other treatment options tested in the study (Table 2), a cost comparison based on maintenance of comparable road quality shows this to be the most cost effective option.

From Table 1, the number of poor weeks of road serviceability identified by the Forest Service over a 12-month, post-treatment evaluation period was used to calculate the number

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Table 2. Cost-Per-Mile Comparison

Treatment Description	Additional Gradings	In-Place Processing	Bentonite Clay ($100/ton)	Flake Calcium Chloride ($160/ton)	Total Cost/Mile
Traditional blading, watering, & compaction	6 x $600 = $3,600	0	0	0	$3,600[3]
Mixing 2.5" deep with in-place processor	6 x $600 = $3,600	$640	0	0	$4,240[3]
Bentonite clay mixed 2.5" deep with in-place processor	5 x $600 = $3,000	$640	$1,300	0	$4,940[3]
1.6 lbs/sq yd flake $CaCl_2$ on surface for dust abatement	4 x $600 = $2,400	0	0	$1,500	$3,900
Bentonite clay mixed 2.5" deep with in-place processor plus 1.6 lbs/sq yd flake $CaCl_2$ on surface	4 x $600 = $2,400	$640	$1,300	$1,500	$5,840
2.2 lbs/sq yd flake $CaCl_2$ mixed 2.5" deep with in-place processor	3 x $600 = $1,800	$640	0	$2,100	$4,540
4.2 lbs/sq yd flake $CaCl_2$ mixed 2.5" deep with in-place processor	1 x $600 = $600	$640	0	$3,900	$5,140

3 Costs for these treatment sections should be increased by at least $400/mi to allow for aggregate surfacing replacement since aggregate loss is controlled by flake calcium chloride on other treatment sections.

Table 3. Cost-To Maintain a Smooth Road Surface

Treatment Description	# of Poor Weeks	Treatment Cost/Mile	Cost to Maintain Smooth Road Surface
Traditional blading, watering, & compaction	44	$3,600	(22 x $600) + $3,600 = $16,800
Mixing 2.5" deep with in-place processor	42	$4,240	(21 x $600) + $4,240 = $16,840
Bentonite clay mixed 2.5" deep with in-place processor	38	$4,940	(19 x $600) + $4,940 = $16,340
1.6 lbs/sq yd flake $CaCl_2$ on surface for dust abatement	35	$3,900	(17 x $600) + $3,900 = $14,100
Bentonite clay mixed 2.5" deep with in-place processor plus 1.6 lbs/sq yd flake $CaCl_2$ on surface	34	$5,840	(17 x $600) + $5,840 = $16,040
2.2 lbs/sq yd flake $CaCl_2$ mixed 2.5" deep with in-place processor	14	$4,540	(7 x $600) + $4,540 = $8,740
4.2 lbs/sq yd flake $CaCl_2$ mixed 2.5" deep with in-place processor	0	$5,140	$5,140

of additional gradings required to maintain a smooth road surface quality. For every two weeks of poor road quality, the cost of one grading was added. For example, if a treatment method resulted in 10 weeks of poor road serviceability, then 5 additional gradings (5 x $600) would be needed to provide a good quality road surface over the length of the study. These costs were then combined with the total cost per mile from Table 2 to give a more accurate comparison of the cost to provide a smooth road surface with each treatment method. The results of this adjustment are shown in Table 3. When downstream maintenance costs are considered, the 4.2 lbs/square yard flake calcium chloride treatment clearly becomes the most cost-effective option.

Reducing Sediment and Dust

One of the largest sources of sedimentation in rivers, streams, and lakes is surface runoff of fine-grained material from unpaved roads. This sedimentation disrupts fish habitats in nearby waterways. The surface runoff occurs during rainstorms, and it is also caused by snowmelt. The problem is worsened whenever a road is bladed because fine-grained materials are in a loose, vulnerable state. Rain shortly after a blading washes a significant amount of fines to nearby watercourses. According to Bob Griel, an engineering consultant with Triple Tree Inc., "The stabilization of this fine material has the potential to keep thousands of tons of sediment out of streams where bull and brown trout as well as salmon live." As for the elimination of airborne dust from vehicular traffic, a visibility and dust nuisance problem for road users has been virtually eliminated.

Based on the results of this study, the Region 1 Materials Engineering Section has recommended the stabilization of roads with flake calcium chloride where ongoing annual blading is taking place to minimize maintenance costs and reduce environmental impact associated with sedimentation and airborne dust.

In June of 2000, the Forest Service stabilized two additional projects that previously required frequent blading maintenance using flake calcium chloride. The Toll Mountain road east of the Continental Divide near Butte Montana was a short test project similar to Copper Creek. Various calcium chloride flake application rates were blade mixed about 2 inches deep. This project was located in a low humidity area, surfacing material was crushed aggregate and road grades were from 6 to 10 percent. Twelve miles of the Selway River Road in northern Idaho were also treated with five lb/sq. yd of calcium chloride flake to a 3-inch depth with the in-place processor. This road is located in a high humidity area adjacent to the Selway River, the surfacing materials are primarily a native decomposed granitic, and road grades were generally less than 2 percent. Evaluations conducted in November 2000 indicate that both roads provided results similar to the Copper Creek project.

Figure 1. Spreading flake calcium chloride in one of the test sections.

Figure 2. Blending with the in-place processor

Figure 3. Compacting after in-place processing

Figure 4. Grading after in-place processing

For more information, contact The Dow Chemical Company Customer Information Group at 1-800-447-4369 or visit www.dowcalciumchloride.com.

References
1 Asphalt Recycling & Reclaiming Association. Full Depth Reclamation - A Century of Advancement for the New Millennium, Annapolis, Maryland: ARRA, January 2001.

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