Quantifying the effect of dust control treatments at Squaw Creek National Wildlife Refuge: Roads and roadside organisms

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Introduction

- Dust control is a challenge for all unpaved road managers.
- Fugitive dust from unpaved roads creates human health concerns in the form of inhalable particulate matter, decreases visibility and driver safety, and compromises road surface integrity through the loss of fine particles.
- Chemical dust control treatments have many benefits, but may also have the potential to harm roadside plants and animals.
- Road managers need better information on the potential impacts of applications of dust control chemicals on roadside organisms. This need is especially great for road managers on wildlife refuges or in national parks and forests.

Objective

To evaluate product performance and environmental safety of selected dust control products under real-world conditions

Study site and test layout

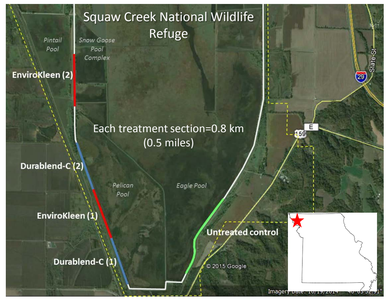


Figure 1. Layout of experimental treatment sections on the southern half of the Squaw Creek auto tour loop. Refuge boundary in yellow.

Squaw Creek National Wildlife Refuge, Missouri

- ~7,500 acres (wetlands, grasslands and forest)
- Designated a Globally Important Bird Area
- Roads immediately adjacent to wetland habitats
- 140,000 visitors/year
- Moderate-to-severe issues with dust


Typical dust conditions prior to treatment


Auto tour loop immediately adjacent to wetland

Ecological pathways

Methods

Initial applications

Two products applied to replicated sections of the Squaw Creek auto tour loop (**Fig. 1**). All road sections (including untreated control) received new surface aggregate prior to road preparation. Products were applied according to vendor specifications.

- **durablend-C™**—Polymer-enhanced calcium chloride from EnviroTech Services, CO. Applied as one Compact & Cap™ mixed-in application.
- **EnviroKleen®**—Synthetic fluid with binder from Midwest Industrial Supply, OH. Applied as initial topical application and a maintenance dose ~10 months later.

Performance monitoring

- 6 visits over 17 months post-application
- Replicated dust measurements made with mobile-mounted DustTrak DRX meter
- Road surfaces assessed and documented
- Discussions with refuge staff and visitors


Road preparation

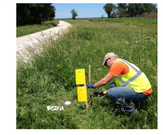

durablend-C™ application


EnviroKleen® application

Methods—Roadside organisms

Aquatic organism test

- Composite surface aggregate samples from all test sections (treated and untreated) taken immediately after application, 11 and 16 months post-application.
- 600-g subsamples soaked in deionized water to create leachates (overlying water).
- Leachates used in 96-hr toxicity tests with juvenile rainbow trout (*Oncorhynchus mykiss*) under static conditions at 12°C.



Roadside invertebrate sampling

- Invertebrates trapped during June-July 2015 as an indicator of invertebrate response after a year of potential product exposure.
- Pitfall and sticky traps installed along four transects adjacent to each test section of road.
- Pitfall traps opened for two 24-hr sampling periods; sticky traps deployed for a 2-week period.

Results—Product performance

- Treatment with either product reduced dust by 89-99% relative to the untreated section (**Fig. 2**) for a period of 11 months after initial applications. These reductions occurred with a single application (durablend-C™) or an application and maintenance dose (EnviroKleen®).
- Refuge staff reported better road surface condition and a reduced need for maintenance on treated sections. No maintenance blading was required for 17 months post-application.

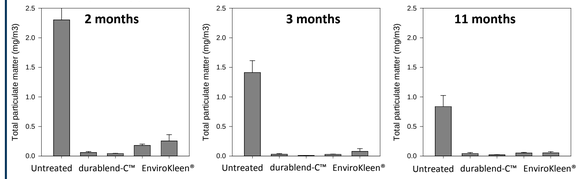


Figure 2. Dust production (average total particulate matter) measured while driving on test sections under standard conditions on three sampling dates (1 sample/sec, n=3 trips/section). Error bars represent standard deviations.

Results—Aquatic organism test

- No leachate caused significant mortality of juvenile rainbow trout in 96-hour tests, despite differences in water quality parameters among leachates (**Table 1**).

Table 1. Leachate test results from treated and untreated aggregates collected from Squaw Creek roads at three sampling periods. Survival values are from three replicate jars with five fish/jar. Water quality values are means (n=2-4) with standard deviations in parentheses.

Aggregate sample source and timing		Rainbow trout survival	Conductivity (µS/cm)	pH	Hardness (mg/L as $CaCO_3$)
durablend-C™	At application	100%	1780 (136)	6.95 (0.04)	788 (65)
	11 months	100%	496 (68)	7.08 (0.15)	216 (30)
	16 months	100%	423 (97)	7.1 (0.22)	185 (43)
EnviroKleen®	At application	100%	124 (17)	7.5 (0.37)	56 (5)
	11 months	100%	68 (7)	7.4 (0.34)	34 (9)
	16 months	97%	90 (22)	7.26 (0.1)	43 (8)
Untreated	At application	100%	85 (12)	7.59 (0.67)	47 (7)
	11 months	100%	93 (22)	7.67 (0.72)	49 (7)
	16 months	100%	79 (13)	7.62 (0.72)	43 (1)
Control water[1]	n/a	93%	253 (1)	7.81 (0.26)	106 (0)

[1]CERC well water diluted to a hardness of ~100 mg/L as $CaCO_3$

Results—Roadside invertebrates

- More than 20 families of invertebrates were captured in roadside traps.
- Capture rates along road sections treated with either product were comparable to those along the untreated road section (**Fig.3**)
- Analyses of species composition along each section are ongoing.

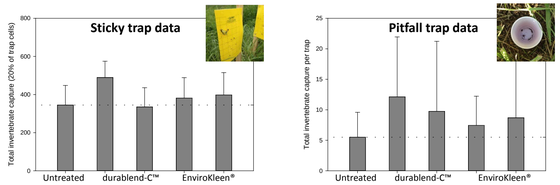


Figure 3. Roadside invertebrate captures on sticky traps (left) and during two cycles of pitfall trapping (right) during summer 2015, approximately one year after initial product applications. Error bars represent standard deviations. Dotted reference line=untreated control value.

Conclusions

- **Treatment with durablend-C™ or EnviroKleen® generally reduced dust production by >90% on treated road sections relative to the untreated section for 11 months after initial applications.**
- **Treatment reduced the need for routine road maintenance and may be a useful strategy for preserving aggregate.**
- **Leachates from treated and untreated aggregates did not negatively affect rainbow trout in short-term toxicity tests.**
- **Dust control treatments did not reduce the number of invertebrates captured in roadside traps the following summer, relative to the untreated section.**
- **These techniques provide an important link between laboratory toxicity test results and field exposures, and could be applied to monitor important target organisms for effects of road treatments in other settings.**

Ongoing work

- Summary of soil chemistry data
- Summary of objective road surface rating data
- Final round of dust measurement (18 months post-application)
- Final comparisons and report, including analysis of product performance, longevity, cost, roadside soil chemistry, and roadside organism responses

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