Best Practices for Dust Control – LRRB Investigation 842

As traffic increases on aggregate surfaced roads there also is a need for dust control. Various approaches can be used, but this research included field tests of the effectiveness of common dust control products.

Summary
During a two-year study a set of dust control applications were evaluated using a mobile air sampling technique. Treatments of calcium chloride, magnesium chloride, and organic polymer-plus-binder were evaluated for standard application rates during the first year and at variable rates during the second year. The treatments were applied to a variety of subject roads in the northwest, east-central, and southwest parts of Minnesota. Average daily traffic levels varied from 25 to 700 vehicles per day.

The overall data trend showed that treatments reduced dust levels. Measurements showed that aggregate surface moisture content was the best predictor of dust control efficiency, and dust levels decreased with increased moisture. Weak positive relationships were measured between dust control efficiency and: application rate, ADT, conductivity, and percent passing the #200 sieve. The weak positive relationships generally reinforce the concept that higher application rates may be more successful on gravels containing greater amounts of material passing the #200 sieve. A negative relationship was measured between dust control efficiency and sand equivalency, showing that treatments on sandy gravel were less effective.

The study participants observed that in addition to dust control a secondary benefit of surface stabilization was present for a period of time. Treated sections that developed surface stabilization were able to reduce maintenance activities to intersection areas only.

Methods
A combination of field and lab work was performed to evaluate the in-place roadway sections, surface materials, and performance of dust palliative treatments. Tests were performed on the in-place materials to determine gradation, plasticity index, and sand equivalency.

The effectiveness of a given dust control treatment was assessed by sampling the surface moisture content and dust production then comparing with results from adjacent control sections.

Dust production was determined by performing three sampling runs with a pickup-mounted collection device that was based on a prototype developed at Colorado State in the 1990’s. The device sampled from a location below the rear bumper and behind the drivers-side rear tire.

Samples were obtained while traveling 40 mph over a one-mile distance, and were collected on microfiber filters. Dust production was reported in units of grams per mile. Dust or moisture control efficiencies were expressed as the percent difference between treatment and control measurements.

Test Sections
A number of cities and counties participated in the study by dedicating sections and donating various levels of local resources for preparation, monitoring, and construction (figures 1 and 2). The Minnesota Local Road Research Board provided funding for the majority of applications in the study.
Performance Observations
A survey of participating engineers found that the use of treatments near intersections reduced the frequency of routine maintenance activities along the entire section by an estimated 50 percent. The participating engineers also perceived that treatments would extend the re-graveling interval, but could not fully quantify the benefit because of the time limitations of the study. Treated area typically developed a dark appearance due to the hygroscopic effect of chlorides, but appearance should not be used to estimate treatment effectiveness.

Test Results
Figure 3 shows mobile dust collection measurements plotted against the corresponding moisture content of the aggregate surface. Moisture levels at or above three percent cause dust production to be reduced.

Figure 3 - Dust vs. moisture.

Statistical trends for dust production over time are shown in figure 4. The trend for control sections is nearly a constant value, 1.9 g/mile, during the entire project. The trend for treated sections shows a reduction in dust production during the early part of the study, and the overall performance was better compared to the control.

Figure 4 – Dust production linear trends.

Figure 5 plots the dust control efficiencies against treatment age. No performance advantage was measured for sections having residual treatments. It is possible that more applications are required over time for a residual effect to be measurable.

Figure 5 – Control efficiency vs. age.
Recommendations
Agencies should use material specifications appropriate for gravel roads. Findings from this study show that treated test sections performed better than control sections, but treatments should be used in situations where they are likely to be most beneficial. Lengthy treatments may be less practical and cost beneficial than spot-treatments applied to problematic areas such as intersections and rail crossings.

- 0.3 gallons per square yard is the usual application rate for standard chloride solutions.
- Although good performance was attained using rates between 0.18 and 0.55, it is advised to use several light applications per season instead of a single heavy application. This helps avoid exposure of potentially weak areas.
- The maximum effective service life in this study was 200 days. Consider using 100 to 150 days to gauge successfulness of a single application.
- Prepare the roadway by loosening the surface material prior to dust control applications.
- Consult with vendors about the materials in the control agent and obtain MSDS for project records.
- Use simple tools like a hydrometer or pH meter to help answer questions about material quality at the time of delivery.
- Observe the treatment process.
- Blade and reshape maintenance on an as-needed basis only. Winter plowing caused significant loss of treated surface aggregate.

For more information on the Dust Control Study, contact
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