ROAD READY R3 RESEARCH

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RESEARCH REVIEW: Dust Control on Gravel Roads: Traditional Methods Using Magnesium and Calcium Chloride

by Curtis Glasoe, PE/PLS, NDLTAP Technical Support Representative

"Dust control for gravel roads has been practiced for many years now in our region and around the world. Dust generated by traffic on a gravel road creates many concerns including: safety issues for the traveling public by reducing visibility, degrading air quality, increasing road maintenance costs due to loss of fines in the gravel and reducing crop yields. Dust control products are a great tool to use for gravel preservation. The increased cost of mining, processing & hauling specified surfacing gravel plus the fact that its availability is limited are good reasons to have a policy on dust control that is connected to the average daily traffic counts for various road segments in your county or township. The reduction in re-graveling and blading costs should be considered as a savings when adding dust control projects into the road budget when planning widespread applications."

– Kelly Bengtson – PE, NDSU UGPTI / LTAP Bridge & Pavement Engineer

Gravel roads are dusty. For many roadways, the dust creates unsafe driving conditions. Additionally, the loss of fine material degrades the ability of the driving surface aggregate to bond together and shed water.

Logically, increased traffic volumes result in increased dust. So what can we do to reduce the dust? As traffic volumes exceed 100 average daily traffic (ADT), consideration should be given to the application of dust control.

Your county should consider having a policy to follow that includes ADT, length of strip applications for rural homes or for road intersections susceptible to dust issues. A policy can reduce your liability and improve the safety of the traveling public. Several counties already have a policy and LTAP can help you develop one.

Spot applications in front of residences near roadways may suffice for some roadway segments. As traffic volumes increase, dust control for full roadway sections should be considered. According to various studies, the volume of gravel material that is blown away or lost from the surface can be estimated at 1 ton of material per mile/vehicle/year. To put it another way, consider a sample roadway with a traffic volume of 250 vehicles per day, we can estimate a loss of 250 tons of gravel per mile/year. That is 10 semi loads of gravel on a mile section of roadway!

In addition to the obvious safety problem of sight distance with dust, a bigger problem is that existing gravel sources are being depleted and not many new sites are being found to provide adequate aggregate to surface roads. Some counties in the state are already going outside county boundaries to secure aggregate surfacing. This serious situation must be addressed through changes in the way we do business.

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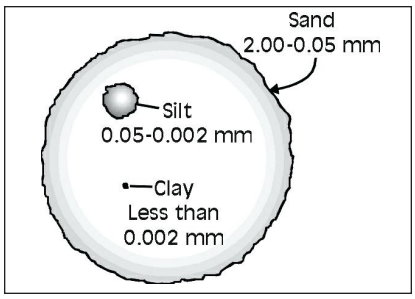
To better understand the dust control problem, information from past studies was reviewed with help from consultants, industry representatives, contractors, and county crews from the oil producing counties. This group determined that many different methods have all been tried and most of them work to a certain degree when used as the manufacturer recommends.

The most prevalent product used for dust abatement is magnesium chloride (MgCl) followed by calcium chloride (CaCl). MgCl is 10-20% lower in cost than CaCl. Oil production water salt brines, lignin sulfonates, chip seals, Permazyme, Base One and a new NDSU developed soybean solution are among the many other dust control options that are available.

The success or failure of dust control applications depends on factors such as gravel properties, weather, traffic volumes, and the application process. Maximizing the success of dust control applications, depends on four key factors:

1. Specify good gravel. A quality surfacing gravel should be tested for gradation with the minus 200 sieve (i.e., a sieve that has 200 wires in 1" means that only very fine material passes through) with a target of between 7-15% of the material by weight passing through the sieve. This material may be either silt or clay.



   Silt has poor engineering properties and tends to take on water. As silts take on water, the roadway's water shedding and structural capabilities are reduced. As such, a gravel surfacing with silt will allow water to migrate downward into the subgrade rather than shed off to the edge of the road. A saturated subgrade means that truck carrying capacity is reduced.

   On the other hand, a clay-based gravel surfacing will in essence cap the subgrade and effectively shed water off of the road surface. Clay helps to keep the subgrade dry and maximize its potential to support truck loadings.

   How do we test for clay/binder in gravel? The minus 200 sieve material should be tested for plasticity index, PI, or clay content, and should be targeted to be between 4% and 12%. The plasticity index tells us how well the minus 200 material will serve as a binder. In other words, it tells us if we have clay in the gravel fines that will serve as the glue to hold the rocks and sand together and to create a water tight surface that sheds water off of the roadway. Quite a few counties are specifying gradation and PI in their crushing contracts.

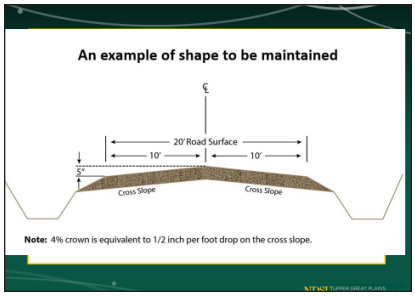
   Similar to concrete, a mix of sand, rocks and a binder (clay in gravel instead of cement in concrete) is needed in gravel (clay) to hold the sand and rocks together. Good gravel, made by specifying gradation and PI, allows us to be better stewards of the finite gravel supplies.

   Recall that gravel loss can be estimated at 1 ton/mile/vehicle/year. That is the case for a poor quality gravel. Good gravel with binder can greatly reduce this loss. Add dust control to good gravel and this loss can be virtually eliminated. Dust control applied to gravel without binder most often yields poor performance. Start with a good product and it will pay off with longer surface replacement cycles and cheaper overall costs for the road agency.

2. Shape and compact the road surface properly. The road should be prepared/shaped with a 4% crown prior to dust control applications. The crown allows water to shed off of the road and preserve the gravel and subgrade materials. With the proper crown, grader maintenance and surface repairs are minimized under normal rain events.

3. Next, water the shaped roadway. The surfacing gravel should have a moisture content of 15% to 20% to ensure good performance by the magnesium or calcium chloride solutions. Prewetting is critical for dust control materials, (e.g., chlorides) to soak into the gravel section a couple inches deep. Chlorides follow the water into the gravel and once in place they draw moisture out of the air. The water pulled from the air serves to maintain a tight and bonded road surface. First time chloride application of about 0.5 gal/square yard is a good starting point. Use a split application to avoid runoff into ditches.

4. Finally, apply the dust control solution according to instructions. The magnesium chloride experts recommend to apply in two applications of 0.25gal/square yard each. The first shot should be applied right behind the watering process and should be allowed to soak in prior to the application of the second shot.



Performance of the dust abatement depends on the quality of gravel. Chlorides and many of the other dust control products require clay to perform.

The following are pointers for specifying and purchasing chlorides.

- It is difficult to compare the different solutions for some of the dust control materials. However, chloride comparisons are pretty easy. Studies show that a mixture of 34.5% -35% calcium chloride is equal to 30% magnesium chloride solution. Because chlorides are mixed with water, verify the chloride concentrations of the material you purchase by testing it with a hydrometer. Do the math to compare chloride options.
- Be sure to consider the cost of: chloride concentration, availability of product, freight to get it to your site, and local contractor availability.
- MgCl tends to perform better in hot weather conditions but CaCl may last longer as it is a heavier molecule than MgCl. Both products produce very good initial results by limiting dust significantly when humidity is above 35%.

The guidelines above are a good starting point for any dust abatement efforts. Quality gravel, treated with a dust control product will help to improve roadway safety and reduce roadway costs. With nearly 60,000 miles of local gravel roads in North Dakota, our efforts to select the right treatment process for the right roadway section is an obligation we owe to the taxpayer.

Please contact ndltap@ugpti.org for additional questions about dust control.

RESOURCES

Aggregate Roads Dust Control A Brief Synthesis of Current Practices. Minnesota Department of Transportation Research Services, June 2013, Michael Marti, SRF Consulting.

Best Practices for Dust Control. Minnesota Department of Transportation Local Road Research Board. 2009.

Calcium Chloride vs. Magnesium Chloride: Dampness in Dust Control Applications. Occidental Chemical Corporation.

DustGard Liquid Product Data Sheet. Compass Minerals. November 2015.

Dust Palliative Selection and Application Guide. U.S. Department of Agriculture Forest Services, Peter Bolander and Alan Yamada.

Unpaved Road Dust Management: A Successful Practitioner's Handbook. U.S. Department of Transportation Federal Highway Administration, Publication No. FHWA-CFL/TD-13-001, January 2013. David Jones, et al.