Road Dust Management Practices
A National and International Perspective

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ABSTRACT

Dust control management is no doubt one of the elusive challenges that have not been resolved in any comprehensive manner. Scale and resources are always operative factors in an agency's will, or ability, to adopt reliable systematic measures. On the matter of scale, global geography, geology and weather conditions have, and always will be, the un-controllable factors. However, at the project or road system level, unsealed road surfaces often stand on their own as the prime generator of dust particles. In some circumstances they may be conveyances of dust by wind, water, and transport from other adjacent activities such as mining, construction, demolition, farming and aviation. In order to comprehensively manage these activities, the components of health and safety, environmental impacts, product selection and reliability, application techniques, cost-benefit analysis, and asset management must in some way all be considered. In a disconnected framework, several states, individual counties, and the international community is facing the challenge, each placing more-or-less emphasis on one or more of the components and solutions. This paper will discuss a sampling of just some of the attempts of those agencies.

INTRODUCTION

"Dust" a general term relating to particles smaller than 10 micrometers (PM10) that are susceptible to airborne transport. Cosmic dust, coal dust, domestic dust, even *"pixie dust"* (1) has all had a part in our collective cultures. Metaphoric religious references to dust are still part of most eulogies today. Our concern however is Road Dust and the management of it. On a global scale, road dust is a small generator of the overall world-wide dust volume. Remote sensing now gives us a clear understanding of the magnitude and scale of global dust transport (Figure 1). Mega dust storms from the Sahara desert can be traced to deposits in Florida that have had an effect on the severity of thunderstorms and hurricanes in that area (2, 3).

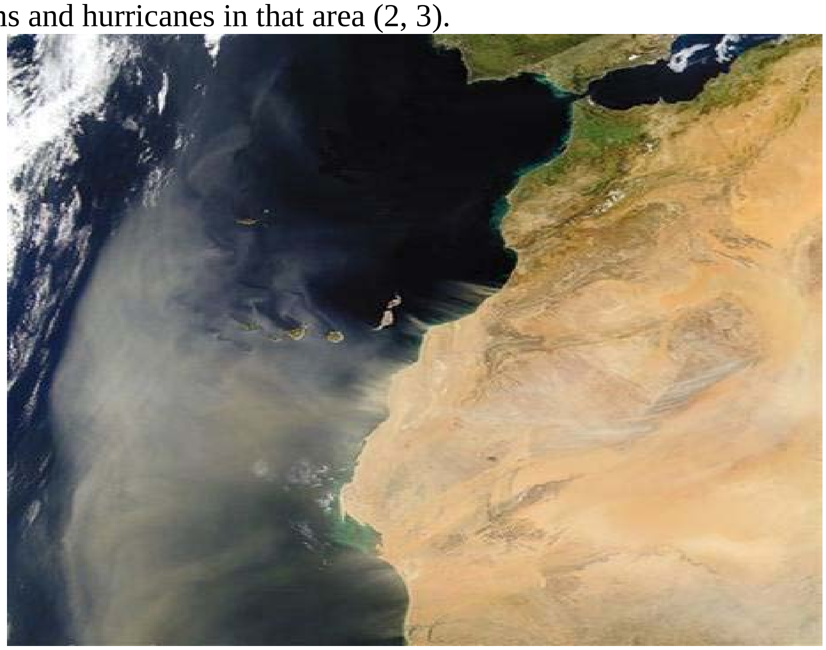

Figure 1. Dust storm blowing off the Saharan west coast of Africa toward the Canary Islands and Florida (NASA photo library)

NASA scientists have also concluded that global climate change produced a temperature differential between the tropical Atlantic and Pacific oceans that were the cause of the great dust bowl in the American Midwest between 1931 and 1939 (Figure 2). The temperature differentials produced large scale weather patterns that inhibited the amount of moisture from the Gulf of Mexico, and subsequently the amount of rain that reached the Great Plains (4).

Figure 2. Texas Dust Bowl era storm (NASA photo library)

U.S. STATE AND COUNTY PROGRAMS

One of the earliest accounts in U.S. "Road Dust Management" history comes from Massachusetts (5):

> *1909 July 25 New York Times, New York, New York*
> *Lenox, MA – "Mrs. William Pollock has caught the fancy for dustless roads from the experiments carried on by the Lenox and Stockbridge authorities, and at her own expense has oiled a mile of highway on Holmes Road, fronting her Holmesdale property, setting an example for the rest of the rich property owners. The experiments carried on by the Lenox village association in sprinkling highways with calcide has proved a failure in Lenox and has been abandoned. This new movement for dustless roads is largely due to the increased number of automobile tourists and the wearing of the surface of the highways by the travel and suction caused by the heavy motors.*

Virginia

According to Mr. William Bushman, former unpaved roads manager for the Virginia D.O.T. for over 17 years, VDOT manages over 18,000 miles of unpaved public roads (6). Based on the South African philosophy of "minimizing aggregate loss" and recommendations by Dr. David Jones, they implemented a comprehensive road management program which includes deep mixing of soil stabilizers. *"If one takes that approach and crafts the maintenance activities appropriately, then dust is not an issue."* This philosophy was validated through their research in Loudoun County, Virginia (7).

Others agree with this. *"And the more dust that leaves your road surface, the less road surface that remains. As dust departs, aggregates and other fines loosen, leading to surface woes and costly replacement with new gravel* (8).

Missouri

The work done by Freeman and Bowders (9,10), shows some promising results to prevent silt-sized particles from migrating up from the subgrade into the surfacing rock by placing a geotextile layer between the base course and the surfacing course (Figures 3, 4, 5).

Figure 3. Geotextile layer installed prior to surfacing.
(Photo courtesy of John Bowders)

Figure 4. Surface layer placement
(Photo Courtesy of John Bowders)

Figure 5. Minimized dust generation from vehicle (Photo courtesy of John Bowders)

Their studies showed that a geotextile layer was successful in maintaining lower silt content in the surfacing layer which resulted in a 50 to 75% reduction in emissions. They went on to conclude that *"In essence, the geotextile could provide low maintenance, long term dust control for the gravel road."*

Kansas

But the unpaved roads that generate dust exist primarily because the rural jurisdictions in which they occur never could afford to pave them in the first place. These road departments may be unable to generate the funds needed to control dust." (11).

Funding maintenance activities has been a long standing challenge for most rural road managers. Since 1989, most counties in Kansas have developed a "cost share" with home owners for dust treatment in front of rural residences in which the county provides the service for a fee. The statement that *"Counties in Kansas are not required to control dust on county roads. No county in Kansas has a free dust control program."* is the underlying fact in the cost-share programs. The rates of cost-share can range from one-third to almost full cost. For example; Magnesium Chloride treatment in Pottawatomie County in 1999 cost the residence only 30 cents per linear foot. The rates in Miami County in 2007 however had risen to $5 per linear foot for asphalt oil and $1.50 per foot for Magnesium Chloride while Coffey County only charged 90 cents per foot in 2007 (12,13,14).

Oregon

Similarly in Oregon, counties promote and regulate the application of dust suppressants by rural residents, however the entire cost and contracting is born by the resident. As an example, Coos county established a county dust abatement policy in 2002 (15) that says:

> *AND IT FURTHER APPEARING to the BOARD that it would not be fiscally possible or desirable to make free dust control to all County residents, but recognizes the importance of dust control, and as such is prepared to allow persons to treat sections of County Roads with a product to control dust, at their own cost, subject to the policies stated herein below.*

INTERNATIONAL ISSUES

Niger

An interesting study that was conducted in Nigeria illustrates the ingenuity of road managers in developing countries to adapt local materials for road maintenance uses (16). The oil palm tree is a common variety that grows extensively in West Africa. Palm Oil is extracted from the fruit of the tree and is used to make a wide variety of commercial products including soap, candles, and margarine. The residual by-product from the extraction process is the shells from the seed kernels of the fruit.

A number of passenger vehicles were used to obtain baseline dust generation samples from untreated sections of the unpaved Minna to Saukankahuta road and were run at speeds ranging from 30 to 80 kph to collect samples. A volume of palm oil seed kernels were then placed on five controlled sections of the unpaved road in 5 meter sections to a depth of 30mm, and the vehicles run within the same speed range for five days. Samples were collected hourly for the duration of the test. Results showed that after five days, the palm kernel shells were effective in reducing the volume of dust generation by 75%; however, no long-term tests have been conducted to determine the durability or longevity of the material.

Cameroon

Regardless of the geography or resources of a country, public outrage is a common theme wherever dust control is not implemented as part of routine maintenance, or a construction project plan. An example of uncontrolled fugitive dust during construction that caused a major disturbance in the local population occurred during construction of the Mutengene-Muea road in Cameroon, West Africa. (17) *"Anthony Akari, an inhabitant of Bomaka said: 'We are suffering a lot from the dust caused by the road construction. The workers go about their job without watering the road. Dust gets into our houses…right into our wardrobes. It has given us chronic cough. For that matter the locals said they mobilized at one moment and blocked the road to compel the road builders to start watering the road."*

Another example from Cameroon of an angry public outcry occurred: "*Graded a few years ago, the stretch of road after Long Street toward Bishop Rogan College is another dust blower. The locals in a bid to slow down speeding vehicles that churn up the dust have arranged stones on the road. Thus, motorists are forced to slow down and dodge around them."*

South Africa

As was mentioned, the South African approach to "minimizing aggregate loss" on public roads is a comprehensive approach to road design and maintenance including deep mixing of soil stabilizers, and the standardized evaluation of non-standard products for selection purposes (18, 19, 20,). In the mining industry, however, just keeping up with fugitive dust emissions during mining activities is a full time activity. In order to reduce vehicle accidents, (amounting to 74% of surface mining accidents with dust as a significant cause), and to mitigate worker health and safety issues, a comprehensive strategy has been developed to set criteria for water-based applications, and an economic evaluation method for cost effectiveness for selection and use of chemical dust palliatives to rejuvenate wearing surfaces to original specifications (21).

Selection Guides and Environmental Issues

Much work has been completed regarding selection guides, best application techniques, maintenance practices, and performance and laboratory testing, by international researchers, U.S. Federal Agencies, the Transportation Research Board, and State Local Technology Assistance Program Centers. These works are well known and well established in the literature. Health and safety of the public and those involved in construction, application and maintenance, and risks to long-term environmental damage of dust palliative and soil stabilization products have been in debate for over 35 years, since the 1973 Time Beach, Missouri disaster where waste oil, contaminated with dioxin, was used as a dust suppressant in a residential neighborhood which resulted in decades of litigation and a superfund cleanup site that cost over $80 million (22). Both of these issues continue to create ad hoc guidance as evidence and new products emerge.

Summary

Dust suppression and soil stabilization has matured to a point in time where they are a major component of short and long-term road design and maintenance programs. In the words of Mr. Melvin Main of Midwest Industrial Supply, Canton, Ohio, and echoed by many in all sides of the industry,

> *"…what's needed is a comprehensive approach to road improvement (design along with preservation of fines and surface smoothness) …Environmental performance…it would seem to me that a standardized set of criterion should be promoted by TRB and developed by ASTM that all users and suppliers could look to as a comparative gauge of environmental performance." (23)*

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