Controlling Fugitive Dust

Background

The Environmental Protection Agency (EPA) has identified airborne particulates (fugitive dust), as one of six principal air pollutants. Furthermore, EPA estimates (Fig. 1) show that up to 40% of fugitive dust may originate from unpaved roads. Using the state of Pennsylvania as an example of the impact that unpaved roads have on the environment, consider that Pennsylvania has in excess of 21,000 miles of unpaved roads, not including private haul roads, farm lanes, etc. Discussions with the Department of Environmental Protection's Air Quality personnel, the Department of Conservation and Natural Resource's Bureau of Forestry, Pennsylvania DOT, the State Conservation Commission (SCC) and the Bureau of Mining, suggest that identifying effective, affordable techniques for monitoring and controlling fugitive dust emissions is becoming an increasingly important need for these agencies. These same fine particulate problems apply in every other state in America. The situation has given rise to "Dust Police" in some states and such monitoring and regulatory agencies will eventually be in place in every state in the country.

There are a number of possible control strategies that can be used to help minimize dust emissions from unpaved roads. These include the use of environmentally friendly maintenance techniques, the use of properly designed aggregate mixtures and the use of water-based polymers as dust and sediment control.

There are three outstanding problems:

1) Lack of funding is always a problem so only a very small fraction of the unpaved roads in a given area get treated.
2) The use of dust suppressants is often beyond the financial resources of small rural towns.
3) The environmental effect of many of the alternative treatments being used as dust suppressants are harmful or, at best, uncertain. Examples of environmentally questionable treatments are cutback oils (petroleum based) and chlorides (salts). Examples of uncertain treatments are vegetable oils. The water based polymers offer the combination of environmentally friendly and effective treatments.

To put this in better perspective, the total particulate emissions from stationary sources in 1999 amounted to only 1.1 million tons nationally.[i] These stationary particulate sources like boilers, kilns, industrial processes, etc. are the kind that are principally and classically addressed by the DEP's Bureau of Air Quality.

Thus these stationary sources represent roughly 4% of the 26 million tons per year of total particulates. Therefore, unpaved road particulate emissions are estimated to be ten times more than emissions from these classic stationary sources of particulates.

DirtGlue Enterprises, 83 Middle Road, Amesbury, MA 01913
1-888-606-6108 - www.dirtglue.com

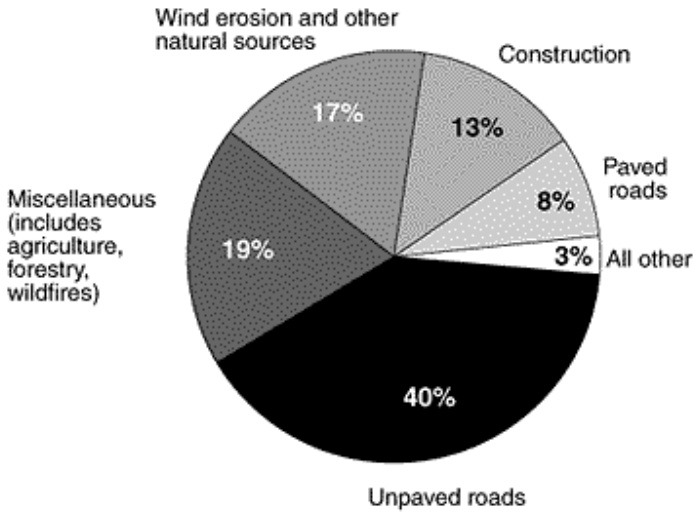

Figure 1. Fugitive particulate matter emissions originate from many sources (for more information see www.epa.gov/air/data/netemis.html). The EPA estimates total fugitive dust emissions at more than 25 million tons per year. Source: EPA, National Air Quality and Emissions Trends Report, 1997.

In summary, fugitive dust emissions from unpaved roads are clearly an important issue. Education of towns and other entities on effective control techniques is clearly important. It may be possible to couple with the Commonwealth's Dirt and Gravel Road Program to expand efforts in this area. Expansion of education programs to include owners and users of farm lanes and mine haul roads is a logical step. There is an apparent need to develop rapid techniques for the monitoring and prediction of fugitive emissions from unpaved roads. It is important to identify techniques to determine the effects of dust suppressants on not only dust, but on nearby plant, animal and aquatic life.

Topical Areas

The following paragraphs outline key topic areas related to fugitive dust from unpaved roads and its effect on Pennsylvania.

Need for Critical Review of the Literature

The answer to many of the questions and needs identified here may already be in the scientific and engineering literature. For instance, monitoring and measuring devices that have been developed for related issues may be suitable for use here. It would seem that a logical first step would be to survey what tools and data currently exist before starting to develop new approaches.

Techniques for Characterization of Road Surfaces

The generation of fugitive dust from unpaved roads is obviously related to the available fine particle content on the road surface. However, many factors affect the amount of dust generated such as moisture content, the presence or absence of suppressants, traffic volume, vehicle weight and speed.

Fine particles are a necessary component of the aggregate that makes up the road surface. Loss of the fine particles causes premature deterioration of the road surface, resulting in extra maintenance costs. Clearly, techniques that allow for the rapid and inexpensive characterization of road surfaces would be valuable both for predicting dust emissions and for making maintenance decisions.

Need for New/Improved Dust Control Techniques.

Current techniques used to control dust generation from unpaved roads are not always effective and sometimes may be environmentally hazardous. There is a need for the development of more advanced dust control techniques. Ideally, in addition to quality aggregate in the appropriate gradation, a high quality dust suppressant would also be used. Water based polymers, such as **DirtGlue™** are excellent dust suppressants that may be used to keep the fine particles in the aggregate matrix, thereby holding the road together while eliminating the health hazard of airborne dust and waterborne sediment.

The Range and Scope of the Problem

Harmful health effects associated with the inhalation of fine particulate matter are well documented.[i] These effects include, but may not be limited to:

- Premature mortality
- Aggravation of respiratory and cardiovascular or pulmonary diseases
- Respiratory related hospital admissions and emergency room visits
- Aggravated asthma
- Acute respiratory symptoms, including aggravated coughing and difficult or painful breathing
- Chronic bronchitis
- Decreased lung function that can be experienced as shortness of breath
- Work and school absences

The most harmful health effects from particulate matter are observed from particles smaller than approximately 2.5 μm (i.e. PM 2.5).

Other negative effects associated with particle emissions include: visibility impairment, climate change and materials damage.

Financial costs associated with dust generation cannot be ignored. Sanders, et al.[4] report that the cost of aggregate replacement necessitated by loss of fine particles to dust can exceed $15,000 per mile per year. In figure 2 the cost of treatment versus average daily traffic is shown (aggregate cost estimate at $1.57/ton – aggregate cost today is substantially higher than when this report was done). Figure 2 easily demonstrates that in most cases the cost of using what are often considered relatively expensive dust suppressants can be justified on dollar costs alone even without considering health and environmental effects.

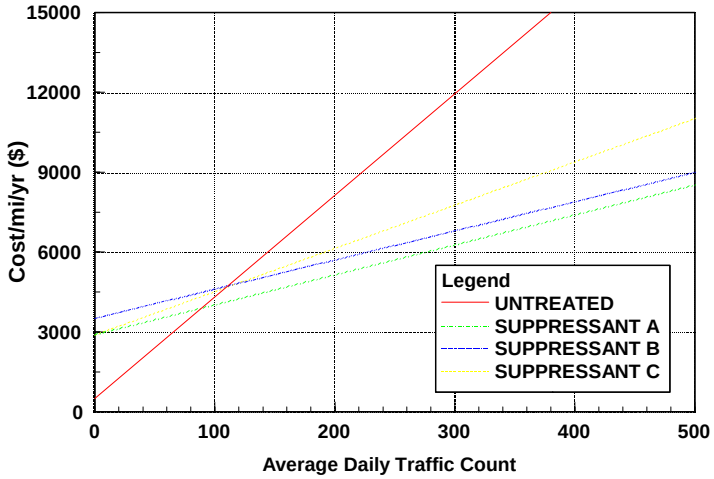

Figure 2. Cost of treatment versus average daily traffic (aggregate cost estimate at $1.57/ton). Adapted from Sanders, et al.[i]

Considerations should include an evaluation of the potential heath effects of the particulate emissions from unpaved roads. Separating health effects and welfare effects is an issue. The ability of particulate emissions to affect nearby waterways has been documented. This adverse effect is an important consideration with respect to decreased water quality and the negative effect that it has on aquatic life.

Much of the information in the above report is courtesy of Michael Silsbee of PSU, D&GRP.