# BAGHOUSE FINES IN ASPHALT PAVING MIXTURES

Extensive use of baghouse dust collectors on asphalt plants has made available large quantities of fines that have been utilized as partial or total replacement for mineral fillers in the mixtures. Lack of information on the characteristics of the fines and uniformity problems have led to suspicions that the fines were in some way associated with field problems experienced in recent years. A number of research projects have been undertaken on the fines; in some cases it has been concluded that a particular generic type of fines possessed some inherent detrimental quality (see NSA MF 181-2, *Slag Baghouse Fines in Asphalt Mixtures).* The most extensive study to date has been NCHRP Project 10-19, conducted at Penn State University.

Results of this study are available in National Cooperative Highway Research Program Report 252, *"Adding Dust Collector Fines to Asphalt Paving Mixtures",* by D. A. Anderson and U. P. Tarris, Penn State University. The report is available from Transportation Research Board, National Academy of Sciences, 2101 Constitution Avenue, NW, Washington, DC 20418. A paper entitled "*Characterization, Use and Specification of Baghouse Fines"* by the same authors, based on this research, was presented at the 1983 Annual Meeting of the Association of Asphalt Paving Technologists.

The NCHRP study objectives were 1) to conduct a state-of-the-art review of the effect of mineral fillers and baghouse dust on asphaltic concrete, 2) to survey current practices and procedures for specifying and handling baghouse dust, and 3) to characterize the baghouse fines currently being collected and used in the industry. To accomplish these objectives, a review of the available literature was made, specifications and procedures used by 45 state agencies were surveyed, and tests were conducted on baghouse from 27 plants in 12 states. Samples were tested for within-day, day-to-day, and plant-to-plant variability of the baghouse dust. Other than grain-size distribution, tests included specific gravity, air permeability, water sensitivity, stiffening effects on asphalts, etc.

No slag dusts were included in this study, but a number of the results and conclusions will be of interest to slag producers. These include the finding of pH values in the range of 10 to 12+ for limestones, dolomites and one traprock (two other traprocks were between 9 and 10). Ten of 27 sources were too coarse to qualify as mineral fillers, with the percentage passing the No. 200 sieve as low as 26% in one instance. The granite, traprock and gravel sources produced more very fine material (less than 1 μm) than did the carbonate rock sources. Generic type, fineness, pH, etc. did not correlate well with the effects of the dusts on asphalts.

## CONCLUSIONS

The general conclusions and suggestions for needed research resulting form the study are reproduced below and based on the research described in this report:

1. Considerable plant-to-plant variability exists in baghouse dust. This variability is related mainly to the efficiency of the primary collection system and the nature of the cold feed aggregate.

2. Generic aggregate type is not a primary factor in determining the fineness or the quantity of the dust entrall1ed in the system gas. There is no basis for developing specifications on the basis of generic aggregate type.

3. The greatest day-to-day and within-day variability in the fineness of the collected dust occurs in the coarse fraction of the dust, >50–75 μm. For a given aggregate source, the coarseness of the dust entrained in the collection system gas depends primarily on the drum gas velocity.

4. Day-to-day and within-day variability in the fineness of the dust is largely dependent on the efficiency of the primary dust collector. The more efficient the primary col1ector, the less variable the fineness of the baghouse dust.

5. Baghouse dust can be quite coarse, exceeding the limits generally accepted for mineral filler (ASTM D 242).

6. Based on limited data and on qualitative observations, it is the researchers' best judgment that most of the variability associated with the quantity of baghouse fines returned to the mix is due to handling procedures.

7. There are wide variations in the stiffening effects of baghouse fines. These effects are not explained by either the fineness or the gradation of the dust. Consequently there is little validity for the use of classification systems based on grain size for the specification of baghouse fines.

8. Stiffening effects can be predicted from bulk volume measurements on baghouse dust (or mineral filler). The free-asphalt volume is a valid concept for predicting the stiffening effect of baghouse dust. A more appropriate procedure is to prepare a dust-asphalt or filler-asphalt mixture using the ratio to be used in the asphaltic concrete mixture and to measure directly the viscosity of the mixture at 60° C (140° F) (ASTM D2171).

9. It is inconsistent to develop a specification for baghouse dust without specifying the entire fine (filler) fraction in the mixture. The baghouse dust may constitute

only a small percentage of the filler, but is the behavior of the entire filler fraction that is significant.

10. There appears to be little justification for developing a new specification for either baghouse dust or the filler fraction until the role of the dust or filler is better understood. A specification based on gradation or size classification cannot be justified, for neither stiffening nor asphalt extension can be uniquely related to gradation.

11. Each asphalt plant must be considered as a unique system because of variations in manufacturers' designs, plant configuration, and aggregate characteristics. Consequently, dust handling systems should be selected according to the particular conditions at each plant. General guidelines for dust handling procedures, for batch and drum mix plants, are presented below:

On the basis of the review of the literature, discussions with state materials engineers and plant operators, and an analysis of the data collected in the project, the following general guidelines are recommended for handling baghouse dust:

1. Drum mix plants: Dust should be introduced at the beginning of the coating zone in the drum simultaneously with the introduction of the asphalt cement.

2. Batch plants:
    a. The preferred method is direct return of the dust to the hot elevator or the No.1hot bin, if proper control of uniformity can be obtained. This requires close synchronization of the operation of the dryer and the baghouse with the feed to the hot bin or the hot elevator. Care should be taken that the No.1 hot bin is not operated too low.
    b. A surge bin and a positive feed system may be added to improve metering uniformity.
    c. If the systems is (a) and (b) do not ensure uniformity in the quantity of fines, it may be necessary to meter the dust into the weigh hopper.
    d. A storage silo does not provide good control when it is used to store baghouse dust and commercial filler if the dust and filler have different properties. A storage silo system may increase uniformity in the quantity of fines in the mix but this may be at the expense of uniformity in the properties of the dust.

## SUGGESTED RESEARCH

On the basis of the research described in this report, it is recommended that additional research be conducted on the role of baghouse dust and fillers on the behavior of asphaltic concrete mixtures. This research should address the following points:

a. The nature and extent of the physical and physicochemical interactions between the fine fraction (filler, including primary and secondary dust) and the asphalt must be better defined. Whereas parameters based on the bulk volume of the filler (% V DB and % V AFR) can explain much of the stiffening effect of the fine fraction, certain ousts exhibit anomalous behavior.

b. The effect of dusts on the compactability of asphaltic concrete mixtures must be defined.

c. The range of dust properties that enhances asphalt extension and the effect of extension on mixture stiffness, fatigue, and the aging characteristics of the asphalt cement should be investigated.

d. The influence of the stiffening effect of filler (including primary and secondary dust) on the fatigue and mechanical behavior of asphalt mixtures needs to be studied.

e. Further research should be conducted in order to determine the variability in the quantity of fines that are introduced into the mix. This research should consider plant handling procedures, plant equipment, plant operating conditions, and generic aggregate types.