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An Evaluation of Control Systems and Mass Emission Rates from Dryer-Drum Hot Asphalt Plants

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The problems associated with the design and operation of appropriate air pollution control equipment for particulate emissions from dryer-drum hot asphalt plants are discussed by outlining the basic process involved, the quantities of particulate matter being emitted, and possible methods of control. The most difficult problem seems to be the emission of a fine aerosol of unburned hydrocarbons generated as a result of the simultaneous heating and mixing of the asphaltic material. From the information presented, it was concluded that in most circumstances the venturi scrubber would be the most viable alternative to meet the 0.04 gr/dscf limitation imposed by the New Source Performance Standards promulgated by the EPA.

Within the past three years a new type of hot asphalt plant has been introduced which utilizes a drum-type dryer with associated equipment to mix the aggregate and liquid asphalt in order to produce a reportedly adequate grade of bituminous paving.[1] This particular process eliminates several pieces of expensive mechanical equipment normally used in either a standard batch or continuous mix asphalt plant.[2] The most difficult problem from an air pollution aspect is a result of the simultaneous heating and mixing of the asphaltic material which causes a fine aerosol of unburned hydrocarbons to be emitted to the ambient air. This is commonly referred to in the industry as "blue smoke."

When first introduced, some manufacturers of these plants claimed that the particulate emissions would meet limitations imposed by air pollution control agencies. It was later found that this was not the case when several plants in Colorado were cited for violations of regulations dealing with visible stack emissions.[3] The question now arises as to what type of control device(s) would be most appropriate for these plants.

The federal Performance Standards For New Stationary Sources[4] allows an emission rate of particulate matter not greater than 0.04 gr/dscf, and less than 20% equivalent opacity. These limitations were subsequently adopted by most state and local agencies including the State of Colorado. Using all available data, the applicability and effectiveness of the various types of air pollution control devices will be evaluated here.

Process Description

A generalized process flow diagram is presented in Figure 1. Proportioned aggregate from the cold-feed system is fed to a continuous belt weighing unit which conveys the proper amount of material into the drum mixer and through the burner flame for drying. The required amount of liquid asphalt is then injected into the drum mixer and mixed with the dry aggregate material. Some plants are equipped with a header or similar device whereby the liquid asphalt can be injected at different points along the drum. This particular feature

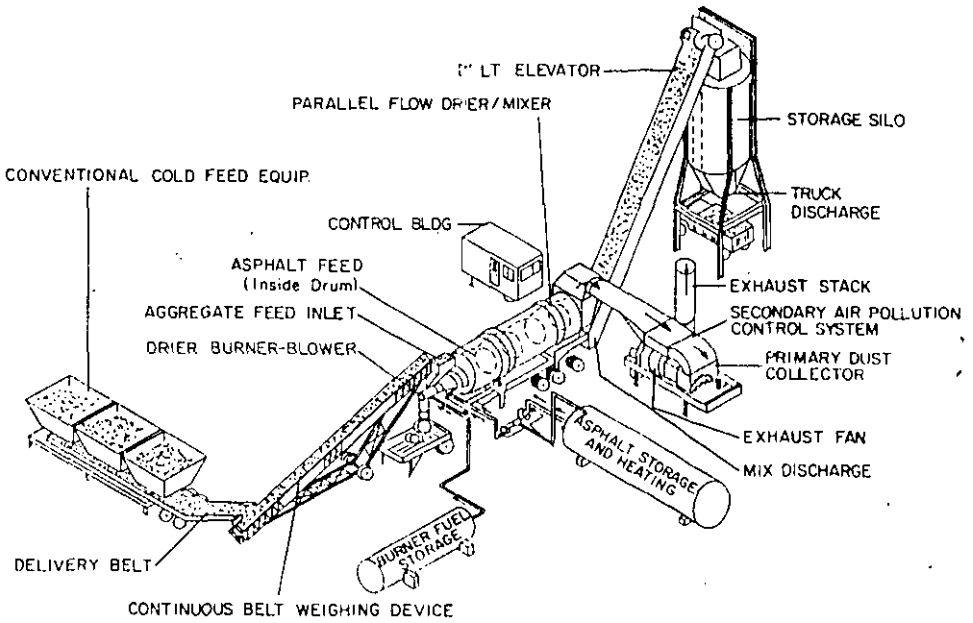

Figure 1. General process flow diagram for dryer-drum hot asphalt plants.

can substantially reduce the amount of unburned hydrocarbons being emitted by keeping the liquid asphalt from direct contact with the burner flame. The bituminous product is then removed from the drum mixer and conveyed to storage. Compared to a standard mix plant this process eliminates the hot side screens, bins, and elevators, plus an additional mixing unit.

Mass Emission Rates

The uncontrolled emission factors as published by the EPA[5] apply only to the standard batch or continuous mix asphalt plants, and there is a large amount of test data available for these plants. This type of information is useful both to the design engineer and for agency permit evaluation.

Unfortunately this is not the case for dryer-drum asphalt plants. The lack of background data is partially due to the relatively small number of these plants currently in operation and certain problems with the stack test procedure for this type of air contaminant. The EPA currently has a study under contract to develop an uncontrolled emission factor for dryer-drum plants using source testing data to be gathered at various locations in the United States. As with the standard type plants, this information can be useful both in the design and evaluation of control devices.

In the interim period a survey was made by utilizing all available sources of stack testing information in order to develop a data base for particulate emissions. Most of the information obtained came from the equipment manufacturers.

Results

The information gathered as described above is summarized in Table I.[6,7] The first two emission rates presented are for uncontrolled plants, and the last three emission rates are for plants with some form of air pollution control equipment. Also from Table I, it can be determined that a two-stage wet washer can meet the 0.04 gr/dscf limitation depending on the particle size distribution.

In only two cases were the data gathered, as a result of the survey, detailed enough to include all operating and testing parameters. A further analysis was conducted by the author, in an attempt to formulate an uncontrolled emission factor for dryer-drum asphalt plants. It was concluded that, like conventional plants, the rate of emission is directly related to the various plant operating parameters. The range of emission factors from a 160 ton/hr plant varies from 4.4 to 48.6 lb of particulate emitted per ton of asphalt produced depending mainly on the percentage of fines in the aggregate. From this relationship, it must be assumed that there is a correlation between the amount of aggregate below 200 mesh being introduced into the dryer, and the mass emission rate. Due to the insufficiency of the data, what this relationship is cannot as yet be defined. However, other factors must also be evaluated, i.e. air velocity, internal flight arrangements, point at which asphalt cement is introduced and other physical arrangements within the drum.

Types of Particulate Control Devices

In the criteria document for the Performance Standards for New Stationary Sources,[8] EPA stated that the only types of control equipment which would meet the 0.04 gr/dscf and less than 20% equivalent opacity limitations would be a properly designed, maintained, and

Table I. Particulate emissions from dryer-drum hot asphalt plants.

Production rate (ton/hr)	Stack gas flow rate (acfm)	Grain loading (gr/dscf)	Emission rate (lb/hr)	Control system
160	49177	30.3	7298.2	None
160	30941	6.0	700.3	None
230	36740	0.045	9.84	Venturi scrubber
125	22440	0.035	5.33	Two-stage Estec
240	57500	0.238	83.6	Wet washer

45.5 #/TON
4.3 #/TON
.042 #/TON
.042
0.369 #/TON

operated baghouse (fabric filter) or venturi scrubber. This is due to the fact that the standard wet washer currently installed on most conventional asphalt plants does not have a collection efficiency sufficient to meet these standards. Due to the nature of the particulate matter being collected from dryer-drum asphalt plants, it has thus far been determined that fabric filtration was not applicable to this type of process. The bags tend to clog and cannot be adequately cleaned using the conventional reverse-flow or pulse-jet cleaning. However, research is underway to adapt fabric filters to this type process. Electrostatic precipitation also cannot be applied to these processes because the power required is not usually available for portable operation and the plates become coated with the oily particulate which significantly reduces the collection efficiency.

There are only two types of devices, other than those mentioned above, potentially capable of meeting the emission limitations. These are either a direct flame afterburner for control of hydrocarbons or a venturi scrubber. Due to the severe limitations on cost and availability of fuel to fire a direct flame afterburner, these devices are impractable to operate. This leaves only the venturi scrubber as the most viable alternative to solve the problem. With these devices, there are difficulties involving the feed-water quality to the venturi. This problem can be overcome by proper design and maintenance.

Discussion

The mass emission rates presented above give a partial basis for estimating the quantities of particulate matter emitted from dryer-drum hot asphalt plants. In addition, the following factors were found to have a direct relation to the amount of air contaminants produced from a dryer-drum plant:

1. *Mix Temperature.* As the temperature inside the dryer is lowered, the amount of contaminants produced is also lowered. Less of the liquid asphalt introduced into the dryer is being flashed off if the mix temperature is kept to a minimum.
2. *Asphalt Injection Point.* Keeping the liquid asphalt away from direct contact with the burner flame will substantially reduce the amount of unburned hydrocarbons being formed.
3. *Coarseness of the Mix.* The less fines in the mix, the less particulate will be generated.
4. *Additives.* Some manufacturers feel that certain chemicals added to the liquid asphalt will aid in the agglomeration of the aggregate particles and tend to reduce the amount of air contaminants being emitted.

Conclusions

The dryer-drum type of asphalt plant has economic advantages over the previous forms of bituminous paving production processes. The particulate emissions do cause problems in the design and operation of air pollution control equipment. The venturi scrubber seems to be the only viable alternative in order to meet the grain loading requirements imposed by most regulatory agencies, and reflects best available control technology. At the present time there is insufficient mass emission rate data available to give both the industry and air pollution control officials an adequate representation of the uncontrolled air contaminants potentially being released to the ambient air.

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