FILE NAME: National Safety Council (NSC)

DATE: 1953 Feb

DOC#: NSC024

DOCUMENT DESCRIPTION: NSC - National Safety News - Practical Aspects of Dust Suppression

Practical Aspects of Dust Suppression

PART I

By W. B. LAWRIE
M.Sc., F.R.M.S., A.I.M.

INCIDENTAL generation of large quantities of dust is a feature of many industrial processes. In some, the dust is dangerous to health; in others, although perhaps innocuous, it appears in objectionable quantities. Higher output often increases the density of the dust cloud generated, so the modern factory may aggravate the dust problem.

The term "dust supression" includes all methods by which atmospheric dust concentrations are reduced. These methods fall into two main groups. One approach aims at prevention of dust generation. The other is directed to the control of dust clouds which have been allowed to form.

The former, which may be described as *dust elimination*, is always the better and often the more difficult method.

The latter, referred to as *dust control*, is never so good, although it may be the only practical expedient. It is, however, of great practical importance to keep in mind these fundamental differences in technique.

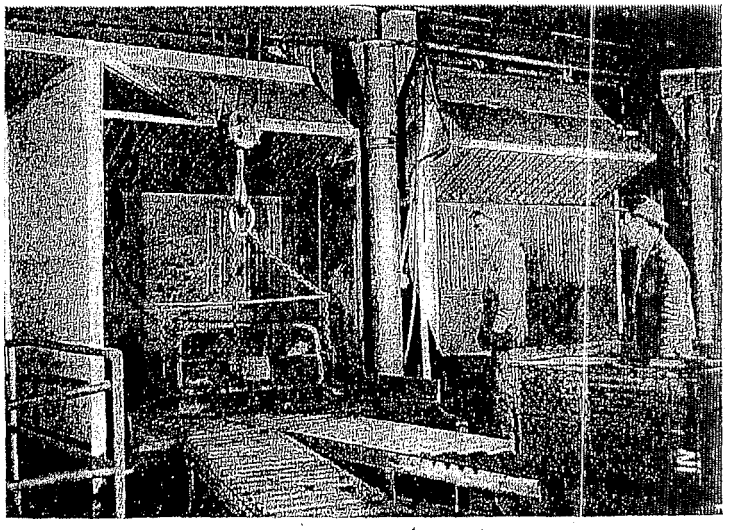
Dust supression can be applied in three ways. First and best is elimination of the dusty process. The second is alteration of the process giving rise to the dust, so that less dust is produced. This is not so good as complete elimination, but it reduces the amount of dust to be controlled, and so facilitates application of control methods. Finally, the dust cloud may be controlled after it has been allowed to form in the atmosphere.

Where no alternative is available, control methods will have to be applied. In the over-all design of a dust supression system, however, they should always be considered last. Success often depends on the thoroughness with which the first two methods have been used, and the degree to which the actual formation of the dust cloud has been restricted before the control methods were applied.

Although local exhaust ventilation is often necessary, it is only one way of controlling dust, and in certain cases may not even represent the major feature of a good dust-suppression system.

Local exhaust ventilation is not always successful. It commonly fails to achieve its end because it has been regarded as the only method, instead of being used in conjunction with other methods of dust suppression.

One other general observation must be made. Local exhaust ventilation is employed to remove dust—not air. This requires some knowledge of the properties of the dust to be removed, and also of the manner in which it might be expected to behave. It also means that the normal method of estimating the requirements of the ventilating system, with reference to the volume of air extracted, may give an inadequate impression of the amount of dust it will remove.



Dust and smoke collector hoods behind shakeouts have a capacity of 18,000 cubic feet of air per minute. (Allis-Chalmers Manufacturing Co.)

This article, which appeared originally in the British Journal of Industrial Safety, *is presented in condensed form through courtesy of the Royal Society for the Prevention of Accidents, London.*

Illustrations are from industrial plants in the U. S. A. Part II of this article, which deals more specifically with local exhaust ventilation, will appear in an early issue.

outgoing air will be high. The building should always be constructed of materials having good thermal properties to ensure minimum heat loss through walls and roof. Heating should, therefore, be considered part of the ventilating problem.

If the processes involve furnaces or other heat sources, the general ventilation will be taken up from floor to roof, and dust and fumes will rise. It is necessary, therefore, to have a roof which is well insulated and warm. This is because the velocity with which hot dust and fumes rise is a function of their temperature.

As the hot column rises, it cools, its upward velocity decreases, and as it moves more slowly it becomes more susceptible to stray drafts which tend to dissipate it throughout the room. If it meets a cold roof or cold air strata, it may be cooled sufficiently to start falling again.

In this case, the roof fans will be trying to extract fumes and dust in an upward direction at a level where these fumes are naturally falling. If the roof is both high and cold, the hot rising column may be chilled to the temperature of the surrounding air before it reaches the roof. Then it will cease to rise, and will level out to form a horizontal layer of dust which will float in the air. It is very difficut to extract this layer if the fan inlets are a few feet above it.

With hot dusty processes the roof should not be flat, because rising columns of hot dust and fume impinging on a flat ceiling will billow outward and spread rapidly. A ridge roof, which will convey the fumes to a high point at which the fans can be placed, will offer far better ventilation.

It is not possible to lay down rules for general application and much more information is still needed. For example, a careful survey of the temperature gradients throughout a building which contains furnaces might well show the ventilating engineer where to place his fans to assist the natural flow of hot, dust-laden air.

In new construction, ventilating engineers should work in consultation with the architects. Cooperation of this kind enables the ventilating engineer to control the incoming air as well as the extracted air; whereas if the ventilating system is added to an existing building he can often control only the outgoing air, which imposes limitations on the whole system.

Only buildings designed for hot processes and upward ventilation have been discussed. Different considerations may be present if the processes are cold, or if the general ventilation system is designed to operate downward from roof to floor. Nothing has been said about arranging the building so that a process needing local exhaust ventilation is near an outside wall to permit short ducts between process and dust arrester.

General Ventilation

General ventilation should not be considered until all specific points of dust or fume production have been dealt with individually, either by local exhaust ventilation or by other methods. Cheap and effective general ventilation becomes possible only when large concentrations of impurities have been prevented from diffusing throughout the atmosphere.

General ventilation should not be used to scavenge a polluted atmosphere. It is highly improbable that it would perform such a function, and even if it did, the dust would have been breathed by the occupants of the room before being extracted. In addition, large quantities of air have to be handled, and ventilation costs rise steeply. The heating of the building will become progressively more expensive and less efficient.

It follows, therefore, that general ventilation should be designed to deal only with small quantities of residual atmospheric impurities after the bulk of the dust has been disposed of at source. If this has been done by local exhaust ventilation the general ventilation should be designed to balance the local systems.

Upward Ventilation

The commonest form of general ventilation is upward ventilation, extracting at the roof. It is also probably the most practicable form in buildings containing scattered sources of heat. In these cases, however, it is desirable that the ventilating engineer should know the method of generation of the dust or fume, its initial temperature, its natural method of propagation or flow, the path it will take and its velocity along this path.

It is evident that the upward extraction of rising air demands a vertical path from the point of origin of the impurity to the fan on the roof. Quite apart from the undesirability of allowing the fumes to spread throughout the room, less ventilation air will be needed to extract a concentrated column which is rising naturally and rapidly to the fan.

Impurities can usually be most easily prevented from spreading by segregating dusty processes in separate buildings. If this is not possible, partitions may be hung from the roof and extended downward as low as possible. This will ensure that warm rising dust and fumes pass the lower edge of the partitions before they cool sufficiently to lose their velocity. They will subsequently be contained, physically, by the partitions as they rise more slowly toward the roof fans.

To prevent dust from spreading, it is essential to control eddy currents and stray drafts. Drafts which are allowed to dissipate rising columns of air may completely vitiate the general ventilation system.

This point is of still greater importance in buildings containing furnaces, where particularly strong eddy currents may be set up by natural convection. It should not be forgotten that furnaces may set up such strong cross currents that a badly de-

—*To page 108*

tested as they are turned in before being issued for use. If tool proves defective it is immediately tagged and turned in to the electrical department for repair. Since a tool can be completely tested in seven seconds, this additional work places no burden on the tool crib. Weighing less than six pounds, it may also be used as a portable instrument to test tools at the point of operation.

Most electrical departments have accepted this new testing device because it aids them in spotting the hazard. It means that after the tool crib attendant has found that the equipment ground is broken or that there is a power ground the tool is then tagged and sent to the electrical department and gives the electrician a clue as to what to look for rather than to spend time tearing down the entire equipment.

Dust Suppression

—*From page 68*

signed ventilating system merely serves to pollute the whole room rendering conditions worse by dissipating impurities which would otherwise have polluted only the air above their point of origin.

Flat roofs offer the worst conditions for upward ventilation. The rising air does not converge to a point at which the fan is placed but spreads horizontally on meeting the ceiling. The best way of dealing with such a state of affairs is to insert a false ceiling.

The false ceiling is perforated all over its surface and the extraction fans are installed in the ceiling above it. There is, therefore, an even extraction rate over the whole area of the ceiling and the rising air will be extracted at the point it meets the ceiling. This method is more efficient if hanging partitions are placed over areas where large volumes of fumes are generated.

Downward Ventilation

Rooms which do not contain hot processes may be ventilated downward, from roof to floor. This method is not so common in British industry, but there seem

re turned in or
ed for use. If a
tive it is imme-
id turned in to
nt for re-
ol can be com-
ven seconds, this
places no burden
. Weighing less
it may also be
le instrument to
point of opera-

departments have
w testing device
them in spotting
eans that after a
it has found that
round is broken
a power ground,
tagged and sent
department and
ian a clue as to
r rather than to
g down the entire

---

ssion

g system merely
' whole room,
t. worse by
ities which would
polluted only the
oint of origin.
r the worst condi-
ventilation. The
ot converge to the
he fan is placed
zontally on meet
The best way o
a state of affairs
lse ceiling.
ing is perforated
ce and the extrac
stalled in the ceil
nere is, therefore
ion rate over the
e ceiling and the
e extracted at the
the ceiling. The
efficient if hang
are placed over
arge volumes o
ated.

Ventilation

do not contain
ay be ventilated
of to floor
not so common in
but there seems

to be a growing tendency to use it in Sweden. Its advantages are obvious and it extracts dust and fumes without lifting them past breathing level in the process. The general method is to blow in suitably heated air at roof level. The incoming air may be blown through distributors or through a perforated false roof.

In the latter method a second, perforated, ceiling is placed below the ceiling and air is introduced under pressure between the ceiling and the false ceiling, so that it enters the room through the perforations in the false ceiling. The air is extracted below breathing level, and if the processes in the room are provided with local exhaust ventilation this may serve to extract all or part of the air. The whole system needs careful balancing.

Supply of Outside Air

All the air extracted from a building must be replaced by fresh air from outside, and this incoming air should be under control. This is because the uncontrolled ingress of air may short circuit the general ventilation system and give rise to drafts. In hot processes they may be strong enough to vitiate the whole ventilating system.

The incoming air should be clean, and great care should be taken to avoid contaminating this air before it enters the building. Air intakes should be arranged so that they cannot draw dusty air from outlet ducts which are discharging from other parts of the building or from particular processes.

One method of preventing this is to place outlet ducts high up over the buildings. These outlet ducts should be designed to discharge at high velocity, so that the used air will be carried away from the factory.

Outlet ducts should never be fitted with covers. These covers restrict the discharge velocity and baffle the air stream, so that the spent air is turned down over the factory roof, instead of being delivered high up into the outside atmosphere.

Ideally, incoming air should be delivered to the place at which it

is needed, because if it is introduced at some distance from this point it will mix with fumes from other sources as it passes through the building. It will, in any case, lose its velocity if it has to travel long distances. If velocity can be maintained, a smaller volume will be needed. On the other hand, drafts must be avoided so that incoming air should not be delivered in the form of a jet, which might impinge on the occupants of the room. When the air has lost its velocity in transit it may still be controlled by reason of temperature.

In plenum systems, it has been found in Sweden that the incoming air can be introduced at a lower temperature than that of the air in the room. As the air is blown in at a height of about 7 feet, this cool air falls to the floor. The angle at which it falls can be controlled by regulating the inlet temperature and the whole system gives a sweeping effect as the cool fresh air falls to the floor before warming up and rising to the roof extractors. This kind of control offers real possibilities, although further information is still needed to obtain the correct air movement by judicious use of velocity and temperature.

One final point might be noticed in general ventilation techniques. Certain industries produce large volumes of dust and fumes at particular stages in the process. In these cases it may represent a considerable saving in heating costs if the general ventilation system is designed so that the extraction volume can be increased to meet the short periods at which the maximum dust or fume production occurs.

Tact is giving a person a shot in the arm without letting him feel the needle.

"Smithers," said the boss to a meek employee, "I understand you've been going over my head."

"Not that I know of, sir," replied the employee.

"Well, isn't it true that you've been praying for a raise?"