DAMAGE CAUSED BY DUST

Dust may cause damage in many ways, but usually it must first lodge on a surface. Larger particles settle rapidly out onto surfaces. The rate of fall of particles is given in Chapter 28, Fig. 1. Those visible to the unaided eye (50 microns or over) fall so rapidly that few remain in the air. However, any large ones which are carried into a room are almost certain to settle and are so noticeable when they have settled as to be very objectionable.

Any air movement, particularly over fabrics or unpolished surfaces, tends to deposit dust on the surface. The smallest particles observable in the microscope are deposited in this way.

A phenomenon of great importance in air conditioning and one not yet generally appreciated is thermal precipitation of dust. This is the tendency for dust to be deposited on any surface which is cooler than the adjacent air. It is largely responsible for outside walls becoming dirtier than partitions. In the case of plaster on wood lath, the dark streaks following the spaces between laths are very noticeable and frequently beams and other structural members can be traced by the difference in blackness of the wall or ceiling. Thermal precipitation deposits particles of all sizes apparently with very little differentiation as to size.

By keeping the surface temperature higher and more uniform, modern thermal insulation decreases the deposit of dust and makes it more uniform and less noticeable.

REQUIREMENTS

The removal of larger particles is always important because they quickly settle out of the air and become noticeable on surfaces as visible dustiness. In many applications the removal of these larger particles will constitute satisfactory performance, and a relatively simple device can be used.

In cities where large quantities of soft coal are burned, the air becomes contaminated with fine black smoke particles. These are deposited on walls, draperies, and other interior surfaces by air movement and by thermal precipitation. Their removal is much more difficult than that of the large particles.

Hay fever is usually due to pollen in the air, and many people, once this trouble has started, are sensitive to minute amounts of pollen, so that almost perfect cleaning may be required. Asthma may be caused by many things, including pollens and fine dusts. Many afflicted with either disease, who have not obtained relief from usual remedies, have found it in a room where the air is efficiently cleaned from small as well as large particles.

In air conditioning systems the maintenance of constant air flow is essential. In summer cooling, a decrease in air flow may cause a reduction in temperature of discharged air. This, combined with reduced velocity, may completely upset the air distribution objective resulting in drafts. The air cleaning equipment must function so that reduction in air flow due to the normal accumulation of dust will not cause faulty operation of the system.

In addition to requirements which are specified the following features are desirable:

1. Low resistance to air flow.
2. Ease of cleaning and maintenance.
3. Efficiency over a wide range of velocities.
4. Binding liquid to catch particles must not contaminate the air.

TESTING

The wide variety of materials and particle sizes which may be present in the air makes the testing of air cleaning devices difficult. Probably no standardized test can cover all of the conditions which may be encountered in service.

Tests have been devised which compare the ability of air cleaners to remove a certain artificial dust under specified conditions. This seems to be the most practical way of comparing various devices, but it may lead to misleading results if the dust is not representative of the dust to be removed in service.

The most common test is that specified by the A.S.H.V.E. Standard Code for Testing and Rating Air Cleaning Devices Used in General Ventilation Work[1]. This Code specifies an artificial dust consisting of a mixture of dusts, which has passed through a 200 mesh screen. The efficiency is measured in terms of the ratio of the weight of dust removed to the weight of dust injected into the air. This is a well-worked-out method for testing the ability of a device to remove the coarser particles, but it is not a satisfactory measure of the ability of a device to remove extremely fine particles. In general, any weight method tends to measure the efficiency of removal of the larger particles present in the test dust. The largest particle specified in this Code is one just passing a 200 mesh screen or one 70 microns in diameter. Assuming a dust containing one such particle to 1,000,000 particles having a diameter of 0.1 micron, the 70 micron particle will have 3.43×10^8 times the weight of one of the 0.1 micron particles, all particles having the same density. If the cleaning device removes the one large particle but removes none of the 0.1 micron particles, the weight efficiency will be the ratio of the weight removed to the weight of dust injected or 99.71 per cent by weight even though only one particle out of 1,000,000 has been removed. This is obviously an exaggerated case, but illustrates the weakness of a weight test in measuring efficiency of removal of fine particles.

In testing air filters at the *National Bureau of Standards*, a much finer dust is used and the efficiency is measured by determining the relative blackness of pieces of filter paper through which air is passed[2]. The test dust used is a sample of dust collected by a precipitator in a local power plant, which of course is not as fine as atmospheric dust. However, this method of measuring efficiency can be used with atmospheric dust to test an air cleaning device under actual operating conditions. The efficiency is determined by drawing samples of filtered and unfiltered air through pieces of filter paper, the volumes of air being adjusted until

[1] A.S.H.V.E. Standard Code for Testing and Rating Air Cleaning Devices Used in General Ventilation Work (A.S.H.V.E. TRANSACTIONS, Vol. 39, 1933, p. 225).

[2] A Test Method for Air Filters, by Richard S. Dill (A.S.H.V.E. TRANSACTIONS, Vol. 44, 1938, p. 379).