

which have to be met in the field, it is natural that many kinds of air cleaning devices are used which cannot be shown satisfactorily in a simple outline. Classifications on three different bases are enumerated herewith:

1. Principle of air cleaning.
 - a. Viscous-impingement filters.
 - b. Dry filters.
 - c. Washers.
 - d. Centrifugal devices.
 - e. Electrical precipitators.
2. Methods of servicing.
 - a. Automatic.
 - b. Non-automatic.
 - (1) Throw-away (replaceable elements).
 - (2) Manually cleaned in place (including one type of electrostatic).
 - (3) Removable for cleaning.
3. Classification according to application.
 - a. General air conditioning.
 - (1) Central cleaning system.
 - (2) Unit ventilator.
 - (3) Window installation.
 - (4) Warm air furnace.
 - b. Removal of smoke and fumes from stack gases.
 - c. Collection of dusts from exhaust systems.

VISCOUS IMPINGEMENT TYPE CLEANERS

The medium in a viscous impingement type filter is usually a fiber pack for non-automatic types or a series of metal plates for automatic self-cleaning types. In either case, the medium is treated with a viscous substance, often an oil or grease, called the *adhesive* or the *saturant*, intended to retain dust particles which come in contact with it. Also, in either case, the arrangement is such that the air stream is broken up into many small air streams and these are caused to abruptly change direction a number of times in order to throw the dust particles, by momentum, against the adhesive. Several desirable characteristics of an adhesive for air cleaners of this type are:

1. Its surface tension should be such as to produce a homogeneous film or coating on the filter medium.
2. The viscosity should vary only slightly with normal changes of temperature.
3. It should prevent the development of mold spores and bacteria on the filter medium.
4. The liquid should have high capillarity, or ability to wet and retain the dust at all operating temperatures.
5. Evaporation should be slight.
6. It should be fire resistant.
7. It should be odorless.

Various fibrous materials have been used as filtering media in unit filters of the viscous impingement type. This includes glass fiber, steel wool, similar *wool* of non-ferrous metals, wire screen, animal hair, hemp fibers, and other materials. In such filters, the medium is often packed more densely on the discharge, than on the approach-side in order to increase the dust holding capacity. This results in a selective arrestance

of dust with the larger particles nearer the approach face. The arrangement also permits some penetration of lint into (but not through) the filter, so that the amount of lint which can be tolerated on the filter is also increased. Due to plane surface area the viscous impingement type filter, however, may be inferior to some dry types where the air carries a high percentage of lint.

The resistance of air filters obviously increases with the air flow through them. For this type filter, face velocities of about 300 fpm and resistances in the range from 0.1 to 0.2 in. W. G., when the device is new and clean, are usual for ventilation system filters. Special filters with low resistances are available for use with gravity warm air furnaces and for other uses where only low pressure is available.

The resistance of these filters increases with dust or lint loading and it is the resistance due to this cause which ordinarily necessitates servicing. The rate of loading obviously depends upon the amount as well as the kind of dust in the air and for this reason, periods between servicing cannot be predicted. Manometers are often installed to indicate the pressure drop across filter banks and they serve to indicate when the filter requires cleaning. The pressure drop tolerated differs between operators and system designs. The resistance of a filter bank can be kept desirably low by periodically servicing some but not all of the units in the bank at one time, providing the difference in resistance between the clean and dirty filters is small.

The method of cleaning viscous impingement unit filters differs for different types of filters and kinds of dust. Much dry dust or lint can often be removed by rapping the filter.

Throw-away filters are constructed of inexpensive materials and are designed to be discarded after one use. The frame is frequently a combination of cardboard and wire.

Cleanable types usually have metal frames. Various cleaning methods have been recommended including: air jet, water jet, steam jet, washing in kerosene, and dipping in an oil. The latter may serve both to clean the filter and add the necessary adhesive.

Automatic Viscous Filters

In an automatic air filter, means are provided to remove the dust from the medium mechanically. Automatic filters with moving cloth media have been constructed. The media is supported on rollers and moves slowly and continuously across the air stream and then through some cleaning mechanism, such as a beater, a vacuum cleaner, or a brushing arrangement. Such filters, however, are not now in wide use, possibly on account of mechanical difficulties, and because of the rapid and sometimes permanent increase of resistance when oily matter is present.

The medium in a typical automatic filter at present consists of a series of specially formed metal plates mounted on a pair of chains. The chains are mounted on sprockets located at the top and bottom of the filter housing, so that the filtering medium can be moved as a continuous curtain up one side and down the other side of the sprockets. The arrangement is such that, at the bottom, the medium passes through a bath of special oil which both serves to remove the dirt from the plates