

equal blackness is obtained. If, for example, one unit of volume of unfiltered air gives the same blackness as four units of volume of filtered air, the efficiency is said to be 75 per cent. This method gives a much better measure of the tendency to blacken walls than the weight efficiency.

### CLASSIFICATION OF AIR CLEANING DEVICES

Considering the wide variety of materials and particle sizes to be removed and the variety of requirements, it is natural that many kinds of devices are used which cannot be shown satisfactorily in a single simple classification. The following outline gives classifications on three different bases:

1. Methods of cleaning.
  - a. Automatic.
  - b. Non-automatic.
    - (1) Throw-away, replaceable elements.
    - (2) Manually cleaned in place.
    - (3) Removable for cleaning.
2. Principle of air cleaning.
  - a. Viscous-impingement filters.
  - b. Dry filters.
  - c. Washers.
  - d. Centrifugal devices.
  - e. Electrical precipitators.
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 FILTERS

The principle of air cleaning used in viscous filters is that of *adhesive impingement*. Dust and dirt in the air, especially soot and carbons, are trapped and retained by successive impingements on coated surfaces. The arrangements of filtering mediums and the kind of materials used are almost unlimited. Since this type of device depends on impingement, it is more effective in catching large particles than small ones. To secure maximum cleaning efficiency, it is necessary to divide the air into innumerable fine streams, to obtain intimate contact between the air and the viscous-coated mediums.

The following are desirable characteristics of a binding liquid:

1. Its surface tension should be such as to produce a homogeneous film-like 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 mediums.

4. The liquid should have high capillarity, or ability to wet and retain the dust at all operating temperatures.
5. Evaporation should be low.
6. It should be fire resistant.
7. It should be odorless.

### Viscous Type Unit Filters

In the unit type viscous filter, the filtering mediums are arranged in units of convenient size to facilitate installation, maintenance, and cleaning. Each unit consists of an interchangeable cell or replaceable filter pad and a substantial frame which may be bolted to the frames of other like units to form a partition between the source of dusty air and the fan inlet.

To secure the maximum dust-holding capacity, the filter medium is usually arranged with large pores or air passages on the entering air side, the filter density increasing gradually toward the leaving air side. This arrangement provides relatively large spaces for the collection of dirt in

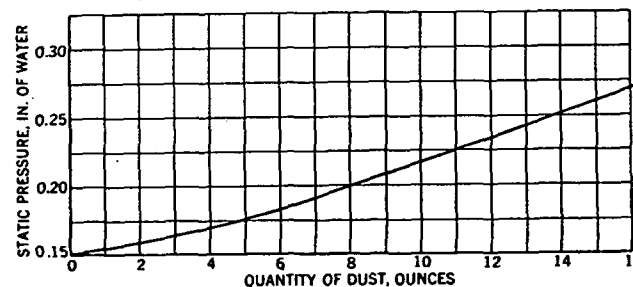


FIG. 1. CHART SHOWING CHANGE IN RESISTANCE DUE TO DUST ACCUMULATION

the front of the filter where the bulk of the dust is taken out without undue increase in resistance, while in the back of the filter the openings are smaller to secure high efficiency in the removal of the finer dust particles.

The resistance of a well-designed unit filter of the adhesive impingement type usually depends upon the velocity at which the air is handled and upon whether the unit is clean or dirty. The cleaning efficiency is usually highest after it has accumulated a certain portion of its maximum load of dirt because some dust collected in the cell acts as an efficient medium for the further seizing of solids from the air. By periodically cleaning a predetermined number of cells, the resistance and capacity of a built-up filter may be held at any desired figure. The frequency of cleaning any installation depends upon the dust concentration of air being cleaned, and on the amount of dirt which can be accumulated in the medium without causing excessive resistance. (Figs. 1, 2 and 3.)

The dust-holding capacity of a given filter is dependent on the type of dust. Lint is particularly difficult to collect because it tends to build up a layer over the face of the filter. In this way a small quantity of dust may cause a serious increase in the pressure drop of a filter.

A chart showing the increase in resistance of a unit filter of the viscous impingement type, when tested with the standard test dust described in