high voltage type have been used for the control of hazardous materials, and for nuisance abatement. They have been applied to flue gases from cement kilns, smelters and paper plants; to exhaust systems serving crushers, grinders and conveyors; to chemical and metal working plants; and to many pulverized-fuel, fly-ash applications. To date, precipitators have been used principally for elevated temperature installations, and dry products that are free of condensation or dampness.

Fabric Collectors

Dust collectors in this group, often known as *cloth dust arresters* or *cloth filters*, remove dust by passing air at low velocity through a filter material. Cotton cloth is the usual material, although wool, glass, asbestos, and metal screen are sometimes employed. Filter velocities depend on dust concentration, particle size, and permissible vibration interval. Normally at about 3 fpm, they often are reduced to 1 fpm or lower where heavy dust loads of very fine material are involved. Velocities in excess of 6 fpm are seldom used, except in automatically vibrated sectional collectors where velocities as high as 20 fpm are frequently employed.

Collection efficiency is high, even for low micron dust sizes, when the collector is properly maintained. As collected material builds up on filter surfaces, increasing the resistance to air flow, such a system must be stopped at 4 to 8 hour intervals so that the dust load can be vibrated from the filter surfaces to reduce the pressure loss.

Filter cloth is supported in the form of envelopes or bags in a suitable steel housing. Space requirements are quite large, generally necessitating an outdoor location. Pressure drop is normally 2 to 4 in. water column. Material is collected dry. Fabric arresters are limited to applications where air is above the dew-point, as condensation packs the collected material with resultant high pressure drop, and prevents removal by vibration. Temperatures should not exceed 180 F for cotton, or 200 F for wool.

Wet Collectors

In a wet dust collector, the contaminant is brought into contact with a liquid, usually water, for removing the dust from the gas stream. The various available designs represent combinations of methods that make cataloging according to principles, pressure drop, or efficiency, difficult. Wet type dust collectors have the ability to handle high temperature and moisture laden gases. The collection of dust in a wetted form eliminates a secondary dust problem in disposal of collected material. However, the use of water may introduce corrosive conditions within the collector, and freezing protection may be necessary if collectors are located outside in cold climates. Space requirements are nominal. Pressure losses and collection efficiency vary widely with design.

1. *Static Washers*. These units, unlike most *air washers*, are designed to handle heavy concentrations of dust. Both scrubber and eliminator plates (each having flooding nozzles) are employed in addition to the bank of sprays ahead of the scrubber plates, and 2 banks of opposed sprays located ahead of the eliminators. A hopper-bottom tank with recirculating pump completes the assembly. Pressure drop is about ½ to ¾ in. of water. Spray towers can be placed in this same group, as they consist of a tower structure with various nozzle arrangements, and usually include an eliminator section at the top.

Wet glass cell washers have special sprays playing on filter cells filled with fiberglass or other filter media. Flooded eliminator plates are used to remove free moisture from the air stream. Pressure drop is about ¾ in. of water, and the length of the unit is comparable to that of a single stage air washer. Applications are usually limited to low dust concentrations.

2. *Packed Towers*. Collectors in this group are essentially contact beds through which gases and liquids pass, either concurrently, counter-currently, or in cross flow, and are used primarily for nuisance abatement of highly corrosive contaminants. The liquid usually enters at the top of the tower, while the gases may enter at the top, at the bottom, or through an open side.

Water flow rates of 5 to 10 gpm per 1000 cfm (70 F volume) are distributed frequently through V-notched ceramic or plastic weirs. High temperature deterioration is avoided by use of brick linings permitting 1600 F gases direct from furnace flues.

Air flow pressure loss for four-foot beds of irregular shaped materials, such as ceramic saddles or coke, range from 1½ to 3½ in. water, with respective face area velocities of approximately 200 to 300 fpm.

3. *Wet Centrifugal*. A number of designs utilize a combination of centrifugal force and water contact to effect collection. In designs of this group, the collector is cylindrical, either in shape of a tower or with the axis horizontal. Air is introduced tangentially, and frequently directed counter-current to flow of water by baffles or directional plates. Water may be brought into contact with the dust particles by keeping collector surfaces washed by spray nozzles, by induced water picked up by the air, or by fall of water due to gravity. Pressure losses range from 2½ to 6 in. water.

4. *Dynamic Precipitator*. This type uses water sprays within a fan housing, and obtains precipitation of the dust particles on the wetted surfaces of an impeller with special fan blade shape. No external pressure drop is involved, although mechanical efficiency is somewhat lower than the mechanical efficiency of standard exhaust fans.

5. *Orifice Type*. In this type, the air flowing through the collector is brought in contact with a sheet of water in a restricted passage. Water flow may be induced by the velocity of the air stream, or maintained by pumps and weirs. Pressure losses vary from 1 in. or less in water wall spray booth collector designs, to from 3 to 6 in. in most industrial collector arrangements. Pressure losses as high as 20 in. are used, with some collectors designed to collect very small particles.

6. *Disintegrator*. This type of unit generally consists of one or more stages, and is largely used for cleaning producer, blast furnace, or other gases where the gas is to be used in engines, and must be practically free of dirt. The spray is generally in the fan inlet, and elimination is effected largely on the fan blades and also on the surfaces beyond.

A special two-element fan is used; the air with its dust content and water spray enters one side of the wheel and is discharged from the *inlet* of the other wheel. As the air passes through the cyclonic chamber, a high degree of scrubbing action takes place.

Relatively high pressure losses are encountered, with resulting high horsepower requirements.

CENTRIFUGAL DUST COLLECTORS

Centrifugal collector design can be divided into four groups:

1. *Cyclone Collector*. This type is commonly applied for the removal of coarse dusts from an air stream, as a precleaner to more efficient dry or wet dust collectors, or as a separator in product conveying systems using an air stream to transport material. Principal advantages are low cost and low pressure drop (¾ to 1½ in. water), but this type cannot be used for high efficiency collection of fine particles.

2. *High Efficiency Centrifugal Collectors*. These have been developed to obtain higher centrifugal force action on dust particles in a gas stream. Centrifugal force is a function of peripheral velocities and angular acceleration, and improvement in dust separation efficiency has been obtained by (a) increasing velocities through a cyclone shaped collector; (b) utilizing a skimmer or other design feature; (c) using a number of small diameter cyclones in parallel; and (d) in some unusual applications, by placing units in series.

While such collectors do not generally reach an efficiency on small particles equal to that of the electrostatic, fabric, or some wet type units, their effective collection