from the top clean air plenum helps to sweep pulsed-off dust away from the filter surface. The pulse jet design is predominantly used because (1) it is easier to maintain than the reverse-jet mechanism and (2) collectors can be smaller and less costly because the greater useful cleaning energy makes operation with higher filtration velocities practical.

The tubular bags are supported by wire cages during normal operation. The reverse-flow pulse breaks up the dust layer on the outside of the bag, and the dislodged material eventually falls to a hopper. Filtration velocities for reverse jet or pulse jet designs range from 5 to 15 fpm for favorable dusts but require greater fabric area for many materials that produce a low-permeability dust cake. Felted fabrics are generally used for these designs because the jet cleaning opens the pores of woven cloth and produces excessive leakage through the filter.

Most pulse jet designs require high-pressure, dry, compressed (up to 100 psi) air, the cost of which should be considered when air-cleaning systems are designed.

When collecting light or fluffy dust of low bulk density (such as arc welding fumes, plasma or laser cutting fumes, finish sanding of wood, fine plastic dusts, etc.), serious attention must be given to the direction and velocity at which dust-laden air travels as it moves from the collector inlet to approach the filter media surface. Dusty air velocity is called **can velocity** and is defined as the actual velocity of airflow approaching the filter surfaces. Can velocity is computed by subtracting the total area occupied by filter elements (bags or cartridges, measured perpendicularly to the direction of gas flow) from the overall cross-sectional area of the collector's dusty air housing to compute the actual area through which dusty gas flows. The total gas flow being cleaned is then divided by that flow area to yield can velocity:

$$V_c = \frac{Q}{A_h - NA_f} \qquad (7)$$

where

V_c = can velocity, fpm
Q = gas flow being cleaned, cfm
A_h = cross-sectional area of collector dusty gas housing, ft^2
N = number of filter bags or cartridges in collector
A_f = cross-sectional area, perpendicular to gas flow, of each filter bag or cartridge, ft^2

The maximum can velocity in **upflow** collectors (i.e., those in which dusty gas enters through a plenum or hopper beneath the filter elements) exists at the bottom end of the filter elements, where the entire gas flow must pass between and around the filters. Unless the maximum can velocity is low enough that pulsed-off dust can fall through the upwardly flowing gas, dust will simply redeposit on filter surfaces. The result is that on-line pulse cleaning cannot function, and the collector must be operated in the downtime pulse mode, with filter cleaning done only when there is no airflow through the collector.

Can velocity is sometimes overlooked when attempting to increase upflow collector capacity with improved fabrics or cartridges. Regardless of the theoretical gas-to-media ratio at which a filter operates, if released dust cannot fall through the rising airflow into the hopper, the collector will not be able to clean itself.

Collector designs in which dusty gas flows **downward** around the filters are much less susceptible to problems caused by high can velocity because the downward gas flow sweeps pulsed-off dust down toward (and into) the bottom dust discharge hopper, from which it can easily be removed.

Perhaps the most significant design difference among the many commercially available cartridge filter units is orientation of the filter cartridges. In collectors having **vertical filter surfaces** (Figure 14), all the pulsed-off dust can fall (by gravity) toward the bottom discharge flange, where it can be removed from the system (presuming

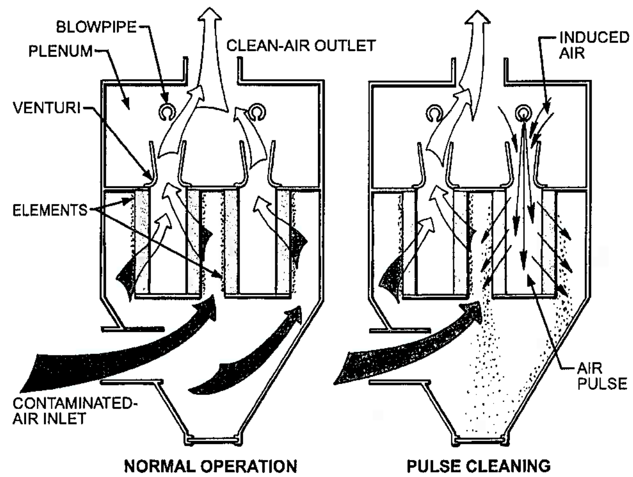

Fig. 14 Pulse Jet Cartridge Filters (Upflow Design with Vertical Filters)

that can velocity is low enough in upflow collectors). However, in designs having **horizontal or sloped filter surfaces**, nearly half of all pulsed-off dust (i.e., that from the top surfaces of the cartridges) must fall back onto that top surface. As a result, up to 50% of the total media area (i.e., nearly all media above the horizontal centerline of each filter cartridge) rapidly becomes blinded by a dust cake that is so thick that little or no gas can pass through to be filtered. This means that collectors having horizontal filter surfaces require twice as much installed filter area to achieve the same level of performance and useful filter life as collectors having vertical filter surfaces.

This chapter can not adequately cover all the collector design variables and experience-related factors that must be considered when deciding which baghouse or cartridge self-cleaning dust collector design is best suited for each particular application. Engineers making dust collector selections are encouraged to discuss all aspects of each application in detail with all vendors being considered. It is necessary to judge

- The relative expertise of each prospective vendor
- Which dust collector design is most desirable
- How much media surface is needed in each design for each specified gas flow rate
- Which filter media is best suited to the particular application
- In the case of pulse-jet-cleaned cartridge collectors, what pleat spacing and pleat depth will give optimum or acceptable dust cake removal performance under the particular application conditions

GRANULAR-BED FILTERS

Usually, granular-bed filters use a fixed bed of granular material that is periodically cleaned off-line. Continuously moving beds have been developed. Most commercial systems incorporate electrostatic augmentation to enhance fine particle control and to achieve good performance with a moving bed. Reentrainment in moving granular-bed filters still significantly influences overall bed efficiency (Wade et al. 1978).

Principle of Operation

A typical granular-bed filter is shown in Figure 15. Particulate-laden gas travels horizontally through the louvers and a granular medium, while the bed material flows downward. The gases typically travel with a superficial velocity near 100 to 150 fpm.

The filter medium moves continuously downward by gravity to prevent a filter cake from forming on the face of the filter and to