In view of the range of these variables, all available test data, application experience, and manufacturers' performance data should be considered.

## TYPES AND APPLICATION

There are a number of principles involved in the operation of industrial air and gas cleaners. They are illustrated by the following types of cleaners:

1. *Mechanical Collectors:* Baffle Chambers, Centrifugal Collectors.
2. *Wet Collectors:* Air Washers, Wet Filters or Packed Towers, Spray Towers, Centrifugal or Inertial Scrubbers, Venturi Scrubbers.
3. *Fabric Collectors.*
4. *Electrostatic Precipitators.*
5. *Adsorbers, Absorbers, and Combustion Devices.*

Units employing these principles may apply them individually or in combination. The important characteristics of any unit are: its collection efficiency, resistance to air or gas flow (power requirements), ability to maintain specified air or gas flow during its operating cycle, and maintenance requirements.

In relation to industrial air cleaners, efficiency of collection is generally presented on a basis of weight removal. In many instances, collection efficiency is expressed in terms of weight removal in specific particle size ranges. Occasionally efficiencies are given in terms of visibility or photometric evaluation. Under other circumstances efficiencies are stated by particle count. For most process recovery problems and air pollution control, the weight basis has been adequate. When loss of visibility is the major problem, light opacity measurements may be required.

From a hygienic viewpoint where air is to be recirculated, only contaminant concentration in recirculated air stream, rather than collection efficiency, should be considered.

Correlation between the various efficiencies is poor due to the wide variation in particle size, size distribution, and shape.

Resistance or pressure drop through any given collector is related to the operating principle, and varies as follows: low resistance collectors, up to 2 in. water; medium resistance collectors, 2 to 8 in. water; high resistance collectors, 8 to 25 in. water.

In mechanical centrifugal collectors of the wet or dry type (power driven impellers or rotors) resistance alone is not of significance since these devices are also air movers and therefore the factor of paramount importance is the overall power consumption of the unit. This is also true of certain types of wet collectors which require auxiliary pumping power.

The ability of any unit to maintain specified air or gas flow during its operating cycle is also a function of its operating principle. For example, inertial collectors of the simple and centrifugal type are able to maintain constant resistance regardless of concentration and particle size. However, adhesive materials may collect at the entry, throughout the unit, and at the exit, and thus cause a reduction in air flow and serious maintenance problems. With the exception of packed towers and wet filters, wet collectors operate at constant resistance throughout their operating cycles. However, they may also be adversely affected by adhesive or corrosive materials. Wet filters or packed towers will eventually become clogged because of retention of inert dusts. Units employing fabric or other filter media will have resistance influenced by the concentration, particle size, shape, and packing characteristics of the aerosol. Their overall resistance during the operating cycle may increase gradually over a known or determined period. Auxiliary cleaning devices such as separate compartments, alternately shaken, reverse air flow, or reverse jet air flow may maintain constant or nearly constant resistance or insure only small fluctuations in air or gas flow. Electrostatic precipitators have the outstanding characteristic of maintaining a constant air flow with an accompanying low resistance. Adsorbers behave similarly to packed towers in that they provide constant resistance until the voids become seriously plugged with inert dusts. This generally requires a matter of several months on normal applications.

Table 1 .... Mechanical Collector Characteristics

| Kind | Efficiency Particle Size Range in Microns >100 | 100–10 | <10 | Resistance (Pressure Drop) | Description and Remarks |
|---|---|---|---|---|---|
| Settling and baffle chambers | Medium | Low | Low | Low | A large chamber to reduce velocity to permit settling. Auxiliary baffles are sometimes used to improve performance. Requires large space. |
| Large-diameter cyclones | High | Medium to low | Low | Low | Considered as single body over 3 ft in diameter. Gases and material must be dry. Air-tight dust bins or continuous removal of material must be provided. Space requirements moderate. |
| Refined design centrifugals | High | High | Medium to low | Medium | Available as multiple small-diameter tubes, scroll-shaped bodies, and multiple louvers. Gases and material must be dry. Air-tight dust bins or continuous removal of material must be provided. Space requirements moderate. |
| Integral rotor type | High | High | Medium to low | See remarks | Rotor acts as air mover and separating element. Usually limited to dry granular materials and dry gases. Low space requirements. No external pressure loss involved but power requirements are higher than usual exhauster. |
| Slotted scroll fan | High | Medium to low | Low | See remarks | Separation takes place in fan scroll. No external loss involved but power requirements are higher than usual exhauster. |



Table 2 .... Characteristics of Wet Collectors

| Kind | Efficiency Particle size range in microns >10 | 10–1 | <1 | Resistance in. Water | Water Rate in Gallons Per 1000 Cu Ft Gas | Maintenance | Description and Remarks |
|---|---|---|---|---|---|---|---|
| Air washers | High | Medium | Low | Low (less than 1) | 5–15 | Medium | Composed of one or more banks of low-pressure sprays and flooded eliminator plates. Space requirements are large. Water is usually recirculated. |
| Wet filters | High | High | Medium | Low (less than 1) | 3–8 | Medium | Composed of one or more banks of low-pressure sprays flooding packed cells of glass or other fibers. Space requirements are large. Limited to low loadings of solid particles. |
| Packed towers | High | High | Medium | High | 5–10 | High | Composed of granular or ceramic packing. Space requirements large. Generally limited to gas absorption. |
| Spray towers | High | Medium | Low | Low | 5–10 | Low | Usually a vertical chamber equipped with low-pressure water sprays at the top or along the walls. Baffle plates may be provided for contacting. Space requirements medium. Usually applied for hot gases. |
| Centrifugal or inertial scrubbers | High | High | Medium to high | Medium (see remarks) | ½–40 | See remarks | This classification includes most of the commercial wet collectors. They may utilize singly or in combination, low- or high-pressure sprays, wetted plates, rotating members, liquid gas contact by induction or centrifugal action. Some of these units (disintegrators) have high overall power requirements for driving the rotor while others have high power consumption for raising water pressures for spray nozzles. Maintenance varies from low to high depending on component parts. Simple gas liquid contact units would be classified as low. Units having rotating members may vary from medium to high depending on the type of service. |
| Venturi scrubber | High | High | High | High (12–25) | 5–10 | Medium | Consists of a simple venturi with low-pressure sprays at throat followed by a cyclonic type separator. Space requirements are low. Unit functions independent of grain loadings. High velocity at venturi throat may cause erosion problems. |

It has been found that inertial separators require the least maintenance. Simple wet collectors rank next in this respect. Complex wet collectors and fabric arrestors require maintenance on a definitely scheduled basis. Electrostatic precipitators require the usual maintenance connected with high-voltage equipment and may vary widely. The maintenance of adsorber type units is minimal and is based primarily on the amount of inert material encountered.

### Mechanical Collectors

There are many types in this group. These range from simple settling chambers utilizing gravitational forces, to complex centrifugal devices using abrupt directional changes or motor driven rotors. They all have the desirable features of constant resistance during their operating cycle and do not require any special construction for temperatures under 750 F. Usually they require less maintenance than other types of collectors.

On the basis of their important characteristics, mechanical collectors may be classified according to Table 1.

### Wet Collectors

In these collectors many methods are used to wet the contaminant and remove it from the air stream. A number