

for *wet collector* designs where water continuously flows downward inside the pipe walls of the collector electrode. The negative discharge electrodes or rods are accurately centered between the usual 9 in. collector electrode spacing, the latter being of positive charge. Precipitation occurs in a single stage wherein ionization and collection are carried on simultaneously throughout the unit, and depend on high potentials of 25,000 to 75,000 volts. The high voltage direct current is supplied by either mechanical or electronic rectifiers.

High efficiencies are obtained by allowing suitable time for contact in the collector zone, and by proper ratio of air flow velocity to that of transverse velocity of the negatively charged particles toward the positive charged collector plates.

Air velocities vary from 240 fpm to 480 fpm with a constant pressure drop of less than $\frac{1}{2}$ in. water. Since the maximum efficiency is obtained with the finer particles at low concentrations, and the precipitation is not effective for large particles, inertial separators are frequently used in series with these units.

Attention should be directed to the prohibition of air recirculation to occupied spaces. High voltage cleaning equipment produces ozone and nitrogen oxides in excessive quantities. The major source of maintenance usually will be in conjunction with the high voltage rectifying equipment rather than the collector. Although usually used for elevated temperature work, unless the gases are pre-conditioned, temperatures in excess of 700 F should be avoided.

Collector electrode cleaning is accomplished by a rapping device, either electrical or pneumatic, without interrupting operation. The dry plate surfaces release the dust into hoppers below the plates. Some wet cleaning methods are also used.

Electronic precipitators require large spaces, maintenance may vary widely, and initial costs are high. Efficiency is a function of the aerosol encountered and usually ranges above 90 per cent.

ABSORBERS, ADSORBERS, AND COMBUSTION DEVICES

One of the important problems in industrial air and gas cleaning is the removal of soluble, insoluble, or combustible gases and vapors from fluid streams before their discharge to the atmosphere. These contaminants may create problems which are distinct from the particulate removal discussed previously. It has been pointed out that scrubbers and other wet collectors may remove gases and particulate matter from contaminated air streams. However, the units described are intended primarily for particulate removal with the exception of the spray or packed towers or wet cell devices.

Absorption devices are intended primarily for the removal of readily soluble gases which can be removed by simple absorbing agents such as water or alkali; for example, the removal of hydrochloric acid gas by a caustic spray.

Adsorption apparatus is intended primarily for removal of organic vapors in either high concentration (solvent recovery) or low concentration (odor removal). The first process is usually carried on as a matter of economic recovery. In the second process, the concentration of the contaminant

must be low enough so that the adsorbent will have a reasonable life before replacement or reactivation.

Combustion, either total or catalytic, may be used to destroy organic compounds, either gaseous or particulate, which create odor problems. The use of catalysts to reduce the temperature needed for combustion is comparatively recent in this field. In some instances the heat of combustion may be recovered for utilization. The temperature necessary for destruction of compounds varies with the nature of the contaminant. However, partial combustion may alter the compound to render it innocuous. The temperature required for complete destruction is usually above 1100 F. Catalysts may only require heating to 500 F or may operate without heating if the gas temperature is above 500 F.

Absorbers

These may consist of spray chambers, packed towers, or wet cell washers through which an absorbing agent is recirculated. The gases collected may be converted to insoluble salts or usable acids and other compounds. The performance of these devices depends upon several factors such as the solubility of the gas, its vapor pressure, its rate of reaction with the absorbent, the velocity through the collector, area of the absorbing surface either as spray droplets or wetted media. These are generally designed for the specific purpose intended. They usually are intended to collect over 95 percent of the contaminant. Resistance depends upon the particular design and ranges from 1 to 10 in. of water in most installations. Their resistance during their operating interval is constant unless serious plugging of packing occurs. Spray units are seldom affected by plugging. Packed absorption devices require a precleaner to remove particulates if long trouble-free service is desired. Maintenance of spray nozzles is a function of the degree of atomization used and of conditions encountered, such as purity of spray liquids.

Protection against corrosion and freezing may be necessary and disposal of waste liquids may create secondary problems.

Adsorbers

These units consist of a chamber filled with a granular adsorbent. The adsorbent may be activated charcoal, silica gel, alumina and other treated solids. Activated charcoal is the most common and has the highest retention per unit weight for organic solvents. Performance of adsorbent beds depends upon their thickness, velocity of the gas passing, mesh size (surface area) of adsorbent and temperature of the vapor being removed. They can be designed to obtain almost complete removal of organic vapors and some inorganic gases. They may be reactivated by the use of steam or heat. Resistance depends upon the adsorbent mesh size, depth and velocity. It may range from less than one inch of water to several inches of mercury.

Adsorbent beds are usually limited, because of their cost, to applications where recovery may be economically feasible. Removal of particulate matter by use of precleaners is necessary if significant loadings are involved as the adsorbent voids are readily plugged. They are not suitable for high