system put in service midway down the height of the tower. The water will be kept above freezing because it will have shorter contact with the air. The mechanical draft tower can be protected by reducing the air flow through the tower, by stopping or reducing the speed of the fans, or by partially closing dampers.

If the system is operated intermittently in freezing weather, water in the basin may freeze and the expansion of the ice may do harm. Freezing during intermittent operation can be prevented only by draining the water basin when it is out of service. On small roof installations, a tank large enough to hold all the water in the system is often installed inside the building and the basin is drained into this by gravity, the pump suction being taken from this inside tank.

A comparison of various types of water cooling equipment is given in Table 4.

Chapter 27

AIR CLEANING DEVICES

Damage Caused by Dust, Classification of Air Cleaning Devices, Viscous-Impingement Filters, Dry Air Filters, Air Washers, Electrical Precipitators, Cleaning of Gases from Exhaust Systems

IN this chapter the term *cleaning* is assumed to mean the removal of particulate matter from the air. The removal of foreign gases and vapors requires entirely different methods and is discussed in Chapter 35.

The cleaning of air involves the removal of many kinds of materials having a wide range of particle sizes and concentrations. The degree of air purification required varies widely, consequently, many types of devices having radically different design characteristics are available.

The various materials that pollute the air are discussed in Chapter 4, Fig. 1, which shows characteristics of particles ranging in size from 8000 to 0.001 microns. The importance of particles in the range from 0.1 to 0.001 microns is open to argument. Particles below 0.1 micron can be seen in some microscopes as specks of reflected light, and a few microscopes using ultra-violet light have a resolving power of 0.1 micron, but the smallest particle which is really resolved in microscopes using ordinary light is about 0.25 micron. The performance of particles below 0.1 micron is, therefore, controversial because no means have been developed for reliably counting or measuring the sizes of the particles.

Even if the discussion is limited to the range from 0.1 micron to 50 microns, from the smallest particle observable in the microscope to the smallest particle distinguishable to the naked eye, this range is so far outside the usual experience that it is difficult to visualize. If particles could be examined through a super microscope having a magnification of 250,000 diameters, a tobacco smoke particle of 0.1 micron would appear to be 1 in. in diameter, or approximately the size of a golf ball; a soft coal smoke particle 0.3 micron in diameter would appear like a baseball; a ragweed pollen grain 20 microns in diameter would appear 16½ ft in diameter, while the 50 micron particle, just visible to the naked eye and able to pass through a 270 mesh screen, would appear to be 50 ft in diameter. Picturing this range in particle size from a golf ball to a sphere 50 ft in diameter may aid in appreciating the problem of cleaning air and the difficulty of devising any single test to adequately measure the performance of air cleaning devices under all conditions of service.