Dusts and cinders in flue gas may be caught by various devices on the market, such as fabric filters, dust traps, settling chambers, centrifugal separators, electrical precipitators, and gas scrubbers, described in Chapter 29.

The cinder particles are usually larger in size than the dust particles; they are gray or black in color, and are abrasive. Being of a larger size, the range within which they may annoy is limited.

The dust particles are usually extremely fine; they are light gray or yellow in color, and are not as abrasive as cinder particles. Being extremely fine, they are readily distributed over a large area by air currents.

The nuisance created by the solid particles in the air is dependent on the size and physical characteristics of the individual particles. The difficulty of catching the dust and cinder particles is principally a function of the size and specific gravity of the particles.

Lower rates of combustion per square foot of grate area will reduce the quantity of solid matter discharged from the chimney with the gases of combustion. The burning of coke, coking coal, and sized coal from which the extremely fine coal has been removed will not as a general rule produce as much dust and cinders as will result from the burning of non-coking coals and slack coals when they are burned on a grate.

Modern boiler installations are usually designed for high capacity per square foot of ground area because such designs give the lowest cost of construction per unit of capacity. Designs of this type discharge a large quantity of dust and cinders with the gases of combustion, and if pollution of the atmosphere is to be prevented, some type of catcher must be installed.

NATURE'S DUST CATCHER

Nature has provided means for catching solid particles in the air and depositing them upon the earth. A dust particle forms the nucleus for each rain drop and the rain picks up dust as it falls from the clouds to the earth. However, it was found in recent studies[5] that rain was not a good air cleaner of the material below about 0.7 micron.

[5]Atmospheric Pollution of American Cities for the years 1931-1933, by J. E. Ives et al (*U. S. Public Health Bulletin* No. 224, March, 1936).

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Chapter 29

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 40.

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 28, 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 16.5 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.