

gases, such as sulphur dioxide and sulphuric acid mist, which are discharged with the gases of combustion. Where high sulphur coals are burned, these sulphur gases present a serious problem.

DUST AND CINDERS

The impurities in the air other than smoke come from so many sources that they are difficult to control. Only those which are produced in large quantities at a comparatively few points, such as the dust, cinders and fly-ash discharged to the atmosphere along with the gases of combustion from burning solid fuel, can be readily controlled.

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 26.

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 coal 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. In fact, without dust in the air to form the nuclei for rain drops it would never rain, and the earth would be continually enveloped in a cloud of vapor. However, it was found in recent studies⁶ that rain was not a good air cleaner of the material below about 0.7 micron.

⁶Atmospheric 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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PROBLEMS IN PRACTICE

1 • Classify the detrimental aspects of air pollution as it affects large industrial communities.

Air pollution may be classified (a) medical, as it affects the physiological functions of people; (b) botanical, as it affects vegetation, trees, plants, shrubs and flowers; and (c) physical, as it affects the discoloration and deterioration of buildings, and the nuisance of soiled interior furnishings, clothes, merchandise, etc.

2 • Distinguish between dusts, fumes, and smokes.

Solid particles ranging in size from 1.0 micron to 150 microns are called *dusts* (micron = $\frac{1}{25,000}$ in.).

Particles resulting from sundry chemical reactions and ranging from 0.1 to 1.0 micron in size are called *fumes*.

Carbon particles less than 0.1 micron in size which generally arise from the incomplete combustion of such materials as coal, oil, or tobacco are called *smokes*.

3 • What are some of the more important physical properties of these various groups of foreign bodies which are of importance in ventilation?

In slowly moving air, dusts tend to settle out by gravity without agglomerating to form larger particles; fumes have the tendency to form larger particles which will settle when they attain the size of approximately 1.0 micron; while smokes tend to diffuse and remain in the air as permanent impurities.

4 • Why is atmospheric pollution an important engineering problem?

- Certain impurities, when present in too great concentrations, cause ill health or even death.
- High concentrations of solids occlude solar radiations.
- Some materials cause permanent injury to parts of buildings, as sulphur fumes corrode exposed metal.
- Extra cleaning expense is incurred in dusty localities.
- Internal combustion engines are damaged by abrasive dusts.

5 • How may the hazards of dust-producing industrial operations best be curtailed?

By providing mechanical exhaust ventilation sufficient to keep dust concentration at a safe level (see Table 3) and then removing foreign bodies to reduce the pollution of outside air.