(month). To the air conditioning engineer this information may indicate the effectiveness of smoke abatement or fuel combustion control methods in his locality, but it does not provide a suitable index of the suspended dust that air cleaners in a ventilating system are expected to capture [3, 4, 5]. Gravimetric or weight data of the type given in Table 2 are preferable. In some cases airborne particle counts may be necessary, as for pollen, bacteria, spores, and dusts causing illness or lung disease.

Dust concentrations by weight cannot be converted directly to concentrations by particle count because of the variability of particle size, shape and specific gravity, and the inherent characteristics of dust counting and weighing procedures. One milligram of dust per cubic meter of air may represent dust counts from 1 million to 100 million particles per cubic foot of air (lightfield microscope technic) according to the size distribution of the airborne dust sample. Information of this type for a specified application is best obtained by simultaneous sampling for both counting and weighing and noting carefully at the time all factors that might affect the reproducibility of the count-weight ratio.

TABLE 2. DUST CONCENTRATION RANGES

LOCATION	GRAINS PER 1000 CU FT[a]	MILLIGRAMS PER CUBIC METER
Rural and suburban districts	0.02–0.2	0.05–0.5
Metropolitan districts	0.04–0.4	0.1 –1.0
Industrial districts	0.1 –2.0	0.2 –5.0
Ordinary factories or workrooms	0.2 –4.0	0.5 –10
Excessively dusty factories or mines	4–400	10–1000
Minimum explosive concentrations	4000–200,000	10,000–500,000

[a] 1 grain per 1000 cu ft = 2.3 milligrams per cubic meter.
1 oz per cubic foot = 1 gram per liter = 1000 grams per cubic meter.

Smoke Abatement

Successful abatement of atmospheric pollution caused by smoke requires the combined efforts of the combustion engineer, industrial executive, public health officer, city planning commission and the community at large. Electrification of industry and railroads, increase in the use of domestic oil and gas furnaces, and segregation of industrial districts is gradually providing effective aid in the solution of this problem.

In the large cities where nuisance from smoke, fly-ash and cinders is more serious, limited areas obtain some relief by the use of district heating. Boilers in these plants are of large size, designed and operated to burn the fuel without wasteful smoke, and equipped in some cases with dust collecting devices. The gases of combustion are usually discharged at a much higher level than is possible in the case of scattered buildings equipped with separate boiler plants.

Time, temperature and turbulence are fundamental requirements for smokeless combustion. Increase of any one of these factors will reduce the quantity of smoke discharged, although excessive turbulence in furnaces may increase the output of ash and cinders. Special care must be taken in hand firing the bituminous coals. (See Chapters 16, 17 and 18 for further discussion on fuel burning technic).

Legislative measures at the present time are largely concerned with reduction of the visible smoke discharged from chimneys of boiler plants. Practically all ordinances limit the number of minutes in any one hour

that smoke of a specified density may be discharged, as measured by comparison with a Ringelmann Chart (Chapter 11, Instruments and Measurements). Ordinances generally do not make specific provision for control of the corrosive and irritant gases, such as sulfur dioxide and trioxide, which are discharged with the gases of combustion. Where high sulfur coals are burned, these sulfur gases present a serious hazard to property, health and vegetation.

In foggy weather the accumulation of these gases in the lower strata of the atmosphere may be such as to cause irritation of the eyes, nose and respiratory passages, and possibly even more dangerous consequences. The Meuse Valley (Belgium) fog disaster has become a classic example in the history of gaseous air pollution. Released in a rare combination of atmospheric calm and dense fog, it is believed that sulfur dioxide and other toxic gases from the industrial region of the valley caused 63 sudden deaths, and injuries to several hundred persons.

Dusts and cinders in flue gas may be caught by various available devices, such as settling chambers, centrifugal separators, electric precipitators, and gas scrubbers. The difficulty of retaining the dust and cinder particles is principally a function of their size, specific gravity, and resistance to wetting if a washer is used. Descriptions of dust collecting devices are given in Chapter 33.

Absorption of Solar Radiation

The loss of light, particularly the absorption of solar ultraviolet light by smoke and soot, is recognized as a health problem in many industrial cities. Measurements of solar radiation in Baltimore [6] by actinic methods demonstrated that ultraviolet light in the country was 50 per cent greater than in the city. In New York City [7] a loss as great as 50 per cent in visible light was found by the photo-electric cell method.

ODOR NUISANCE

A problem companionate with smoke abatement is the control of odor nuisance in the neighborhood of industrial plants discharging noxious or offensive air contaminants. Community planning and zoning will avoid much of the difficulty in the future, but meanwhile many industrial cities must resort to corrective measures by requiring the installation of air cleaning devices, the alteration of manufacturing processes, or by legal termination of the offensive operation in residential or commercial districts.

The development and manufacture of more effective and economical air cleaning devices for application to industrial plants will make it possible for many industries to continue operation in their original locations if desired, even though the community standards of air purity become more rigid. To a limited extent such developments already are benefiting the manufacturer, his employees, and his neighbors, when cleaning of the air from ventilated dusty processes makes it possible to return the reclaimed or recovered air to the workroom atmosphere instead of discharging it to the outside with its full load of contamination (Chapter 33).

The control of outdoor odor nuisance is especially troublesome because of the extremely minute quantities of contaminant that are capable of offending through a wide area. New industrial chemicals with strange