

stallation, and varies widely with changes in furnace conditions. In order to obtain a representative sample it is necessary to traverse the inlet and outlet of the catcher with a sampling tube which faces into the gas flow. The velocity of the gas into the sampling tube must be the same as the velocity of the gas in the duct at the instant the sample is taken. The swirls and eddy currents in the ducts make it difficult to obtain consistent readings, but if the test is conducted by some one of experience, an indication of the approximate efficiency can be obtained.

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.

PROBLEMS IN PRACTICE

1 ● Classify the detrimental aspects of air pollution as it effects 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 1) and then removing foreign bodies to reduce the pollution of outside air.

6 ● How may the pollution of the atmosphere be lessened?

By compelling industrial plants to install dust catching and smoke controlling devices. In many cities the domestic heating plant is one of the most serious offenders, but these plants are too small to justify the installation of dust catchers. Public education in improved firing methods would be of considerable help in this field.

7 ● Compare the dry and wet types of dust catchers.

The dry types are very effective in removing the larger dust particles but the smaller particles generally pass through other kinds than the electric precipitator. The dry types also require considerable space and therefore sometimes introduce resistance to the flow of air. The wet types are effective in removing some of the smaller dusts and the water-soluble gases. The principal disadvantage of the washer is its short life caused by the corrosive action of the wash water.

8 ● What size particles are detrimental to health?

While fairly large particles may enter the upper air passages, those found in the lungs are seldom more than 10 microns in size, and comparatively few of them are more than 5 microns. It is agreed that particles between $\frac{1}{2}$ and 2 microns may be harmful; some authorities place the upper limit at about 5 microns, and some incline to extend the lower limit to 0.1 of a micron.

9 ● Is the shape of the particle of any significance?

Hard particles with sharp corners or edges have a cutting effect on the delicate mucous membranes of the upper respiratory tract which may lower the resistance of the nose and throat to acute infections. This is aggravated by the irritating effects of some chemical compounds which may be taken in with the air and which act to reduce resistance.

10 ● What are the principal meteorological effects of smoke and dust?

a. The reduction in the amount of light received. Measurements have shown that visible light may be as much as 50 per cent less intense in a smoky section of a city than in a section that is free from smoke. Ultra-violet light is reduced as much or more, and in some cases is cut out entirely for a time.

b. Smoke and dust aid in the formation and prolongation of fogs. City fogs accumulate smoke and become darker in color and very objectionable. The sun requires a longer time to disperse them, and when the water is evaporated, there is a rain of smoke and soot particles that have been entrained.

11 ● Why has not smoke abatement been more effective?

Because communities have not been made sufficiently aware of the possibilities of burning high volatile fuels smokelessly and of separating cinder and ash from the stack gases to a degree that will prevent a nuisance.

12 ● Is the abatement of dust and cinders important?

Yes. Only a small percentage of the solid emission from stacks is smoke, in the accepted popular sense; the remainder is fly-ash and cinders. While black smoke is disagreeable and its tarry matter and carbon particles soil anything with which they come in contact, the cinders and some of the ash are hard and destructive. They also, together with dusts from industrial processes, make up the hard, sharp, irritating, air-borne solids that are breathed by individuals not working in a dusty mill or factory.

13 ● Are air-borne impurities causative factors in hay fever, bronchial asthma, and allergic disorders?

Yes. Recent medical investigations indicate that 90 per cent of seasonal hay fever and 40 per cent of bronchial asthma are caused by air-borne pollens, tree dusts, and other allergic irritants.

14 ● Name some essential requirements for the smokeless combustion of fuels.

Time, temperature, and turbulence. A study of these factors is usually of value in overcoming a smoke nuisance.