Mr. R. L. Moore

May 19, 1954

Dust Counting Equipment

Mr. Cilley has requested that an investigation be made of the dust counts throughout the mill and possible methods of reducing the amount of dust for improved hygenic conditions. Mill management is ever working on this problem and dust counts are periodically made by the Bureau of Industrial Hygiene. The problem of dust counts and methods of reducing same are under active study by the Air Hygiene Committee of the Asbestos Textile Institute.

The first step in any dust count program is to select suitable equipment. There appears to be a difference of opinion relative to equipment as the impinger collector is generally used here while the thermal precipitator is used in England for collecting the dust particles. It is understood Mr. Luttenberg is arranging a conference with Dr. Shilen of the Pennsylvania Bureau of Industrial Hygiene for a discussion of dust counting equipment. Also, dust counts will undoubtedly be discussed at the June meeting of the Air Hygiene Committee of the Asbestos Textile Institute.

For background information, a brief literature search was made in Chemical Abstracts on dust counts, in which the following facts were noted relative to the operation, limitations, and comparisons among various types of instruments

Many types of equipment for determining dust counts or dust concentrations have been developed. The total amount of dust in air can be determined by drawing a known amount of air through a suitable filter and the amount of dust determined by weighing (1). Stokinger and Laskin (2) report the electrostatic precipitator in which the dust particles are made to settle out by an electric field is best suited for the determination of dust concentrations. However, it is not suited for size-distribution of most particulates because of size segregation along the collecting surface, and because of aggregation of particles.

Several types of apparatus are suitable for dust counts. In the impinger type (3) the air is drawn through a jet to impinge on water. The dust is retained as a suspension from which it is allowed to settle out on a special type of microscope slide and the dust particles counted. Its efficiency increases with the sampling velocity which is normally about 28 liters per minute. Its efficiency is about 40%.

Chernbury of Penn State reports (4) the midget impinger method of collecting, analyzing, and evaluating dust is purely empirical and gives only relative

results which are subject to errors in interpretation if considerations are not given to limitations concerned with the ability of the apparatus to draw dust into the nozzle tube, the loss of the dust by the liquid, the shattering of the dust on impingement, the stability of the dust in the liquid, the size range of the dust, etc. When the necessary corrections are applied, the midget-impinger method yields results comparable with other methods of evaluating dust.

In the cascade impactor (3), the air is passed consecutively through four jets of decreasing size onto a glass slide coated with an adhesive. It is reported (2) to have given excellent particle-size analyses in the size range of 0.2 to 50 microns. It yields rapid and reliable results in the characterization of dust and can be used for the size distribution analyses of mixtures of dusts.

Below the useful range of the cascade impactor (2), the thermal precipitator is the most useful instrument. This instrument (5) makes use of the fact that there is a dust free space around a hot body, in this case an electrically heated wire placed between microscope cover slides on which the dust is deposited Tests show that the instrument collects almost 100% of the dust particles in the air. A very slow sampling rate, normally 7 cc/min., is required.

Magill in describing techniques for smog analysis (6) reports a cascade impactor was used to collect samples over brief periods of time and to follow atmospheric changes closely. A thermal precipitator is advantageous in that it appears to collect all fine particles, but it must be operated at very low air flow rates.

Several photoelectric devices and dust cameras for measuring directly the concentration of dust particles in the air have been reported. These are based on the interference of a beam of light by dust particles in the air.

For accurate dust counts, special attention must be given to sampling techniques as, the selection of location, the use of mixing baffles, and the need of isokinetic sampling (7).

Since it has been reported that there is no unfavorable physical reaction from asbestos dust in the lungs which is under 10 microns or over 50 microns in length, our emphasis should be directed toward counts in that size range. This appears to be the range in which the cascade impactor or impinger is most effecti while the thermal precipitator is most effective for finer particles. Therefore, the cascade impactor is given first choice and the impinger second choice.

The accuracy of any dust counts will depend more on the care of taking the sample and making the counts than on the type of apparatus used.

M. S. Maier

ms
cc Messrs. Cilley
Luttenberger
Stefl

REFERENCES

(1) Dust in Industrial Atmospheres. Determination of mass concentration by the Volatile Filter Method. P. F. Holt., Metallurgia 44, 52-4, 1951.

(2) Air Pollution and particle-size toxicity problems. H. E. Stokinger and S. Laskin, Nucleonics, 6, No. 3, 15-31, 1950.

(3) Dust in Industrial Atmospheres. The impinger and cascade impactor. P. F. Holt, Metallurgia, 43, 250-9, 1951.

(4) The use and limitations of the midget impinger for counting dust. H. B. Charnbury, Proc. National Air Pollution Symposium, 1949, pg. 184-92.

(5) Dust in Industrial Atmospheres. Determination of the particle count. P. F. Holt, Metallurgia, 43, 151-2, 1951.

(6) Techniques employed in the analysis of Los Angeles Smog, P. L. Hagill, Proc. National Air Pollution Symposium, 1949, pg. 61-8.

(7) Sampling of dust-laden gases. C. J. Stairmand, Trans. Inst. Chemical Engineers, 29, 1951, pg. 15-44.

Pertinent Articles

An appraisal of present-day field instruments. A. N. Setterlind, Am. Ind. Hygiene Assoc. Quarterly 9, 35045, 1948.

Relation between and precision of dust counts. C. E. Brown and H. H. Schrenk, U. S. Bureau of Mines Report, Investigation No. 4568, 1949 (35 pp).