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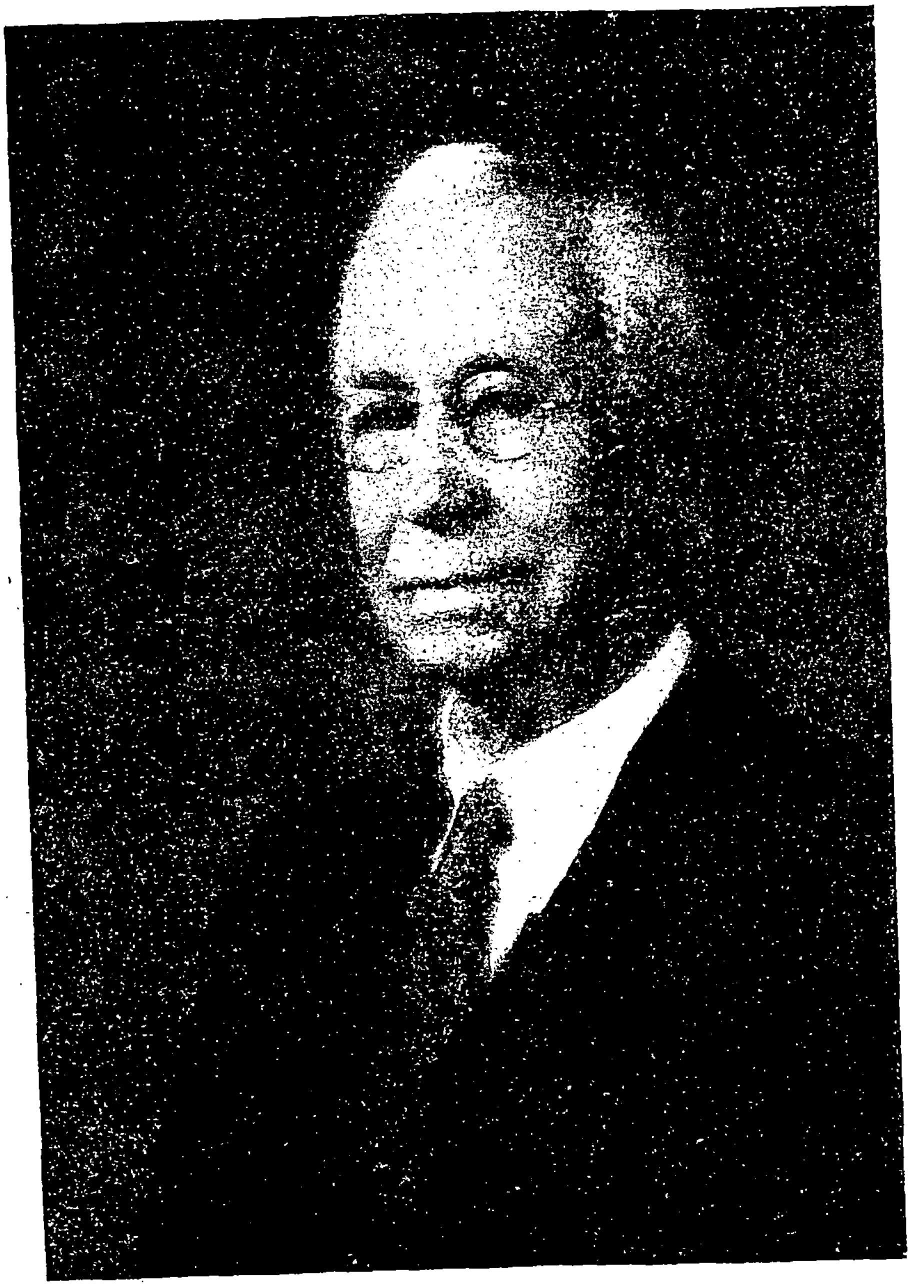

DAVIS BROWN
1944

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charge and can be attracted to plates or electrodes when given the proper kind of electrical charge. It is generally conceded that the electrical-precipitation type of collector is much more effective than any other type, but its use has been restricted largely by the cost of investment.

IV. Conclusion

The question of cleaning the atmosphere is becoming one of the most widely discussed questions among manufacturers of the present day. The human be at the rate of approximately 56 pounds of while at rest and many times that amount wl it is important, therefore, that the atmosphe must use constantly be kept as clean as we make it.

Robinson Ventilating Company
Zelienople, Pennsylvania.

DISCUSSIONS OF ROBINSON PAPER ON DUST REMOVAL AND COLLECTION

(A) DUST COLLECTION*

By T. J. Barry

I. Introduction

The elimination of dust generated in any industrial operation involves, as a general rule, (1) its removal from the point of generation, (2) transportation to the point where it is to be separated from the gases in which it is suspended, (3) its actual separation from the gases, and (4) the disposition of the gases and the collected material.

This is usually taken care of by properly designed hoods located at the point of generation, a duct system, a dust collector, and a fan.

The air and dust must be removed from their source at a velocity sufficiently high to insure control of the dust.

The type of dust separator or collector to use depends on many factors, such as the type of dust, moisture content of the gas, temperature, size of particle, location of the collector, and space available.

II. Classification of Dust Collectors

Dust collectors can be classified generally into settling chambers, cyclones and other inertial apparatus, viscous filters, gas washers, cloth collectors, and electrostatic precipitators.

(1) Settling Chamber

A settling chamber is simply a chamber in which the gas velocity is reduced to a point where the dust will fall out of the gas by gravity. Naturally this will only remove the very coarse particles and has a limited application.

(2) Cyclone Collector

The cyclone type of collector depends upon the centrifugal forces acting on the dust particle to separate it from the gas. In general, the higher the gas velocity and the smaller the radius, the higher the efficiency of the cyclone.

There are many variations in the design of commercial cyclones which materially increase their application in dust-collection work. They are limited, however, as is all equipment. There is a definite field for each type.

A simple cyclone is perfectly satisfactory for separating shavings, sawdust, etc., from a woodworking shop, but it is not worth much on a job where the dust particles are small and the dust is readily "air-borne."

A "high-efficiency" cyclone is well adapted to those jobs where the temperature is a factor, such as fly-ash collection and collectors for driers and kilns.

There are many designs of these collectors which have a definite place in the scheme of things.

The mechanical separator, of the type in which the fan serves the dual purpose as the source of suction or pressure and a cyclone collector, is subject to the same limitations as the cyclone itself and has a bad feature in that all of the dust-laden air goes through the fan. If it is an abrasive material, the fan wheel takes a beating and causes high maintenance.

(3) Viscous Collectors

The viscous type of collector, where the dust-laden gas passes through a labyrinth filter and the dust particles are caught or trapped by the viscous surface, is limited in application and cannot be considered for the collection of industrial dusts.

(4) Wet Collectors

The wet separator or washer has been built for many years and is made in many designs, such as the tower washer, the disintegrator, and scrubbers.

Blast-furnace gas and coke-oven gas are frequently cleaned by this type of equipment. During the past few years, the wet collector has been applied to other fields, such as foundry dust and dust from metal grinding.

Water is usually the fluid used, although it has been found that many dusts cannot be removed by the water alone and other materials must be added to promote the wetting of the dust particles.

The wet systems are limited in application and require attendant equipment, such as pumps and sludge-removal equipment, which add to the operating cost of the system.

(5) Cloth Collectors

Cloth collectors are made in several designs and are the simplest means of separating the dust from the gas. Their field of application is wide and their limitations are quite well known.

Cotton cloth can be used on the gases when the temperature is below 150°F. The life of the cotton decreases rapidly as the temperature goes higher. Wool cloth can be used up to 250°F.; above this temperature asbestos cloth is used.

The bags and screens made of glass have not been too successful.

If the gas temperature goes below the dew point, trouble is likely to develop with cloth arrestors. In many cases, this can be overcome by heating the gas or by insulating the casing of the collector.

The principle of operation of the cloth separator is well known and the factors affecting its design are primarily (1) type of dust, (2) temperature of gases, (3) moisture content of the gases, (4) dust loading, (5) intermittent or continuous use, and (6) method of removal of the dust from the hoppers.

The operation simply consists of having a material in the cloth that will stand the temperature and permit a filter cake of dust to build up on the cloth so that the dust will be filtered out of the air by this combination. A micron particle is $^1/_{25,000}$ of an inch in maximum dimension, so that when we speak of a particle $^1/_{10}$ of a micron in size, it is only $^1/_{250,000}$ inch in its longest dimension.

The filter cake of dust therefore really does the filtering of the small particles, and, as a result, the accumulation of dust must be periodically removed; otherwise the pressure drop through the collector will build up until the flow of air or gas ceases.

The three general type of cloth arrestors are (1) the screen type, where the cloth is held on wooden or metal frames by one of several methods, (2) the envelope type, where the cloth is more or less in the form of an envelope and fits over a frame to hold it in position, and (3) the bag type, where inverted bags are attached to a plate between the dust hoppers and the bag section and are supported from the top, usually by springs attached to the shaking device. In this type, the dust-laden gas enters under the

* Received July 13, 1944.

bag plate, flows through the bags into the baghouse, and the cleaned gas is pulled out by means of a fan.

In the design of a system using this type of equipment, the ratio of air flow to cloth is an important factor and receives a great deal of attention from the designer and should receive a lot more attention from those who install the equipment, as the life of the filtering material and the pressure drop through the collector are vitally affected by this factor. On some types of dust a ratio of 1 cubic foot of air per square foot of cloth must be used. A dust of this type has a flat surface, such as the flaky-type metal dust. With carbon black and similar materials, the ratio should not exceed 2 to 1; with foundry dust and clay dust, 3 to 1. When these figures are exceeded, maintenance is invited.

A continuously operated arrestor is made in two or three sections. It should be made in three sections for best results. Periodically, each section is cut out of the system and the bags are shaken to remove the excess filter cake. This operation is generally taken care of automatically by a timer.

A classifier section or planum chamber is usually built into the cloth arrestor to drop out the heavier material by a reduction of velocity and also to insure uniform distribution of the dust-laden gases to the cloth section.

If the arrestor is used with a grinding or buffing system and there is a possibility of sparks or fire being carried over, a spark arrestor is installed ahead of the bag section.

If the dust is explosive (and many are), the cloth should be positively grounded to eliminate the possibility of a static spark igniting the dust.

(6) Electrostatic Precipitation

Electrostatic precipitators will be discussed later by Mr. Begoon.

III. Conclusion

A dust condition in a plant is a cause of expense. If it is a health hazard it should be eliminated regardless of cost. If it is not a health hazard, it is a nuisance which causes excessive equipment maintenance, rejected products, and dissatisfied workers, and, as a result, a lower quality of workmanship.

The question of whether or not to recirculate the air from a dust collector has caused much discussion. The air should never be recirculated unless it is certain that it does not contain toxic material and that it is entirely free from all harmful dust at all times.

A plant with an adequate supply of fresh air (although it costs more to heat in the winter months) will have fewer lost-time accidents than the plant where the air becomes "dead" after a few hours. The results will more than pay for the extra cost of heating the air.

The writer has tried to keep this discussion as "nontechnical" as possible and to refrain from comments as to whose or what type equipment is the best for any particular job.

Dust collecting is a combination of art and science. It involves the proper design of the entire system from the point of dust generation to the final disposal of both the collected material and cleaned gases.

There is more engineering in doing a good job than meets the eye. When one sees so many jobs where the lines are too big and fill up with dust or are too small and do not get enough of the dust away from the source and the equipment inadequate or of the wrong type, it makes one wonder just how to paint the picture so that it can be seen that a properly designed system will pay dividends even though it seems to be "just a dead operating cost."

PARK BUILDING
PITTSBURGH, PENNSYLVANIA

(B) ELECTRIC AIR CLEANING*

BY G. F. BEGOON

I. Introduction

Electrostatic air cleaning as applied in ventilating systems is a new and revolutionary electronic development. Why is there any need for air cleaning, let alone electric air cleaning?

We have falling upon our cities today, at the amazing rate of 1950 tons per square mile per month in Pittsburgh, 1530 tons in Chicago, 1450 tons in Baltimore, and comparable figures in other cities, dirt particles which have become the source of great economic waste and maintenance expense. Within our homes and places of business they blacken and damage paint, wallpaper, drapes, and decorations, soil fabrics, cause excessive maintenance of industrial machinery, etc.

The size of these particles is measured by a minute metric unit known as the micron. A micron is equal to one thousandth of a millimeter, or $^1/_{25,000}$ of an inch.

Generally speaking, the miscellaneous dusts, pollen, and other particles larger than 1 micron tend to settle from the air unless it is in motion. Inasmuch as we are interested in air in motion, we are concerned with the particles it carries. These range from heavy industrial dusts of 8000 microns down to tobacco-smoke particles as small as $^1/_{10}$ micron. This is pretty small, when it is considered that a 10-micron particle is about the smallest that can be seen with the naked eye.

Until recently, no practical method had been devised to really clean the air of the very small particles. Although mechanical filters are effective in removing the larger dirt particles, i.e., from about 5 microns up, they are practically useless in attempts to catch the very fine particles which comprise 80 to 90% of the total and are less than 1 micron in diameter.

* Received June 22, 1944.

II. Electrostatic Precipitation

The only effective method known today for removing these very fine particles from an air stream is electrostatic dust precipitation, the principles of which have been known for many years and applied successfully in such applications as boiler stacks, smelters, and cement mills, and are known as Cottrell precipitators. The high voltage used in the Cottrell system (from 30,000 to 100,000 volts) causes such a high generation of ozone, however, that the air thus treated is not safe for breathing purposes and hence not suitable for ventilating systems.

This is the problem that was solved by scientific research in perfecting the electric air cleaner that operates at voltages which generate so little ozone that its concentration is in the order of that found out of doors on a bright sunny day.

The voltages used are 13,000 for ionization and 6000 for collection. These are obtained by means of a rectifier or power pack. The house voltage of 115 volts, 60-cycle, single-phase, is stepped up to about 6000 and rectified to direct current by two electronic tubes. By means of a modified voltage doubling circuit the proper ionizer and collector plate voltages are obtained.

By 1937, the electric air cleaner had reached the point of practical use, and a few installations were made as the air-cleaning component of air-conditioning or ventilating systems in offices, stores, banks, and other commercial buildings. These installations were made to obtain relief from annoying and costly air-borne dirt, dust, soot, and smoke which soil and damage merchandise in stores and shops and cause frequent redecoration and excessive cleaning expense.

In subsequent years, further installations were made in similar establishments and many other types of businesses, such as cleaning the air in pharmaceutical and chemical plants where the slightest microscopic specks cause imperfections in products and processes.

The electric air cleaner is used to clean the ventilating air for large rotating electrical machinery in steelmills, power plants, and substations. Failures of these machines