Dust Control

PLAINTIFF'S EXHIBIT

DOW-1048

Operation & Maintenance

Selecting In-Plant Dust-Control Systems

ST0255496

These guidelines for planning and evaluating dust-control systems point out how to select from the very first the right system for a particular situation. This is very important, not only from the cost standpoint, but also from the federal and state regulation-compliance standpoints.

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The Occupational Safety and Health Act (OSHA) of 1970 is one factor making decisions regarding dust control more critical in 1974 than ever before for the chemical process industries (CPI). Because it is a condition easily monitored, violations are promptly cited. And since collection, separation and disposal of the dust are all involved, Environmental Protection Agency (EPA) regulations are also in force. In addition, labor-union pressures and local and regional agencies have initiated an increasing number of rules on plant-dust control.

Another factor that has become a real consideration in the choice of dust-control equipment is that, for the first time in the history of the CPI, such basics as raw materials and energy are in short supply.

Define the Needs and Dust Problem

A well-designed dust-control system will often serve several purposes, if they are thought of early enough:

Compliance—Outside emissions can be controlled for EPA compliance, or in-plant dust for OSHA compliance.

Material Recovery—Motor-bearing breakdowns, equipment wear, overheating, etc., can occur because dust got into places where it did not belong. And since cleaner plants tend to develop cleaner work habits in employees, the dust-control system should be evaluated in this light also. Often, vacuum cleaner hoses can be plugged in for employees to clean their areas (Fig. 1).

Scrap Removal—Large-area sheets can frequently be handled efficiently with dust-control systems. This applies also to paper and plastic trim, etc., which can also pose problems.

Shutdown—Consider whether the process can stand a shutdown of the dust-control system for cleaning the dust separator. If it is feasible to do so, the system can be relatively inexpensive; if not, an automatic, continuous, self-cleaning system should be installed.

Special Features—If raw materials are costly, safeguards against contamination, and an automatic system for recycling the collected dust may be warranted. Utility costs may be high enough to make it economical to return the cleaned air to the plant to reduce heat loss. The system may need special storage capacity so that it can be emptied only during low-traffic periods.

Next, consider these other parameters:

Dust Source—Dust can be handled most efficiently when trapped at its source. At what points is it generated? Is dusting continuous or intermittent? What is the worst condition? The highest flowrate must be specified or the system will likely clog.

Surrounding Atmosphere—Consideration should be given to such factors as temperature of plant air, humidity, equipment, congestion, number of workers and existing heating and cooling systems.

Dust Characteristics—These include particle size, shape and distribution, specific gravity, bulk density, hygro-

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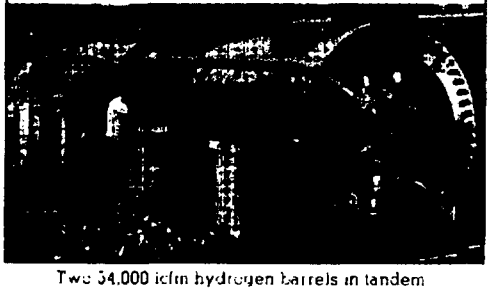

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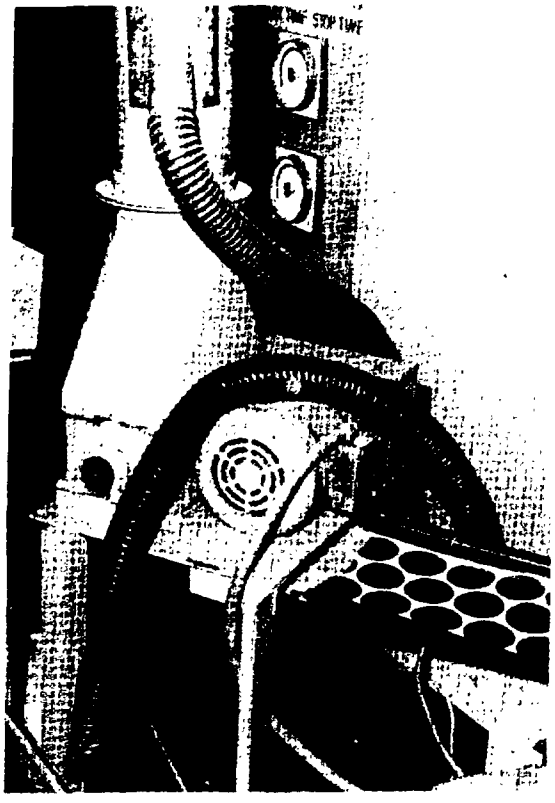

VACUUM HOSES help employees clean work areas—Fig. 1

scopic tendencies, toxicity, explosiveness, corrosiveness, abrasiveness. Dust characteristics affect hooding, duct sizing and layout, fan power, separator sizing, materials of construction and filter fabric.

Product Characteristics—If the material produced is lightweight (flakes, powders, light sheets), the system must gather dust without picking up product. Hood design and velocity patterns are important here. Also, the product's surface finish may be of a quality that is downgraded by dust, or the product may be susceptible to temperature changes caused by air flow.

Air-Flow Dynamics—These vary with size and number of hoods, nature of dust, production process, and distance of hoods from separators. Since OSHA has set specific ppm limits on numerous airborne dusts and fumes, the dust-control system must balance these limitations against the expense of in-plant-air turnover rate.

Expansion Plans—Anticipate expansion plans, size the main ducts, and allow space for separators so that future needs can be met. One sign of a good system is room for growth, but this must be thought of at the outset

Build or Buy

The next decision is what parts of the system are to be purchased and what can be provided by plant personnel. One extreme is having the entire design and installation done by plant people; the other one is to contract out the entire job on a turnkey basis.

The expertise and workload of the plant's engineering group usually determine the extent to which the system is contracted out. Advantages of hiring outside specialists include time saving, wider experience, and availability of the latest dust-control techniques.

It is hazardous today to estimate the cost of a dust-collection system. While the central separator and exhaust fan are offered in standard sizes, the cost of a turnkey contract depends on variables such as: (1) the number and type of pickup hoods required; (2) size and length of ducts; (3) special anticorrosion coatings or metals needed; (4) anticxplosive safeguards such as special valves, motors and redundant standby equipment; (5) separator size and air-flow/cloth-area ratio; and (6) separator cleaning mechanism (manual, automatic, or continuous automatic).

An old rule of thumb—which has become less accurate as codes tighten and costs escalate—is that a turnkey system, not including electrical work, costs from $2.50 to $5/cfm. A 10,000-cfm system would cost from $25,000 to $50,000, including survey work, engineering, fabrication, installation and startup to meet guarantees.

Alternatives to the turnkey contract, however, are numerous. Plant engineers could develop the basic concept with consultants designing the system, or they could take the project through the engineering stage and ask for bids on the specifications. Then, perhaps only the separator and blowers need to be purchased.

Previous experience of staff engineers should be evaluated realistically before taking on the job at the plant. Experience in heating, ventilating and air-conditioning (HVAC) can be helpful, but it is not enough. The principles of dust collecting, conveying, and separating are quite different. HVAC systems usually work under positive pressure, with minimum disturbance of people by air flow. By contrast, dust-control systems operate under negative pressure, inducing air flow in exactly the right places. If the best approach seems to be to turn to outside system suppliers, find one that you can trust so that the job may be left entirely to him.

Anatomy of a System

Look for evidence of good design in the overall system and its major components, such as hoods, ducts, separator and blower. Simplicity can mean efficient operation and less maintenance The system should occupy as little space as possible, and not interfere with operations.

Hood Design—Look for solid, welded construction, where airflow dynamics have been given proper consideration. The hoods should: be well anchored and as close to the dust generator as possible to reduce duct length and improve efficiency; out of the way of worker motion and visibility; and not interfere with plant lighting. Swingaway hoods should be specified where needed.

Duct Design—Flange or welded slip-joint construction provides rigidity and air tightness. Look for long, straight runs to sustain good flow patterns. Branches should enter the main duct at no more than a 30-deg angle to avoid abrupt changes in direction and velocity of air (Fig. 2). Any duct descending to a dust-generating point must be so placed that the operator will not want to remove it.

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Separating fact from fiction: bolted vs. welded tanks.

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FICTION: Welded tanks fit the job better because they are custom made.

FACT: While welded tanks are more likely to be totally custom fabricated for the job, this fact is no assurance that they are better tailored to meet engineering requirements. Butler bolted tanks are individually engineered and computer calculated to take into account weight and flow of material stored and environmental conditions such as wind load and seismic factors.

FICTION: Welded tanks perform better because they are made of heavier gauge steel.

FACT: Better performance is frequently not the reason heavier gauge steel is used in welded tanks. The fact is that there is no choice. Often, the less costly, lighter gauge walls would be more than adequate, but the lighter gauges (used in bolted tanks) are not suitable for welding.

FICTON: Welded tanks are more "weatherproof" . . . will protect their contents better than bolted tanks.

FACT: Butler bolted tanks are *designed* to hold *in* stored liquids . . . which is much more difficult than keeping wind and rain *out*.

In addition to tight, safe storage, flexibility of design and greater economy in basic materials cost, Butler bolted tanks offer other advantages over welded tanks.

For instance, Butler bolted tanks are shipped in compact, manageable units which permit maximum shipping and erection economy. Welded tanks small enough to be shop-welded are bulky and more expensive to ship.

The cost of labor for on-site welding of tanks is high, and sometimes the labor available is of dubious quality. All of this adds to the price you pay for welded tanks.

Also, Butler bolted tanks are coated at the factory, under controlled conditions, by experienced and highly skilled workmen. On field-welded tanks it is difficult to maintain uniform quality control of coatings.

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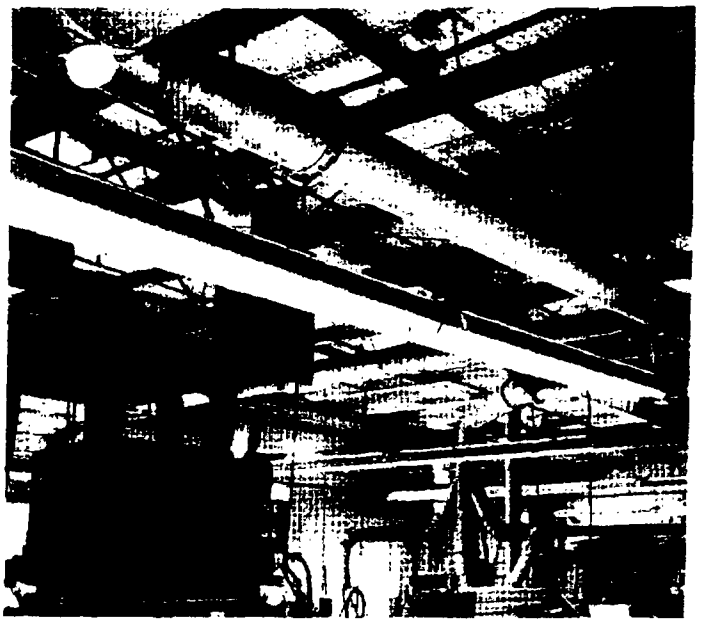

LONG, STRAIGHT RUNS keep good flow patterns—Fig. 2

Flexible ducts help with difficult-to-reach hoods. However, rigid ducts perform better and usually turn out to be more economical.

Fabric Separators—This unit should be easily accessible for inspection and for emptying in any kind of weather without stopping system operation. It should also be housed with firm supports. A knockout chamber to remove some particulate matter, especially when the dust is abrasive, improves the efficiency and the life of the separator. The cleaning of its filter tubes, whether done by a mechanical shaking device or by jets of cleaning air, should be simple. Check for correct airflow-to-cloth-area ratio, and for safeguards against wear points at the entrance and exit of the tubes.

The choice of a mechanical shaker or a pulse air cleaner depends on the nature of the dust. If it cannot be efficiently removed by blowing out the tubes, mechanical shakers may be needed, even though this requires that pressure be taken off the tubes while they are shaken.

If the process will not allow shutdown for filter cleaning, then either a continuous automatic method—where parts of the mechanical-shaker separator can be taken offstream for cleaning—or a continuous air-cleaning filter must be provided. Usually, in systems handling 20,000 cfm or less, it is more economical to install a pulse air-cleaning filter than a continuous-automatic mechanical-shaker separator.

Other Separators—Other than fabric-type dust separators, the kind most commonly seen for dry materials is the cyclone. But with air-quality codes in most states already requiring better than 90% efficiency in separating particulate matter from air (or emissions of no more than 0.02 grains/ft^3), it is unrealistic to expect a cyclone cleaner to meet air-pollution codes.

Nevertheless, cyclones are valuable as precleaners in dust-control systems handling: (1) abrasive material that can be partially separated from the dust to reduce wear on fabric filters; (2) thin, stringy material such as paper, plastic webs or lint that can be precleaned from the air to reduce the frequency of cleaning fabric filters; and (3) heavy loads to help take the load off the fabric filter.

Another separator is the gravity-settling chamber. Again, this usually acts as a precleaner rather than as a final separator. Consisting of a baffled chamber placed in the main airflow path, the entering air drops in velocity and changes direction. Heavy particles then fall out of the air stream to the chamber bottom, where they are periodically removed. This unit is often included when there is danger of drawing sparks into the pickup hoods, because water—run into the chamber bottom—extinguishes the sparks.

Although other types of separators have also been used, it is difficult to generalize for specific situations what alternatives there might be for fabric-filter systems. Some of the newer approaches to dust separation may become important in the future, but the standard, central filter with fabric media continues to be the most efficient separation method for the amount of energy expended.

Exhausters—The size of these units should be such as to move the required air with minimum power consumption. Check for inspection access doors. Look also for proper guards on V-belts, as well as adequate belt ventilation. If fans are on a platform, there are codes on access and strength of platform and ladders that should be consulted.

Choosing a Contractor

To help evaluate outside consultants or system suppliers for your dust-control problem:

1. Visit a few, recent dust-control systems the contractor has engineered and installed, and discuss the systems with your counterparts in these plants.

2. Is the contractor familiar with your product and manufacturing process? Be certain he is taking a systems approach to your dust-handling job. Gathering the dust and conveying it to the separator must be as efficient as the separation of the dust from the air.

3. Ascertain that the supplier is familiar with state and federal air-quality codes, and is experienced in filing appropriate compliance forms with labor departments and air-pollution control agencies. These codes change frequently. In some instances, only accredited engineers can file the compliance forms.

4. Has the contractor considered worker movements and avoided changing accustomed motions? Can equipment be inspected and serviced without undue exertion? Has he discussed work motions and paths with machine operators?

5. Will the contractor perform every function needed in the job? If not, who has responsibility for the subcontracted aspects? The functions usually required of the contractor are: testing, source analysis, concept development, engineering and drafting, fabrication, installation, startup and followup.

Factors beyond bid figures for dust-control systems must be considered. See to it that total installation costs and successful startup are included. Ascertain that the

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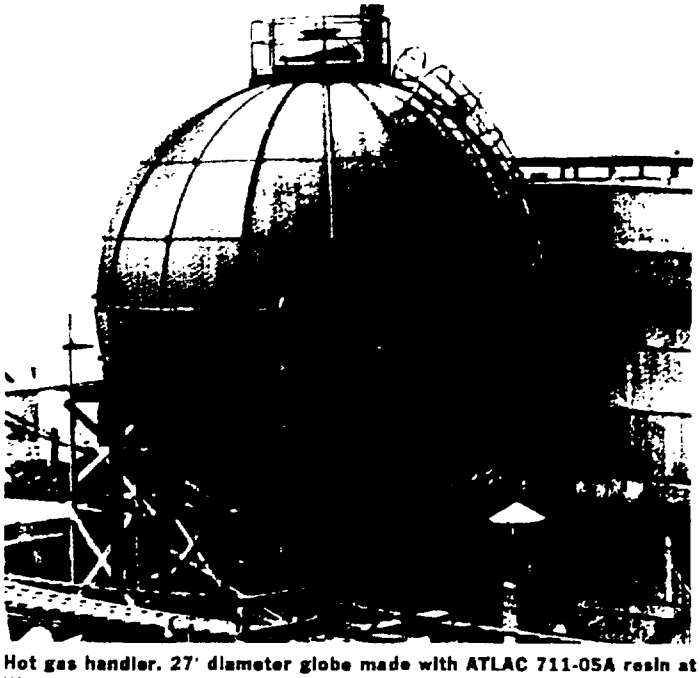

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HOOD under conveyor belt draws in asbestos dust—Fig. 3

system will not adversely affect production or product quality, that operating costs of the system are taken into account, and that system capacity is optimum for your operation.

Look for the danger of secondary problems such as may be encountered in dust-hopper emptying and dust disposal at the separator, or for weather effects on separator inspection and emptying, and for a possible problem with system noise.

Have the contractor definitely determine any interruption of production during system installation. Check on effect, if any, of system on insurance rates. Ask for details on prefabrication of hoods, ducts and supports before delivery. You may eliminate some confusion, interruptions and hazards.

Difficult Problems Solved

Drastic improvements in plants where dust control was once considered impossible are now accomplished every day. Some examples are the following:

Explosive Dust—In the manufacture of a basic component for plastics, the material was so explosive that installing a new dust-control system had to be approached with the assumption that explosions in or around the dust-control system were inevitable. This required special precautions, not only in design and system function, but in erection as well.

Therefore, the system was designed with: exhausters with nonferrous fans to eliminate sparking; explosion-proof motors; heavy, shock-proof casings on separators; large blowout panels on hoods and ducts (with tethers, so they could not become missiles); explosion- or shock-triggered shutoff valves in the ducts to isolate and eliminate secondary explosions; separators isolated from remainder of system; high ratio of vent area to cubic content; explosion vents between plant and separators; careful grounding of all components; sparkproof bins; and a special two-stage unloading arrangement to seal off collected dust from the separator while the hopper was unloaded.

In erecting the system, no onsite welding, brazing or soldering was permitted. Parts were prefabricated, and no electric tools were used at the site. To prevent sparks, only brass hand-tools were used for assembly purposes.

Fine, Toxic Dust—At a leading manufacturer of pigment compounds, dust in the difficult-to-capture 0.10 to 10-micron range was generated. At two of the 200-gal mixing tanks, when 50-lb bats of pigment powder were added, bursts of dust resulted from dumping the bags.

This problem was solved by designing the collection hoods for these tanks as "flip tops," which raise to permit adding the sacks of pigment, and then close until the dust is taken into the system. Further precautions included pressure-relief vents and a nonferrous exhaust fan to prevent sparks.

Stringy, High-Volume Asbestos Dust—In a floor-tile manufacturing plant, some 3,500 lb/d of dust was generated in grinding and screening of vinyl asbestos, limestone and various chemical pigments. Employee health and safety, product quality, community relations and housekeeping were at stake.

Therefore, 20 intake hoods at dust generating stations and conveyor belts were installed, and hoods—varying in size to accommodate the density of generated dust—were located either over or under the major dust sources, such as the grinder, screens and conveyor exchange points (Fig. 3). A large, two-hopper dust separator was chosen to handle the large volume. About 20% of the dust can now be recycled to the production process.

Outdoor Dusts—Both OSHA and EPA compliance were at stake and community relations were in jeopardy for a ready-mix concrete company, which generated large volumes of highly visible dust at its outdoor mixer-truck loading station. A specially designed swingaway collection hood was therefore installed, which collects the dust at its source. During loading, the hood drops into position over the loading-hopper discharge and over the truck-loading gate. Then it swings out of the way when loading is complete, so trucks may move freely in and out of the area. The swingaway hood is connected to a separator, which draws in the cement particles. Emissions were reduced 90%. ■

Meet the Author



Lester T. Owen is sales engineering manager for dust-control systems with G. A. Kiesster Co., 11-T Taylor Rd., Edison, NJ 08817. During the seven years he has been with Kiesster, he has been involved in solving dust-control problems for the chemical process industries. Prior to joining Kiesster, he spent 12 years with Monsanto Chemical Co., Springfield, Mass.—where he was production superintendent—and at the Addyston, Ohio, plant where he was plant engineer. Before, he was general manager of Pfizer's Quigley Div. in Sayreville, N.J. He studied mechanical engineering at the University of Missouri.

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