TECHNOLOGY

Modern Chimney Sweeps

Modern machines and electrical devices in factory chimneys, waste gas outlets and even in our homes, work to keep the air clean.

By DAVID PURSGLOVE

➤ MODERN "CHIMNEY sweeps" are hard at work helping to keep America's air safe to breathe.

The chimney sweeps who get most of the glory are working in the giant smokestacks and gas systems of huge factories.

Others do not work around chimneys at all, but in tanks of water. However, they are not cleaning water, but still doing the chimney sweep's job of cleaning up and hauling away smoke and dust.

And there may even be yet another type of chimney sweep hard at work right now in your home, local restaurant, bakery or department store.

These are not the little dirty-faced, grimy-clad young boys of early England who periodically crawled into chimneys and swept down the soot. They are, instead, modern mechanical and electrical devices that work continuously and automatically to eliminate soot even before it forms.

Thanks to these machines, the air we breathe is cleaner and fresher than would otherwise be possible in a highly industrialized nation.

Although many industries have adopted smoke-cleaning devices to maintain good community relations or to comply with local laws, at many factories the cleaner and fresher air is only a by-product of a more important, dollar-wise, function of smoke cleaning. These devices save industry millions of dollars a year that would otherwise literally go up in smoke.

Valuable, often strategic, materials are reclaimed from smokestacks, particularly in the chemical and metallurgical industries.

In some industries careful policing of smoke is an absolute necessity for protection of life. The ores of many metals vital to the electronics industry contain arsenic compounds that must not be allowed to drift over the countryside.

Four Kinds of Sweeps

Although there are nearly as many different techniques for cleaning smoke as there are plants to employ them, the majority of them fall into one of four major categories: scrubbing, centrifuging, filtration, electrostatic precipitation.

Scrubbing, as the term implies, simply is a matter of passing a factory's gases and smoke through tanks of water or water spray towers which remove objectionable impurities. The gas flow then is dried and released into the atmosphere.

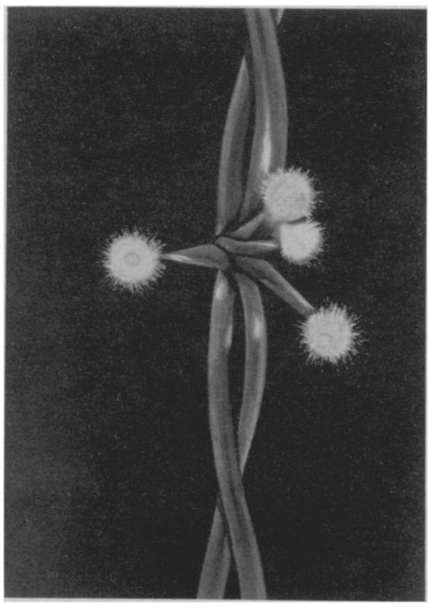
Sometimes the water is treated with chemicals which react with the gas or its solid-particle content to form either harmless compounds or compounds which are retained in the scrubbing solutions. This is particularly true in the case of materials which form acids in moist atmospheres. The scrub water is treated with caustic potash which neutralizes acids.

The high speed of flow of hot gases from many industrial processes is utilized to remove solid particles by centrifugation. This is similar to the use of laboratory centrifuges to separate solids from liquids. A test tube containing a liquid with solids in suspension is whirled at a high speed. The force of gravity draws the solids to the bottom of the tube.

In removing solids from smoke, the gases are passed at high speed through spiral coils which whirl the gaseous suspension. The gravitational force thus created draws out the heavier solids and permits the lighter gases to continue out the stack.

A modification involves passing the gases through a tank containing baffles. The gases are able to negotiate the sudden change in direction, but the heavier particles continue in a straight path and are trapped.

Familiar, everyday examples of smoke cleaning by filtration may be seen in filter-tip cigarettes and ordinary household vacuum cleaners.



MODERN CHIMNEY SWEEP — Barbed wire similar to farm fencing has been used by engineers of Koppers Company, Inc., Baltimore, Md., to solve a smoke cleaning problem nearly 50 years old. The electrical discharge needed to capture smoke particles is not hindered by a build-up of smoke on this wire. The barbs remain clean and "sparkling."

A filter mat made of wool or cotton waste, shredded and matted asbestos, specially prepared paper, steel wool, spun glass or packed chemicals is placed in the gas flow lines to trap solid particles of ash, oil smoke, metallurgical ores and other materials that comprise smoke.

Such filters are often used at air ducts into a plant to protect machinery and sensitive processes from the grinding or chemical effect of impurities. When used to eliminate smoke from waste gases, the filters often must be placed after a tank or tower that first cools the gases to prolong the filter life.

However, some filters, particularly those made of asbestos or metal "wools," can be used directly in smokestacks and effectively remove particulate matter from gases up to around 1,000 degrees Fahrenheit.

Some filters actually are only skeleton structures to support liquids which do the filtering. One type in wide use consists of an endless belt of steel mesh which passes through an oil bath and then through a portion of the exhaust gas pipe or smokestack. Oil trapped in the mesh collects smoke and dust particles.

Bagging the Smoke

Bag-type filters, quite similar to the dust collecting bags in vacuum cleaners, also are in wide use. Most of these rely on a very fine weave to mechanically trap dust and smoke particles. Others, however, are designed to take advantage of the fact that most small particles to be trapped carry a slight electric charge. Various fabrics possess slight charges, usually from the time of their manufacture. When a fabric carrying a charge opposite to that on the dust particle is used as a filter the bag will stop, by electrostatic attraction, much smaller particles than could be stopped mechanically by the fabric weave alone.

The smoke and dust collectors most often heard about utilize an electrostatic attraction created artificially. These are the very expensive, but highly efficient, electrostatic precipitators.

A wire suspended in the smokestack, or several wires arranged in units occupying their own buildings in the exhaust gas system, imparts an electrical charge to the smoke particles. Near the wire are metal plates carrying an opposite charge which attract the charged particles.

Only recently a major problem of electrostatic precipitator designers for nearly 50 years was overcome.

Ideally, all smoke particles would be attracted, electrically, to the charged plates. However, in practice, some smoke adheres mechanically to the energizing wire, producing an insulating effect that can be overcome only by increasing the power load.

When the wire becomes coated, there is no longer any control over where and when

the charging field will build up around the wire. The use of barbed wire has solved the problem.

Earlier, scientists in Europe learned barbed wire points always remain clean and provide a continuous electrical discharge. By properly spacing the barbs, engineers can control the discharge throughout the entire precipitator.

Laboratory and pilot plant models were built in Europe by Dr. W. T. Cosby of W. C. Holmes & Co., Ltd., Huddersfield, England, and Fred Frauenfelder of Elex, Ltd., Zurich, Switzerland. The first full-scale barbed-wire precipitator was built in the United States under the direction of J. Marcus Mousson, Metal Products Division, Koppers Company, Inc., Baltimore, Md., in cooperation with the European engineers.

Dust Removal by Electricity

Electrostatic precipitators, as well as filtering devices and a few modified scrubbers, are in daily use in many homes and business places.

An ingenious and very simple modification in electrostatic precipitators for home, office and store use has been made by Electro-Air Cleaner Company, Inc., McKees Rocks, Pa. This provides a greater particle collecting surface in a smaller space.

Unless influenced by magnetic or other electrical fields, electricity and particles electrically charged will travel in the straight line that is the shortest distance between electrodes. Thus, dust and smoke collected in a precipitator will form a straight line down the charged plates, following the parallel straight line formed by the hanging electrode. This is a trace of the shortest straight path between the charging wire and collecting plate.

However, in the case of an electrode hanging exactly in the center of a circular cylinder, all points on the cylinder are equidistant from the electrode.

Electro-Air Cleaner engineers have devised a unit featuring a rigid energizing electrode suspended between two curved collecting plates, each a segment of a circular cylinder. Dust is collected over most of the interior surface of the unit, which can be made quite small in contrast to a precipitator featuring flat plates.

Other methods of eliminating smoke and dust particles from smoke and household air include impaction, agglomeration and settling.

Gases to be cleaned by impaction are hurled against rods, cylinders or screens which trap particles impacted on them. Filtering is a type of impaction.

The technique of agglomeration consists of treating the particles chemically, mechanically or electrically to cause many small particles to coagulate into larger particles for easier removal. Agglomeration often precedes filtering, centrifuging or settling.

Settling can be used in unit operations or in small continuous operations in which waste gases can be allowed to collect in tanks stored long enough to permit suspended particles to settle to the bottom.