ENGINEERING

Solutions to Air Pollution

Non-smoking factory stacks from overfire air jets, proper firing and new smokeless home heaters aid in the smoke abatement program.

By A. C. MONAHAN

➤ WITH winter ahead, smoke pollution of the atmosphere will greatly increase. The millions of coal furnaces in private homes will be partly responsible, and to their smoke will be added that from millions of heaters used in other types of buildings. Improperly adjusted oil and gas burners will also help.

Smoke alone is not the only air-polluter. However, it is the visible pollution and it is largely unnecessary. Fumes from industrial processes are often far more dangerous.

Elimination of fumes is a matter for owners and public authorities, but the authorities need public backing and perhaps public pushing. Smoke pollution from private furnaces can be controlled by the home-owner himself.

Cars Pollute the Air

Nature combines with man in polluting the atmosphere. Pure air is found only in places free from nature's pollution such as over certain mountain ranges and far out over the ocean. Dust is the ordinary pollutant, but the dust, in addition to tiny particles of earth, may contain germs, plant pollen and vegetation. Wind is responsible for the dust in the air, and also for the many miles that dust often travels.

Ordinarily of more importance is the air pollution from industrial activities that discharge invisible gases, fumes and chemicals into the air. Also important are the exhaust gases, including poisonous carbon monoxide, discharged by the millions of motor vehicles on American streets and those coming from the now widely used diesel engines. Atmospheric pollution from these sources presents one of the most difficult problems in the "pure air" program.

Smoke Abatement

Active steps have been long underway in industrial cities to abate the smoke and the accompanying fly ash nuisance. Some 50 American towns had anti-smoke regulations 25 years ago, and similar regulations had been enacted in many European industrial cities. Today, most American cities have antismoke regulations. Methods of smoke abatement are well established. But getting rid of the smoke and fly ash is only part of the job. The abatement of the invisible gases and fumes, which sometimes include active poisons, from factories, automobiles and incinerators is a problem yet far from solved.

"Smog" is defined in recent dictionaries, in which the relatively new word has found a place, as a combination of smoke and fog, particularly apt to occur in smoky cities. However it may be with Pittsburgh smog, Los Angeles smog can not be blamed on coal smoke because oil and natural gas are the principal fuels of southern California.

Los Angeles is reported to have some 10 to 20 days out of the year with smog so irritating that people's eyes and nostrils smart with it. Dust, industrial fumes and irritants resulting from the incomplete combustion of hydrocarbon fuels are thought to be to blame. The geographic position of the city seems to aid the collection of the smog in the urban area. It is a city ringed with mountains except on the ocean side. The smog appears on the days when normal winds do not drive the haziness away.

"Smokeless" Stacks

Earliest attention in the American smoke abatement problem was directed naturally toward the belching factory chimneys and equally obnoxious coal-burning steam locomotive stacks. Both are in year-round operation. They emit little more smoke in the winter months than during the summer. Scientists got busy on the problem years ago and reasonably successful methods for the abatement of their smoke have been worked out.

For the most part, industry cooperated with public officials in the smoke abatement program. Now the nuisance from these sources is approaching elimination. Underfeed stoker equipment and overfire air jets have been found to be effective methods for smoke abatement because they strike at the heart of the problem.

How they work is best understood with a knowledge of the generally accepted theory on the formation of smoke. Hydrocarbon vapors, when heated to high temperatures without enough oxygen to cause complete combustion, decompose to form finely divided carbon particles or soot. These are difficult to burn; hence, the fundamental principle of smoke abatement is not to burn smoke after it is formed, but to prevent its formation.

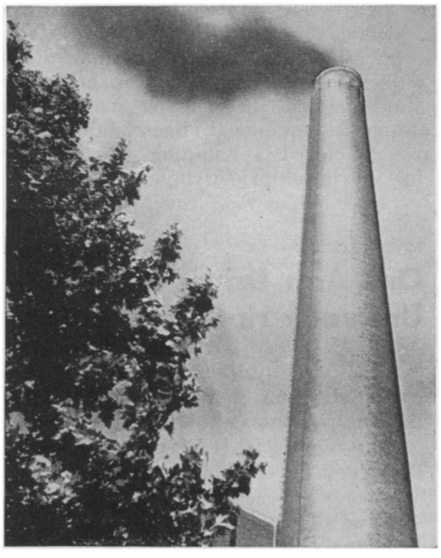
Overfire Air Jets

Overfire air jets accomplish this by forcing air into the furnace where it is needed and mixing it with unburned gases. If an excess of air is already present, the jets mix this air with the combustibles.

Tests have shown that, where there are no unburned-gas losses, but smoking is chronic, smoke is effectively eliminated with no change in boiler efficiency by the injection of overfire air accompanied by a compensating reduction in primary air supply to maintain constant excess air, according to a bulletin of Battelle Memorial Institute, Columbus, Ohio, where much study to the smoke abatement problem has been given.

Filtering, blowing and electrical means have all proved successful in smoke abatement from factory stacks. The filter, placed within the chimney, is a porous material that will not burn, such as steel wool, and it is capable of catching the fine particles in the smoke.

One blowing method uses the principle of centrifugal force in a whirling column of air to force the particles to the inside walls of the chimney for later cleaning. The electrical method gives the rising particles a static electric charge so that



BELCHING CHIMNEY — These factory chimneys which added greatly to air pollution are no longer necessary with the scientific smoke abatement methods now available.

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SMOKELESS FURNACE—A smokeless household furnace of the University of Illinois, being inspected by Prof. J. R. Fellows, its inventor, has a coal-coking chamber in its front.

they are attracted to electric plates on the sidewalls.

Proper Firing

The principal part that home-owners can play in the smoke abatement program is in furnace firing. The handling of a home furnace requires skill. It pays to acquire the necessary skill. Proper firing not only eliminates smoke but it contributes heavily in fuel-bill savings.

Clean flues and properly operating checks and dampers are, of course, essential. Proper firing has to do with regulation of the furnace drafts and with the method that the coal is placed on the firebed. Bituminous coal contains considerable volatile combustible matters which are wasted up the chimney if not consumed in the furnace.

Spreading the coal over the entire bed of burning matter releases these volatiles, and releases also great quantities of smoke. Good firemen stack the bituminous coal in a cone in the center, or in a sloping heap on one side. Combustion then takes place at the foot of the slope, and little smoke results.

No matter how much the amateur or professional fireman may think he knows about the best methods of firing and operating a furnace, he should read the recommendations of experts which they base on scientific experimental work. Such recommendations are available without cost from the U. S. Bureau of Mines, several state universities and technical schools, and particularly from Bituminous Coal Institute, Washington, D. C.

Smokeless Furnaces

Old-style bituminous furnaces will necessarily be in use for many years, but in time they will be replaced with smokeless home-heaters recently developed. Among agencies responsible for these new-type furnaces are Bituminous Coal Research, Inc., Pittsburgh; Battelle Memorial Institute, Columbus, Ohio, and the Engineering Experiment Station of the University of Illinois at Urbana. Work in the latter two is under joint sponsorship of Bituminous Research and a group of stove manufacturers.

The so-called Illinois smokeless furnace shows the trend in development. In it, each charge of fresh coal is converted to coke in a coking chamber at the front of the furnace. Coking heat comes from the coke-burning chamber in the rear. The volatile matter released as a gas from the fresh coal in the coking process mixes with secondary air introduced through vertical air passages adjacent to the combustion flue. The mixture then passes over live coals in the coke-burning chamber, where it is ignited. The result is "no smoke."

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ANATOMY

Fetal Heart Is Simple, Grows to Complex Organ

➤ WHEN the heart starts out in the beginning of a new life, it is a very simple sort of pump and not the complex organ that it is when the animal gets to the point of starting life on its own, Dr. Bradley M. Patten, anatomy professor of the University of Michigan School of Medicine, explained in his first national Sigma Xi lecture at the University of Illinois in Urbana, Ill.

The first heart beat does not occur in a miniature of the chambered and efficiently valved adult heart, Dr. Patten explained. In the egg cell there are very simple structures that develop into a temporary cardiac pump that starts the circulation going and keeps it in operation during the time the most elaborate heart mechanism is being formed.

The young heart cannot cease operations "for alterations", Dr. Patten explained. All the time it is changing from the simple tubular structure which first sets the blood in motion, until it becomes its chambered and valved final form, the circulation can never be allowed to cease, even momentarily.

Although most of Dr. Patten's work has been done on the chick, studies show that there are similar stages in the human and other mammal hearts, and that the stages in the formation of the blood corpuscles and the beginning of circulation are similar.

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PHYSICS

Stay Away from Bats If Noises Irritate You

➤ IF THE sound of fingernails scratched on a blackboard or the squeak of a street car as it goes around a corner is annoying to you, don't go near bats.

Prof. W. H. Pielemeier of Pennsylvania State College, has found that the cry of a bat four inches from its mouth is 104 to 110 decibels in the 13 to 14 kilocycle sound band. This is about equivalent to the nerve-irritating noises of a fingernail on a blackboard or a trolley squeak.

Normal speech is about 60 to 70 decibels, and a jump of 40 decibels to 100 means an increase of 100 times in the intensity of the sound.

The bat's loud warning cry can be heard at a distance of 12 feet or more.

When several bats are flying near each other and are using their sodar system, a natural detecting system similar to sonar or to radar, they are not confused by each other. Possibly each one knows his own voice by its ultrasonic spectrum, Prof. Pielemeier concludes in his report to the Acoustical Society of America.

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