CHEMISTRY

The Search for Clean Air

Scientists are beginning a new attack on the problem of automobile exhaust gases which they believe will help bring air pollution under control.

By DAVID PURSGLOVE

➤ THE URBAN air pollution and smog problem stemming from automobile exhaust gases may be brought under control by a group of scientists now trying to find out why auto exhaust gases do not burn completely, and under what conditions they may be made to burn.

In the meantime, other scientists are accelerating their search for devices to eliminate smog produced by cars. Many solutions have been proposed. None has worked to date.

The problem is a matter of making a commonplace mixture of simple hydrocarbons, gasoline, burn in practice in an automobile the way a theory on paper says it should. Under ideal conditions a hydrocarbon mixed with oxygen from the air burns to produce carbon dioxide and water vapor, plus energy. That is what happens during the human respiration process when the air we breathe joins the food we take in as fuel in a burning process that sustains life. However, the automobile engine is not nearly as efficient as the human body. Too much gasoline escapes from the engine without being completely burned.

This partial combustion results in an exhaust gas mixture loaded with methane (the dreaded gas of coal mining), ethylene, nitrogen, hydrogen, acetylene, and extremely dangerous carbon monoxide, as well as carbon dioxide and water vapor.

The mixture of gases already listed is dangerous enough, scientists say, even without the addition of other combustion products that react with the gases, particularly in the presence of sunlight which has a photochemical effect on the mixture, to produce further noxious compounds.

Solutions to the Problem

Drs. Raymond Friedman and Bernard Greifer, physical chemists specializing in combustion studies at Atlantic Research Corporation, Alexandria, Va., believe they are on the track of the right answer. They are trying to find out under which ideal conditions the mixture of exhaust fumes can be made to burn, and why. Working under a grant from the Air Pollution Foundation, a private Los Angeles organization of companies and individuals, the combustion scientists have designed and built a unique apparatus in which a controlled mixture of gases known to be present in exhaust fumes will be forced to burn under various desired conditions in a flat, easy-to-study flame.

When Drs. Friedman and Greifer have reported the facts, the Air Pollution Foundation hopes they will be encouraging enough to interest manufacturers, perhaps the automobile industry itself, in producing a control device developed from the new information.

Automobile manufacturers have spent $3,500,000 in the past two and a half years on research directed toward cleaning up exhaust fumes. The laboratories have turned over every research stone that looked as if it might hide the answer, but every approach investigated has drawbacks.

Some of the exhaust treatment methods being studied by industry are:

1. *Absorption:* Attempts have been made to have gases absorbed into liquids which would be discarded or periodically regenerated. The main drawback is that the equipment would be too bulky. Also, absorbents are not efficient enough.

2. *Adsorption:* Gases could be adsorbed on the surface of a suitable agent, such as activated carbon. This system, utilizing the gas mask principle, involves simple and inexpensive equipment and is reasonably efficient. However, the adsorbing agent would have to be regenerated or replaced too often.

3. *Centrifuging:* Gases are whirled at high speed until the noxious components are separated and trapped. The equipment is complicated, expensive and not efficient enough.

4. *Filtration:* An attempt could be made to separate gases just as mud is separated from water by passing it through paper or another filtering medium. As a rule, however, the basic theory just does not apply to gases.

5. *Refrigeration:* Some gases would freeze and settle as solids, others would be slowed down enough in molecular motion to be trapped by other means. Here the problem of bulky and expensive equipment adds the factors of high power consumption and difficulty of handling large amounts of collected water.

6. *Air Dilution:* The exhaust would not smell as bad at the tail pipe. There is still just as much pollutant entering the air.

7. *Recycling:* Exhaust is passed back through the engine for a second try at burning. This system is not very efficient, means modification of the engine, and might lead to heavy deposits at the intake.

8. *Addition of Chemicals:* Appropriate chemicals are fed into the exhaust stream to combine with noxious gases to form more pleasant compounds. The main trouble here is that there are no "appropriate" chemicals. Most of the undesirable exhaust components are inert and will not react. Besides, it would require a complicated meter constantly adjusting itself to driving conditions to vary the feed flow of the chemicals.

9. *Oxidation:* The gases would be made to react with oxygen, the way they are supposed to, to complete the combustion. Most chemists and engineers agree the answer lies here, either with the use of a

AN EYEFUL OF SMOG—These "smog victims" record their reactions to eye irritants in automobile exhaust gases. The car is mounted on a dynamometer and operated under simulated driving conditions at the Stanford Research Institute's Atmospheric Chemistry Laboratory, South Pasadena, Calif. The subjects' eyes are affected differently under changing operating conditions of the engine.

catalyst or by means of a forced-air afterburner.

Chemical catalysts promote full oxidation without themselves undergoing material change. A small tank of platinum pellets in the exhaust system near the motor block, or in the muffler, is efficient, but too expensive. Price alone is not the only drawback to platinum and other catalysts. The lead added to most gasolines to improve anti-knock qualities "poisons" the catalyst by gradually building up a coating that prevents contact with the gases.

Perhaps an effective answer to the automobile air pollution problem would be to reduce the power and so-called "performance" of automobiles. Scientists have implied at public meetings and stated flatly in private that the motorist has brought the exhaust problem on himself with demands for ever-increasing power and more and more "instantaneous performance." The total effort of today's engines is directed toward meeting these demands and there is nothing left to cope with exhausts.

However, as Drs. Friedman and Greifer stated while assembling their new burner in the Alexandria laboratory, "smog is deadly serious, but the most pressing problem brought upon us by the automobile still stems from the person behind the wheel—traffic accidents still lead fumes in killing people."

Science News Letter, November 30, 1957

Do You Know?

Many *migrating birds* fly at night because they hunt food in the daytime and seek to avoid the turbulent air of daylight hours.

Porelon is a new basic synthetic material in which liquid can be contained, as it is being manufactured, then given off at a predetermined rate.

Today, more than 40,000,000 people, approximately 30% of the total U. S. *population,* are over 45.

Hourly *fuel* consumption of turbine aircraft will be from 2,000 to 2,400 gallons, exceeding the yearly consumption of two passenger cars.

Questions

ANTHROPOLOGY—What is another name for pigweed? p. 345.

GEOPHYSICS—What is the name of the region of the atmosphere in which airglow occurs? p. 339.

MEDICINE—How is the steroid aldosterone related to sodium storage in the body? p. 344.

Photographs: Cover and p. 339, Massachusetts Institute of Technology; p. 343, Bell Telephone Laboratories; p. 346, Stanford Research Institute; p. 352, Mobile Racks, Inc.

METEOROLOGY

First Snows Predicted

➤ A WEATHER Bureau table predicting dates for the year's first one-inch snowfall is now available.

Although the list was published after the first post-summer snow in many parts of the country, it should still prove valuable to snow tire and snow-removal equipment manufacturers, as well as to those responsible for removing snow from streets and highways.

The table shows the first days in fall or winter on which one inch or more of snowfall is likely to occur, and the chances of this occurrence. It was prepared by H. C. S. Thom of the Weather Bureau's office of climatology.

The table lists probabilities for 164 cities in the United States and Canada. Some representative dates for a few scattered cities are:

New York—on the average of once in 20 years the first one-inch snowfall will hit before Nov. 20; once in ten years before Nov. 27; once in three years before Dec. 10, and nine out of ten years before Jan. 12. A snowfall of at least one inch will occur 98 out of every 100 years.

Washington, D.C.—average of one in 20 years before Nov. 5; one in ten before Nov. 15; one in three before Dec. 7, and nine out of ten before Jan. 28. Occurs every year.

Detroit—average of one in 20 years before Nov. 3; one in ten before Nov. 9; one in three before No. 22, and nine out of ten before Dec. 23. Occurs every year.

Chicago—average of one in 20 years before Nov. 5; one in ten before Nov. 12; one in three before No. 26, and nine out of ten before Dec. 30. Occurs every year.

Seattle, Wash.—average of one in 20 years before Nov. 20; one in ten before Dec. 2, and one in three before Dec. 27. Occurs 72 out of 100 years.

Mr. Thom's report appears in the Weather Bureau's *Monthy Weather Review* (Aug.).

Science News Letter, November 30, 1957