

The other type of engine modification system is achieved by a combination of the following changes:

(1) Leaner carburetor calibration under idle and road load conditions. The leaner fuel-air mixture promotes more complete combustion.

(2) Slightly earlier choke release. Since time is reduced during which a rich fuel mixture is fed to an engine, the amount of unburned hydrocarbon exhausted is reduced.

(3) Increased closed-throttle air flow. This provides a leaner mixture while idling.

(4) Retarded ignition at idle. This provides more complete combustion of the leaner idle mixture and minimizes the effect of increased air flow on idle speed.

(5) A vacuum advance control valve. Retarded ignition timing produces increased hydrocarbon emission during deceleration. The control valve senses the higher manifold vacuum associated with deceleration and advances the timing to normal.

None of these engine modifications decreases the emissions of oxides of nitrogen. Some may even increase them. Complete combustion of the hydrocarbons produces higher combustion temperatures; and the higher the combustion temperature, the greater the oxidation of the nitrogen in the combustion air. This Department is currently carrying on intensive research on the control of nitrogen oxides, and we expect that development of controls will progress so that nitrogen oxide emission standards can be established for 1970 model year vehicles. Two specific techniques now under study are exhaust gas recirculation and water injection, both of which reduce peak combustion temperatures.

Another approach to automotive pollution control is through afterburners which oxidize the products discharged from the engine exhaust. Both catalytic and direct flame afterburners were intensively developed primarily by automotive accessory manufacturers, to meet the 1959 California standards for emissions of hydrocarbons and carbon monoxide. By June 1964 three catalytic afterburners were approved for use on new cars in California and one direct flame afterburner was approved for use in both new cars and used cars. The approval by the California Board of more than one afterburner for new cars triggered a requirement that the majority of 1966 model year cars sold in California meet the standards adopted in 1959. Shortly after the standards were triggered, the automobile manufacturers announced that their high volume production 1966 cars to be sold in California would meet the standards through engine modifications, and the new car market for afterburners in California was essentially destroyed for the time being.

This market situation for afterburners can be changed by any of several happenings. First, the approval by the California Board of a second afterburner for used cars would trigger the requirement for their installation on most used cars in the State. Second, the necessity of meeting more stringent exhaust standards than the present ones may cause afterburners to become more competitively attractive to the auto makers, either in addition to or instead of engine modification. Third, the prospect, in the not too distant future, of standards for oxides of nitrogen in the exhaust should cause a second round of development of catalysts that will remove these oxides. If the ultimate route to oxides of nitrogen abatement is by catalytic reduction, it becomes more attractive to build oxidation catalysts for hydrocarbon and carbon monoxide removal into the same device. Lastly, the elimination of lead from gasoline could conceivably result in an afterburner which would last the life of the car or at least that of the other components of the engine exhaust assembly. A device which has this life, and which combines an oxide of nitrogen reducer and a hydrocarbon and carbon monoxide afterburner, and which is attached to the exhaust manifold of an engine having modifications to reduce pollutant emissions, should continually provide an emission essentially free of all the principal exhaust pollutants. That would be a combination hard to beat.

Fuel modification is being studied as a means of lowering hydrocarbon emissions. However, the only regulation of fuel composition in the United States intended to abate automotive emissions is a Los Angeles requirement that no gasoline may be used which has a degree of unsaturation greater than Bromine Number 20. This limits the olefin content of gasolines; certain olefins are more active than other components in producing photochemical smog. The drawback to this regulation is that the automobile engine cracks gasolines to produce olefins even if olefins are not originally present in the fuel.