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EVALUATION OF THE OWENS-ILLINOIS TOROIDAL CERAMIC REACTOR

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Background

Representatives of Owens-Illinois, Inc. contacted the Test and Evaluation Branch to request a brief evaluation of a vehicle equipped with ceramic toroidal reactors of their design. As reactors of this type will be evaluated in the studies being conducted by NASA on ceramic reactors, a test program was initiated.

System Description

Owens-Illinois supplied a 1971 full-size Chevrolet station wagon for the EPA testing. This vehicle was equipped with a 350 CID engine, automatic transmission, and two-barrel carburetor.

Headers from the exhaust ports carried exhaust gases directly to the toroidal reactors on either side of the engine. The volume of each reactor was less than one-half cubic foot.

Ceramic material was used in the reactor. An air pump was employed to supply secondary air to the reactors for oxidizing air. The vehicle's carburetion was modified resulting in an extremely rich air-fuel mixture.

Test Program

The vehicle was tested once according to the 1975 FTP as described in the July 2, 1970, Federal Register.

A two-bag hot start 1972 Federal test was run immediately following the 1975 test with the secondary air diverted away from the manifold reactors.

While exhibiting reasonably low hydrocarbon and oxides of nitrogen, the reactors do not exhibit good carbon monoxide control. Apparent from the extremely high carbon monoxide value when the secondary air was diverted from the reactors, the vehicle was operating extremely rich. Analytically, fuel consumption for the vehicle was 7.7 miles per gallon.

Test Results

The following table shows the results of testing at EPA.

Emission Results

1975 FTP
(All results in grams per mile)

HC	CO	CO_2	NOx
0.50	21.3	1097.8	0.76

Hot 1972 FTP
(With secondary air)

HC	CO	CO_2	NOx
0.40	12.9	1061.5	0.72

Hot 1972 FTP
(Without secondary air)

HC	CO	CO_2	NOx
8.97	>150*	480.9	0.59

*(A carbon balance indicates that this carbon monoxide value is approximately 380 grams per mile)

Conclusions

1. Reactor warm-up should be improved. The use of insulation on the headers to reactor is well as on the reactor itself could improve this characteristic.

2. The extremely rich mixture resulted in excessive carbon monoxide. Optimization of emission control should be investigated at leaner mixture settings.

3. As the reactor is not immediately effective at cold start, leaner choke operation or shorter choke duration is indicated.

4. As leaner operation is investigated further, oxides of nitrogen control, perhaps EGR, may be indicated.