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Effects of Methanol-Gasoline Blends on Emissions

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Test and Evaluation Branch
Emission Control Technology Division
Environmental Protection Agency

Background

The Test and Evaluation Branch of the Emission Control Technology Division is responsible for investigating any approach to control technology which shows promise of producing significant reductions in emissions. There has been considerable interest expressed in the effect on emissions of blending methanol with gasoline. A test program was set up to determine what influence the addition of methanol to gasoline would have on a car which was not designed to be operated on such a blend.

Test Program

Two blends of gasoline and methanol were tested. One blend contained 7% methanol and the other contained 11%. These blends have a lower heating value or energy content per volume than pure gasoline, approximately 3% and 4% lower respectively. The test vehicle was a 1970 Chevrolet equipped with a 350 CID engine and an automatic transmission.

All tests were run as specified in the 1975 FTP (Federal Register, No. 221, Vol. 37, November 15, 1972). A total of 10 tests were performed. Initially, two baseline tests were run using Indolene HO (unleaded) gasoline for fuel. Following the baseline tests, three tests were run on each of the two blends. The base fuel used for the blends was Indolene HO (unleaded).

The blends of gasoline-methanol were briefly evaluated to determine whether or not phase separation would occur when exposed to low ambient temperatures.

Test Results

The 11% blend caused a 17% increase in HC, a 41% decrease in CO, a 35% decrease in NOx and an 8% decrease in fuel economy in miles per gallon. The 7% blend caused a 10% increase in HC, a 34% decrease in CO, a 24% decrease in NOx and a 6.5% decrease in fuel economy in miles per gallon. Fuel economy on a BTU per mile basis was somewhat lower for blend operation when compared to baseline. To investigate the phase separation question, one pint of the 11% blend was placed in outside ambient conditions (10°F) for an overnight soak. After standing for approximately 15 hours, the 11% gasoline and methanol blend had separated into two phases. Another pint of the 11% blend was stored in a freezer (0°F) for the same time period. This bottle showed no evidence of separation.

Conclusions

It appears that the use of a methanol-gasoline blend in a production vehicle not designed to run on such a blend can produce significant reductions in CO and NOx. However, the accompaning increase in HC found in this test may have been due to lean misfire due to the effective leaning of the air/fuel ratio by the addition of methanol. Since lean misfire is not a desirable operating conditon, changes would have to be made to the carburetion to correct this situation on those vehicles exhibiting that problem. The vehicle also exhibited poor driveability (backfiring, stalling, etc.) when running on the methanol-gasoline blend, again typical characteristics of overlean operation.

The separation of the methanol-gasoline blend exposed to low ambient temperatures and moisture would indicate potential problems requiring extensive investigation and resolution prior to the widespread use of such blends.

Significant deterioration in fuel economy on both a volume and energy basis resulted from use of the methanol-gasoline blends.

Methanol-Gasoline Blend
1970 Chevrolet 350 CID
1975 Federal Test Procedure
(mass emissions in grams/mile)

	HC	CO	NOx	MPG
Baseline	1.78	12.2	3.68	12.0
	2.05	14.0	3.43	12.5
Average	1.92	13.1	3.56	12.3
11% Blend	2.08	7.3	2.40	10.8
	2.10	7.7	2.48	11.2
	2.54	8.1	2.59	11.8
Average	2.24	7.7	2.39	11.3
% Change from baseline	+17%	-41.2%	-32.9%	-8.1%
7% Blend	2.08	8.5	2.34	11.8
	2.19	8.9	2.90	11.3
	2.08	8.4	2.91	11.4
Average	2.12	8.6	2.72	11.5
% Change from baseline	+10.4%	-34.4%	-23.6%	-6.5%

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