

#2 ULSD vs #2 HPCD

A 10 Week Comparative Study of Fuel Economy and Vehicle Emissions conducted by Resource 100, LLC for The City of Dublin, Ohio

Testing Partnership



Experimental Design

The goal of this HPCD validation project is to compare various attributes of two diesel fuels, conventional #2 Ultra Low Sulfur Diesel (ULSD) and High Performance Clean Diesel (HPCD) as produced by EcoChem Alternative Fuels (EAF). The subjects of the two fuels are school busses owned and operated by the City of Dublin School District. The attributes compared were:

- Fuel economy (MPG)
- NOX emissions (PPM)
- HC emissions (PPM)

The experiment to compare the two fuels could have been designed in two ways. One way would be to recruit 12 busses and operate 6 busses on the ULSD and the other 6 busses on HPCD. Then, after a suitable length of time measure the various attributes of interest for each bus. This would lead to independent samples for which it is expected to find certain variability among the busses --- they all have different baseline fuel economy and emission profile depending on age, maintenance history and other factors. It was observed that a problem arises if this variability is large in that it could completely hide an important difference in the fuel economy and emissions between the two fuels.

The other method, a paired design, attempts to remove some of this variability from the analysis so it is possible to more clearly see any difference in fuel economy and emissions of the fuels studied. In this case we would start with the same 12 busses, but this time each bus was required to test both fuels.

It was then decided to reduce the number of busses in the experiment to 9 for the purposes of the paired analysis and keep the other 3 busses running on the ULSD to the earlier of the conclusion of the experiment or at a point where any season variation in the fuels could be accounted for and corrected. This is described in the section following.

Subject Vehicles

There were 12 busses owned and operated by the Dublin Ohio School District (DOSD) that were utilized in this evaluation project. The same busses were used throughout. The busses were selected to be representative of the DOSD fleet including low mileage, medium mileage and large mileage busses. The busses all were used to transport students in everyday activities of the DOSD.

Data Management

All data was collected utilizing a strict protocol designed and agreed to in a formal Validation Project Plan (VPP) before the evaluation process began. Important features of the data collection include:

1. All busses were fueled on previously determined days of the week; in most cases Monday, Thursday and Friday.
2. By mutual consent, the busses were fueled by a representative of the City of Dublin, Ohio (Dublin) and not the DOSD.
3. All data was recorded on log sheets by Dublin and forwarded by email to Resource100 LTD for input to database and statistical analysis. A sample log sheet is shown in Appendix A.
4. A similar procedure was followed for the emissions testing. On certain pre-arranged days of the week, early in the morning as the busses were first placed into service emissions testing was performed by Dublin utilizing a 5-gas analyzer.
5. Photographs were taken of each fueling showing the bus and odometer reading so that data could be verified. A sample photograph is shown in Appendix B.
6. All data entry was double checked and verified for accuracy.

The Periods of the Experiment

As indicated previously, with the paired design the evaluation started with 9 busses operating on both fuels. EFA disclosed that in their opinion it was likely that busses would show an increase in vehicle emissions of HC and NO_x and reduced fuel economy for a period of time following the introduction of the HPCD. The theory behind this is that the HPCD does a "scrubbing" of engine parts and during that time frame it is possible that many particles will be released through the fuel, combustion and exhaust system thereby actually reducing performance. The length of this Cleansing phase was estimated to be about 3-4 weeks.

Therefore, the project was broken into 3 distinct periods: Baseline, Cleansing and Validation

Executive Summary

Parameter	HPCD Percent Change over ULSD	Units measured
Fuel Economy	+ 16.1%	MPG
HC Emissions	- 12 %	PPM
NO _x Emissions	- 13%	PPM

- When corrected for seasonal variations of .167 MPG, the HPCD fueled busses showed an average 1.2 - .167 or 1.033 MPG net improvement in fuel economy. On a percentage basis, this equates to 1.033/6.4 or 16.1%. The expected average increase in MPG by using HPCD rather than conventional ULSD is 16.1%. These results are show graphically in Chart 2 below. The bottom section of each bar is the average MPG for each bus operating with ULSD. The top section is the incremental boost in MPG on average by the change to using exclusively HPCD.

Although individual busses varied, in every case, the HPCD showed an improvement in fuel economy.

- When corrected for seasonal variations, the HPCD fueled busses produced on average 12% less HC emissions than while operating on the ULSD.
- When corrected for seasonal variations, the HPCD fueled busses produced on average 13% less NO_x emissions than while operating on the ULSD.
- It is the opinion of Resource100 LTD that the for the subject vehicles HPCD fuel produced statistically significant results of improved vehicle fuel economy and reduced vehicle emissions over conventional # 2 ULSD fuel.

“WITH 45% OF OUR EMISSIONS IN THE STATE OF OHIO BEING VEHICLE EMISSIONS, ECOCHEM’S ABILITY TO IMPACT IT BY 15% IS TREMENDOUS. THIS IS A PRIME EXAMPLE OF ENVIRONMENTAL PROTECTION AND BUSINESS NOT HAVING TO BE MUTUALLY EXCLUSIVE.”



*Scott Nally,
Director,
Ohio EPA*