Fuels, Engines, and Emissions

Assessment of Corrosion Potential in Diesel Exhaust via Application of a Specialized Probe

Background

With more stringent federal standards for diesel engines due to take effect in the next year, manufacturers of diesel engines are incorporating exhaust gas recirculation (EGR) to reduce emissions of oxides of nitrogen (NOx). Recirculated exhaust is used in automotive engines as a diluent in the fuel-air mixture to reduce peak combustion temperatures and thus reduce NOx emissions.

However, during the combustion of diesel fuel, corrosive gases containing sulfur and nitrogen are produced. With EGR these corrosive gases are returned to the intake manifold, where ambient conditions (such as temperature and humidity) and coolant conditions are believed to play a critical role in the formation of highly corrosive acidic compounds, especially sulfuric acid.

Development of an in situ measurement system would significantly advance the understanding of the corrosion potential associated with EGR, thereby enabling engine manufacturers to establish boundary conditions on engine operation in order to avoid enhanced corrosion.

The Technology

A Cormon Ceion corrosion measurement system was evaluated in the intake section of a heavy-duty diesel engine equipped with EGR. The system was originally designed to monitor physical degradation in industrial oil pipelines. This effort represented the first attempt to adapt this technology to measure corrosion within engine exhaust.

During the evaluations, the probe response was measured under steady-state conditions against the fuel's sulfur content, EGR fraction, and dewpoint margin. For each test setting, the probe required 15 to 20 minutes to stabilize. Typically, an accurate measurement could be made within 30 minutes for each operating setpoint. The probe response was highly sensitive to each test parameter, and the measured corrosion rates were determined to be highly repeatable (typically within 5%).

Several diesel engine manufacturers have utilized the ORNL probe, since corrosion behavior can be elucidated much more quickly than through traditional coupon studies,

Less dependence on foreign oil, and eventual transition to an emissions-free, petroleum-free vehicle

Probe and sensing elements used in evaluating corrosion behavior in a diesel engine.

which require very long engine operation times (>100 hours).

Currently, the probe is being modified for multi-channel capability and additional probe elements are being procured for further investigations.

Benefits

- Demonstrated in situ, near-real-time corrosion measurement in engine exhaust.
- Repeatable performance
- High sensitivity (<1 μm resolution)

Where Can I Find More Information?

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