DOE Funding Leads to Successful Corrosion Probe Tests in Diesel Engines

Background

Exhaust gas recirculation (EGR) is one method for reducing nitrogen oxide (NO_x) emissions from diesel engines in heavy-duty vehicles and for complying with EPA emission standards. EGR involves the recirculation of a portion of exhaust gas back into the engine cylinder, where the exhaust acts as a diluting agent and lowers the combustion temperature, thereby curbing the formation of NO_x. While this reduction in NO_x formation is the main advantage of EGR, the process is problematic in that it involves the reintroduction of corrosive exhaust gases into the engine. Thus, there is a need to assess the corrosion potential that accompanies EGR and enable diesel engine manufacturers to set boundary conditions on engine operation to prevent damaging levels of corrosion. Based on this need, the U.S. Department of Energy provided funding for Oak Ridge National Laboratory (ORNL) to test a corrosion probe in diesel engines.

The Technology

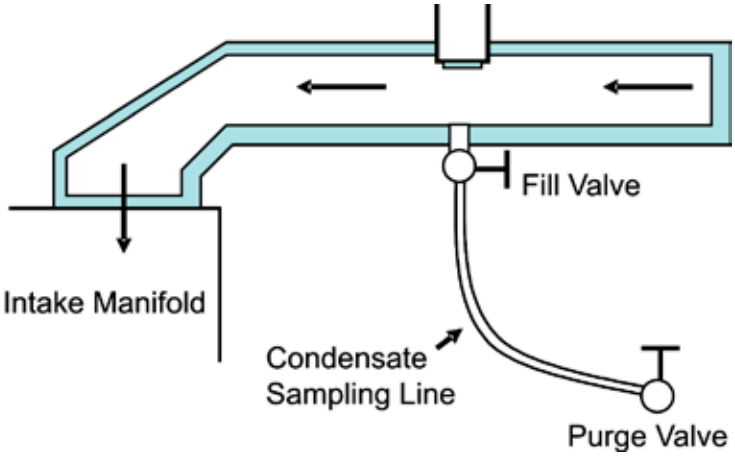
The corrosion probe used by ORNL in diesel engine testing was originally manufactured by Cormon Ltd. and designed to monitor the wear in oil pipelines and for use in underwater applications.

This electrical resistance–based corrosion probe operates via two spiral elements composed of mild steel. One element is exposed and measures the change in electrical resistance associated with both corrosion (mass loss) and temperature. The second element is insulated to prevent mass loss through corrosion and therefore measures the electrical resistance associated with temperature only. The electrical resistance measured from the insulated probe can be used to correct the result from the un-insulated probe to get the actual change in resistance associated with corrosion. The *in-situ* probe can give results within 30 minutes and is relatively inexpensive. It has significant advantages over "coupon studies," the previous method of measuring corrosion in diesel engines, which require more than 100 hours of engine operation per test as well as tedious coupon installation and removal. These studies have also shown that corrosion in EGR systems is directly related to water condensation and fuel sulfur levels, thus providing fundamental information to engine

system engineers on the causes and mechanisms associated with corrosion.

Current Status

The engine evaluation performed by ORNL was extremely successful and resulted in several diesel engine manufacturers and engine component manufacturers requesting ORNL's help in using the probe to obtain a better understanding of the phenomena leading to corrosion for a particular metal or alloy. Based on these efforts, engine manufacturers have made changes to their engine operating schemes to avoid corrosive regimes. Publication of the results of the corrosion probe experiments have led several diesel engine manufacturers to take a more detailed look at EGR chemistry and corrosion. The probe could also be used in other combustion systems such as boilers, coal combustion, and so forth.



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