Ethanol Emissions Detection in Exhaust Gas of Flex-fuel Vehicles by Mass Spectrometry
Technology #14284

Applications

The increase in ethanol usage as a transportation fuel has led to stricter regulations set by the EPA due to the harmful effects of the acetaldehyde that forms once ethanol is released into the atmosphere. This technology can be used for ethanol emissions testing by car manufacturers, research laboratories, and certification laboratories in addition to ethanol gas detection in refineries and other plants where ethanol gas is present.

Problem Addressed

Current US Environmental Protection Agency (EPA) and California Air Resources Board (CARB) regulations for E85 (a blend of 85 percent ethanol and 15 percent gasoline) require the measurement of ethanol and carbonyls such as acetaldehyde. With the use of mass spectrometry, ethanol emissions detection can be completed quickly online, and without the risk of interference by other component species in the exhaust gas, which is an issue usually encountered with photoacoustic sensors used for ethanol emissions detection. This technology also eliminates the need for additional techniques, such as gas chromatography, to separate the components of the exhaust gas before emissions testing. This technology can be used with existing mass spectrometers just by adding new software; no new equipment is required. This mass spectrometry method is an improvement over the photoacoustic sensors and gas chromatography most car manufacturers are currently using. Photoacoustic sensors are prone to interference from other gas components in the flex-fuel vehicle exhaust gas. Gas chromatography requires manual handling and lengthy analysis before emission results are available.

Technology

This ethanol emissions detection technology uses mass spectrometry to measure ethanol in E85 or other gasoline/ethanol mixtures in the exhaust gas of alternative-fuel/flex-fuel vehicles. Mass spectrometry measures ethanol by detecting the ethanol-specific ion fragments present in the exhaust gas. This mass spectrometry ethanol emissions detection method begins with collecting a sample of exhaust gas. Through ionization, the sample is used to form a plurality of charged molecule species. Afterwards, the plurality of charged molecule species are separated by means of mass spectrometry. Through these steps, the method is able to detect ethanol among the charged molecule species. Experiments on pure gasoline and E85 confirmed that mass spectrometry can single out ethanol emissions. The measured ethanol concentrations agree with results found using gas chromatography, which is very accurate but time-consuming.

Advantages

- Rapid and accurate ethanol detection in exhaust gas
- Software works with existing mass spectrometers, meaning no new or custom equipment is

255 Main Street, room NE 18-501
Cambridge, MA 02142-1601
Phone: 617-253-6966 Fax: 617-258-6790
http://tlo.mit.edu
Contact the Technology Manager: tlo-inquiries@mit.edu
required
- Free of interference from other exhaust gas component species, a common problem with photoacoustic sensors
- Eliminates the need for complex handling and time-consuming analysis necessary with gas chromatography

Categories For This Invention:
- Energy
- Biofuels (Energy)
- Hydrocarbons
- Other (Hydrocarbons)

Intellectual Property:
Detection of ethanol emission from a spark ignition engine operating on gasohols
Issued US Patent
8,589,084

Inventors:
Wai Cheng
P. Kenneth Kar

Publications:
Using Mass Spectrometry to Detect Ethanol and Acetaldehyde Emissions from a Direct Injection Spark Ignition Engine Operating on
SAE World Congress 2011. SAE Technical Paper
No. 2011-01-1159

External Links:
Sloan Automotive Laboratory
http://web.mit.edu/sloan-auto-lab/

Image Gallery: