ChevronTexaco

CRC E-65 Project Summary
Fuel Effects on Permeation Emissions

Presented to the CARB CBG4 Panel Discussion

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Mike Ingham
Co-Chair, CRC Emissions Committee

E-65 - Project Description

Objective: Measure long term resting loss permeation from fuel system components; California focus

- 10 vehicles typical of CA in-use fleet (1978-2001 MY)
- 3 CARB fuels: MTBE & ethanol at 2 wt% oxygen, and non-oxy
  - — Order of testing: MTBE, ethanol, non-oxy
- Test rigs hold fuel system components in same orientation as on vehicle
  - — Stabilize rigs at 105°F
  - — Measure permeation at 105°F, 85°F, and CA 2-day diurnal
- CARB co-funded study

E-65 - Typical Test Rigs

E-65 - Results

- For the ten vehicle fleet tested, permeation emissions increased in every vehicle when switching from the MTBE fuel to the ethanol fuel.
- For nine of the ten vehicles, permeation emissions decreased when switching from the ethanol fuel to the non-oxygenated fuel.
- Diurnal permeation emissions averaged 1.4 grams/day higher for the ethanol fuel compared to the MTBE fuel, and 1.1 grams/day higher compared to the non-oxygenated fuel; these differences are statistically significant at the 95% confidence level, while the difference in permeation between the MTBE and non-oxygenated fuels is not.
- This is equivalent to average permeation increases of 65% for the ethanol fuel compared to the MTBE fuel, and 45% compared to the non-oxygenated fuel.
- Between 85 and 105°F, steady-state permeation emissions more than doubled for all three test fuels; this is consistent with prior observations, which have shown a nominal doubling of permeation for each 10°C increase.

E-65 – Concerns Raised About Project

- The study didn't include the most modern vehicle evaporative emission control technologies.
- The study didn't address 10% ethanol blends, which are in common use outside of CA.
- The study didn't address aromatics content effects; it has been stated that aromatics "rough up" elastomer surfaces, facilitating permeation.
- The study required exposing test fuels to high temperatures for extended periods, which may have led to peroxide formation, particularly in the ethanol fuel; peroxides are known to attack elastomers.

E-65 – CRC Follow-On Study

Objectives: Extend project to include vehicle evap technologies not available at the time the original study was initiated; test 10% ethanol blend; test aromatic content effect; tie back to original project.

- 4 test vehicles: 2 from E-65 fleet (Rigs 1 & 2) plus LEV II and PZEV examples
- 4 test fuels: non-oxy, ethanol (2 & 3.5 wt% oxygen), high aromatics variant
- Testing protocols consistent with E-65

E-65 – Response to Peroxide Concern

- All three test fuels were inhibited against peroxide formation.
- If ethanol fuel had formed peroxides that damaged elastomers, we would not expect permeation emissions with the non-oxygenated fuel to return to the same level as seen with the MTBE fuel, which they did for nine of ten vehicles tested.
- Current peroxide levels in the three fuels measure:
  - MTBE 2.00 ppm, EtOH 1.00 ppm, Non-oxy 1.20 ppm
- Peroxides will also be measured after aging at 105°F