Issues in Ethanol Permeation Modeling

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August 11, 2006

Overview

- Predictive Model relies on existing EMFAC populations and activities
- EMFAC emissions numbers from in-house, contracted and EPA tests
- We use the best information available
- There are always uncertainties
- We identify where research is needed

Permeation Research Summary

- EMFAC Evaporative emissions database
  - Based on thousands of Surveillance SHED tests
- CRC E65 Study (2003-2004)
  - Fuel systems only, Permeation Only, 3 fuels
- CRC E77 Study (On-going)
  - Whole cars, 1 fuel, 120 F, 7 & 9 psi RVP, Permeation and Vapor Displacement, Tank temp and ambient temp
- EPA “Ethanol Curve” (2006)
  - Several different fuels up to E85

Inventory Issues

- High Emitter Augmentation Ratio
- Multiplicative Correction not Additive
- Resting Loss is 90% Permeation
- Correlate to Fuel Temp not Ambient Temp
- High Temperature Dependence

- Off road Ethanol Effects

High Emitter Augmentation Ratio

- No experimental data
- ARB selected 1.05
- Stakeholders proposed 1.02
- ARB reviewed comments and arguments and agrees to the figure 1.02
- We recommend research to refine or verify this number

Multiplicative Ethanol Correction

- ARB chose to use E65 data as a multiplicative correction
- Multiplicative corrections are easier to apply to emission regimes for extrapolation into future to different fleets
- Industry suggested additive correction
- Results are quite similar to additive correction approach

Fuel Temperature Correlation

- Accepted test method is based on ambient temperature, not fuel temperature. There is no existing data base for fuel temperatures.
- This makes it easier to tie to local or seasonal meteorological conditions
- Industry comment is that liquid fuel temperature (i.e. fuel tank temperature) is more appropriate for driving force
- E77 Study might shed some more light on this
- Will require major restructuring of EMFAC evaporative routines.

90% Permeation Factor

- ARB hypothesized resting loss is surrogate for permeation and resting loss is 90% permeation
- Fraction could be 80% to 100% depending on vehicle age, time of day
- E77 study should help to address this

Temperature Dependence

- EMFAC temperature performance of permeation routine is due to use of resting loss as surrogate for permeation
- Industry suggests interpolation of E65 85°F and 105°F steady state results
- E65 steady state results are relatively flat with temperature. EMFAC resting loss correlations are steep with temperature
- Methods agree over the range 60°F to 90°F.
- EMFAC method diverges high in high 90s°F. Predictive model is based on the Cal 8-h O3 DV Temp profile (65-88°F SCAB, 66-91°F Statewide average).

Offroad Ethanol Effect

- Current offroad estimates are based on diurnal tests of 5 lawnmowers
- ARB is pursuing emission testing for other offroad equipment types
- Offroad emission effect will likely not be included in this round of revision of the Predictive Model.

Conclusion

- ARB staff assessment is that the existing uncertainties are not significant enough to delay moving forward
- ARB is recommending additional research to resolve uncertainties
- Inventory working group will be looking at these in detail. We want to work with you toward the next model update.

Model RVP Sensitivity

- Present EMFAC analysis done in 1998-99.
- Diurnal: 7 psi and 9 psi RVP fuels.
- Running Loss: 400 vehicles, 6.5 to 13 psi RVP.
- LEV2 cars are assumed to have consistent response.
- LEV2 cars will not dominate fleet until 2010 or after.

ARB Response: RVP Sensitivity

- More research needed to update RVP performance.
- Permeation might be a function of RVP
- We don’t expect much room to lower evap emissions below present 7 psi.