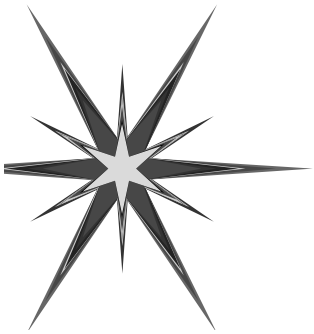

EFFECTS OF SULFUR ON EXHAUST EMISSIONS

A PROPOSAL FOR MOBILE6

Tesh Rao
EPA-Assessment and Modeling Division
Mobile6 Workshop
October 1, 1997

OBJECTIVES

- Identify valid data
- Develop correlations between sulfur and exhaust emissions as a function of pollutant type, emitter class and type of emissions
- Determine how best to incorporate effects computed from the correlations into MOBILE6
- Discuss issues and concerns

ÐATA

- ATL-Phase I
  - 20 Normal Emitters
  - 16 Higher Emitters
  - Tier0 Vehicles: Mostly 1987 and later model years
  - Two fuels in which sulfur was only variable targeted to be altered (112 & 371 ppmW)
  - Data/analysis have been peer reviewed

ÐATA, cont.

- ATL-Phase II
  - 27 Normal Emitters
  - 12 Higher Emitters
  - Tier0 Vehicles: Mostly 1986 and later model years
  - Two fuels in which sulfur was only fuel parameter significantly altered (59 & 327 ppmW)
  - Data/analysis have been peer reviewed

ÐATA, cont.

- ATL-Phase III
  - 11 Normal Emitters
  - 8 Higher Emitters
  - Tier0 Vehicles: Mostly 1987 and later model years
  - Three fuels in which sulfur was only fuel parameter significantly altered (9.3, 315, & 782 ppmW)
  - Bag data not available for start/running anlaysis

DATA, cont.

- Auto/Oil Studies
  - 10 Normal Emitters (Cleaner Tier0 vehicles)
  - No Higher Emitters
  - Sulfur varied from 11 to 466 ppmW (10 levels)
  - An “extension” fuel (S=901 ppmW) was also tested on the same vehicles (we could not access bag data, however, for this fuel)
  - All data, except “extension” fuel results, peer reviewed

ÐATA, cont.

- SAE Paper 950778
  - Older technology vehicles (Tier0 vehicles: post-1983, but pre-1990)
  - 9 normal emitters
  - 1 higher emitter
  - Three different levels of sulfur tested (61, 338, & 685 ppmW)
- SAE Paper 952510
  - Tier1 production vehicles
  - 6 normal emitters
  - Two different levels of sulfur tested (31 & 317 ppmW)

ÐATA, cont.

- Waiting for final data on effects of sulfur on emissions from advanced technology vehicles
- There are currently two different studies underway to evaluate these effects--AAMA/AIAM test program and the CRC test program--

Data Analysis

- Data will not be stratified by fuel injection system (PFI, TBI, or CARB)
- Based on construction of previous fuel emission models, it will be assumed that sulfur's effect on emissions has no interaction with other fuel parameters
- It will also be assumed that sulfur's effects are independent of emisison level within normal and higher emitter groupings

Data Analysis, cont.

- High emitters are defined as those vehicles emitting greater than or equal to twice the HC standard on base fuel on the FTP
- Start and running emissions are calculcated using the correlations developed from bag data
- Where possible, emissions data will be stratified by composite, start and running emissions

Data Analysis, cont.

- Several different methodolgies for plotting and analyzing the data were attempted
- Working in averaged g/mile space was chosen as the methodology to generate initial correlations because the effects calculated matched previous analyses the best & because of its simplicity

Data Analysis, cont.

- These correlations will be used to calculate sulfur's effect on composite, start, and running emissions by vehicle technology and by emitter class
- It was found that the form Emissions=A*ln(S)+B fit all of the data the best

INCORPORATION ISSUES

- Propose that sulfur's effects on exhaust emissions be computed based on the preceeding correlations using 339 ppmw (national average) as the baseline
- The correlations shown above will be used to calculate percent change effects only

INCOPORATION ISSUES, cont.

- Due to logisitical problems using the sulfur dial for RFG areas, we propose that the sulfur dial can only be used to compute sulfur adjustments in non-RFG areas
- If the sulfur dial is used to determine benefits of reducing sulfur in non-RFG areas, this analysis does not address the issue of compliance with A/D

INCORPORATION ISSUES, cont.

- Eventually, if MOBILE is going to be capable of estimating actual in-use impacts from sulfur changes, it should also be able to address effects of other fuel parameters as well. Currently, we do not have the requisite data to undertake this type of analysis

INCORPORATION ISSUES, cont.

- Based on the current data available, we propose the following valid ranges for using the sulfur dial in MOBILE6:
  - Tier0: 25ppmW<S<900 ppmW
  - Tier1: 30 ppmW<S<339 ppmW
- Once the data from the CRC and AAMA/AIAM testing programs become available, the accuracy and range of sulfur's effects on emissions from both Tier1 and advanced technology vehicles can be improved

INCORPORATION ISSUES, cont.

- Coordination with Tier2 study and timely arrival of LEV/advanced technology data

SPECIFIC TOPICS ON WHICH WE REQUEST COMMENTS ON

- High emitter treatment & general analysis methodology
- Limitation of the use of sulfur dial to non-RFG areas
- Compliance with anti-dumping issues
- Inclusion of the effects of all fuel parameters into MOBILE
- LEV/advanced technology data review & reaching consensus on test programs currently underway
- Additional data concerns/data availability

EFFECTS OF OXYGEN ON EXHAUST CO EMISSIONS

A PROPOSAL FOR MOBILE6

Tesh Rao
EPA-Assessment and Modeling Division

OBJECTIVES

- To develop a more accurate estimate of the effects of oxygen and oxygenates on exhaust emissions of CO
- To more accurately match model estimates to ambient CO data than the current MOBILE estimates

ANALYSIS

- Nationwide CO non-attainment problems diminishing
- We would like to keep the analysis for computing exhaust CO effects based on oxygen addition as simple as possible

POST-1987 VEHICLES

- We propose that the CO exhaust emissions model be used to predict oxygen and associated impacts on exhaust CO emissions
- This model is based on actual vehicle emissions data
- The methodology used to construct the model is very similar to that used to construct the RFG Complex Model
- This model has been reviewed and is published as SAE paper 961214

POST-1981, PRE-1987 VEHICLES

- We propose that the recently completed ARCO analysis be considered once it is peer reviewed
- The ARB database for older vehicles was used to generate a model capable of predicting CO emissions as a function of fuel parameters
- The regression methodology used to construct the final model is again similar to the Complex Model methodology
- As an alternative, the current MOBILE estimates can also be used to estimate effects from these group of vehicles

PRE-1981 VEHICLES

- Propose to use the current estimates in MOBILE5 for estimating “older technology”(pre-1981)effects
- Numbers based on 1988 analysis on effects of oxygenates on older vehicles
- The contribution of these MY vehicles to in-use emissions is quickly diminishing and the effect (however large) will not play a major role in determining overall oxygen effects on the in-use fleet

ASSUMPTIONS

- Effects computed for composite emissions can be directly applied to determine start and running emission effects
- “Typical” 2.7 weight percent MTBE and 3.5 weight percent ethanol fuels were used to compute “all fuel parameters” entries in table
- The effects at colder temperatures are the same as those computed at ambient conditions

PROPOSED PROCEDURE

- Keepcurrent options for the user input structure the same. The numbers proposed will be developed from the entries in the table, to better capture oxygen's effects on CO emissions
- Our overall proposal is to use effects calculated by the exhaust CO model for post-1987 vehicles (which are split inot two emitter categories), ARCO's analysis for 1981-1987 vehicles (as long as it is reviewed), and MOBILE5 estimates for pre-1981 vehicles

PROPOSED PROCEDURE

- MOBILE6 will internally weight the effects appropriately for the calendar year that needs to be evaluated
- For the 1990 calendar year, this methodology results in an approximate oxyfuel benefit of 14.3% for 2.7 wt% oxy blends and 16.1% for 3.5 wt% oxy blends (compared to 23% and 30% reduction estimated by MOBILE5, respectively)