

Air Quality Impacts from Ethanol Use

Presented to

Ozone Forum --- **& Technical Roundtable**

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Outline

- Ethanol Impacts on Ozone
- Impact on Control Strategies
- Low Level Blend Findings from AQMD Ethanol Forum
- Commingling Effects
- Perspective on E-85 Fuel Ethanol

Focus on 2003 Air Quality

- Highest ozone concentrations since mid 90's
- Exceptionally warm-stagnant year
- Co-mingling of ethanol and MTBE increase evaporative emissions
- Permeation adding to evaporative emissions increase
- Modeling sensitivity analyses (assuming co-mingling and permeations) suggest a 10-20 ppb potential increase in maximum ozone concentrations due to evaporative emissions enhancement

Ethanol Impact on Ozone Formation

- Different blends of ethanol have been suggested for future Basin distribution E6, E10, E85
- Chemistry Question:
 - > Implications are that increased ozone production from enhanced evaporative VOC emissions are partially offset due to reduced CO emissions for E6 – E10
- Meteorological Interference:
 - > Episode days are typically much hotter than average and evaporative emissions may increase faster and in greater totals

Impact on AQMD Control Strategies

- Federal oxygenate mandate is no longer in effect
 - > neighboring gas stations may have different blends – some with ethanol and some without
 - > potential return of co-mingling, and enhanced permeation
- Need to evaluate the impact of potential ethanol market penetration scenarios
- Nominal increases in VOC in future years may lead to ozone exceedances



Ethanol Blend Issues Addressed at June 15, 2006 AQMD Ethanol Forum

- Permeation
- Predictive Model Accuracy / Robustness
- Mitigation strategies
- CO / HC tradeoffs
- Commingling
- Certification test fuel
- Greenhouse Gas Benefits

Excess Permeation Emissions from Ethanol Use

2010, South Coast Air Basin, tpd

	Peak Summer Temperature Assumed	
	86 ° F	97 ° F
On-Road	8.7	17.4
Off-Road	11.3	22.6
Total	20	40

Predictive Model Accuracy / Robustness

- Current data set based on older vehicle and fuels data
- New data on ULEV and SULEV show complicated interaction between gasoline volatility and ethanol
- Update should ensure science is correct—model can have big effect on emissions as well as economic viability of reformulated gasoline
- 10% ethanol blends show an increase in NO_x emissions

Mitigation strategies

- ARB required by state law to ensure control measures do not increase emissions (SB 989)
 - Permeation emissions impact of the transition from Phase 2 to Phase 3 gasoline must be mitigated.
- ARB will evaluate both fuel and non-fuel strategies to mitigate emission increases
- Predictive model could provide fuel strategy if resulting reformulated gasoline is economic
- Summertime zero ethanol policy is fuel strategy but would not be favored by refining or ethanol industries
- It's not clear that fuel offset requirements alone will be sufficient.



CO / HC tradeoffs

- Suggestions that HC increases are fully offset by CO reductions if CO reactivity is adjusted as proposed by the ethanol industry.
- ARB is updating its analysis and the predictive model but do not expect for CO reactivity to significantly offset permeation increases



Commingling

- Commingling of ethanol in non-ethanol blends recognized as resulting in higher RVP and potentially higher evaporative emissions and could have been partially responsible for Basin's high ozone in 2003

E-85 Fuel Ethanol

- Very limited fueling stations at present
- Some incremental toxic and evaporative HC benefits from FFV use compared to gasoline
- Need for P-ZEV certification
- Logical longer term synergy:
 - Plug-in Hybrid FFV optimized on Renewable E-100:
 - e.g., *Saab 9-3 prototype with 30% fuel economy benefit compared to gasoline*

Conclusions

- Low level blends of ethanol create excess emissions & AQ impacts
- Essential to fully mitigate these emissions
 - *one option: zero oxygenate gasoline in summer months*
- Need to address off-road as well as on-road emissions impacts
- Role of renewable E-85 fuel ethanol expected to grow, dependent on cellulosic conversion technology (*i.e., better enzymes*)