Global Trends in Motor Vehicle Pollution Control: Future Challenges For Developing Countries

SIAT 2003
Pune, India
January 2003

Summary

- Developing Countries Have Made Great Progress
- Future Vehicle Growth Mainly in Developing Countries – Great Health Challenges
- Progress in Reducing Vehicle Emissions Has Started But Major Steps Are Needed
- Fuel Quality in Asia is Critical
  - Current Trends
  - Desulfurization Costs & Benefits
- I/M Very Important As Well

Global Trend In Motor Vehicles
California’s Standards Apply Equally To Gasoline and Diesel Vehicles

Air Quality in Los Angeles Is Greatly Improved

Heavy-duty Vehicles Emission Reduction In Europe On ETC Test Cycle

New Standards For Japanese Vehicles (October 2005)

50 PPM Sulfur Maximum by 2004
Diesel Fuel Specifications Around The World

Global Trends in On Road Motor Vehicle Emissions (Normalized to 1990)

Global Distribution of Vehicles and People

Number of Registered Vehicles in Delhi, 1971-2002
Motor Vehicle Production in China

- 1982: 500
- 1985: 1,000
- 1988: 1,500
- 1991: 2,000
- 1994: 2,500
- 1997: 3,000

2002: First Three Quarters
Domestic Made Vehicles Up 34%
Passenger Cars Up 46%

A Love Affair With The Car Is Growing!

The Vehicle Population in Asia is Unique

Increased Risk of Premature Mortality Due To 10µg/m³ PM$_{2.5}$

JAMA, March 2002

Motorcycle Annual Production and Sales

Output

Sales volume

Year


*10,000
The Vehicle Population Is Expected To Grow Rapidly

A Median Estimate is 120 million Vehicles & 200 Million Motorcycles by 2030 – Tsinghua University

New Vehicle Standards In Asia

New Vehicle Standards in Asia

Elements of a Comprehensive Vehicle Pollution Control Strategy

Clean Vehicle Technology

Appropriate Maintenance

Transportation & Land Use Planning

Clean Fuels

Clean Vehicle Technology

New Vehicle Standards in Asia

Heavy Duty Diesel Truck Standards

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Source: Mr. Iyer

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**Fuel Quality is Critical**

- Elimination of Lead in Gasoline Allows Catalyst Technology
- Very Low Sulfur Levels
  - Enhances All Catalyst Technology Performance
  - Necessary To Use Advanced Technologies
  - Other Benefits
- Other Fuel Properties Also Important

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**Ambient Pb Concentrations in Bangkok and Pb in Gasoline from 1988 - 1998**

- Premium ULG was introduced in 1991
- Regular ULG was introduced in 1993
- Complete phase out of regular leaded gasoline in 1993
- Complete phase out of premium leaded gasoline in 1995
Why Are Fuels Important?

- Fuel Constituents Directly Affect Emissions
- Fuel Changes Can Immediately Impact on Emissions/Air Quality
- Fuel Composition Can Enable/Disable Pollution Control Technology
Cost of Reducing Sulfur in Diesel Fuel in Asia (High Sulfur Grade)

Better to Do It All At Once Rather Than in Multiple Steps

New York City Retrofit Experience

Swedish Retrofit Program All Trucks Above 3.5 Tons

Very Low Sulfur Fuel Dominates The Market
Diesel Particulate Filters

Reductions:
-80 to 95% PM
-80-100% HC, CO
-80%+ toxins

Exhaust (CO₂, H₂O)
Out.

Issues to balance:
- sulfate formation
- regeneration and back pressure
- Fuel Economy

Exhaust (PM, CO, HC)
Enter

Ceramic Honeycomb
Wall

Dealing With Dirty Diesels

Clean Them Up
- ULSD
- Oxidation Catalysts
- PM Mass (25%)
- Diesel PM Filters
  - PM Mass (90+%)  
  - PM Number(90+%)  
- Certification Process
  - To Do Well

Switch To CNG
- Fuel Availability & Infrastructure
- New Engines Not. Conversions
- PM Mass
- NOₓ
- Certification Process
  - To Do Well

Bottom Line: Clean Diesels with Very Low Sulfur Fuel or CNG with OxCat Can Substantially Reduce Emissions BUT Only If Done Well

Test Type: Mass 31 or IM240 or Other

Vehicle As received

Fuel Cell - NOₓ

NDIR - CO, HC
Field grade

NDIR - CO
Field grade

NDIR - CO₂
Field grade

Emmissions Measurements: Mass - grams/mile

Fuel: As received

Test Type: Mass 31 or IM240 or Other

VMAS

31 sec
30 mph

57 mph
240 sec

MASS 31 Test Cycle: Transient, loaded mode

IM240 Test Cycle: Transient, loaded mode
Problems with Idle CO Testing

Idle CO check:

- Proper extension pipes especially for 2&3 wheeler vehicles are not used
- Chances of leakages in the system leading to inappropriately low readings
- Carburetor adjusted to pass the test

Vehicle Inspection and Maintenance (I/M) Program

- Purpose:
  - To Assure that vehicle is properly maintained and used
  - Identify Dirtiest Vehicles & Get Them Repaired

  *Centralized
  *Match Test To Technology

- General Attributes:
  - Relatively short
  - Relatively simple

- Types
  - Idle
  - 2-Stage Idle
  - Steady Speed Loaded
  - Transient Loaded

Elements of A Successful I/M Program

- Centralized Testing
- Public Awareness
- Appropriate Procedures
- Strong Enforcement
- Privatized

- Good Quality I/M
- Environment Oversight & Auditing
- Inspector Training

- Appropriate Standards & Metrics

Transportation Planning & TDM Are Critically Important

- Public Transportation Alternatives
- Land Use Planning
- Road Pricing
- Other
Conclusions

- Great Progress Has Been Made In Reducing Vehicle Emissions in OECD Countries
- Vehicle Population Growing Rapidly in Non-OECD Countries Leading To Serious Air Pollution/Health Problems
- Lack of Low Sulfur Fuels is Major Impediment To Reducing Emissions in Developing World
- ULSD with DPFs or CNG with Ox Cats Are Capable of Substantial Emissions Reductions
- I/M Critically Important

THANK YOU VERY MUCH

www.walshcarlines.com
School Bus Emissions Comparison of Conventional Diesel & 371 PPM S Fuel with CNG and Low Emissions Diesel & 14 PPM S Fuel

California Air Resources Board Study Of Oxidation Catalyst On CNG Bus

- Aldehydes Reduced by 95%
- NMHC Emissions Reduced by 88%
- 1,3 Butadiene Below Detection Limit
- Additional Reduction of PM, CO and Total HC
- Additional Reduction of Ultrafine PM

Bottom Line: Clean Diesels with Very Low Sulfur Fuel or CNG with OxCat Can Substantially Reduce Emissions BUT Only If Done Well