HEAVY DUTY VEHICLES EMISSION POLLUTION CONTROL IN CHINA

Likunsheng Beijing EPB

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2. Review of Heavy Duty Vehicles Emission Control in China
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1. Basic Information of Atmosphere in Beijing

- From 1970’s to 1990’s
  focus on PM & coal burning
- The end of 1990’s
  highlight of vehicle pollution
- Beginning of the new century
  typical combined pollution
- Control process
  TSP $\rightarrow$ PM10 $\rightarrow$ PM2.5
Concentration of SO2, NO2 and PM10 in Beijing

- Decline of SO2 is most obvious, up to 82%
- Decline rate of NO2 and PM10 achieved 23% and 38%
Percentage of PM2.5 Concentration in Beijing

- Concentration of PM2.5 drop 4% in 2014 compare with 2013
- Average concentration of PM2.5 was 85.9 μg/ M³ in 2014
Challenge of Improve Air Pollution

- Geography of Beijing
  Surrounded by mountains, not conducive to the dispersion of pollutants.
Location: 40 degrees north latitude

Low precipitation: below average 450mm for recently a decade
• The height of mixing layer is about 1,200m in Beijing. It’s more easier to form a “gray cap”
2. Review of Heavy Duty Vehicles Emission Control in China

- Above 231.6 million vehicle in China.
Vehicle emission by fuel type

Gasoline 83.5%

Diesel 15.2%

NG 1.3%
Vehicle emissions by emission standard

China 4 and above 16.0%
Below China 1 6.3%
China 1 12.9%
China 2 12.4%
China 3 52.4%
Phase out yellow label vehicles

- Phase out 6 million yellow label vehicles in 2014
- Basically eliminate yellow label vehicles in key regions by the end of 2015
- Basically eliminate yellow label vehicles in key China by the end of 2017
Stringent emission standard

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Promote clean fuels

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<th>环保指标</th>
<th>GB19147</th>
<th>GB19147</th>
<th>GB19147</th>
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<th>上海</th>
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<td>十六烷值</td>
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<td>≥49</td>
<td>≥45</td>
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<td>密度（kg/m³）</td>
<td>810-850</td>
<td>810-850</td>
<td>810-850</td>
<td>800-845</td>
<td>800-845</td>
<td>820-845</td>
<td>810-850</td>
<td>报告</td>
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<td>多环芳烃（质量分数/%）</td>
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<td>润滑性，磨斑直径（μm）</td>
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<td>≤460</td>
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<td>≤460</td>
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<td>2015.1.1</td>
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</table>
3. Review of Heavy Duty Vehicles Emission Control in Beijing

Vehicles Population in Beijing

annual growth rate as high as 15%
Proportion of Vehicles Emission pollutants in Beijing’s ambient air

- CO: 86%
- Nox: 57%
- THC: 38%
Emission Control of New Vehicles in Beijing

Beijing implements strict standards two years ahead of the national phase.

- CHINA 1 (equal Euro 1) in 1999
- CHINA 2 (equal Euro 2) in 2002
- CHINA 3 (equal Euro 3) in 2005
- CHINA 4 (equal Euro 4) in 2008
- CHINA 5 (equal Euro 5) in 2013
- Publish and implement local standard of Aqueous urea solution for euro 4 HD diesel vehicles
- Supply Adblue in gas stations, and HDV service stations
Emission test lab of Beijing EPB

- Conformity of Production and In-use Compliance test every year
- Test engine and whole vehicle emission in engine bench and PMES
Improvement of Fuel Quality in Beijing

- Implement euro2 local fuel standards in 2004
- Implement euro3 local fuel standards in 2005
- Implement euro4 local fuel standards in 2008
- Implement euro5 local fuel standards in May 2012 (Sulfur content is 10ppm in Petrol and diesel)

Make all vehicles pollutants emission reduced by 10% ~15%
# Diesel Fuel Standards in Beijing

<table>
<thead>
<tr>
<th>Item</th>
<th>Beijing Phase 2</th>
<th>Beijing Phase 3</th>
<th>Beijing Phase 4</th>
<th>Beijing Phase 5</th>
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</thead>
<tbody>
<tr>
<td>Sulfur ≤</td>
<td>500ppm</td>
<td>350ppm</td>
<td>50ppm</td>
<td>10ppm</td>
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<tr>
<td>Cetane ≥</td>
<td>49 (5#0#-10#)</td>
<td></td>
<td>51 (5#0#-10#)</td>
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<tr>
<td></td>
<td>47 (-20#)</td>
<td></td>
<td>49 (-20#)</td>
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<td></td>
<td>45 (-35#)</td>
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<td>47 (-35#)</td>
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<tr>
<td>Aromatics ≤</td>
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<td></td>
<td>11</td>
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<tr>
<td>T95°C ≤</td>
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<td>365</td>
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<tr>
<td>Density kg/m³</td>
<td>810-850 (5#0#-10#)</td>
<td>820-845 (5#0#-10#)</td>
<td>800-845 (5#0#-10#)</td>
<td>800-845 (5#0#-10#)</td>
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<tr>
<td></td>
<td>800-845 (-20#-35#)</td>
<td>800-840 (-20#-35#)</td>
<td></td>
<td>790-840 (-20#-35#)</td>
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</tbody>
</table>
Supplemental Engine’s National Test Procedure Off–Cycle Emission Standard

- High “off-cycle” NOx emissions in urban driving, because poor low temperature performance of SCR systems for China 4 and China 5.
Release 2 local standards, that supplement an additional test cycle (WHTC) for HDV engines emissions testing, and a Portable Emissions Measurement System (PEMS) test for whole vehicle.

- Limits and Measurement Methods for Exhaust Pollutants from Compression Ignition and Gas Fuelled Positive Ignition Engines of Vehicle (Bench Mode Methods)

- Limits and Measurement Method of Emissions from Heavy Duty Vehicle (PEMS Method)
- Every euro 4 and euro 5 new engine and HDV that registered in Beijing must meet local standards.

<table>
<thead>
<tr>
<th>Phase</th>
<th>WHTC</th>
<th>Limit of NOX (g/KW.h)</th>
<th>PEMS</th>
<th>WWM (Work-based Window Method)</th>
<th>NTE (Not-To-Exceed)</th>
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<tr>
<td>IV</td>
<td>3.7</td>
<td>7</td>
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<td>V</td>
<td>2.8</td>
<td>5</td>
<td>4</td>
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</table>
- About 8,000 euro 4 and euro 5 heavy diesel buses that were registered before local standards are retrofitted for meet local standard
- Organized engine manufactures to keep SCR warm up and calibrate ECU
- Reduce by 60% each bus NOx emission
Control of in Use Vehicles Emission

LUGDOWN method is used to test HDV in more than 100 dynamometer testing lines in 43 inspection stations
Establishment of Environmental Label System

- Yellow (<euro1 gasoline, <euro3 diesel), green (<euro5) and blue (euro 5) labels
- Use of electronic tags, embedded chips in 2009
- Functions: information storage and remote reading
- Vehicles without labels are illegal on the road
**Inspection and Penalties**

- Inspection sites include random roadside locations and fleet stations and entrances of city.

<table>
<thead>
<tr>
<th>Items for Inspection</th>
<th>Penalty of inspection violation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Environmental label</td>
<td>$35</td>
</tr>
<tr>
<td>Smoke emission testing</td>
<td>$50-$500</td>
</tr>
<tr>
<td>Emission control device and Record of Adblue injection</td>
<td>$800-$1500</td>
</tr>
<tr>
<td>OBD MIL and code</td>
<td>$50</td>
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</tbody>
</table>
Traffic Restriction of Yellow Label Vehicles

- Traffic restriction of yellow label vehicles began in 2003
- Forbidden to run within the 5th ring road from Jan. 1st 2009
- Forbidden to run within the 6th ring road from Oct. 1st 2009
Phase out of Aged Vehicles by Financial Incentive

- **Yellow label vehicles:**
  - from 2009 to 2010
  - $750
  - About 156,000 were retired or replaced
  - reduce 315 tons of emissions daily.
● Aged vehicles that served over 6 years (2011-2014)
  – Average $ 800
  – Over 1.4 million were retired or replaced
  – reduce 300,000 tons of emissions per year

● Aged vehicles that served over 6 years (2015- )
  – aged vehicles must be retired
  – Average $ 1,000
  – Focus on phase out HDV, up to $ 6,500 (include national policy $ 3,000)
More than 9000 heavy diesel vehicles, including buses, coaches, trucks, were retrofitted with DPF.
Off-road retrofit pilot program

- 25 off-roads are being retrofitted with DPF, include excavators, wheel loaders, compactors, etc.
Development of Electric and NG Vehicles

- Over 30,000 electric and NG vehicles in Beijing, include buses, garbage trucks, etc.
- Over 1,600 charging piles and charging stations have been constructed
Development of Public Transportation System

- 20,000 Buses
  - 90% meet euro 4 standard or above
  - New buses must meet euro 5 standard since 2011
  - 3,000 Euro 5 LNG buses in 2013

- Pilot program of 1000 Euro 6 buses will be running in 2015
Revise and Implement New Local Law

- Implement The Regulations of Beijing Municipality on Atmospheric Pollution Prevention and Control from Mar 1, 2014
- Include 8 Chapters and 130 articles
- Chapter 5 is Prevention and Control of Emission from Motor Vehicles and Off-Road Mobile Machineries:
  - Duty of Production enterprises and sellers
  - Use and maintenance of vehicles
  - Fuels of vehicle
  - Inspections
4. The next steps
Research Beijing 6 emission standards

- Engine emission standard similar to Euro 6
- Add whole vehicle emission test
- Organize a fleet and engines to do verify test
- Will be implemented about 2017
Control of in Use Vehicles Emission in Regional Areas

- Set up Beijing and Surrounding Area Vehicles Emission Control Cooperation Office, which is composed of Beijing EPB and neighboring provinces’ EPB.

- The emphasis of the Office are:
  - 20,000~30,000 heavy duty trucks that registered in neighboring provinces run into Beijing, and more than 80% emit excessive standards. They will be listed in “smoke blacklist” and fined by local EPB.
  - Inspection new vehicles in markets and conduct COP test in the regions.
Thank your attentions