Taiwan Motorcycle Emission Control Experience

By
Jeff S.C. Chuang
Environmental Protection Administration
Gov. of the R.O.C.
Subjects

• Introduction
• Previous and Current Emission Regulations
• In-Use Conformity
• Future Trend
Introduction

• Status in Taiwan
  — Population density: more than 600 persons per square km
  — GNP: USD12,300 (yr 1999)
  — Total registered motorcycles: 10,932,150 (Dec. 1999)
  — Motorcycle density: more than 300 vehicles per square km
  — Nearly every two persons own a motorcycle
Distribution Map of Motorcycles in Taiwan

unit: Total of motorcycles

Total of motorcycles in Taiwan:
10,932,150 (12/1999)
### Total Amount of Sales of Domestic Motorcycles

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>2 Stroke</td>
<td>547,003</td>
<td>549,166</td>
<td>396,970</td>
<td>370,236</td>
<td>208,595</td>
</tr>
<tr>
<td>Ratio (%)</td>
<td>58.0</td>
<td>54.2</td>
<td>46.0</td>
<td>46.1</td>
<td>35.6</td>
</tr>
<tr>
<td>4 Stroke</td>
<td>396,833</td>
<td>464,219</td>
<td>465,496</td>
<td>433,421</td>
<td>377,088</td>
</tr>
<tr>
<td>Ratio (%)</td>
<td>42.0</td>
<td>45.8</td>
<td>54.0</td>
<td>53.9</td>
<td>64.4</td>
</tr>
<tr>
<td>Total</td>
<td>943,836</td>
<td>1,013,385</td>
<td>862,466</td>
<td>803,657</td>
<td>585,683</td>
</tr>
<tr>
<td>Variation (%)</td>
<td>6.9%</td>
<td>-14.9%</td>
<td>-6.8%</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Average Driving Mileage Per Year in Comparison between 2 and 4 stroke motorcycles
Previous and Current Emission Regulations

- Process of Exhaust Emission Control
- Emission Standards for Motorcycles in Taiwan
- Technology Review in Each Phase
- Reduction Effectiveness in Last Decade
Process of Exhaust Emission Control

- New Motorcycles
- Certification
- COP
- On-line Inspection & Quality Control
- Sampling
- Recall Program
- I/M Program
- Research for Improvement of Air Pollution

To implement more stringent emission standards
## Life Cycle of Motorcycles

### Emission Standards for Motorcycles in Taiwan

Remark: Emission Standards for in-use Motorcycle CO: 4.5%, HC: 9000ppm

<table>
<thead>
<tr>
<th>Category</th>
<th>Stage</th>
<th>Effective Date</th>
<th>Type Approval</th>
<th>Idle Test</th>
</tr>
</thead>
<tbody>
<tr>
<td>All</td>
<td>1</td>
<td>1988.1.1</td>
<td>5.5, 8.8</td>
<td>None</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>1991.7.1</td>
<td>3.0, 4.5</td>
<td>ECE40</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>1998.1.1</td>
<td>2.0, 3.5</td>
<td>15,000km</td>
</tr>
<tr>
<td>2 stroke</td>
<td>4</td>
<td>2003.12.31</td>
<td>1.0, 7.0</td>
<td>ECE15</td>
</tr>
<tr>
<td>4 stroke</td>
<td></td>
<td>2.0, 7.0</td>
<td>(cold start)</td>
<td></td>
</tr>
</tbody>
</table>
mission Test driving pattern for Motorcycles (as ECE 40)
Control Room

Test Room
T:25± 5℃
H:5.5~12.2 gH2O/kg-air

Driver’s Aid

Cooling Fan

Analyzer system

Diluted

Exhaust

CFV-CVS

Roller

DC Motor

Velocity(kph)

Road load simulation

Time(sec)

File:Testequip.ppt

Environmental Protection Administration
Government of the Republic of China

Calibration Gas

Blower

Computer Cubicle

Exhaust out
Technology Review in Each Phase

Stage 1 (1988)
- Carburetor
- 6,000km durability req.
  - 2 stroke
  - Catalyst Technology + Secondary Air System
  - 4 stroke
  - Secondary Air System

Stage 2 (1991)
- 15,000km durability req.
  - (High Quality Carburetor)
  - 2 stroke
  - High Efficiency Catalyst + Secondary Air
  - 4 stroke
  - Catalyst Technology + Secondary Air

Stage 3 (1998)
CO Reduction Effectiveness in Last Decade

* These certification data must be qualified to meet Stage 2 standard from 30 June 1991 for new motorcycle types and from 1 July 1992 for all new new motorcycles.
**HC+NOx Reduction Effectiveness in Last Decade**

* These certification data must be qualified to meet Stage 2 standard from 30 June 1991 for new motorcycle types and from 1 July 1992 for all new motorcycles.
In-Use Conformity

- **Recall Programs (Driving Pattern Test on Chassis Dynamometer)**
  - Objective and Standard of Recall
  - Test Results of Recall Programs

- **I/M Programs (Idle Test)**
  - Penalties and Incentives of I/M Programs

Test Results of I/M Programs
Objective and Standard of Recall

Objective:
Properly maintained motorcycles must meet regulation standards, otherwise manufacturers must recall and repair them.

Standard of recall:
- Preliminary investigation test: Conformity test will continue if average emission from a selection of 5 motorcycles in each selected engine family can not meet emission standards, or more than 3 test data fail from each engine family.
- Conformity test: Recall must be done if average emission can not meet mission standards from 10 data measured from the same engine family.
# Test Statistics of Motorcycles in Recall Programs

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Engine Family</td>
<td>3</td>
<td>7</td>
<td>4</td>
<td>7</td>
<td>10</td>
</tr>
<tr>
<td>Quantity of Motorcycle Tests</td>
<td>16</td>
<td>36</td>
<td>20</td>
<td>35</td>
<td>50</td>
</tr>
<tr>
<td>Number of Test Failures</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>Number of Recalls</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>
Test Results of CO Emission from Recall Programs

![Chart showing average CO emission from test data (g/km) for years 1996 to 2000.](chart.png)

- **Stage 2**: Year 1996 and 1997 exceed the regulation standard. Year 1998 falls below the standard.
- **Stage 3**: Year 1999 and 2000 are within the regulation standard.
Test Results of HC+NOx Emission from Recall Programs

<table>
<thead>
<tr>
<th>Year</th>
<th>Average HC+NOx Emission from Test Data (g/km)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1996</td>
<td>Stage 2</td>
</tr>
<tr>
<td>1997</td>
<td></td>
</tr>
<tr>
<td>1998</td>
<td></td>
</tr>
<tr>
<td>1999</td>
<td>Stage 3</td>
</tr>
<tr>
<td>2000</td>
<td></td>
</tr>
</tbody>
</table>

Stage 2

Regulation Standard

Stage 3
Penalties and Incentives of I/M Programs

● Road-side Test（Idle）

To hart motorcycles for an idle test on the side of the road by 23 local environmental authorities: The government will impose a fine of NT$1,500 if the motorcycle can not meet the emission standards of I/M Programs.

● Periodical Test（Idle）

The Central Environmental authorities will inform owners to have a periodical idle test at the local test station: The government will impose a fine of NT$3,000 if owners do not follow the test information on the schedule.
Encourage people to inform EPA of high emission motorcycles

Anyone can report high emission motorcycles to the environmental authorities. The Taiwan EPA will notify the owner to take an idle test for this motorcycle at the local test station. If it can not pass the emission standards, the person who made the report can receive a bonus of NT$100.
Quantity of Motorcycle Participation in the Periodical Idle Test for I/M Programs

Year


Quantity of Motorcycle's participation at I/M Programs


~2000, 09, 30
Ratio of Participation in the Periodical Idle Test for I/M Programs in 1999
Ratio of Failure in the Periodical Idle Test for I/M Programs

1996.01.22～2000.09.30

Ratio of Failure

Age (year)

Test Results of CO Emission from Periodical I/M Programs in Taipei City

<table>
<thead>
<tr>
<th>Year</th>
<th>Test Data (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1993</td>
<td>5</td>
</tr>
<tr>
<td>1994</td>
<td>3</td>
</tr>
<tr>
<td>1995</td>
<td>4</td>
</tr>
<tr>
<td>1996</td>
<td>2</td>
</tr>
<tr>
<td>1997</td>
<td>1</td>
</tr>
<tr>
<td>1998</td>
<td>2</td>
</tr>
</tbody>
</table>

Standard: 4.5%
Test Results of HC Emission from Periodical I/M Programs in Taipei City

Average HC Emission from Test Data (ppm)

Year


Standard: 9000 ppm
### Emission Improvements for Motorcycles after adjustment to Standards in comparison with the Original from Periodical Idle Test for I/M Programs in 1999

<table>
<thead>
<tr>
<th>Motorcycle Emission</th>
<th>2 Stroke</th>
<th>4 Stroke</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>CO (%)</td>
<td>HC (ppm)</td>
</tr>
<tr>
<td></td>
<td>Original</td>
<td>Adjusted</td>
</tr>
<tr>
<td>Average</td>
<td>5.41</td>
<td>1.75</td>
</tr>
<tr>
<td>Reduction</td>
<td>67.5%</td>
<td>50.1%</td>
</tr>
<tr>
<td>Samples</td>
<td>531,126</td>
<td></td>
</tr>
</tbody>
</table>
Future Trend

- Taiwan EPA provides subsidy for purchasing low emission motorcycles, including electric scooters, fuel-injection motorcycles, etc.
  - To eliminate old motorcycles: A subsidiary payment of NT$3,000 will be given for motorcycles over seven years old.
  - To encourage purchase of electrical scooters: A subsidiary payment of NT$20,000 for the purchase of new electrical scooters has amounted to more than 20,000 up to the present time.

To encourage purchase of low emission motorcycles: Subsidiary payments have not yet been confirmed for items including EMS, fuel injection system & high efficiency catalyst technology.
Stage 4 emission standard will be implemented from 31 December 2003

- Cold start test will be adopted to simulate the normal riding condition
- To reduce 2 stroke engines: Standard of HC+NOx for 2 stroke (1 g/km) is more stringent than 4 stroke (2 g/km).

Requirements to meet emission regulations in the future:
Installation of accurate fuel metering, high conversion efficiency catalyst and low emission control strategies for motorcycles.

Emission regulations for motorcycles of displacement greater than 700cc will be stipulated in six months year after entering WTO.
Promote Periodic Inspection For Motorcycle Exhaust Emission

1. There are 1,883 stations established for motorcycles periodic inspection. Inspection station receives 80 NT Dollars (about 2.5 USD) subsidy from EPA for each motorcycle inspected. Approximately five to six million motorcycles are inspected each year, and accounts for 60% of the motorcycles registered.
Promote Periodic Inspection For Motorcycle Exhaust Emission

2. The cost of setting up a motorcycle inspection station is about 400,000 NT (about 11,430 USD) Dollars. Total cost for 1,883 motorcycle inspection stations is about 20,000,000 USD. It includes the inspection facilities, personal computer hardware/software. It also requires an area of about ten square meter and two-trained inspection operators.
Promote Periodic Inspection For Motorcycle Exhaust Emission

3. Motorcycle dealers according to the regulation can operate motorcycle inspection station. The failing motorcycles can get on site maintenance and fix to substantiate the object of improving in use motorcycle emission control.
Promote the Purchase of Electric Motorcycles and Electric Bicycles

1. A performance-based subsidy of 15,000 to 21,000 NT Dollars (430 to 600 USD) is provided for each purchase of electric motorcycle. By August 2001, EPA has subsidized 22,702 electric motorcycles. The total subsidy is about 600,000,000 NT Dollars (17,143,000 USD).

2. A subsidy of 3,000 NT Dollars (86 USD) is provided for each purchase of electric bicycle. By August 2001, EPA has subsidized 1,096 electric bicycles. The total subsidy is about 3,288,000 NT Dollars (94,000 USD).
Announce the Fourth stage Emission Standards for Motorcycle and Draft Subsidy Plan for Motorcycles with Injection Engine

1. In May 1999, EPA announced the fourth stage emission standards for motorcycle. The new emission standards shall go into effect on December 31, 2003. It is predicted that 70% of four strokes motorcycles can meet the standards based on the current technologies. However, two stokes motorcycles may be forced to stop production due to lack of technologies breakthrough.
Announce the Fourth stage Emission Standards for Motorcycle and Draft Subsidy Plan for Motorcycles with Injection Engine

2. Taiwan EPA is drafting economic incentive measures for public to purchase motorcycles. Manufacturers and importers are encouraged to offer for sale on the market motorcycles which adopt fuel injection engine, catalytic converter and comply in advance with the 50 % limits of fourth stage emission standards.