PROPOSAL FOR AN NEW REGULATION FOR VEHICLE INDOOR AIR QUALITY (VIAQ)

Jongsoon Lim
(jongsoon@ts2020.kr)
1. Background

2. Korea Case study

3. International Status

4. Conclusion
Background

◆ Consumers are increasingly concerned about indoor air quality from household, workplace and vehicle

✓ Various chemical materials are emitted from vehicle interiors
✓ VOCs and Aldehydes are included in the vehicle indoor air

◆ Chemical materials are harmful to human body

✓ Causes symptoms such as headaches, eye irritation, sneeze, and so on
✓ Such symptoms may not only affect drivers' health but also safe driving.

Discussions on vehicle indoor air quality is necessary to protect driver’s health and safe driving
## Harmful Substances & Its Effect on Human Body

<table>
<thead>
<tr>
<th>Item</th>
<th>IARC</th>
<th>Effect on Human Body</th>
</tr>
</thead>
<tbody>
<tr>
<td>Formaldehyde</td>
<td>1</td>
<td>As colorless liquid with strong stimulating smell, it causes skin infections and invades the mucosa</td>
</tr>
<tr>
<td>Benzene</td>
<td>1</td>
<td>Causes skin and eye irritation, is extremely dangerous when inhaled, and in serious cases, causes leukemia and increases the occurrence rate of lymph cancer and blood cancer</td>
</tr>
<tr>
<td>Ethyl benzene</td>
<td>2B</td>
<td>Affects internal organs, lungs, central nervous system</td>
</tr>
<tr>
<td>Styrene</td>
<td>2B</td>
<td>Stimulates eyes, skin, nose, respiratory system, causes sleepiness or unconsciousness</td>
</tr>
<tr>
<td>Toluene</td>
<td>3</td>
<td>Stimulates central nervous system, causing nausea, and abnormalities in stomach and nerve system</td>
</tr>
<tr>
<td>Xylene</td>
<td>3</td>
<td>Causes nerve stimulation, skin infection, cornea damage and so on, damages kidney and reproductive functions</td>
</tr>
</tbody>
</table>

### Carcinogenic Classification Standard of International Agency for research on Cancer

- **Group 1**: Carcinogenic to humans
- **Group 2A**: Probably carcinogenic to humans
- **Group 2B**: Possibly carcinogenic to humans
- **Group 3**: Not classifiable as to its carcinogenicity to humans
◆ Sick House Syndrome & Sick Car Syndrome: became a social issue

✓ New car driver feel a headache, eye irritation, sneeze and so on

✓ The main cause is the chemical materials that emitted from vehicle interiors

<KBS news “Hazardous substances in new car interiors”>
Interview: I feel slight headache and dizzy…
New car consumer survey

- Surveyed 800 people who purchased a new car
  - Feeling the physical symptoms under driving: 51.5%,
  - Headache 31.5%, Eyes irritation 31%, Sneeze 15.8%, Fatigue 11.1%...

Vehicle interior materials:

- SEAT
- DOOR TRIM
- CARPET
- IP
- HEADLINING
- BACK SHELF PANEL
- CONSOLE

- Formaldehyde
- Toluene
- VOCs
- Amines
- Phthalate
- PAHs

- Headache
- Dizzy
- Sneeze
- Dyspnoea
- Sleepiness
- Allergy
- Smell
The progress of rule making

◆ 2005 Research on new car Indoor Air Quality basic investigation
◆ 2006 Research on Driver Risk Assessment of new car
◆ 2007 Private and Public Conference, Public Hearing, Seminar
  ➢ Public Announcement of 「Management Guideline of Vehicle Indoor Air Quality」
◆ 2010 Checkout test on 9 new vehicle model released in 2009
◆ 2011 Checkout test on 9 new vehicle model released in 2010
◆ Establish a VIAQ guideline on harmful substances

✓ reflecting the new vehicle’s IAQ risk evaluation and the characteristics of the vehicle

✓ Vehicle’s indoor air quality measurement method

<table>
<thead>
<tr>
<th>Time</th>
<th>Temp stabilize Min. 12hr</th>
<th>Ventilation 30min</th>
<th>Close door Sealing 2hr</th>
<th>sampling 15min</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cabin Temp</td>
<td>25℃</td>
<td>25℃</td>
<td>25℃</td>
<td>25℃</td>
</tr>
</tbody>
</table>

✓ Harmful substance limit

<table>
<thead>
<tr>
<th>Item (㎍/㎥)</th>
<th>Formaldehyde</th>
<th>Benzene</th>
<th>Toluene</th>
<th>Xylene</th>
<th>Ethyl benzene</th>
<th>Styrene</th>
</tr>
</thead>
<tbody>
<tr>
<td>Limit</td>
<td>250</td>
<td>30</td>
<td>1,000</td>
<td>870</td>
<td>1,600</td>
<td>300</td>
</tr>
</tbody>
</table>
Checkout whether automobile manufactures comply with guideline

- **Car Preparation**: 14 days
- **Room Temperature Stabilizing Sampling**: 2 hours
- **Sample Analysis**: GC/MS, HPLC, Content Analysis
The result of checkout test

<table>
<thead>
<tr>
<th>Year</th>
<th>Item</th>
<th>Formaldehyde</th>
<th>Toluene</th>
<th>Ethyl benzene</th>
<th>Styrene</th>
<th>Benzene</th>
<th>Xylene</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Limit</td>
<td>250</td>
<td>1,000</td>
<td>1,600</td>
<td>300</td>
<td>30</td>
<td>870</td>
</tr>
<tr>
<td>2011</td>
<td>Avg</td>
<td>35</td>
<td>1,046</td>
<td>102</td>
<td>14</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>Min</td>
<td>8</td>
<td>108</td>
<td>20</td>
<td>7</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>Max</td>
<td>56</td>
<td>2,846</td>
<td>470</td>
<td>25</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>2012</td>
<td>Avg</td>
<td>20</td>
<td>328</td>
<td>66</td>
<td>33</td>
<td>7</td>
<td>199</td>
</tr>
<tr>
<td></td>
<td>Min</td>
<td>4</td>
<td>85</td>
<td>18</td>
<td>4</td>
<td>5</td>
<td>45</td>
</tr>
<tr>
<td></td>
<td>Max</td>
<td>29</td>
<td>753</td>
<td>131</td>
<td>136</td>
<td>13</td>
<td>379</td>
</tr>
</tbody>
</table>
International VIAQ Status

- TOYOTA (1991): VOC study
- Korea (2005): VOC study
- China (2007): VOC
- Germany (1991): Germany VOCs Report
- JAMA (2005): VOC
- China (2012): VOC Guideline
- Korea (2010): Guideline
◆ VOCs related research began since 1970

✓ **Netherlands, France, Sweden** and other countries conducted researches

✓ **Germany** conducted researches from a long time ago related to the smell suppression of new cars

• From the beginning of 1990s, research on VOSc evaluation method of a new car’s indoor space was conducted, led by **TÜV NORD** , TÜV (Technology Inspection Association)

• In TÜV Rheinland, TOXPROOF certification system on new car’s indoor air quality is operated

< Composition of TÜV NORD Vehicle Indoor air Quality Measuring System>
Japan Automobile Manufacturers Association (JAMA) leads IAQ Research

- In February 2005, led by JAMA, “Countermeasure Guidance on the Reduction of vehicle Indoor VOCs” is announced

- In March 2006, trucks and buses are added and the guideline is amended

- In case of sedans, in 2007 and in case of commercial vehicles such as trucks and buses, in 2008, new cars sold within Japan is recommended to meet the guidelines
◆ VOCs related researches began from the end of 1990s

✓ In case of CARB (California Air Resources Board), indoor air quality research result on 2 sedans, 1 SUV and 1 school bus in 1998 and 7 school buses in 2003 was announced.

✓ EPA (Environmental Protection Agency) Report on the necessity of indoor air quality research

✓ “Journal of Exposure Analysis and Environmental Epidemiology” 2003

✓ SAE Technical PAPER 2010-36-0390 “New Vehicles Cabin Indoor Air Quality”
◆ IAQ Research by China’s Indoor Decoration Association Indoor Air Reduction Center & Guangzhou Environment Inspection Center

✓ Conducted indoor air quality situation investigation on vehicles respectively (in 2007)

◆ Announcement of IAQ Regulation by Chinese Environment Protection Agency (2012)

✓ Enactment of relevant Acts of national level based on situation investigation and research results

  ▪ HJ/T 400-07 December 2007 "Determination of Volatile Organic Compounds and Carbonyl Compounds in Cabins of Vehicles"

  ▪ GB/T 27630-2011 01 March 2012 “Guideline for air quality assessment of Passenger car”

  (Newly Manufactured Vehicle Indoor Air Quality Management)

✓ Ministry of Land, Infrastructure and Transportation Notification No. 2007-539, 5 June 2007)
  “Newly Manufactured Vehicle Indoor Air Quality Management Standard”

✓ HJ/T 400-07 December 2007 "Determination of Volatile Organic Compounds and Carbonyl Compounds in Cabins of Vehicles"

✓ GB/T 27630-2011 01 March 2012 “Guideline for air quality assessment of Passenger car”
## Comparison of vehicle indoor air quality limit

<table>
<thead>
<tr>
<th>Harmful Substances</th>
<th>Korea</th>
<th>China</th>
<th>ISO</th>
</tr>
</thead>
<tbody>
<tr>
<td>Formaldehyde</td>
<td>250</td>
<td>100</td>
<td>-</td>
</tr>
<tr>
<td>Benzene</td>
<td>30</td>
<td>110</td>
<td>-</td>
</tr>
<tr>
<td>Toluene</td>
<td>1,000</td>
<td>1,100</td>
<td>-</td>
</tr>
<tr>
<td>Ethyl Benzene</td>
<td>1,600</td>
<td>1,500</td>
<td>-</td>
</tr>
<tr>
<td>Xylene</td>
<td>870</td>
<td>1,500</td>
<td>-</td>
</tr>
<tr>
<td>Styrene</td>
<td>300</td>
<td>260</td>
<td>-</td>
</tr>
<tr>
<td>Acetaldehyde</td>
<td>-</td>
<td>50</td>
<td>-</td>
</tr>
<tr>
<td>Acrolein</td>
<td>-</td>
<td>50</td>
<td>-</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>6 types</td>
<td>8 types</td>
<td>-</td>
</tr>
</tbody>
</table>
## Management status of manufacturers

<table>
<thead>
<tr>
<th>Manufacturers</th>
<th>Management Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>GM</td>
<td>VOC management based on GM standard</td>
</tr>
<tr>
<td>FORD</td>
<td>VOC management based on FORD standard</td>
</tr>
<tr>
<td>VOLVO</td>
<td>Management based on Chinese regulations</td>
</tr>
<tr>
<td>Nissan, Honda, Toyota</td>
<td>Management based on Japanese Automobile Manufacturers Association (JAMA) guideline</td>
</tr>
<tr>
<td>Porsche</td>
<td>Management based on German Automobile Industrial Association VDA 270 (smell test), VDA 275 (measurement of formaldehyde emission), VDA 278 (volatile organic compound) regulations</td>
</tr>
<tr>
<td>Jaguar Land-rover</td>
<td>Applies Japanese and Chinese regulations</td>
</tr>
<tr>
<td>Hyundai, Kia</td>
<td>Management based on Korean regulations</td>
</tr>
</tbody>
</table>
To protect driver and passenger’s health and safe driving, discussions are needed for Vehicle indoor air quality.

Need for discussion on a unified standard before more standards per country are enacted.

New regulation proposal on vehicle’s indoor air quality:

- Harmful substance permissible limit emitted from vehicle’s interior materials
- Vehicle’s indoor air quality measurement method
Thank you

Senior Researcher
Jongson Lim
jongsoo@ts2020.kr

Chief Researcher
Hyunwoo Lee
peterlee@ts2020.kr