Air Pollution Control Measures in Korea

Chul-Whan CHA*

Through the pursuit of the materialistic life which has resulted from technological advances, the sources of air pollution have multiplied and diversified. The three sources that have most accelerated air pollution are over population, rapid urbanization and industrialization.

The SO₂ and TSP levels of the larger cities were slightly over the environmental standard but the states of CO, HC and NOₓ pollution remain beneath the standard indicated.

Countermeasures were taken to correct these problems and they can be summarized in the following three steps:

The first step taken to decrease the SO₂ concentration was to recommend the transfer of the use of coal briquets to the cleaner oil fuels as well as providing low sulfur oils through the installation of desulfurization facilities and expanding the LNG supply within the Seoul metropolitan area. The transfer is not yet complete but the government now provides low sulfur fuels to the Seoul community.

The second step taken was the reduction of dust particles through stricter supervision and the incentive of financial support for dust control facilities from the government.

The third and last step was the reduction of oxidants through the installation of catalytic converters and the resultant use of unleaded gas with these converters in all automobiles produced since January 1988. Such as the already existant problems of acid rain and asbestos as well as the future problems of heavy metals in the air and the depletion of the ozone layer.

However, many air pollution problems still exist. To cope with all of these problems we must have international as well as national cooperation for technological development and information.

1. Rise of air pollution issue

It is evident that coal has been a major source of air pollution in the western society since the era of the industrial revolution. Since then, as we all know, the sources of air pollution have multiplied as a result of pursuit for convenience in life which was enabled by technological advancement.

However, the diverse air pollution sources can be said to have arisen from three primary sources: population growth, urbanization, and industrialization.

In Korea, from the 1960’s, steady population growth has been remarkable combined with rapid industrialization and urbanization. Therefore, it is generally accepted that the air quality in Korea has significantly deteriorated since the 1960’s.

1.1 Population growth and urbanization

The population density of Korea in 1988 was 429 persons/km² ranking fourth in the world following Bangladesh (702 persons), Bahrain (692 persons) and Taiwan (459 persons)

However, it becomes the first in the world when only inhabitable area is considered.

The high population density creates problems not only in housing, provision of food, employment, etc. but also in protection of air quality.

The trends of population growth and urbanization in Korea are shown in Table 1[13].

Korea’s population growth rate has decreased steadily since 1970’s due to the continuation of country-wide efforts of the family planning and population policy. The urbanization rate, however, may reach about 81% in 2000 as seen in developed countries[4].

Similar to Japan (76%), the U.S. (74%), the U.K. (78%), Germany (75%), and Belgium (87%), past urbanization phenomena in the ESCAP region may be understood as the results of pushout forces in rural areas of low income and cultural levels rather than pull-into forces of cities due to industrialization.

In particular, the population growth trends and population densities of Seoul, Pusan, and Daegu summarized in Table 2[5] show an inevitable rise of environmental problems.

1.2 Industrialization

In the industrial structure 1964, agriculture,
Table 1. Population growth and urban population

<table>
<thead>
<tr>
<th></th>
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</tr>
</thead>
<tbody>
<tr>
<td>Total population</td>
<td>24,989</td>
<td>31,435</td>
<td>38,124</td>
<td>41,056</td>
</tr>
<tr>
<td>Urban population</td>
<td>9,784</td>
<td>15,749</td>
<td>26,191</td>
<td>30,381</td>
</tr>
<tr>
<td>Rural population</td>
<td>15,205</td>
<td>15,686</td>
<td>11,933</td>
<td>10,675</td>
</tr>
<tr>
<td>Urban population rate</td>
<td>39.2</td>
<td>50.1</td>
<td>68.7</td>
<td>74.0</td>
</tr>
</tbody>
</table>

Urban population: Population in cities (population of 50,000 or more) and towns (population of 20,000 or more).

Table 2. Trends of population growth and population densities of 3 largest cities

<table>
<thead>
<tr>
<th>Year</th>
<th>Seoul</th>
<th>Busan</th>
<th>Daegu</th>
</tr>
</thead>
<tbody>
<tr>
<td>1963</td>
<td>Population (1,000 persons)</td>
<td>3,255</td>
<td>1,360</td>
</tr>
<tr>
<td>Density (persons/km²)</td>
<td>5,309</td>
<td>3,777</td>
<td>3,943</td>
</tr>
<tr>
<td>1985</td>
<td>Population (1,000 persons)</td>
<td>9,646</td>
<td>3,517</td>
</tr>
<tr>
<td>Density (persons/km²)</td>
<td>15,736</td>
<td>8,098</td>
<td>4,463</td>
</tr>
</tbody>
</table>

Table 3. Trends of industrial structure

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Agro-forestry &amp; fisheries</td>
<td>39.7</td>
<td>39.1</td>
<td>34.9</td>
<td>27.0</td>
<td>23.5</td>
<td>15.8</td>
<td>13.7</td>
</tr>
<tr>
<td>Mining &amp; manufacturing</td>
<td>12.7</td>
<td>15.5</td>
<td>20.5</td>
<td>22.3</td>
<td>28.4</td>
<td>29.5</td>
<td>28.9</td>
</tr>
<tr>
<td>(Manufacturing only)</td>
<td>(11.8)</td>
<td>(13.6)</td>
<td>(18.6)</td>
<td>(21.0)</td>
<td>(27.2)</td>
<td>(28.0)</td>
<td>(27.5)</td>
</tr>
<tr>
<td>Social indirect capital &amp; other services</td>
<td>47.6</td>
<td>45.4</td>
<td>44.6</td>
<td>50.7</td>
<td>48.1</td>
<td>54.7</td>
<td>57.4</td>
</tr>
<tr>
<td>Social indirect capital</td>
<td>5.3</td>
<td>9.2</td>
<td>10.3</td>
<td>13.3</td>
<td>11.9</td>
<td>17.4</td>
<td>19.0</td>
</tr>
<tr>
<td>Other services</td>
<td>42.3</td>
<td>36.2</td>
<td>34.3</td>
<td>37.4</td>
<td>36.2</td>
<td>37.3</td>
<td>38.4</td>
</tr>
<tr>
<td>Total products</td>
<td>100.0</td>
<td>100.0</td>
<td>100.0</td>
<td>100.0</td>
<td>100.0</td>
<td>100.0</td>
<td>100.0</td>
</tr>
</tbody>
</table>

foresty and fishery shared 46.8%, social indirect capital and others 35.8%, mining and manufacturing only 17.3% of GNP. The gross national product (GNP) in 1964 was US$2.87 billion.

In 1987, two decades after 1964 the GNP became US$118.6 billion and industrial structure changed significantly: Social indirect capital and others covered 56.6%, mining and manufacturing 29.9%, agriculture, forestry and fishery only 13.6%, which tells that the nations has achieved a big economic growth and the secondary industry has grown rapidly.

The acceleration of the second industries has led to its overtaking the size of the first industries since the mid-1970's, as shown in Table 3(6).

However, as shown in Table 4(7), comparative statistics on industrial structure show that Korea's first industry percentage is still much higher in domestic income than those of other countries, which signifies that there is room for expansion of the secondary industry that will be accompanied by even more pollution.

Here, I would like to analyze some of the industries that are important with regards to air pollution.

1.2.1 Energy industry

(1) Power generation

The size of the power generation facilities in Korea has expanded rapidly since 1962 with the 5-year power source development plan. The power generation capacity has increased 42 times between 1962 and 1986, i.e., from the capacity of 434 MW to that of 18,060 MW (Table 5)(8,9).

Of the 18,060 MW in 1986, thermal power shared 61% and water power 12%, which, in 1962, was 57% and 33%, respectively. Increasing
dependency on thermal power generation signifies the potential of a power generation sector of concentrated air pollution because of the fossil fuel that is burned in thermal power generation.

(2) Petroleum and coal

Besides the use of petroleum as a source for power generation, it is also widely employed for other uses. Table 6 shows the uses of petroleum for power generation and other purposes.

Petroleum is used not only as raw material for chemical products but also as a heating fuel for industrial complexes, production facilities, apartments, and large buildings.

Korea imports all of its petroleum from other

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**Table 4. Comparison of industrial structures (1981)**

<table>
<thead>
<tr>
<th>Country</th>
<th>Employment 1st</th>
<th>Employment 2nd</th>
<th>Employment 3rd</th>
<th>Domestic income 1st</th>
<th>Domestic income 2nd</th>
<th>Domestic income 3rd</th>
<th>Comparative productivity 1st</th>
<th>Comparative productivity 2nd</th>
<th>Comparative productivity 3rd</th>
</tr>
</thead>
<tbody>
<tr>
<td>Korea</td>
<td>29.7</td>
<td>23.3</td>
<td>47.0</td>
<td>13.7</td>
<td>28.9</td>
<td>57.4</td>
<td>0.461</td>
<td>1.240</td>
<td>1.221</td>
</tr>
<tr>
<td>Japan</td>
<td>10.0</td>
<td>34.7</td>
<td>55.3</td>
<td>3.3</td>
<td>38.4</td>
<td>58.4</td>
<td>0.330</td>
<td>1.107</td>
<td>1.056</td>
</tr>
<tr>
<td>U.S.A.</td>
<td>3.5</td>
<td>28.9</td>
<td>67.6</td>
<td>2.9</td>
<td>31.3</td>
<td>65.8</td>
<td>0.0829</td>
<td>1.083</td>
<td>0.973</td>
</tr>
<tr>
<td>U.K.</td>
<td>1.7</td>
<td>35.4</td>
<td>62.9</td>
<td>1.9</td>
<td>38.3</td>
<td>59.8</td>
<td>1.118</td>
<td>1.092</td>
<td>0.951</td>
</tr>
<tr>
<td>W/Germany</td>
<td>5.2</td>
<td>45.0</td>
<td>49.8</td>
<td>2.2</td>
<td>43.8</td>
<td>54.0</td>
<td>0.423</td>
<td>0.973</td>
<td>1.084</td>
</tr>
<tr>
<td>France</td>
<td>8.6</td>
<td>34.3</td>
<td>57.1</td>
<td>4.0</td>
<td>36.5</td>
<td>59.5</td>
<td>0.465</td>
<td>1.064</td>
<td>1.042</td>
</tr>
<tr>
<td>Italy</td>
<td>13.3</td>
<td>37.4</td>
<td>49.3</td>
<td>5.9</td>
<td>40.6</td>
<td>53.5</td>
<td>0.444</td>
<td>1.086</td>
<td>1.085</td>
</tr>
</tbody>
</table>

**Table 5. Increase of power generation capacity**

<table>
<thead>
<tr>
<th>Year</th>
<th>Total</th>
<th>Hydro power</th>
<th>Thermal power</th>
<th>Atomic power</th>
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</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Capacity</td>
<td>%</td>
<td>Capacity</td>
</tr>
<tr>
<td>1962</td>
<td>434</td>
<td>143</td>
<td>33.1</td>
<td>201</td>
</tr>
<tr>
<td>1972</td>
<td>3,871</td>
<td>341</td>
<td>8.8</td>
<td>3,530</td>
</tr>
<tr>
<td>1982</td>
<td>10,304</td>
<td>1,202</td>
<td>11.7</td>
<td>7,836</td>
</tr>
<tr>
<td>1986</td>
<td>18,060</td>
<td>2,224</td>
<td>12.3</td>
<td>11,070</td>
</tr>
</tbody>
</table>

* The numericals in parentheses are percentage.

**Table 6. Requirement of petroleum by use**

<table>
<thead>
<tr>
<th>Year</th>
<th>For power generation</th>
<th>For non-power generation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1964</td>
<td>1,095 (14.7)</td>
<td>6,373 (85.3)</td>
</tr>
<tr>
<td>1968</td>
<td>7,143 (19.1)</td>
<td>30,233 (80.9)</td>
</tr>
<tr>
<td>1972</td>
<td>15,493 (19.4)</td>
<td>64,397 (80.6)</td>
</tr>
<tr>
<td>1976</td>
<td>31,344 (26.2)</td>
<td>88,366 (73.8)</td>
</tr>
<tr>
<td>1980</td>
<td>44,593 (24.3)</td>
<td>138,905 (75.7)</td>
</tr>
<tr>
<td>1984</td>
<td>38,452 (19.8)</td>
<td>156,107 (80.2)</td>
</tr>
</tbody>
</table>

**Table 7. Major energy index**

<table>
<thead>
<tr>
<th>Year</th>
<th>Coal</th>
<th>Petroleum</th>
<th>Hydroelectric atomic</th>
<th>Firewood &amp; charcoal</th>
<th>Total energy consumption (in 1,000 TOE)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1964</td>
<td>43.7</td>
<td>9.6</td>
<td>1.6</td>
<td>45.1</td>
<td>11,487</td>
</tr>
<tr>
<td>1968</td>
<td>34.2</td>
<td>34.8</td>
<td>1.5</td>
<td>29.5</td>
<td>15,823</td>
</tr>
<tr>
<td>1972</td>
<td>27.0</td>
<td>53.5</td>
<td>1.2</td>
<td>17.9</td>
<td>22,307</td>
</tr>
<tr>
<td>1976</td>
<td>29.3</td>
<td>58.8</td>
<td>1.5</td>
<td>10.5</td>
<td>30,306</td>
</tr>
<tr>
<td>1980</td>
<td>29.9</td>
<td>61.3</td>
<td>3.1</td>
<td>5.7</td>
<td>44,115</td>
</tr>
<tr>
<td>1984</td>
<td>36.8</td>
<td>52.3</td>
<td>6.6</td>
<td>4.3</td>
<td>53,850</td>
</tr>
</tbody>
</table>
countries. In 1984, 46% was imported from middle east countries such as Saudi Arabia, a decline from 1980, when 90% was imported from this area. In the absence of desulfurization facilities importation of low quality oil containing high sulfur inevitably caused deterioration of air quality.

Coal covers more than 30% of Korea’s energy demand (Table 7). Most coal has been used for the production of briquets which were made of anthracite (smokeless coal). However, recently, the use of bituminous coal has been increasing, which is another source of air pollution.

In reviewing the energy sector in view of air pollution attention should be paid to the fact that in industries, overconsumption of energy and the rate of energy loss is high. Korea has achieved a high economic growth in the 1970’s maintaining 9% or more of an annual average rate. As there is a relatively high correlation between the energy consumption of a nation to its economic growth, the rapid increase of oil consumption can be explained by the parallel growth of the economy.

The rate of energy loss is high because many power supply facilities of industries in Korea are old or outdated. According to the report of a survey done between 1978 and 1979, the mean energy loss rate was 21.5% within total industries, 31.6% in metal industry, 30.5% in paper industry, and 23.6% in textile industry. The data is based on a survey of 806 massive energy-consumption establishments, which covered 74.2% of the total energy consumption of industries.

In the case of 230 large buildings and apartments, the average energy loss rate was 41.4%, which reveals that most of the heating facilities were old or outdated.

1.2.2 Petrochemical and basic chemical industries

The petrochemical industry in Korea started developing fullscale since 1962 with the operation of the Ulsan Petrochemical Industry Complex. The Yeochon Petrochemical Complex was completed in 1979. Fuel for heating has been provided with LPG and waste oil which are the by-products of production lines. Natural gas, naphtha, etc. are used as raw materials.
As the petrochemical industry is centralized, each plant of a line system assembled in a certain area within the grounds. Thus, the possibility of concentrated pollution is high and the damage may be great in cases of accidents or malfunctions.

1.2.3 Cement and glass industry

Korea has already secured its position as one of the world’s leading producers of cement in 1970s by virtue of the broad increase in domestic demands and exports along with the industrialization process of cement production.

Air pollution caused by cement industry arises from particulates and noise generated in the process of crushing raw materials. Sulfur contents can be satisfactorily removed by chemical reaction in dry-clean and the plasticity process, and the particulates also can be completely removed by bag filters, cyclones and electrostatic precipitaters. However, considerable amounts from processes where pollution control measures can not be applied or from sites of open air storage.

Glass industry is consuming energy massively. Air pollution from the glass industry is caused by the combustion of bunker-C oil in melting furnaces.

1.2.4 Automobile industry

The automobile industry is a technology-intensive interdisciplinary industry. Recently, this industry has been developed rapidly enough to export automobile even to U.S.

There were not more than 30 thousand automobiles in Korea in 1960. However, that number is now said to be over 2 million and is expected to increase rapidly. Automobile industry causes various environmental problems because of the processes involved in many parts of the production. Furthermore, automobiles themselves are pollution sources of exhaust gas, noise, etc.

2. The State of Air Pollution

The Ministry of Environment Administration is operating 42 automatic and 193 semi-automatic monitoring stations nationwide in order to monitor the level of air pollution. Within these monitoring networks sulfur dioxide (SO₂), total suspended particles (TSP), carbon monoxide (CO), hydrocarbon (HC), and nitrogen oxides (NOx) are measured. So far, the states of CO, HC, and NOx pollution are not so severe as to be problematic. The states of SO₂, TSP and Oxidants are shown in Figures 1.2) and Tables 8.a, 13').

In the case of SO₂, 1,160 thousand metric tons were estimated to have been emitted into the environment in 1986. Among the sources of SO₂ emission, heating and transportation account for about a half, industry about 30%, and power generation about 20%.

The source of particulates emission is very diverse: dust from stripped sites or roads, open coal storage sites, and smoke from the chimneys of production facilities and others.

In Korea, the numbers of gasoline-powered vehicles and diesel-powered vehicles are about the same. The oxidant problem occurs mainly from the gasoline powered vehicles. The average daily driving mileage of a taxi and bus in Korea is 310 km and 338 km respectively, which is about double of their U.S. and Japanese counterparts. Until June 1987, the average emission rate of Koreamade automobiles in Korea was 7 to 9 times as much as that of U.S. or Japanese made automobiles.

Therefore, these two factors are the main reasons
of the significant air pollution from motor-vehicles even though the number of these automobiles is few.

3. Countermeasures for Air Pollution

3.1 Measures to decrease $SO_2$ concentration

Major sources of $SO_2$ emission are coal briquets burned for home heating and bunker-C oil for large apartment buildings, industries, and power generation.

The emission of $SO_2$ from burning of coal briquets accounts for about 60% of the total $SO_2$ emission. However, at present, it is not easy to adopt proper measures to reduce the $SO_2$ emission from the burning of coal briquets because yeontan is a major heating source for the common people. The drastic transfer of coal briquets to some other less pollutive heating source is difficult unless there is a considerable price decrease of other fuels. At present, the Ministry of Environment Administration is stressing public relation programs for common people to increase environmental awareness, thereby prompting the voluntary transfer of coal briquets to other cleaner fuels. In fact, in spite of price advantage, the burning of coal briquets involves considerable dangers in daily life because of the indoor accumulation of carbon monoxide, which causes death by inhalation.

The focus of public relations is to inform the public that the harm outweighs the benefits of low cost heating, thereby making those relatively better-off aware that a change to some other fuel is desirable.

Most imported oil contains high sulfur concentrations. Until 1980, for example, bunker-C oil contained 4% sulfur.

In 1981, bunker-C oil with 0.3% of sulfur was imported for the first time and used by the Seoul Power Plant located in Seoul. With the expanded provision of 1.6% sulfur bunker-C oil to large combustion facilities in the Seoul area, the $SO_2$ concentration of 0.094 ppm in Seoul in 1980 was lowered to 0.057 ppm in 1982.

From 1982, the provision of low sulfur oils was expanded to other areas such as the satellite cities around Seoul and other cities with industrial complexes. These low sulfur oils contain 1.6% sulfur for bunker-C oil (previously 4%) and 0.4% for diesel fuel (previously 1%).

At present, these low sulfur oils are provided to 19 large cities and 10 counties, these countries usually surrounding the large cities. However, calling these oils “low sulfur” may not be quite accurate since 0.3 to 0.8% sulfur oils are used in other countries such as the U.S. and Japan.

Therefore, as a basic measure, the installation of desulfurization facilities is being pursued and its schedule is shown in the Table 9.

By virtue of this measure, low sulfur oil can be provided through the whole country from 1990, thereby reducing the $SO_2$ concentration considerably.

As another measure to reduce sulfur dioxide concentration is the Seoul Metropolitan area, clean energy such as liquefied natural gas (LNG) is being supplied. Korea has imported 2 million tons of LNG a year from Indonesia since 1987. Imported LNG is processed in Pyungtack, located about 80 km South from the Seoul downtown area, and is brought to Seoul and its vicinity areas by pipeline.

Large buildings of more than 6,600 m² are the first target for LNG use. It was recommended in 1987 that these buildings use LNG, replacing bunker-C oil. However, it became obligatory for these buildings from the September of 1988, just before the 1988 Seoul Olympic Games. Thus, it reduced $SO_2$ concentration considerably.

The Ministry of Environment is also planning to adopt a measure to adjust the LNG price in order to promote replacing coal briquets by LNG and recommend large-scale apartment complexes to substitute a LNG burning system for the existing bunker-C oil burning system, thereby lowering $SO_2$ concentration step by step.

3.2 Measures for Particulates

The particulate problem in Korea is aggravated by many construction work. There are many other sources of particulates, such as unpaved roads, stripped sites, open storage site for coal, land-fill sites for solid wastes, and individual houses.

As measures to reduce particulates concentration, installation and normal operation of dust
collection equipments are being promoted through the enhanced supervision of particulate emission facilities. Efforts are being pursued to change the average citizen must be aware of how important particulates emission reduce.

There are some favorable incentives given to install dust collection equipments. Special depreciation, exclusion from some tax assessment targets, and long-term low interest loans have proved to be effective.

Attempts are being made to reduce the amount of particulates from stripped sites by means of flowering plants such as cosmos, gross lawns, and, in some cases, even cultivation. In addition, dust on roads downtown or on main streets are to be absorbed by vaccum refuse carts or cleaned by water.

In order to reduce dust from open coal storage sites, and large-scale construction work sites, the Ministry of Environment has created a standard for the facilities created to prevent flying particulate sources. According to the standard, it is required that tents, walls, or roofs be installed over the open coal storage sites, and trucks and other heavy vehicles should be washed off before going out of the construction-work sites.

3.3 Measures for oxidants

Oxidants, which cause photochemical smog result from the chemical reaction of nitrogen oxides and hydrocarbons catalyzed by ultraviolet rays. The oxidant problem is not so serious as it is in western countries yet because there are not as many motor vehicles.

In a few areas, the oxidant concentration goes up higher than 0.1 ppm, the ambient environment threshold limit for oxidants. An oxidant concentration of higher than 0.1 ppm has been observed in only a few places like Kwanghwamun, a spot in Seoul downtown where traffic volume is extremely dense, and this is once in a while. It is well known that in Los Angeles where the number of motor vehicles are great with many sunny days, photochemical smog situation is the worst in the world in spite of the fact that it has the tightest motor vehicles emission standards in the world. In the case of Tokyo, Japan, oxidants warnings were issued as many as 43 times in 1973.

As explained before, the number of motor vehicles is about two million, of which about a half are gasoline-powered motor vehicles. The daily driving mileage in Korea is about 47 km, which is about double of those in other countries. In addition to this long daily driving mileage, the emission standards are looser than those of the U.S. and Japan by 7 to 8 times. Furthermore, automobile ownership is presently increasing at an enormous rate. All of these facts combined say that there may be a serious photochemical smog problem in the near future.

To cope with this oxidant problem, less-pollutive motor vehicles were produced and sold from July in 1987. Since July 1987, catalytic converters were installed first to small cars and to medium-sized automobile. Since January 1988 catalytic converters have been installed to every automobile on the production line15,16).

Emission standards for automobiles with catalytic converters are about the same as that of the U.S. federal emission standards.

To make catalytic converters work normally, the provision of unleaded gasoline is indispensable. Therefore unleaded gasoline should be provided by all gasoline stations. Thanks to the full cooperation of oil refinery firms and gasoline stations, 1,800 gasoline stations, 70% of nation’s total of 2,600, have dealt with unleaded gasoline since July 1, 1987, and, at present, the rate is approximately more than 90%. Therefore, the difficulty of using unleaded gas was over estimated, there have been no problems in other countries even at the beginning of the implementation of the program.

Some noticeable measures were also taken to prevent filling leaded gasoline to motor vehicles made for unlead gasoline. Among others, the price of unleaded gasoline is the same as that of leaded gasoline. The inlets for unleaded gasoline are narrower than those for leaded. Again injection guns for unleaded gasoline are made to be different from those for leaded gasoline, and unleaded gasoline is colored yellow.

Lastly tax incentives were prepared to facilitate the sale of motor vehicles with catalytic converters.

We believe that the policy and various measures adopted to promote less-pollutive motor vehicles are a very successful example to developing countries.

However, there are still problems related with exhaust gas of motor vehicles, i.e. problems related with exhaust gas from existing leaded gasoline and problems from diesel-powered motor vehicles.

To reduce pollution from existing leaded gasoline-powered motor vehicles, thorough maintenance and good driving habits are indispensable. Therefore, small task forces for checking exhaust gas levels were formed and are active in many cities. Similarly, promotion of public relations to
increase environmental awareness has also kept pace with the regulation measures.

Until today, there was no practical technology to reduce exhaust gas emission from diesel-powered vehicles. In Korea, however, there have been some studies with regards to this problem and the revision of urban traffic means are being considered.

4. Concluding Remarks

So far some of the most important air pollution problems have been evaluated. However, many air pollution problems still remain.

The problems of acid rain and asbestos are those we have already faced. The problems of heavy metals in the air and depletion of ozone layer are expected to be problems of the near future.

To cope with all of these problems, we have to take joint-measures for technological development and exchange technological information through international cooperation. Both of these would be of great value. It is because the characteristics of pollution are similar in nature, and also because it is efficient to mobilize every possible source of modern scientific knowledge.

It should be kept in mind that as far as environmental conservation is concerned, man-kind has a common fate, because there is "only one earth."

References

14) NIER: Seminar on Major Themes and Measures for Air Quality Improvement in Korea, 72 (1988).