Philippine Engineering Journal (2000) XXI (2): 1-13

A STUDY ON THE STATE OF THE TRANSPORTATION ENVIRONMENT IN METRO MANILA

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ABSTRACT

In the 1990's, the degradation of the atmospheric environment specifically air pollution brought about by the rapid increase in motor vehicle traffic, as reflected by the rapid increase in vehicle registration in 1988-1999, had become a major concern in Metro Manila, where a number of local and foreign agencies had conducted air pollution monitoring studies. The objectives of this paper are to determine conditions and trends in the transportation environment, that is, the micro-environment of roads in Metro Manila and review urban and transportation policies of the government pertaining to the improvement of the transportation environment.

These studies have conducted that total suspended particulates or particulate matter, followed to some degree, by nitrogen oxides and carbon monoxide, are the key air pollutants attributed to motor vehicle traffic. Other pollutants such as sulfur oxides, total organic gases and lead are still below critical levels.

The National Urban Policy Agenda of the NEDA deals on policies for the improvement of the urban environment and the transportation environment of Metro Manila through the urban environment management and Metro Manila policy modules, respectively. Transportation policies through the DOTC deals on emission standards and inspection of motor vehicles through the Clean Air Act of 1999.

I. INTRODUCTION

The over-concentration of economic activities in Metro Manila accompanied by the continuing rapid motorization have contributed to increased traffic demand. The continuing increase of motor vehicles (more than 1 million registered vehicles in Metro Manila in the year 1999) and the slow catch-up of infrastructure provision through the construction of urban arterial roads, urban expressways and rail-based mass transit systems have caused continued congestion in Metro Manila's major arterial roads as well as the metropolitan segments of the intercity expressways. Aside from the prohibition of the use of leaded gasoline in April 2000, there have been no other significant controls on emissions either through stricter vehicle inspection or apprehension of all smoke-belching motor vehicles (including tricycles). These have continued to contribute to the deterioration of the atmospheric environment specifically

the transportation environment where established ambient air standards had been exceeded by relatively high concentration levels of suspended particulate matter (SPM) and total suspended particulates (TSP) which are mostly attributed to poorly-maintained diesel-engine vehicles. A study conducted by the Asian Development Bank in 1992 forecasted that assuming there is no implementation of additional controls on vehicular emission, pollution load from vehicles in 1990 will at least double by the year 2050.

The paper seeks to determine the conditions and trends in the transportation environment, that is, the micro-environment of roads in Metro Manila. In particular, this paper aims to:

a) review related studies on the transportation environment conducted by various agencies and organizations;
b) demonstrate the trends of concentration of major air pollutants in the transport environment;
c) review the urban and transportation policies of the government pertaining to the transportation environment.

II. REVIEW OF STUDIES ON AIR POLLUTION IN METRO MANILA

This section summarizes the air pollution monitoring and assessment studies and research conducted in Metro Manila from 1990 to 1999. The following institutions and projects are the major sources:

- Environmental Management Bureau (EMB), Department of Environment and Natural Resources (DENR)
- Asian Development Bank (ADB) – Vehicular Emission Control Planning (VECP)
- World Bank (WB) – Urban Air Quality Management Strategy in Asia (URBAIR)
- Japan International Cooperation Agency (JICA)– Metro Manila Urban Transportation Integration Study (MMUTIS)
- National Center for Transportation Studies (NCTS), University of the Philippines (UP)
- Japan Society for the Promotion of Science (JSPS) – Impact Analysis of Metropolitan Policies on Development and Environmental Conservation in the Philippines

2.1 Air Pollution Emission Inventory for Metro Manila 1990

In 1990, the Environmental Management Bureau (EMB) in collaboration with the United Nations Development Programme (UNDP), conducted an emissions inventory project titled "Air Pollution Emission Inventory for Metro Manila 1990". This study provides information on sources and quantities of 6 criteria air pollutants emitted from motor vehicles, stationary sources and area sources in Metro Manila for the year 1990. The 1990 inventory is focused on the refinement of the 1987 emission estimates and improvement of methodologies for calculating the emissions. The 6 criteria pollutants are: total organic gases (TOG), carbon monoxide (CO), oxides of nitrogen (NO_x), oxides of sulfur (SO_x), particulate matter (PM), and particulate matter that is 10 μm or less (PM_{10}). The inventory also included 5 toxic air contaminants such as lead, benzene, ethylene dibromide (EDB), ethylene dichloride (EDC) and asbestos.

2.2 Vehicular Emission Control Planning in Metro Manila – Asian Development Bank

In 1992, Asian Development Bank (ADB)-funded study on "Vehicular Emission Control Planning in Metro Manila" was completed and submitted to the ADB and the Environmental Management Bureau of the Department of Environment and Natural Resources (EMB-DENR) by the consultants, Engineering Science, Inc. and Basic Technology and Management Corporation, with contributions from experts abroad and the Philippines. The objective of the study was to characterize the Metro Manila air pollution problems in quantitative terms such that short and long-term measures could be recommended which, if implemented, would result

in reducing vehicular emissions to a level consistent with healthy air quality. Components of the project include:

a) measurement of ambient air quality using the latest equipment, methodologies and quality assurance procedures
b) direct measurement of emissions from diesel and gasoline engines using current measurement technology
c) estimates of total motor vehicle emissions and projections of emissions to year 2005
d) establishment of the relationship between vehicle emissions and ambient air quality
e) estimation of human health effects of current air quality
f) assessment of the ability of the present enforcement and institutional structure to effectively address the air pollution problem
g) recommendation of measures that could substantially reduce air pollution

The project team set up 5 monitoring stations on major streets in Metro Manila, consisting of Ermita station, ADB/EDSA station, DENR/NCR station, Monumento/MCU station and San Lorenzo Village. All stations monitored particulate matter, three stations included lead monitoring and the Ermita station also monitored gaseous pollutants of carbon monoxide, nitrogen dioxide, and for short periods, total oxidants, sulfur dioxide and hydroxides. The DENR/NCR station also monitored carbon monoxide and nitrogen oxides for a 2-month period.

Ambient monitoring results confirm that particulate matter is the pollutant of primary concern in Metro Manila followed closely by lead. Geometric concentrations of PM_{10} exceed proposed Philippine ambient guideline concentrations. Measured total suspended particulates (TSP) also exceed the guidelines at even larger percentages. Carbon monoxide and nitrogen dioxide were observed to occasionally exceed the guidelines.

2.3 Urban Air Quality Management Strategy in Asia (URBAIR) – Metro Manila Report – World Bank

The World Bank through Metropolitan Environmental Improvement Program (MEIP) started the Urban Air Quality Management Strategy (URBAIR) in 1992. The main objective of URBAIR is to assist local institution in the cities of Mumbai, Jakarta, Kathmandu, and Metro Manila to develop action plans that would be an integral part of their air quality management system for the metropolitan regions. This involves the assessment of air quality and environmental damage on health and materials, the assessment of control options, and comparison of costs of damage and cost of control options (cost-benefit or cost-effectiveness analysis). From this, an action plan was set up containing the selected abatement measures for implementation in the short, medium and long term.

This report specifically for Metro Manila suggests action plan containing abatement measures for the short, medium and long term. This report aims to assist policy makers in the design and implementation of policies, monitoring and management tools to restore air quality in Metro Manila.

2.4 MMUTIS Environmental Impact Analysis Study – Japan International Cooperation Agency

The National Center for Transportation Studies, under the JICA-funded Metro Manila Urban Transport Integration Study (MMUTIS), conducted air pollution concentration monitoring in Metro Manila in 1997.

This study covers the air pollution in Metro Manila and its adjoining area. Air pollution comes from mobile, stationary, and area sources. The air pollutants are composed of these complexes. Mobile sources (motor vehicles) emit the largest amount of carbon monoxide (CO), nitrogen oxides (NO_x), lead (Pb) and suspended particulate matter (SPM). In this study, CO, NO_2, Pb and SPM were measured as main pollutants from mobile sources. Simultaneously with the air pollution level monitoring, wind speed and wind direction and 24-hour traffic

volume count were undertaken. The monitoring utilized the latest Air Pollution Monitoring System by Horiba, Ltd., equipped with gas sampling mechanism and automatic recorder-analyzers, an air pollution monitoring equipment and vehicle donated by the Japan International Cooperation Agency (JICA) to the National Center for Transportation Studies.

The general objective of the study is to conduct environmental surveys to obtain data on air pollution levels in Metro Manila and adjoining area. The air pollution data will be used to assess present environmental conditions and predict future conditions based on current trend with no outside intervention.

Specifically, this survey aims to ascertain the levels of the following air pollutants: Carbon Monoxide (CO), Nitrogen Dioxide (NO_2), Suspended Particulate Matter (SPM) and Lead (Pb).

In this study, the eight (8) survey sites were selected for north and south area of Metro Manila and adjoining area to grasp the air pollution level of whole of MMUTIS study area. The five (5) survey sites are located on major thoroughfares which carry heavy traffic load and another three (3) survey sites were selected as background to comparison with the data of roadside environment. Air pollution and wind speed and direction surveys were conducted on several days in February and April of 1997 at the various sites using the Horiba.

Based on the results of the surveys, it is concluded that Metro Manila is fast becoming highly polluted due to the increase in motorized transit and population growth.

2.5 Empirical Analysis on the Relationship Between Air Pollution and Traffic Flow Parameters

Teodoro and Villoria (1997) proposed an empirical model estimating ambient concentration of an air pollutant, specifically carbon monoxide (CO) at roadside environment which is a function of traffic volume, vehicle speed, wind speed and direction, using multiple linear regression and non-linear parameter estimation in one location in Metro Manila. A sensitivity analysis was conducted to identify the significant parameters and the model was validated by the pollution monitoring data from another site. Collected air pollution data (NO, SPM, CO), meteorological data (wind data) with simultaneous 14-hour daily classified traffic flow observation for one week in February-March 1996 along EDSA at Camp Crame mid-block segment, are presented in detail in the master thesis paper of Teodoro (1996). The study utilized the latest Air Pollution Monitoring System by Horiba, Ltd., equipped with gas sampling mechanism and automatic recorder-analyzers, an air pollution monitoring equipment and vehicle donated by the Japan International Cooperation Agency (JICA) to the National Center for Transportation Studies. The thesis was conducted under the graduate program in civil engineering specializing in transportation engineering at the University of the Philippines being implemented jointly by the National Center for Transportation Studies and the College of Engineering.

2.6 JSPS-NCTS Air Pollution Survey Using Filter Badge in Metro Manila

The Japan Society for the Promotion of Science (JSPS) and the National Center for Transportation Studies (NCTS) of the University of the Philippines (UP), with assistance from the Pacific Consultants, Inc., conducted a filter badge survey to measure NO_2 concentration levels at the road sides of 9 signalized intersections and 5 mid-block road sections in Metro Manila on March 24 to April 3, 1998. Traffic flow and speed data was simultaneously collected while the filter badges are placed at the survey sites in order to relate traffic flow characteristics with air pollution.

Aside from filter badge, the Horiba was also used to measure various pollutants (NO_x, CO, SPM, SO_x) and wind data in various types of locations (1 mid-block road section and 1 open

area) in Metro Manila on March 24-27, 1998. The main objective of this study is to understand air quality in Metro Manila.

2.7 Tokyo Institute of Technology Air Pollution Surveys

The Tokyo Institute of Technology Transportation Planning Laboratory, under the Japan Society for the Promotion of Science (JSPS)-funded 5-year project called "Impact Analysis of Metropolitan Policies on Development and Environmental Conservation in the Philippines", have conducted air pollution surveys on road side sections at 22 locations in Metro Manila, the first one in July and the second one in November of 1998. This laboratory is involved under the JSPS Sub-Group 3 which deals on the micro-scale simulation of the transportation environment. The objectives of the study are:

a) to evaluate the impact of change in vehicle performance, driver behavior and traffic control measures on traffic flow and traffic environment through the modification and application of the existing traffic flow simulation system
b) to analyze the relationship between network traffic flow and the pollutant emission level from roadside pollutant concentration
c) to analyze the environmental effects of the implementation of various transportation policies

Data collection consisted of traffic flow characteristics survey and air pollutant concentration survey at roadside. The first data collection, conducted on July 13-15, the air pollution survey involved measurement of roadside pollution in terms of total particulate matter (TPM) weight concentration and atmospheric parameters such as temperature, humidity and wind velocity at 1-minute intervals. This survey covered 9 intersections and 5 mid-block road sections. The second data collection was conducted on November 14-19, which involved air pollutant concentration survey on 7 additional mid-block road sections and 1 signalized intersection, consisting of TPM and nitrogen dioxide (NO_2) concentration measurements.

III. TRANSPORTATION ENVIRONMENT QUALITY TRENDS

In this section, the annual trend of selected air pollutants (particulate matter, sulfur dioxide, nitrogen oxides, carbon monoxide, lead and total organic gases) will be shown in terms of the annual variation of the measured concentrations. Historical data comes from mainly the Environmental Management Bureau of the Department of Environment and Natural Resources (DENR) and recent data comes from other institutions and the corresponding implemented research projects and studies. In the historical data (1976-1995) provided by the DENR, it can be noticed that there was no pollution data in 1984 and 1985. This was due to certain air pollution measurement equipment being abandoned and new ones being installed.

3.1 *Particulate Matter (PM/SPM/TSP)*

Figure 1 below shows the 20-year trend from 1976 to 1996 of the concentration of total suspended particulates (TSP) in Metro Manila. From 1978 to 1982, the concentration levels observed from various monitoring stations are still mostly below the proposed ambient air standard of 90 $\mu g/m^3$. However, in 1987-1996, most of the measured concentrations exceed the standard by as much as 3.5 times, an indication of the worsening problem of particulate pollution, which was also one of the findings of the 1992 ADB study.

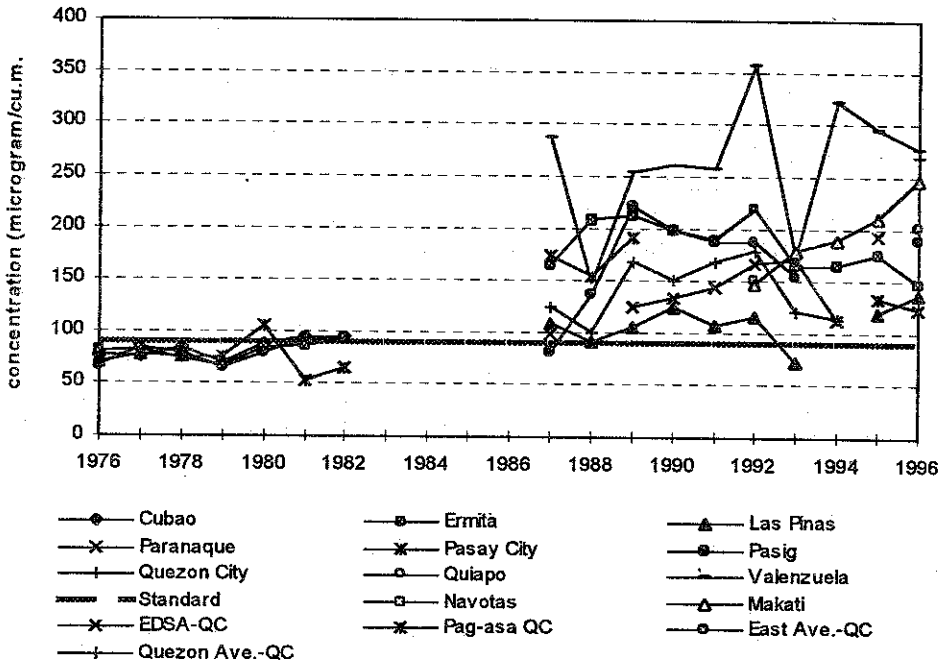

Figure 1. Trend of total suspended particulates (TSP) in Metro Manila (annual average of 24-hour measurements)

While Figure 1 shows the historical long-term measurements of total suspended particulates, Figure 2 shows the recent daily average concentrations of particulates in terms of suspended particulate matter (SPM) in 1996, as measured by Teodoro (1996) and in 1997, as measured by the MMUTIS Project (NCTS, 1997). From Figure 2, there had been an increase in SPM concentration, as indicated by the high concentration values at Quirino Avenue and Taft Avenue in 1997 exceeding the proposed Philippine standard of 150 $\mu g/m^3$ for short-term concentration. The major problem of the concentration of particulate matter exceeding standards from 1987 to 1996 can be explained partially by the rapid increase of registered diesel-engine vehicles. Table 6 in section 3.2.2 shows the vehicle registration data for various vehicle/fuel types. The total number of registered diesel-engine vehicles increased by almost 1.9 times from 1987 to 1996, compared to 1.4 times increase from 1980 to 1986. Note also that the general vehicle registration increased by 1.4 times from 1987 to 1996 while it is only 0.6 time from 1980 to 1986.

Table 1 and Table 2, respectively, show the results of short-term concentration values of SPM at various locations in Metro Manila in 1998 and the hourly variation at a single location (open space in Makati City) in 1999. These studies are funded by the Japan Society for the Promotion of Science (JSPS) with the objective of relating traffic flow and air pollution levels primarily particulate matter through micro-scale simulation of the traffic environment (JSPS, 1999). Only M-3 out of the 14 locations in Metro Manila exceeded the standard of 150 $\mu g/m^3$

for short-term concentration of particulate matter. This can be explained by the high volume of buses passing through the EDSA road.

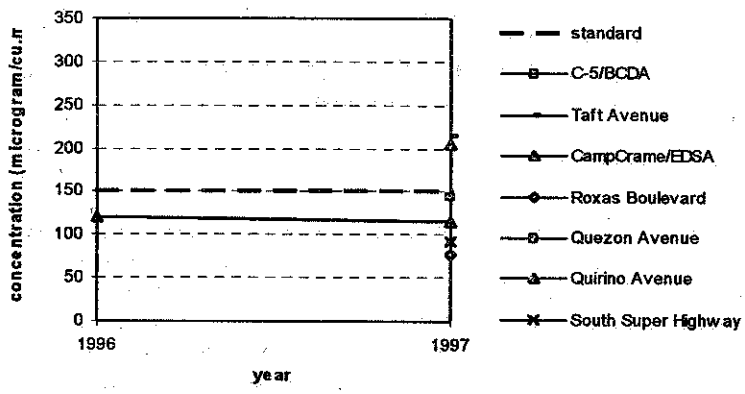

Figure 2. Concentration of suspended particulate matter (SPM) in Metro Manila in 1996-1997 (daily average)

Table 1
Short-term concentration (hourly value) of SPM at various locations in Metro Manila in 1998

	concentration ($\mu g/m^3$)	time of measurement
M-1 (España Avenue at Macaranas Avenue)	75.4	7:40
M-2 (Shaw Boulevard at Sunshine Square)	78	8:30
M-3 (EDSA at Guingua Avenue)	192.6	6:30
M-4 (EDSA at Arellano Avenue)	62.4	9:55
M-5 (C-5 at Villamor Airbase)	55.4	9:35
M-6 (Paseo de Roxas at Makati City)	87.3	17:00
M-7 (Taft Avenue at Pasay City)	43.6	9:20
M-8 (Gil Puyat Avenue at Pasay City)	99.5	11:00
M-9 (Quezon Avenue at Quezon City)	77.6	11:00
M-10 (M. Adriatico Street at Ermita)	24.4	11:00
M-11 (Taft Avenue at Malate)	80.4	9:00
M-12 (M. Adriatico Street at Ermita)	52.6	11:00
M-13 (Aurora Boulevard at Quezon City)	47.4	9:00

Source: Idchara, K. (1998) Analysis of the relationship of air pollution and traffic flow characteristics in Metro Manila, M. Eng. Thesis, Department of Civil Engineering, Tokyo Institute of Technology

Table 2
Short-term concentration (hourly average) of SPM in 1999 at open space (in front of Makati Medical Center)

concentration ($\mu g/m^3$)	time of measurement
42.3	8:15-8:47
77.23	9:00-9:32
95.8	9:45-10:17
106.00	10:30-11:02
61.03	11:15-11:47
89.4	14:15-14:47
78.57	15:00-15:32
62.73	15:45-16:17

Source: Hirata, T. (2000) Analysis of roadside air pollution in Metro Manila, Undergraduate Thesis, Department of International Development Engineering, Tokyo Institute of Technology

3.2 Sulfur Dioxide (SO_2)

The historical pollutant concentration of sulfur dioxide relied mainly on the data coming from the EMB-DENR long-term monitoring stations. From a range of 0.016 to 0.038 ppm in 1977-1983, the range of concentrations decreased to 0.002 to 0.032 ppm in 1986-1984. It can be noticed that all measured concentrations did not exceed the national ambient air standard of 0.14 ppm for sulfur dioxide. This means that air pollution due to sulfur dioxide is still not a major problem compared to particulate matter pollution.

3.3 Nitrogen Oxides (NO_x)

Figure 4 shows the trend for nitrogen dioxide concentrations from selected months in 1991, 1992 and 1998. Data in 1991 and 1992 comes from the Vehicular Emission Control Planning Study (ADB, 1992) while the 1998 data comes from the JSPS Filter Badge Survey (Pacific Consultants, 1998). Both are short-term measurements. Data from the ADB study are monthly averages while JSPS data are 3-day averages. In the ADB data, the proposed national ambient air quality standard for NO_2 (0.04 ppm) was exceeded once in December 1991 while in March 1998 where more locations were surveyed, the measured concentrations at 8 out of 14 locations (denoted by I-1 to I-9 and M-1 to M-5) exceeded the standard. This is an indication that the pollution of nitrogen dioxide or oxides of nitrogen in general, are becoming to be a major problem in Metro Manila.

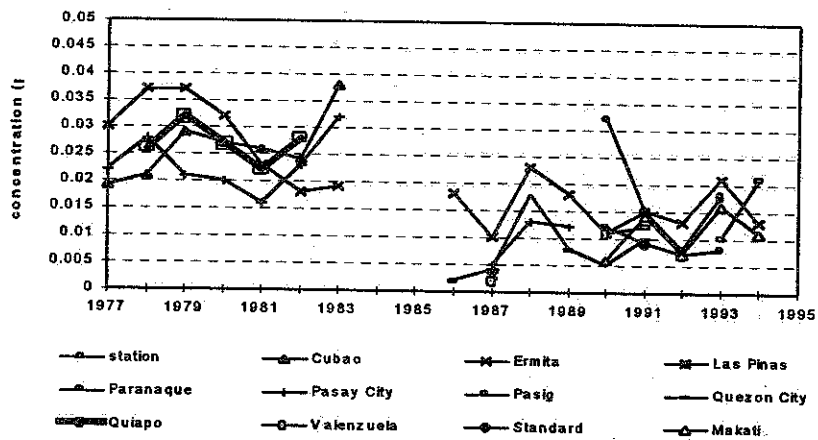

Figure 3. Trend of sulfur dioxide (SO_2) concentration in Metro Manila

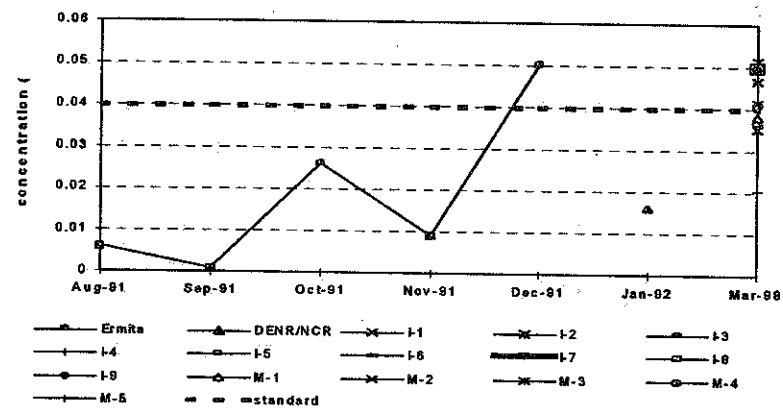

Figure 4. Trend of nitrogen dioxide (NO_2) concentration in Metro

3.4 *Carbon Monoxide (CO)*

Figure 5 shows the annual trend of 8-hour concentration values of carbon monoxide (CO) from 1977 to 1983 and for the years 1991, 1996 and 1998. The earlier set of concentration measurements comes from the monitoring stations of the EMB-DENR while the 1991 data comes from the ADB (1992). The 1996 data comes from the study of NCTS (Teodoro, 1996), the 1997 data came from the MMUTIS Environmental Impact Study (NCTS, 1997) while the 1998 data comes from the JSPS surveys (Pacific Consultants, 1998). It is clear that CO did not exceed the proposed national ambient air standard of 9 ppm for CO (8-hour value) in the 1970s and 1980s. The concentration of CO started to exceed the standard in 1991 and the next in 1998, which is an indication that it has started to become a major pollutant in the 1990s.

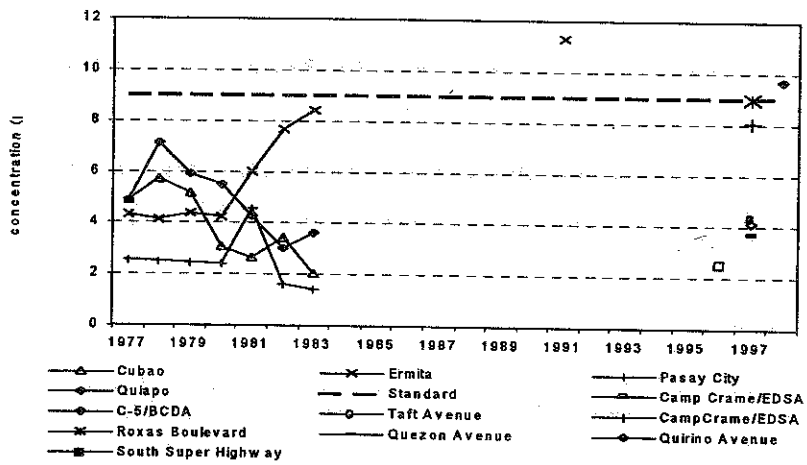

Figure 5. Trend of carbon monoxide (CO) concentration in Metro Manila

3.5 *Motor Vehicle Registration Trend*

Figure 6 shows the trend of the motor vehicle registration according to fuel type (gas or diesel) and vehicle type.

In the 1980-1999 trend of motor vehicle registration in Metro Manila (Figure 7), two periods of growth can be distinguished. The first period covers the years 1980-1987 where the growth rate is relatively low and the vehicle registration level was still below 500,000. The second period covers 1988-1999 where a rapid growth in vehicle registration jumped from 500,000 to greater than 1.2 million vehicles in 1999. In both periods of growth, there are years when the growth was negative, and these may be largely influenced by the economic conditions of the country. The crises in the early 1980's and political instability that started in 1983 may have decreased the vehicle registration levels in 1984 and 1985. The currency crises in 1997 in Eastern Asia decreased the vehicle registration levels in 1998. Except for these 3 years, the other years exhibited increases in vehicle registration.

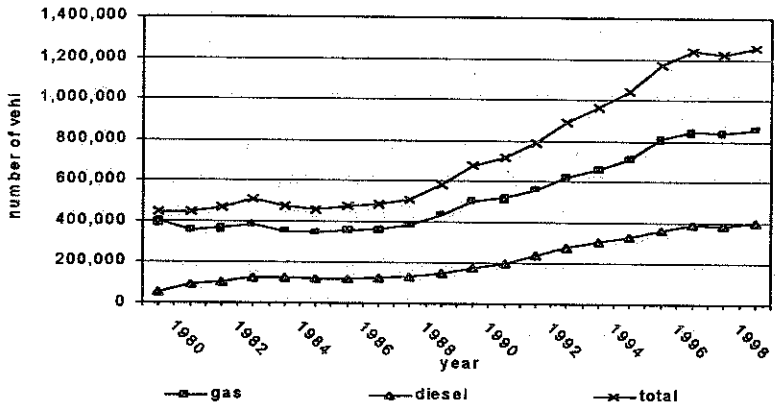

Figure 6. Motor Vehicle Registration By Fuel Type (Gas/Diesel)

IV. URBAN AND TRANSPORTATION POLICIES FOR IMPROVEMENT OF THE QUALITY OF THE TRANSPORTATION ENVIRONMENT IN METRO MANILA

4.1 Urban Policies

In the National Urban Policy Agenda (NUPA) of the National Economic and Development Authority (NEDA) of the Philippines, two policy modules deal with the transportation environment in Metro Manila:

- Policy Module 4 – Urban Environment Management
- Policy Module 7 – Metro Manila

The urban environment management policy module seeks to provide greater local participation in the management of the urban environment. There are 4 basic policies, as outlined below:

1) Mitigate pollution in urban areas through local governance
2) Adopt a "polluters pay" policy
3) Provide rewards and incentives for good performance in Environmental Quality Management
4) Incorporate environmental education into formal and nonformal school programs

In the Metro Manila policy module, nine (9) policies are proposed which are aimed at maintaining its role as the center of economic activities of the country as the Philippines heads towards increased industrialization.

1) Manage the growth of Metro Manila by making more efficient use of existing land supply and infrastructure
2) Integrate density controls with infrastructure and land use plans and zoning
3) Expand/Improve infrastructure of basic urban policies
4) Allow and encourage competition among utility companies and agencies
5) Rehabilitate the physical environment
6) Manage existing traffic and mitigate future congestion
7) Incorporate disaster mitigation principle in urban infrastructure and service delivery planning and implementation
8) Improve metropolitan management, planning and implementation
9) Identify additional measures including incentives to private sector participation in socialized housing development

Of the above 9 policies, Policy 1), 5) and 6) are directly aimed at reduction of motor vehicle emissions in Metro Manila. Policy 1) expects to encourage growth of other employment centers close to the housing areas of the metropolis in order to reduce work trip distances, as well as vehicle emissions and tidal traffic flows.

Policy 5) includes a program that will reduce vehicle emissions starting with the phase out of smoke-belching engines and of the use of leaded gasoline. The use of leaded gasoline has already been prohibited since April 2000 as part of the implementation of the Philippine Clear Air Act of 1999. With respect to the phase out of smoke-belching engines, the Metro Manila Development Authority (MMDA), under the Anti-Smoke Belching Project of the Asian Development Bank-assisted Metro Manila Air Quality Improvement Sector Development Program, has started in April 2000 the implementation of the anti-smoke belching regulations through enforcement and apprehension of smoke belching vehicles. The private sector was also tapped to assist the MMDA in these activities. It also has a component on the implementation of the emission standards for motorized tricycles in coordination with the local government units. However, there are still no local standards developed for the tricycles. In the Clear Air Act, standards are available for motorcycles that were considered very strict by tricycle operators and drivers associations. Due to this problem, the Philippine Council for Industrial and Energy Research (PCIERD) of the Department of Science and Technology (DOST), had initiated a research project entitled "Standards Development for the Local Tricycle/Motorcycle Sector", which deals not only with the development of test standards and protocols for the local tricycle but also the development of the standard configuration in the design for the conversion of motorcycles for use as tricycles, and the study on the effects of various unleaded fuel-oil mixtures on 2-stroke and 4-stroke engines. It is being planned that NCTS will be the lead implementing agency of this research together with Filcar Foundation, De La Salle University, Department of Energy and the Metals Industry Research and Development Center of the DOST.

Policy 6) contains the following components:

a) implementation of the short and medium term recommendations of the Updated Traffic and Transport Management Plan for Metro Manila (1993-1998) including expansion of mass transit
b) requirement of traffic impact assessments (TIA) for buildings, mixed-use, and subdivision developments
c) encouragement and building of infrastructure for pedestrianization
d) professionalize traffic enforcement to reduce traffic congestion caused by incompetent enforcers and to ensure strict and consistent enforcement of traffic regulations
e) planning for and the implementation of traffic demand measures

The expansion of rail-based mass transit systems network will significantly reduce the vehicle trips thereby reducing vehicle emissions.

The requirement of TIA for buildings and other developments will contribute to the prevention of future traffic congestion that will be caused by the developments. In the TIA process, future traffic impact is forecasted through trip generation and the corresponding traffic demand generated that will pass through the road network of the impact area. Effects of traffic demand caused by the development are assessed through impacts on road capacity. Mitigation measures are also recommended in the conduct of the TIA. Currently, NCTS is conducting a research funded by the Japan International Cooperation Agency (JICA) entitled "Formulation of Guidelines for the Traffic Impact Assessment (TIA) of Urban and Regional Development Projects", where the objectives are to formulate a set of guidelines for the conduct of traffic impact assessment for urban and regional developments in the Philippines, develop a set of mitigating measures aimed at alleviating traffic impacts, and institutionalize the conduct of TIA. The research is on its final stage and several options are being considered and discussed with the concerned agencies and organizations with respect to the institutionalization of the process.

The encouragement of pedestrianization started in Manila with the closure of Carriedo Street in Quiapo area in 1999. The MMDA has started to consider to pedestrianize the Redemptorist Road in Baclaran area in Parañaque in 2000. However, the impacts on traffic in the area are not being studied well. Pedestrianization and the construction of pedestrian facilities are also the focus of recent projects of the national government with the foreign funding agencies.

One aspect of professionalization of traffic enforcement is training of traffic enforcers. NCTS has conducted trainings for the MMDA in the year 2000 for their traffic management capability building.

Measures for transportation demand management currently being implemented by the MMDA are the modified odd-even license plate scheme and the truck ban. The Unified Vehicle Volume Reduction Program (UVVRP) prohibits private vehicles to pass through identified major roads in Metro Manila one day of the week, depending on the ending number of their license plates. Truck ban prohibits trucks from passing identified major arterial roads at peak traffic periods of the day.

4.2 Transportation Policies

Cal (1999) outlined the transportation policies of the government, as listed below:

1) Deregulation of transport services
2) Strict control pertaining to safety, environmental quality, and level of service
3) Maximization of Private Sector Participation (PSP)/Public-Private Partnership (PPP)
4) Adoption of full cost recovery and "users pay" principles
5) Adoption of economic, social and environmental criteria in investment decision-making
6) Devolution and decentralization
7) Reorganization of the transport sector bureaucracy

Policy 2) directly deals with the preservation of the transportation environment in Metro Manila. Through the Philippine Clear Air Act of 1999, the Department of Transportation and Communications (DOTC) is directed to implement the emission standards for motor vehicles. It also has been given powers to inspect and monitor emissions of motor vehicles, prohibit the use of motor vehicles or a class of motor vehicles in any area or street at specified times, and authorize private emission testing centers duly accredited by the Department of Trade and Industry (DTI). Furthermore, a motor vehicle must pass the emission tests before registration. Also, fines and penalties are imposed on drivers and operators of non-complying vehicles.

The Clean Air Act phases out leaded gasoline and effectively engines and components that use leaded gasoline. The Act also directs the Department of Energy to improve composition of fuel and fuel-related products for increased efficiency and reduced emissions.

V. SUMMARY AND CONCLUSIONS

In the 1990's, the degradation of the atmospheric environment specifically air pollution brought about by the rapid increase in motor vehicle traffic, as reflected by the rapid increase in vehicle registration in 1988-1999, had become a major concern in Metro Manila, where a number of local and foreign agencies had conducted air pollution monitoring studies. These studies have concluded that total suspended particulates or particulate matter, followed to some degree, by nitrogen oxides and carbon monoxide, are the key air pollutants attributed to motor vehicle traffic. Other criteria pollutants such as sulfur oxides, total organic gases and lead are still at below the air quality standards.

The National Urban Policy Agenda (NUPA) of the NEDA deals on policies for the improvement of the urban environment and the transportation environment of Metro Manila through the urban environment management and Metro Manila policy modules, respectively. Transportation policies through the DOTC deals on emission standards and inspection of motor vehicles through the Clean Air Act of 1999.

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