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Sub: Information on Air Quality Management & Practice in Chittagong City, Bangladesh.

Attached, please find reports regarding information on Air Quality Management & Practice in Chittagong City, Bangladesh for making Benchmarking Report on Urban Air Quality Management and Practice in CAI-Asia and APMA Cities, as per your fax dated 8<sup>th</sup> May, 2003.

Thanking you.

(Khan M. Ibrahim Hossain)

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# Air Quality Management in Chittagong, Bangladesh

Prepared by  
Air Quality Management Project  
Department of Environment  
Government of the People's Republic of Bangladesh

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## **I. Situational Analysis**

### **a. Geography and climate**

Chittagong is a port city situated in the southern region of Bangladesh. The city is surrounded by hills to the east and the Bay of Bengal in the south - west. One of the most beautiful rivers in Bangladesh, the Karnaphuli River flows into the Bay of Bengal through this city.

The city has a complete tropical monsoon climate with hot, wet summer and dry, cool winter seasons. Average maximum temperatures are between 29°C and 35°C and average minimum temperatures are between 12°C and 17°C. The total annual rainfall throughout the city varies generally between 2159 mm (85 inches) and 3048 mm (120 inches) rising sometimes to 3810 mm (150 inches). On average, approximately 80% of the yearly rainfall occurs during the May to September monsoon.

During the summer season, winds are generally from the south east. Easterly and north easterly winds prevail during the winter periods. Chittagong can be affected by cyclones in the October to November and April to May periods.

### **b. Demography**

The 2001 national census determined that the Chittagong statistical metropolitan area had a population of approximately 3.2 million in approximately 430,000 households. The average household size is 4.

### **c. Energy production/sources**

Bangladesh has a total energy production of approximately 3100 MW. Demand significantly exceeds production, particularly during the summer months resulting in regular load shedding across the country. Demand is expected to rise to over 6,000 MW in the next 5 years. Most of the country's power is produced from gas (about 70%). The remainder is produced by oil with small amounts produced from coal and hydro power.

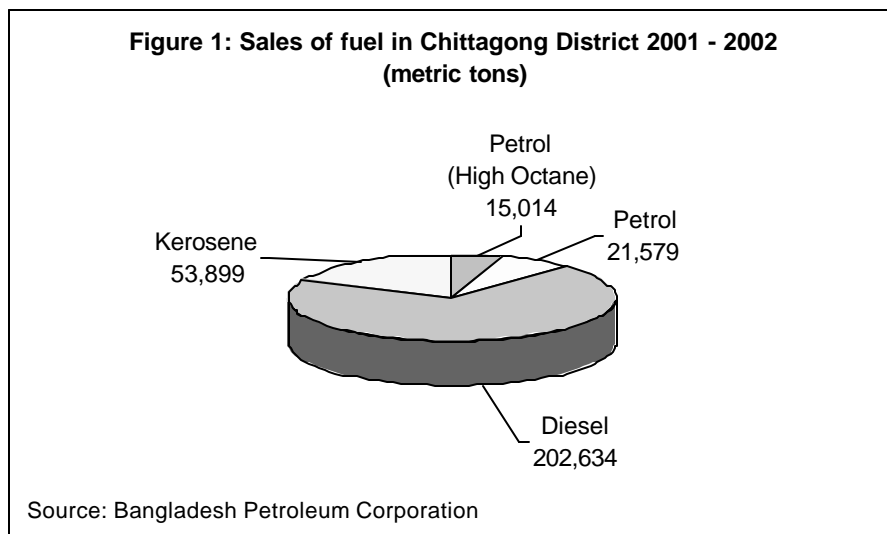
Power consumption in Chittagong is significant as it is the second largest city in Bangladesh and has a large industrial sector.

Chittagong is located close to a large hill tract region that provides the only significant hilly area in an otherwise flat country. Kaptai Lake hydro-electric power station was established in 1962 in the Chittagong Hill Tract region and supplies power to Chittagong.

GoB has drafted a renewable energy policy. The policy promotes the use of wind power, biomass and solar energy. Pilot projects demonstrating the use of wind power for pumping drinking and irrigation water have been established in the areas around Chittagong. Biomass is a major source of fuel for cooking in the rural areas of Bangladesh but is not used extensively in urban areas like as Chittagong.

Bangladesh's only oil refinery (Eastern Refinery of Bangladesh) Station is located in Chittagong. It is owned and operated by the government-owned Bangladesh Petroleum Corporation. Total capacity of the refinery is around 33,000 barrels per day. About 1400 bbl/day of crude oil is sourced locally whilst the remainder is imported.

Figure 1 shows the fuel sales data for Chittagong District in 2001 – 2002. Approximately 70% of fuel sold was diesel.



#### d. Industry

Chittagong's status as a port city has attracted significant industrial development. Most of the industries have been built near the Bay of Bengal and the Karnaphuli River. Industries include ship-breaking, steel production, food processing, textiles, petroleum products, chemical manufacturing and many others.

Department of Environment has classified industrial premises into four categories ranging from clean to highly polluting. In 2001, Chittagong officially had 10 highly polluting industrial premises, 45 moderately polluting industrial premises and 48 less polluting industrial premises.

The areas to the north and east of the city contain a good number of brickfields. The kilns use coal, rubber tyres, oil and other products for fuel resulting in significant emissions and potential impacts on air quality in Chittagong.

#### e. Transport

Transportation around the city of Chittagong is primarily by motor vehicle. There is no metro rail service. Rickshaws provide an important transport service but are limited to some extent by the hilly terrain.

Vehicles registration data for Chittagong District from Bangladesh Road Transport Authority are presented in Table 1. It is likely that the majority of these vehicles are used within Chittagong City.

**Table 1: Total number of vehicles registered in Chittagong District from 1990 to 2002**

Source: BRTA Chittagong

Category	Number registered
Motorcycle	9,402
Autorickshaw	13,741
Autotempo	1,501
Car	9,590
Jeep	596
Microbus	5,170
Pickup	2,078
Bus/Minibus	914
Truck/others	3,636
<b>Total</b>	<b>46,628</b>

Auto rickshaws and auto tempos make up a significant proportion of the total vehicles fleet. Most of these vehicles are powered by two stroke engines. Two stroke engine three wheelers were banned from Dhaka from the 1<sup>st</sup> of January, 2003 and Government is planning to introduce similar bans in other cities including Chittagong in the near future.

Almost all buses and trucks and many of the jeeps and pickups are diesel vehicles.

## II. Air Quality Monitoring

Limited ambient air quality monitoring is carried out by the Department of Environment in Chittagong as part of the Department's routine environmental monitoring program. Batch sampling of suspended particulate matter, NO<sub>2</sub> and SO<sub>2</sub> is carried out using high volume air sampler. All three pollutants are measured at the same time using the same sampler.

Monitoring is carried out each month at various industrial, commercial and residential locations. Results are generally reported to the Department of Environment headquarters in Dhaka but are not publicly released on a regular basis.

Monitoring data provided by the Department of Environment's Chittagong Division is presented in Appendix 1. A discussion of the data and air quality trends is provided in Section 3 part (c).

### III. Urban Air Quality

#### a. Ambient air quality standards

Current ambient air quality standards for Bangladesh are defined in the Environment Conservation Rules, 1997. The current standards are presented in Table 1 of Appendix 2.

The Department of Environment is currently in the process of revising the ambient air quality standards. A proposal to adopt US NAAQS (primary standards only) as long term ambient air quality objectives has been approved by stakeholders and now in the final stage of approval. For lead in ambient air, the WHO guideline level will be adopted instead of the US NAAQS.

#### b. Emissions standards

##### 1. Mobile

Schedule 6 and 7 of the Environment Conservation Rules, 1997, set out emission standards for mobile sources. The schedules are presented in Tables 2 and 3 of Appendix 2.

The Department of Environment is currently revising the emissions standards for motor vehicles. A proposal to adopt Euro 2 standards for new petrol and CNG vehicles and Euro 1 standards for diesel vehicles has been approved in terms of Bangladesh -2 and Bangladesh-1 respectively by stakeholders and will be submitted for Government approval during 2003. Emission standards for in-service vehicles have also been established by the Department of Environment and now in the final stage of Government approval.

##### 2. Stationary

The Environment Conservation Rules, 1997, also set out Schedules and associated Rules for emission standards for discharges from industry. In general, these regulations focus on TSP, mercury, SO<sub>2</sub>, sulphuric acid, halogens and halogen acids. The emission limits are set in terms of wt per unit volume of gaseous discharge. Table 4 in Appendix 2 lists some of the standards. There are other standards set for industrial boilers and the likes of.

#### c. Ambient air quality levels and trends

The basic air quality monitoring data provided in Appendix 1 indicates that ambient concentrations of SPM exceed the current standards on a regular basis and there are some exceedences of the SO<sub>2</sub> and NO<sub>x</sub> standards.

Given the heavy reliance on the use of diesel vehicles for transportation in Chittagong, the age of these vehicles and the poor standards of maintenance, it is not surprising that SPM levels are high.

Department of Environment's Air Quality Management Project has commenced the establishment of an air quality monitoring network in Dhaka. Preliminary results have shown that ambient concentrations of PM10 and PM2.5 are high during the non-monsoon period but reduce significantly during the monsoon. Similar trends are likely to be present in Chittagong.

#### **IV. Impact of Air Pollution**

At present there is a limited understanding of ambient air quality in Chittagong. The monitoring undertaken by the Department of Environment in Chittagong indicates that ambient concentrations of PM are likely to exceed standards. The sources of air pollution and general conditions are similar to Dhaka.

#### **V. Enforcement & Control Strategies**

Department of Environment carried out some assessment of emissions from industrial premises as part of the environmental clearance program. The Bangladesh Road Transport Authority has a legal mandate to ensure gross polluting vehicles do not operate on the road network. However, capacity to carry out this mandate is limited.

The Department of Environment's Air Quality Management Project (AQMP) commenced work in Dhaka in 2000 and is developing the air quality management capacity.

The AQMP is currently implementing vehicle emissions reduction programs including inspection and maintenance, mechanic training and public awareness in Dhaka and is expected to be extended to Chittagong in 2004.

Bangladesh Road Transport Authority is developing capacity for control of gross polluting vehicles in Dhaka through the Dhaka Urban Transport Project. This capacity may also be used to extend the BRTA's control program in Chittagong.

Government of Bangladesh is also promoting the use of CNG in urban areas across Bangladesh. Current focus of the program is on Dhaka. However the first CNG filling station in Chittagong was established in June, 2003.

#### **VI. Conclusions**

In general, there is only a limited understanding of air quality in Chittagong. The rapid urban development that has occurred and is ongoing in Dhaka is also occurring in Chittagong and therefore Government has recognized that there is a real need to improve air quality management capacity in Chittagong.

The Department of Environment's Air Quality Management Project is an important initiative that is making significant improvement in institutional capacity in Dhaka. Extending this capacity to Chittagong is an important component of the next phase of the project that will commence next year.

### Appendix 1: Ambient air quality monitoring data for Chittagong

Monitoring data below was provided by the Department of Environment, Chittagong Division.

**Table 1: Results of Ambient Air Quality Analysis at Various Industrial Areas in Chittagong.**

Place	Date	SPM in mg/m <sup>3</sup>	SO <sub>2</sub> in mg/m <sup>3</sup>	NOx in mg/m <sup>3</sup>
<b>Ambient air quality standards for industrial and commercial areas</b>		<b>500</b>	<b>120</b>	<b>100</b>
Nasirabad Industrial Area	09/04/2003	675.8	93.5	97.4
	11/03/2003	904.6	120.4	128.8
	16/01/2003	817.2	107.8	118.5
	18/11/2002	628.4	93.6	98.5
	09/10/2002	589.4	102.1	104.5
Sylhet Steel Mill, Nasirabad Industrial Area, Chittagong	07/05/2003	779.22	147.32	155.53
	13/04/2003	579.3	129.2	135.6
Kabir Steel Mill Ltd, Madam Bibirhat, Shitakundu, Chittagong	09/02/2003	412.6	49.3	55.8
Khwaja Ajmir Steel Ind. Ltd. Madam Bibirhat, Shitakundu, Chittagong Kabir Steel Re-rolling Mills Ltd. Boro Kumira, Shitakundu, Chittagong	08/02/2003	420.8	68.2	74.3
	08/02/2003	430.5	51.3	59.8
Kabir Steel Mill Ltd. 34/B, Kalurghat Industrial area, Chittagong	09/02/2003	432.6	42.3	52.5
Royal Cement Ltd. Boro Kumira, Shitakundu, Chittagong	08/02/2003	435.5	-	-
Pahartali Industrial Area, Chittagong	25/02/2003	612.8	112.2	118.4
Kukar Laboratories, Kalurghat, Chittagong	14/05/2002	489.7	-	-
Chittagong Cement and Grinding CO. Ltd.	31/10/2002	900.32	-	-
	08/06/2002	581.1	-	-
Sangu Gas Processing Plant, Salimpur, Chittagong	15/09/2002	165.12	16.24	24.13
Northern side of the Confidence Cement Co. Ltd. Bibirhat, Shitakundu, Chittagong	20/06/2002 - 22/06/2002	348.25	-	-

**Table 1 (Cont.): Results of Ambient Air Quality Analysis at Various Industrial Areas in Chittagong.**

Place	Date	SPM in mg/m <sup>3</sup>	SO <sub>2</sub> in mg/m <sup>3</sup>	NO <sub>x</sub> in mg/m <sup>3</sup>
<b>Ambient air quality standards for industrial areas</b>		<b>500</b>	<b>120</b>	<b>100</b>
Southern side of the Confidence Cement Co. Ltd. Bibirhat, Shitakundu, Chittagong	20/06/2002 - 22/06/2002	362.	-	-
Western side of the Confidence Cement Co. Ltd. Bibirhat, Shitakundu, Chittagong	20/06/2002 - 22/06/2002	461.18	-	-
LGS (Ind.) Pty. Ltd. Pahartali Industrial Area	13/02/2002	467.42	74.02	78.52
CEPZ	07/07/2002	138.88	31.11	37.11
Baejid Steel, Nasirabad Industrial Area, Chittagong	14/02/2002	474.17	88.24	96.14

**Table 2: Results of Ambient Air Quality Analysis at Various Commercial Areas in Chittagong.**

Place	Date	SPM in mg/m <sup>3</sup>	SO <sub>2</sub> in mg/m <sup>3</sup>	NO <sub>x</sub> in mg/m <sup>3</sup>
<b>Ambient air quality standards for commercial areas</b>		<b>400</b>	<b>100</b>	<b>100</b>
Chittagong WASA, Mood 1, Agrabad Commercial Area	09/04/2003	804.3	111.4	115.7
	15/01/2003	683.8	103.7	110.3
	04/09/2002	576.51	82.33	88.15
Biplob park, Nasirabad	10/04/2003	618.3	105.8	115.7
	24/02/2003	587.9	97.8	102.7
	03/09/2002	523.01	76.38	81.32
Chittagong WASA, Mood 1, Agrabad Commercial Area	17/11/2002	613.5	113.2	107.8
	08/10/2002	587.8	89.4	93.2
	13/02/2002	580.74	81.49	92.12
Tigerpas Police Box, Chittagong	11/03/2003	812.7	124.2	134.9

**Table 3: Results of Ambient Air Quality Analysis at Various Residential Areas in Chittagong.**

Place	Date	SPM in mg/m <sup>3</sup>	SO <sub>2</sub> in mg/m <sup>3</sup>	NO <sub>x</sub> in mg/m <sup>3</sup>
<b>Ambient air quality standards for residential areas</b>		<b>200</b>	<b>80</b>	<b>80</b>
Chandgaon Residential Area	25/02/2003	208.4	20.2	28.3
	02/09/2002	172.6	18.9	20.2
Khulshi Residential Area	12/03/2003	308.4	42.2	54.8
	14/02/2002	213.08	51.29	60.17
	16/01/2003	312.5	81.6	92.4
	19/11/2002	282.8	46.7	54.4
	10/10/2002	317.8	58.5	61.9

Note:

1. SPM- Suspended Particulate Matter
2. NO<sub>x</sub> Oxides of Nitrogen
3. SO<sub>2</sub> Sulphur di- oxide

## **Appendix 2: Summary of standards relating to air quality in Bangladesh**

**Table 1: Ambient Air Quality Standards for Bangladesh  
(micrograms/m<sup>3</sup>)**

SL No.	Area	Suspended Particulate Matters (SPM)	Sulphur Dioxide (SO <sub>2</sub> )	Carbon Monoxide (CO)	Oxides of Nitrogen (NO <sub>x</sub> )
Ka	Industrial and mixed	500	120	5000	100
Kha	Commercial and mixed	400	100	5000	100
Ga	Residential and rural	200	80	2000	80
Gha	Sensitive	100	30	1000	30

**Table 2: Emission standards for motorized vehicles**  
(Schedule 6 of the Environment Conservation Rules, 1997)

Parameters	Unit	Value
Black smoke*	HSU (Hartridge Smoke Unit)	65
Carbon monoxide	g/km	24
	Percent volume	4
Hydrocarbon	g/km	2
	ppm	180
Oxides of nitrogen	g/km	2
	ppm	600

\* Measuring at two thirds of maximum rotating speed.

**Table 3: Emission standards for mechanized water vessels**  
(Schedule 7 of the Environment Conservation Rules, 1997)

Parameters	Unit	Values
Black smoke*	HSU (Hartridge Smoke Unit)	65

\* Measuring at two thirds of maximum rotating speed.

**Table 4: Emission standards for stationary sources  
(Environment Conservation Rules, 1997)**

Sl.No	Parameters	Values(mg/Nm <sup>3</sup> )
1.	Particulates (Ka) Power station of capacity of 200 MW or more (Kha) Power station of capacity of less than 200 MW	150 350
2.	Chlorine	150
3.	Hydrochloric acid vapor and mist	350
4.	Total fluoride (as F)	25
5.	Sulphuric acid mist	50
6.	Lead particulates	50
7.	Mercury particulates	10
8.	Sulphur dioxide (Ka) Sulphuric acid production (DCDA process) (Khan) Sulphuric acid production (SCSA process) ( DCDA: Double conversion, double absorption, SCSA: Single conversion single absorption) Lowest height of stack for sulphur dioxide dispersion: (Ka) Coal based power plant (1) 500 MW or more (2) 200 MW – 500 MW (3) Less than 200 MW (Kha) Boiler (1) Steam per hour – up to 15 tons (2) Steam per hour – more than 15 tons (Q = SO <sub>2</sub> emission in kg/hour)	kg/ton acid 4 100 ..... 275 m 220 m 14(Q) <sup>0.3</sup> 11m 14(Q) <sup>0.3</sup>
9.	Oxides of nitrogen (Ka) Nitric acid production (Kha) Gas based power stations (1) 500 MW or more (2) 200 – 500 MW (3) Less than 200 MW (Ga) surgical oven Kiln soot and dust	3 kg/ton acid 50 ppm 50 ppm 40 ppm 30 ppm 200 ppm mg/Nm <sup>3</sup>
10.	(Ka) Blast furnace (Kha) Brick kiln (Ga) Coke oven (Gha) Lime kiln	500 1000 500 250

Source: Schedule –11, Rule 13, Environment Conservation Rules 1997, (page 3135, 3136, Bangladesh Gazette, 28 August 1997) (translation by A Islam).