ENVIRONMENT & DEVELOPMENT GROUP

KOM OMBO 200MW PV PROJECT
ACWA Power

Baseline Survey – Ambient Air Quality Survey

February 2020

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1. INTRODUCTION

This report presents the results of a three-days monitoring of ambient air quality at the ACWA Power 200MW Kom Ombo solar PV project site, Koom Ombo, Aswan. The measurements commenced T 1100 hr, on Sunday 2 February, 2020 and ended at 2200 hr, Wednesday 5 February, 2020.

2. APPLICABLE REGULATIONS

Ambient air quality is regulated by Environmental Law 4/1994 as amended by Law 9/2009 and its Executive Regulation amended by decree 710/2012 (Table 1). Given that there are no residents in the area monitored, but there are other industrial facilities, the AQ measurements are benchmarked against the 'industrial 'standards.

Table 1: Ambient Air Quality Parameters as mentioned by Environmental Law 4/1994 as amended by Law 9 /2009 and its Executive Regulations amended by decree 710/2012

Pollutant	Area	Emission Limit Value in µg/m3 unless specified otherwise			
		Hour	8 hours	24 hours	1 year
SO2	Urban	300	-	125	50
	Industrial	350	-	150	60
CO	Urban	30 mg/m^3	10 mg/m^3	-	-
	Industrial			-	-
NO2	Urban	300	-	150	60
	Industrial	300	-	150	80
Total Suspended Particulates TSP	Urban	-	-	230	125
	Industrial	-	-	230	125
Particulates < 10 µm, PM10	Urban	-	-	150	70
	Industrial	-	-	150	70
Ozone	Urban	180	120		
	Industrial	180	120		

3. METHODOLOGY

3.1 SAMPLING AND MEASUREMENT PLAN

Air quality measurements were conducted in accordance with the requirements stipulated in Annex 5 of the Executive Regulations of Environmental Law 4/1994 (decree 710/2012), covering hourly and daily concentrations of sulfur dioxide (SO2), nitrogen dioxide (NO2), and carbon monoxide (CO). Accordingly, continuous air quality measurements were taken for three consecutive days covering the following parameters:

- Carbon Monoxide (CO)
- Nitrogen Dioxide (NO_2)
- Sulphur Dioxide (SO_2)

Air samples were also taken on filters for measuring total Suspended Particulates (TSP) and Particulates less than 10 µm (PM10). Ozone concentration was measured 10 times during the three days of monitoring using colorimetric gas detector tubes. Times of measurements covered different times of day. All measurements were taken at a location was about 180 meters south of the road and about 980 meters west of the eastern boundary of the site (24°37'14.17"N, 32°47'58.53"E).

Figure 1: Photo of AQ monitoring equipment (left) and ozone colorimetric gas detection tube (right).

3.2 Equipment and Standard Methods Used for Sampling and Measurement

Air quality sampling and measurements were based on international standard methods recommended by the American Society for Testing & Materials (ASTM), US Environmental Protection Agency (EPA) and the Japanese Industrial Standards (JIS). These methods are listed in the table below.

Table 2: Equipment and Standard Methods Used for Sampling and Measurements

#	Parameter	Standard Method and Instrument/Equipment
1	Sulfur Dioxide	JIS Method B 7952, UV Fluorescent Continuous Monitor (Thermo- England)
2	Nitrogen Dioxide	ASTM Method D 3824, Chemiluminescent Continuous Monitor (Thermo- England)
3	Carbon Monoxide	ASTM Method D 3162, IR Absorption Continuous Monitor (Thermo- England)
4	PM10	EPA Compendium Method IO-1.1, Air Metrics Air Sampler (USA)
5	TSP	EPA Compendium Method IO-2.1, Air Metrics Air Sampler (USA)
6	Ozone	Colorimetric gas detector tubes

4. QUALITY CONTROL PLAN

The Quality Control plan includes two parts, one is the quality control of sampling, and the other is the quality control of the measurement. These are ensured as follows:

- **Sampling Quality Control**
  - The pump and the flow meter used for the sampling of PM10 and TSP were calibrated according to the EPA Compendium Method IO-2.1.
  - The balance used for the gravimetric measurements of PM10 and TSP filters was calibrated using different standard weights.
- **Measurement Quality Control**
  - Sulfur dioxide continuous monitor was calibrated using a zero air (zero calibration) and a standard sulfur dioxide gas cylinder (span calibration) by a calibration certified laboratory (Reference Lab of National Institute for Standards)
  - Nitrogen dioxide continuous monitor was calibrated using a zero air (zero calibration) and a standard nitric oxide gas cylinder (span calibration) by a calibration certified laboratory (Reference Lab of National Institute for Standards)
  - Carbon monoxide continuous monitor was calibrated using a zero air (zero calibration) and a standard carbon monoxide gas cylinder (span calibration) by a calibration certified laboratory(Reference Lab of National Institute for Standards)

Equipment calibration certificates are shown in Annex 1.

5. WEATHER CONDITIONS DURING MONITORING

Figures 2 and 3 provide an overview of ambient temperature and windspeed during the air quality monitoring period.

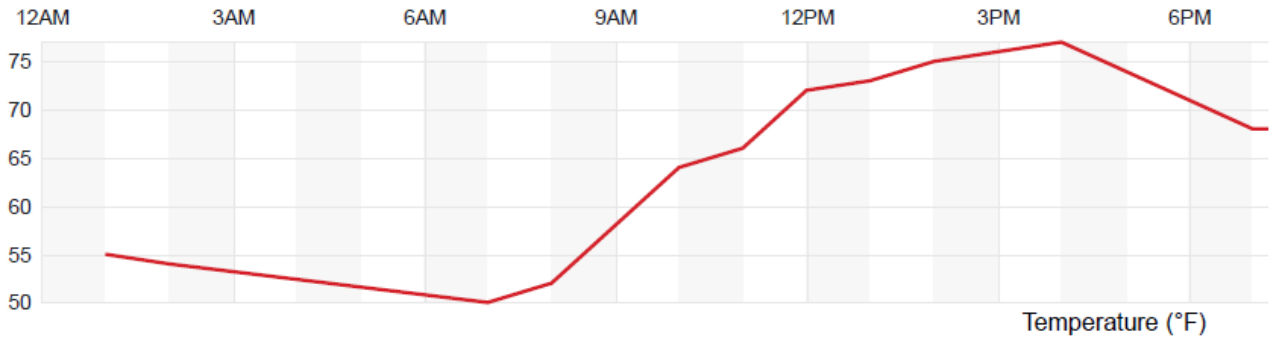

Figure 2: Temperature (°F) - Weather Conditions during Monitoring

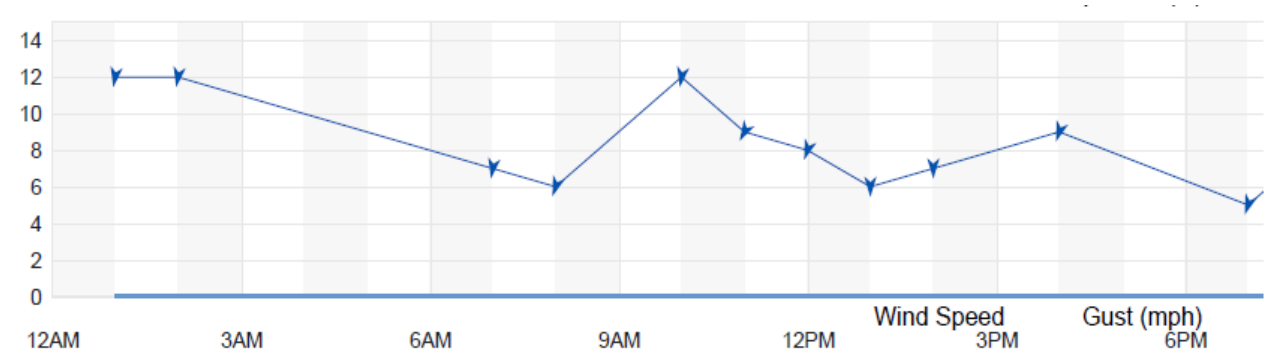

Figure 3: Wind Speed and Gust - Weather Conditions during Monitoring

6. MEASUREMENT RESULTS

6.1 DAY 1

6.1.1 Hourly Concentrations of Gases/CO 8h average

Table 3: Hourly Concentrations of Gases/CO 8h average - Measurement Results for Day 1

Date	Time	SO_2 (µg/m³)	NO_2 (µg/m³)	CO (mg/m³)	CO 8h avera
2/2/2020	11:00	8.4	8.4	1.6	1.54
	12:00	7.6	6.7	1.6	
	13:00	8	6.4	1.6	
	14:00	7.4	6.5	1.5	
	15:00	7.9	7	1.6	
	16:00	7.9	7.8	1.5	
	17:00	7.9	7.1	1.5	
	18:00	7.8	7.4	1.4	
	19:00	7.7	7.5	1.3	1.41
	20:00	7.9	8.4	1.4	
	21:00	7.7	7.2	1.4	
	22:00	7.9	7.4	1.4	
	23:00	8.1	9.4	1.4	
	24:00	7.7	8.7	1.5	
3/2/2020	01:00	7.7	8.6	1.5	
	02:00	7.4	8.9	1.4	
	03:00	7.4	8.5	1.6	1.54
	04:00	7.3	9	1.5	
	05:00	7.5	9.4	1.5	
	06:00	7.2	9.,1	1.5	
	07:00	7	6.9	1.5	
	08:00	7.7	10.2	1.5	
	09:00	7	8.2	1.6	
	10:00	6.5	10.4	1.6	
Hourly Limit Values		**300**	**300**	**30**	**10**

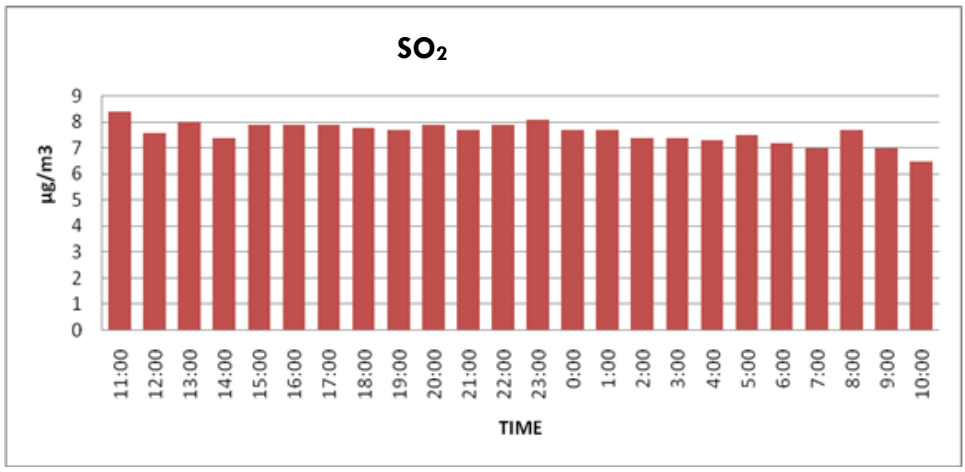

Figure 4: SO_2 Measurements Day 1

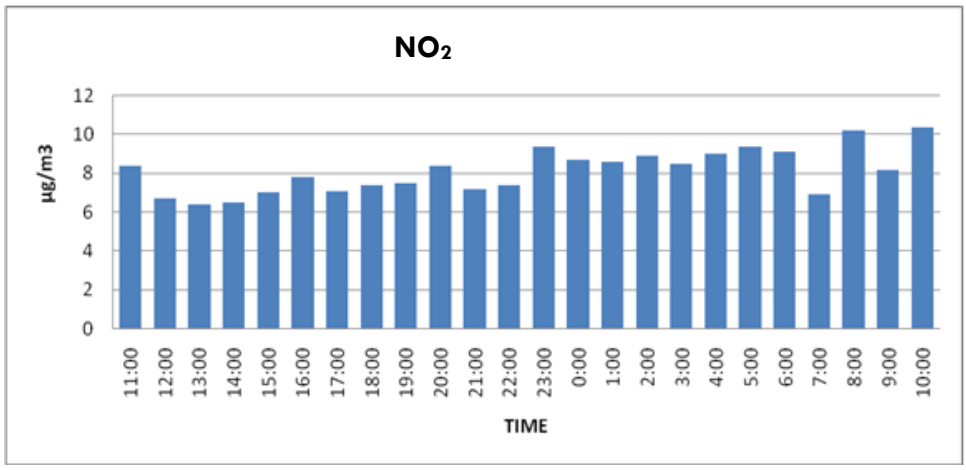

Figure 5: NO_2 Measurements Day 1

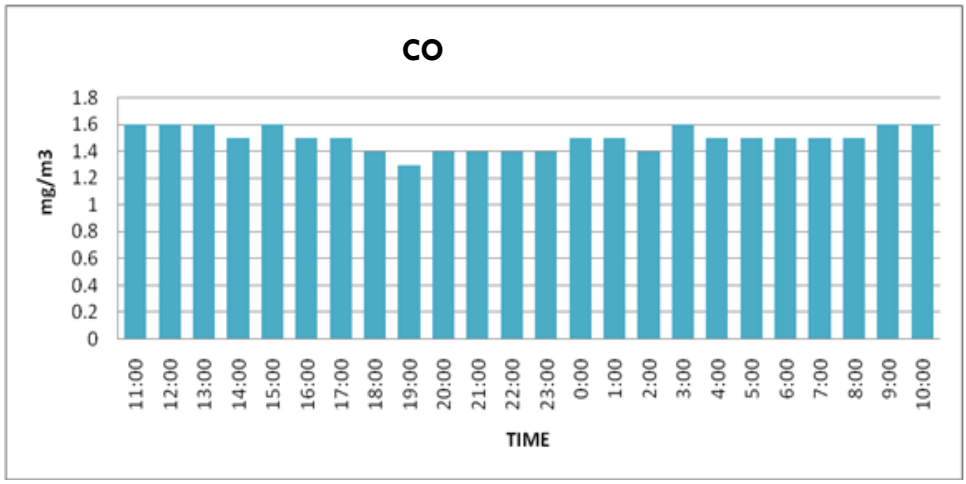

Figure 6: CO Measurements Day 1

6.1.2 24 – Hour Average Concentrations of Gases and Dust

Table 4: 24 – hour Average Concentrations of Gases and Dust - Masurement Day 1

Pollutant	Concentration (µg/m³)	Limit Values
SO_2	7.61	**125 (µg/m³)**
NO_2	7.75	**150 (µg/m³)**
CO	1.5 mg/m3)	**-**
PM10	25.6	**150 (µg/m³)**
TSP	53.4	**230 (µg/m³)**

6.2 DAY 2

6.2.1 Hourly Concentrations of Gases/CO 8h average

Table 5: Hourly Concentrations of Gases / CO 8 H Average - Measurement Results for Day 2

Date	Time	SO_2 (µg/m³)	NO_2 (µg/m³)	CO (mg/m³)	CO 8h ave (mg/m³)
3/2/2020	11:00	9.8	8.9	1.5	1.45
	12:00	8.8	5.3	1.5	
	13:00	6.4	4.6	1.4	
	14:00	7	7.5	1.4	
	15:00	7.2	6.7	1.4	
	16:00	7.8	6.9	1.4	
	17:00	7.6	5.8	1.4	
	18:00	7.1	5	1.6	
	19:00	7.4	9.1	1.6	1.638
	20:00	7.1	8.7	1.6	
	21:00	7.8	7.5	1.6	
	22:00	7.7	8.3	1.6	
	23:00	7.1	7.7	1.7	
	24:00	7.8	9.2	1.7	
4/2/2020	01:00	6.9	7.3	1.6	
	02:00	7.1	6.8	1.7	
	03:00	7.2	8.3	1.6	1.563
	04:00	6.4	8.4	1.5	
	05:00	6.5	8.1	1.6	
	06:00	6.4	6.2	1.5	
	07:00	7.5	4.3	1.6	
	08:00	6.6	5.6	1.6	
	09:00	6.9	5.2	1.6	
	10:00	7.6	6.1	1.5	
Limit Values for 1h average		**300**	**300**	**30**	**10**

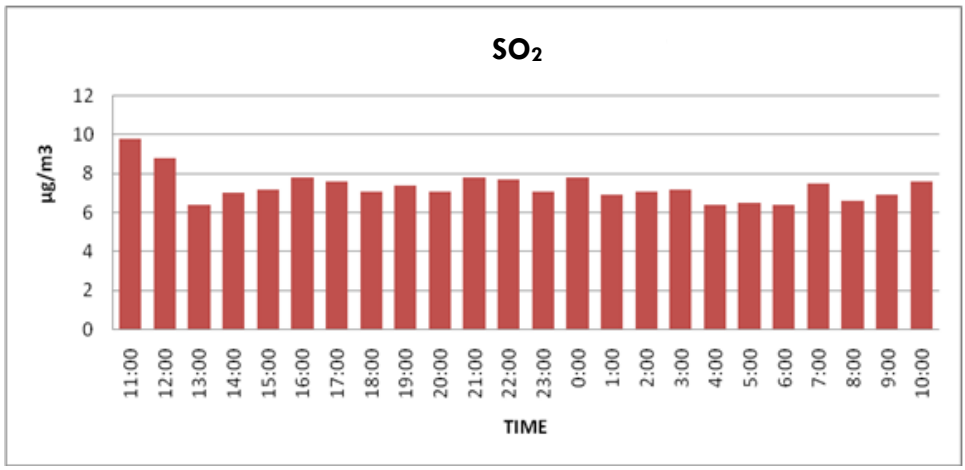

Figure 7: SO_2 Measurements Day 2

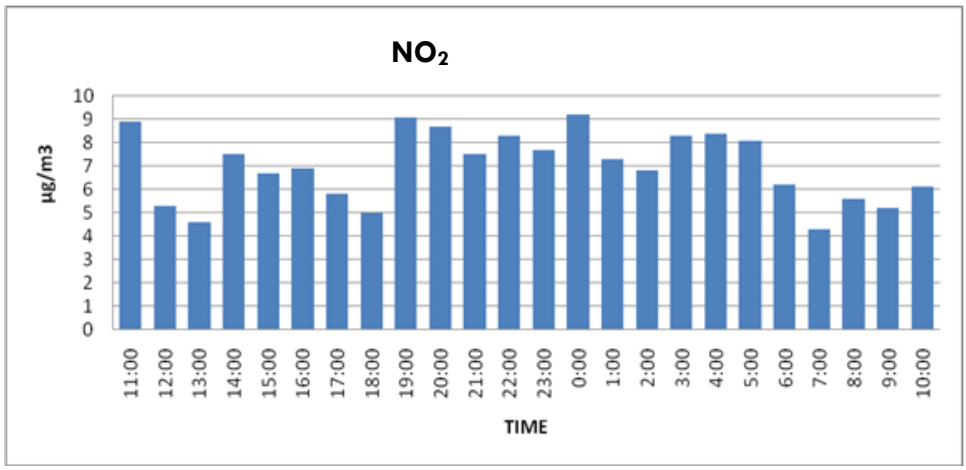

Figure 8: NO_2 Measurements Day 2

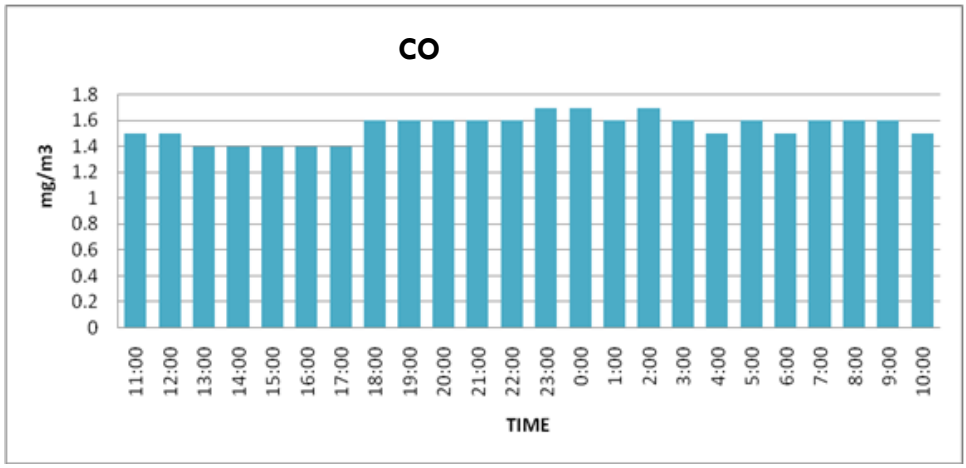

Figure 9: CO Measurements Day 2

6.2.2 24 -hour Average Concentrations of Gases and Dust

Table 6: 24 -hour Average Concentrations of Gases and Dust - Measurement Day 2

Pollutant	Concentration (µg/m³)	Limit Values
SO_2	7.32	**125 (µg/m³)**
NO_2	6.98	**150 (µg/m³)**
CO	1.55 (mg/m3)	**-**
PM10	29.8	**150 (µg/m³)**
TSP	56.4	**230 (µg/m³)**

6.3 DAY 3

6.3.1 Hourly Concentrations of Gases/CO 8h average

Table 7: Hourly Concentrations of Gases/CO 8h average - Measurement Day 3

Date	Time	SO_2 (µg/m³)	NO_2 (µg/m³)	CO (mg/m³)	CO 8-h ave (mg/m³)
4/2/2020	11:00	7.3	5.5	1.2	1.338
	12:00	6.4	5.9	1.2	
	13:00	7.2	6.1	1.4	
	14:00	7	6.4	1.4	
	15:00	7.5	6.6	1.4	
	16:00	7.7	6.8	1.3	
	17:00	7.1	6.9	1.5	
	18:00	7.5	6.1	1.3	
	19:00	4.7	5.9	1.4	1.413
	20:00	7.8	5.8	1.4	
	21:00	7.6	5.6	1.4	
	22:00	7.8	6.3	1.5	
	23:00	7.5	6.4	1.3	
	24:00	7.3	6.8	1.5	
5/2/2020	01:00	7.7	6	1.4	
	02:00	8.4	7.2	1.4	
	03:00	7.8	6.2	1.9	1.475
	04:00	7.5	5.4	1.7	
	05:00	7.7	5.7	1.4	
	06:00	7.5	6.4	1.2	
	07:00	4.9	7.1	1.5	
	08:00	7	6.2	1.6	
	09:00	7.5	6.1	1.2	
	10:00	6.6	7	1.3	
Limit Values 1-h average		**300**	**300**	**30**	**10**

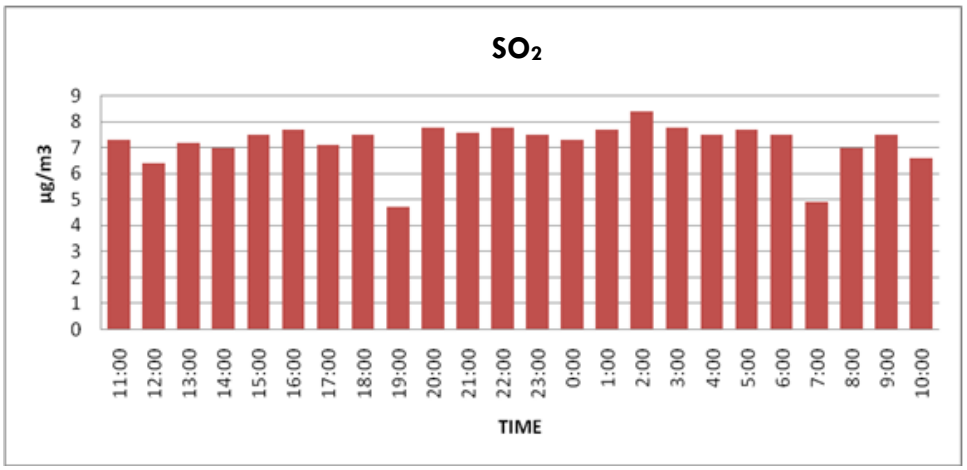

Figure 10: SO_2 Measurements Day 3

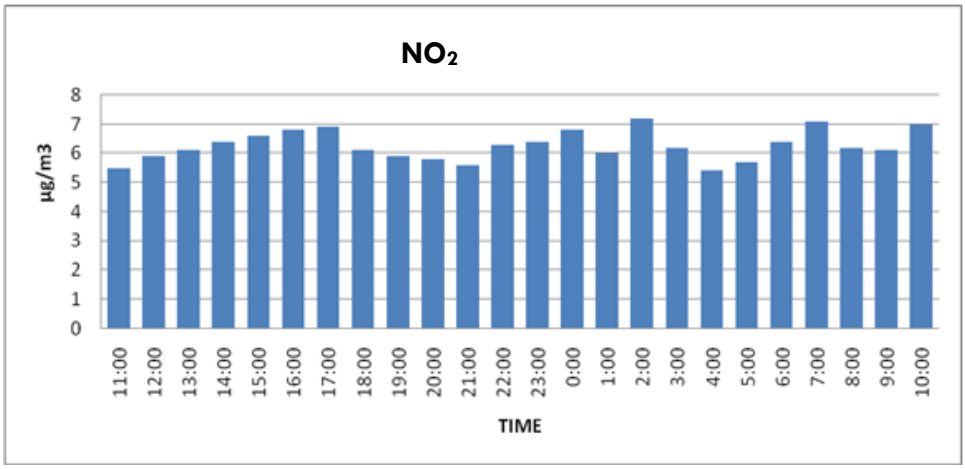

Figure 11: NO_2 Measurements - Day 3

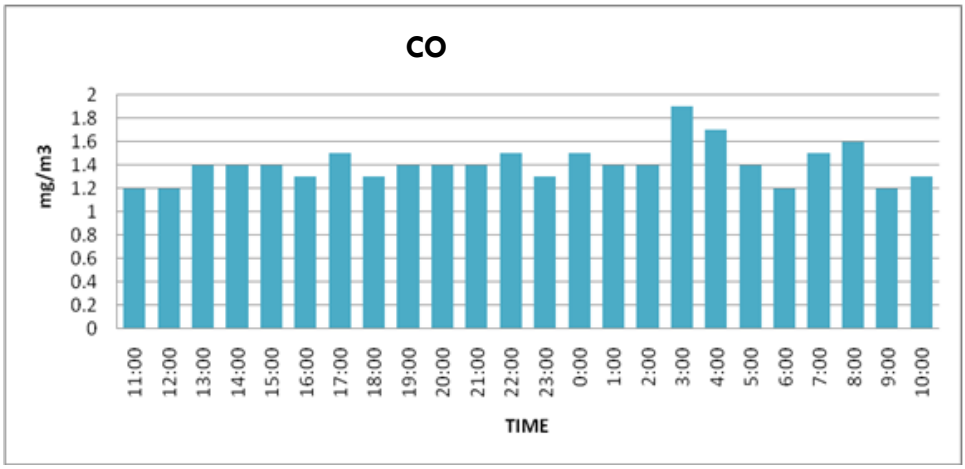

Figure 12: CO Measurements - Day 3

6.3.2 24 -hour Average Concentrations of Gases and Dust

Table 8: 24 -hour Average Concentrations of Gases and Dust - Measurement Day 3

Pollutant	Concentration (µg/m³)	Limit Values
SO_2	7.21	**125 (µg/m³)**
NO_2	6.27	**150 (µg/m³)**
CO	1.41 (mg/m3)	**-**
PM10	26.2	**150 (µg/m³)**
TSP	53.8	**230 (µg/m³)**

6.4 Ozone Measurements Results

Ozone has been measured in the same location 10 times at different times of day, resulting in the following values:

Table 9: Measurement Results for Ozone

Day / Measurement	Time			
Day 1	**9 am**	**1 pm**	**6 pm**	**10 pm**
Measurement, ppm	0.0001	0	0.0002	0
Day 2	**10 am**	**4 pm**	**11 pm**	
Measurement, ppm	0	0.00012	0	
Day 3	**11 am**	**5 pm**	**11 pm**	
Measurement, ppm	0.0003	0.0004	0	

Ambient standards for 1h average: 180 µg/m³ ≡ 3.1ppbv =0.0031 ppmv

7. SUMMARY AND CONCLUSIONS

- The prevailing wind during the measurement period was northern. The wind speed reached 19.2 km/h. The temperature reached about 24◦C at 3 pm and dropped to 15◦C at 6 am.
- The hourly concentrations of sulfur dioxide, nitrogen dioxide and carbon monoxide were low compared to the limit values mentioned in the law no. 4/1994 - annex no. 5.
- The 24- hour concentrations of sulfur dioxide, nitrogen dioxide, PM10 and TSP during the 3 monitoring days were low compared to the limit values mentioned in the law no. 4/1994 and its amended executive regulations no. 710/ 2012 annex no. 5.
- There is no limit mentioned in law 4/1994 and its amended executive regulations no. 710/2012 to the 24-hour concentration of carbon monoxide. But only 8 h average limit of 10 mg/m^3.
- Peaks and lowest concentrations of SO2, NO2 and CO at the monitoring location are as shown in the following table.
- Ozone is almost undetected

Table 10: Summary of Ambient Air Measurements

Parameter	Peak concentration	Lowest concentration
Day 1		
SO_2	8.4	6.5
NO_2	10.4	6.4
CO	1.6	1.3
Day 2		
SO_2	9.8	6.4
NO_2	9.2	4.3
CO	1.7	1.4
Day 3		
SO_2	8.4	4.7
NO_2	7.2	5.4
CO	1.9	1.2

REFERENCES

- American Society for Testing & Materials (ASTM) methods D3162, D3824, D3686, D3687 and D5337.
- Japanese Industrial Standards (JIS) method B7952.
- EPA Compendium Method IO-2.1 and IO-1.1.