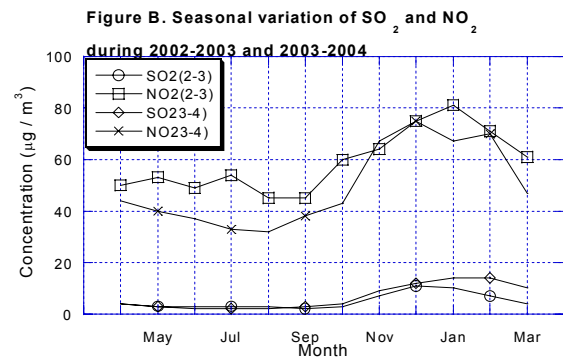
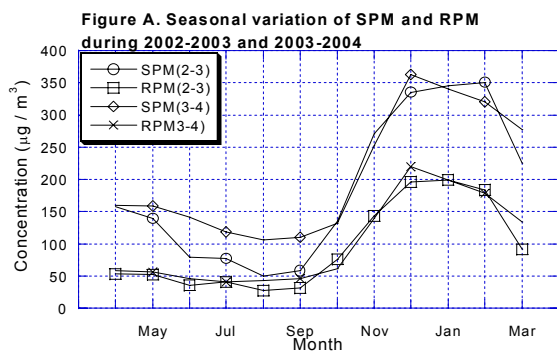


## Report on a study on:

# Impact of Kalipuja-Diwali-2005 fireworks on ambient air quality

## Scope of work

This study was undertaken to identify, if any, the impact on ambient air quality of the festive event of playing of fire-works by the public during the Kalipuja – Diwali days of year 2005. Usually, this festival takes place during a time when the season approaches winter, the climate changes from very wet, humid, hot and windy days of heavy downpore to the days of lesser temperature with much serener northerly winds. It has been noticed that the concentrations of air pollutants in Kolkata maintain it highest of the year during winter (Figures A and B). The trends of the indicator air pollutants (SPM, RPM,



SO<sub>2</sub> and NO<sub>2</sub>) are found to have a steep rise in the recent years. For an analysis, the following air quality standards are used.

Parameters	National Ambient Air Quality Standard for Residential Area
SPM	140 (µg/m <sup>3</sup> )
RPM	60 (µg/m <sup>3</sup> )
SO <sub>2</sub>	60 (µg/m <sup>3</sup> )
NO <sub>2</sub>	60 (µg/m <sup>3</sup> )

## Methodology & Approach

The ambient air quality of Kolkata is being monitored by the WBPCB through a network of seventeen (17) fixed monitoring stations distributed in the city. These stations were identified keeping in mind all possible air quality conditions existing in the city, and are thus representative of the air quality which is breathed in by the city dwellers.

It is well known that playing with fire-works is a conscious activity. The person playing the fire-works is nearest to the place of incident and thus is the worst exposed individual so far as the

impact of the pollutants out of the fire-works on humans is concerned. The people actively taking part in the event are most vulnerable for the detrimental effects of the air pollutants out of the fireworks. Firework thus is a localized activity, and it is important to ascertain if the people leaving around and not willingly involved in the activity of fireworks, are being directly affected or not. The instant study during the Kalipuja-Diwali period of 2005 was undertaken to verify this proposition. For this purpose, a big housing complex, such as Bengal–Ambuja Housing Complex, situated at the south-astern extreme of the city on North-Eastern by-pass lived by approximately 3,500 people (about 700 families) was chosen as a model system. The housing has tall 13 storied buildings distributed in a circular manner with a big open space and greenery in between where only playing of fireworks is allowed by the housing management. Air quality was measured for the indicator pollutants (e.g., SPM, RPM, SO<sub>2</sub> & NO<sub>2</sub>) at the Ground and Fourth floor of this housing, and the study period spanned both the events of Kalipuja (01 Nov) and Diwali (02 Nov) for the year 2005.

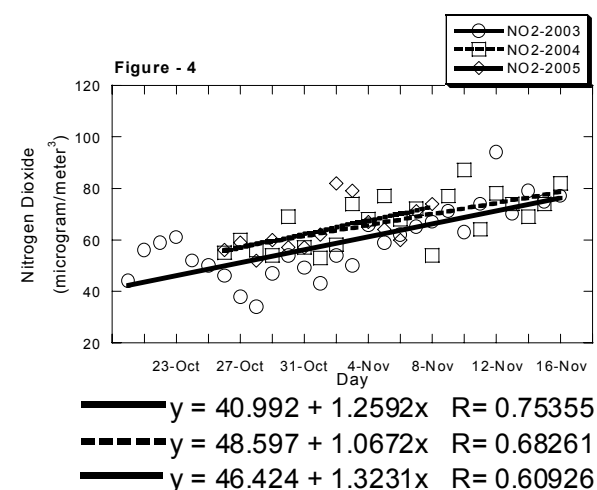
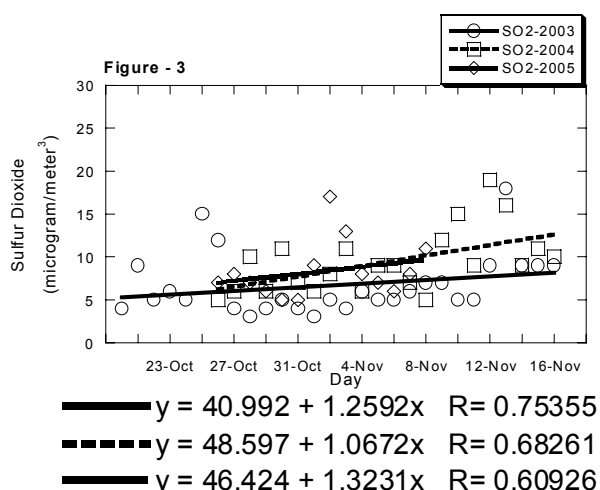
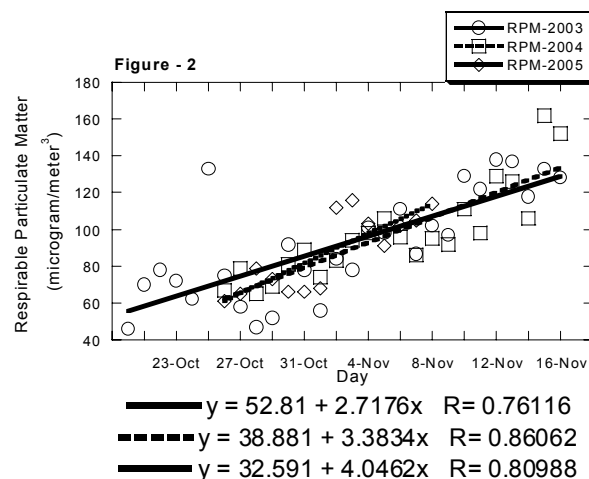
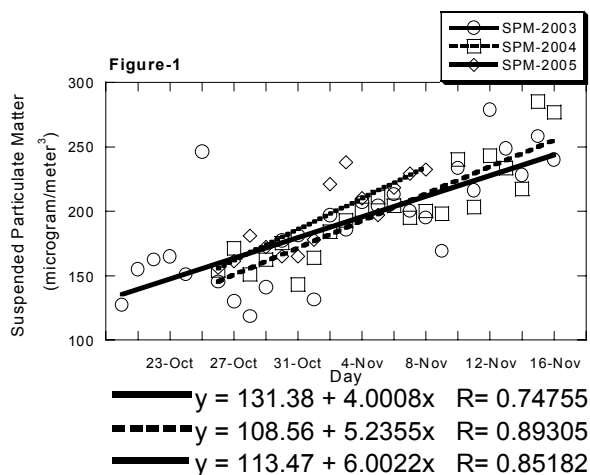
### **Findings of the Study**

Analysis through graphical representation of the data obtained experimentally is used for interpretation, and the trend lines for the behavior of the pollutants were constructed through 'linear least square' fitting of the data. The finding of the analysis of the data are summarized below and results and their analysis are presented in the annexure.

- As regards ambient air quality (for the parameters SPM, RPM, SO<sub>2</sub> and NO<sub>2</sub>), no special behavior around those days (e.g., 31 Oct to 04 Nov, 2005) could be observed. This indicates a little influence of the event(s) on the ambient air quality.
- The ambient air quality behaved in normal way during this time of the year, and was found to have not been impacted by the playing of fireworks.
- The quality of air in a close proximity of the activity appears to be adversely affected.

The observation presented here is that from a model study at only one place in the city. The results obtained thus are not statistically significant. Further, conclusive statements can not be made in absence of specific health impact studies.

Figures 1, 2, 3 and 4 (respectively for SPM, RPM, SO<sub>2</sub> and NO<sub>2</sub> respectively) show the distribution of daily fluctuations and their general trends for the averaged ambient air



The figures above represent the general variation of the standard air pollutants during the period of onset of winter in Kolkata for years 2003, 2004 and 2005. The trend lines for the pollutants drawn with least square fitting are Year 2003 (continuous line), Year 2004 (dashed line) and Year 2004 (dotted line). The trend lines for the individual pollutants are found to be of great agreement to each other over the years. The linear least square fit equations and the corresponding correlation coefficients are presented with the plots for reference.

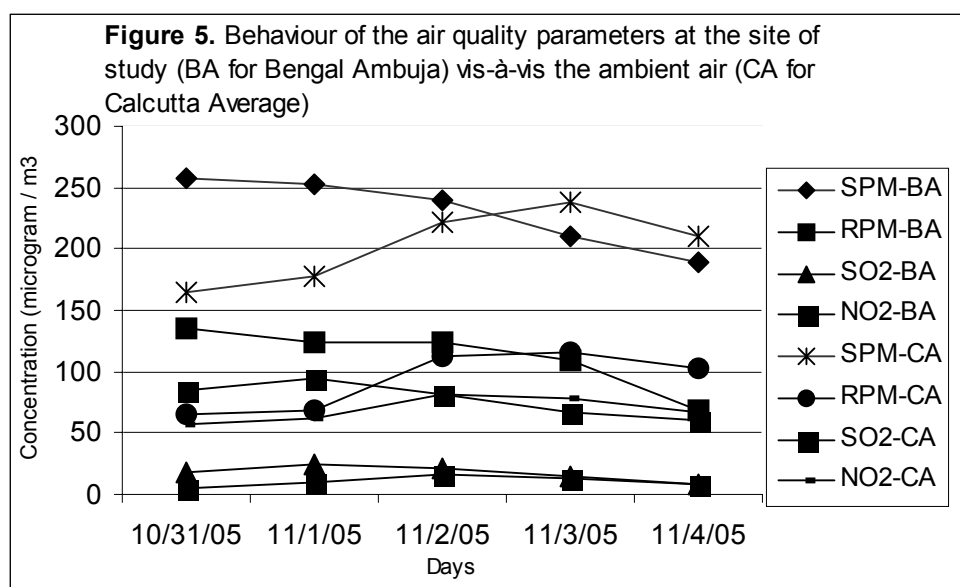
quality of the city. The air quality data presented here are the daily averages of the same measured by the WBSEB in 17 different locations of the Kolkata Metropolitan City area according to the guidelines of the Central Pollution Control Board and the time period of the data presented here was chosen to be 20<sup>th</sup> October to 16<sup>th</sup> November for the years 2003, 2004 and 2005 to include the days of Kalipuja for those years. Kalipuja took place on 24<sup>th</sup> Oct on 2003, 11<sup>th</sup> Nov on 2004 and 01<sup>st</sup> Nov on 2005. The divergence of the data presented here and the trend lines were found not to show any special behavior around those days indicating a little influence of the event on the air quality. The pollutants monitored were found to behave in normal way during this time of the year and was not found to confront any perturbation from the

playing of fire-crackers during Kalipuja – Diwali which could be interpreted, putatively, to impair the air quality to the extent that could have serious negative bearing on human health.

Table 1. Daily averages in microgram per meter cube of the air pollutants at the monitoring station Ground Floor (GF) and Forth Floor (4F) of the Bengal Ambuja Housing Estate.

	SPM-GF	RPM-GF	SO2-GF	NO2-GF
31-Oct-05	257	135	17.3	84.7
01-Nov-05	252.3	123.3	25	95.3
02-Nov-05	240.3	124.3	22	82.17
03-Nov-05	210.67	109	14.5	67
04-Nov-05	188.5	68	8.75	60.75
	SPM-4F	RPM-4F	SO2-4F	NO2-4F
31-Oct-05	226.5	112.5	11.67	72.67
01-Nov-05	217.67	107.67	19	78.5
02-Nov-05	199	98	16.67	71.17
03-Nov-05	170	89.3	11.3	63.17
04-Nov-05	161.5	56.5	7	52
	SPM-Kolkata	RPM-Kolkata	SO2-Kolkata	NO2-Kolkata
31-Oct-05	165	66	5	57
01-Nov-05	178	68	9	62
02-Nov-05	221	112	17	82
03-Nov-05	238	116	13	79
04-Nov-05	210	103	8	67

Table 1 above represent the air quality data obtained during the study period mentioned. It is found that the data obtained at the forth floor was less than that at the ground floor for all the parameters which is a natural consequence of diffusion of the pollutants. Plotting of the data for the ground floor presented in figure 5 revealed the following.



The air quality of the housing was influenced by the playing of fireworks. The housing dwellers started playing fireworks from 31 October 2005, the day previous to Kalipuja and continued till the Diwali day. Consequently the parameters reported very high value on 31 Oct (the start day of the study) and 01 & 02 November represented by the BA marks while those marked CA and representing the Kolkata average data reported lower values. The air quality, as measured through all the four parameters, smoothed out and both the BA and CA marks became parallel stopping of the firework playing beyond 02 November. The effects observed here are at one single place and analyzable for statistical significance for the causal relationship. Further, the differences in data, especially for the gaseous pollutants, were not pronounced enough and the

difference observed here could have happened at any other station on any other day due to natural and non-specific variations. Further, detailed study at statistically significant number of stations associated with corresponding health effect study is required for conclusive causal correlation between the event(s) and the air quality. However, being a model study, It can be concluded from the observations that the quality of air appears to have an influence of fireworks in a close proximity of the activity. The individuals close to the place of fireworks are receiving very high exposures of the pollutants and thus playing of fireworks in an ill ventilated place should be avoided.