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ASSESSMENT OF AMBIENT AIR QUALITY IN THE SURROUNDING AREA OF COMPOST PLANT, DELHI, INDIA

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ABSTRACT A short-term study was conducted with a view to assess the ambient air quality in the surroundings area of compost plant at Okhla, Delhi. Three selected locations viz., CRRI Campus, Hazi Colony, and Gaffar Manzil were selected during the month of November 2008. The study revealed that 24 hourly average concentration of respirable suspended particulate matter (RSPM) at all selected locations were alarmingly high as compared to National Ambient Air Quality Standards (NAAQS) specified by Central Pollution Control Board (CPCB) 2009, during the study period. The 24 hourly average concentrations of sulphur dioxide (SO_2) and ammonia (NH_3) were within the permissible limits prescribed by the NAAQS. Nitrogen dioxide (NO_2) concentration was found to exceed the permissible limits at all the three locations with percent exceedence ranging between 67%-75%. High concentrations of NO_2 could be due to auto-exhaust emissions on Delhi- Mathura road, burning of LPG gas for domestic use, incinerator stack gases and diesel run electric generator. The concentrations of H_2S were low, which could be due to aerobic nature of waste processing composting plant. The 8 hourly average concentration of CO was quite high at all the three monitoring stations. Percent exceedence of CO levels ranged between 83% - 86%. The localized domestic and automobile emissions in surrounding areas could be the major contributor of CO. The overall assessment of the air quality during the study period at selected locations indicated that the maximum contribution of pollutant responsible for critical Air Quality Index (AQI) values was the respirable particulate matter (RSPM) which fell under the category of severe on majority of the days.

Keywords: Compost Plant, Air Pollutants, Air Quality Index (AQI)

INTRODUCTION

Urbanization, industrialisation, rapid growth of vehicular population, management and handling of huge generated solid waste is presently receiving increased attention in Delhi, India ; due to its significant impact on human health and environment. People living in urban areas are exposed to complex mixture of environmental pollutants due to heterogeneous and spatial distribution of emission sources and meteorological conditions (Mandal et.al 2011). The adverse health impacts caused by air pollutants result in long term reduction of productivity and consequent deterioration of economic conditions. The common symptoms of air pollution are acute and chronic respiratory health effects, mucosal membrane irritation, eye irritation, headache and skin diseases. Besides anthropogenic sources, air pollution due to suspended particulate matter (SPM) is also contributed by natural sources, especially in arid and semi-arid areas. So management of ambient air quality in cities and adjoining areas in India is presently a major concern of the local municipal authorities for protection of public health.

Most of the urban cities in India, approximately 90% of the generated municipal solid waste (MSW) is dumped to landfill location without any treatment. Composting is low cost technology of diverting organic waste from landfill to valuable product of agricultural purposes. Presently a very small fraction 8-9% of generated is used for compost production by various public or private enterprises (Saha et.al 2010).Most of the composting plant in India is not functioning properly, so odour problem is the major problem in and around the composting plant. Exposure to organic dust at composting workplaces is associated with adverse acute and chronic respiratory health effects. Therefore it becomes deemed necessary to assess the ambient air quality status in the affected areas for delineation of preventive as well as corrective actions. CSIR-NEERI carried out the study on assessment of ambient air quality of locations viz., CRRI campus, Hazi Colony, and Gaffar Manzil situated near to the compost plant siteduring the month of November 2008. The study was undertaken with an objective to assess the impact on the ambient air quality in the surrounding residential areas due to compost plant. The findings of the study are summarized in this paper.

MATERIALS AND METHODS

The Study area included the compost plant and three residential locations, identified around the compost plant viz. CRRI campus, Hazi Colony, Gaffar Manzil as shown in Table 1 and figure 1.

Table 1: Location of Air Quality Monitoring Stations

S. No.	Monitoring Station	Location	Area Category	A (m)	B (m)	C
1	Okhla Compost Plant	MCD Office	Industrial	8	4	-
2	Central Road Research Institute (CRRI)	Traffic & Road Safety Division Building	Residential/ Institutional	400	7	SW
3	Hazi Colony	H/O- Md. Sariq, G-47, Hazi Colony	Residential	200	8	E
4	Gaffar Manzil	H/O- Md.Umaruddin. H. No. 349, Street 13, Gaffar Manzil	Residential	350	6	NE

A: Approx. Distance from Boundary Wall of Compost Plant
B: Approx. Height above Ground Level
C: Direction of Monitoring Station from Compost Plant

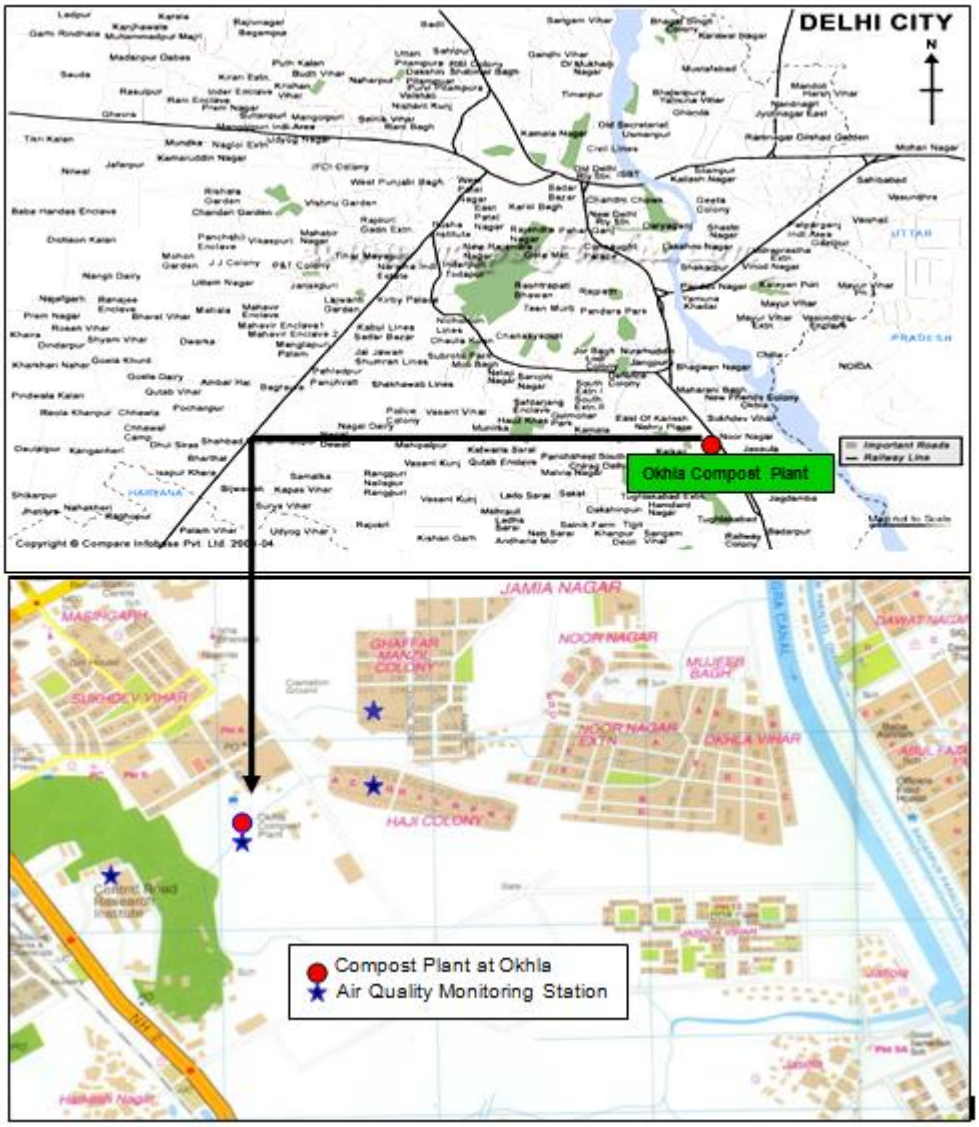


Figure 1: Location of Air Quality Monitoring Stations

The 24-hourly ambient air quality monitoring was carried out thrice a week for a period of four weeks, during the month of November, 2008. The prevailing wind direction was north-west during the study period. The wind rose during the study period as shown in figure 2.

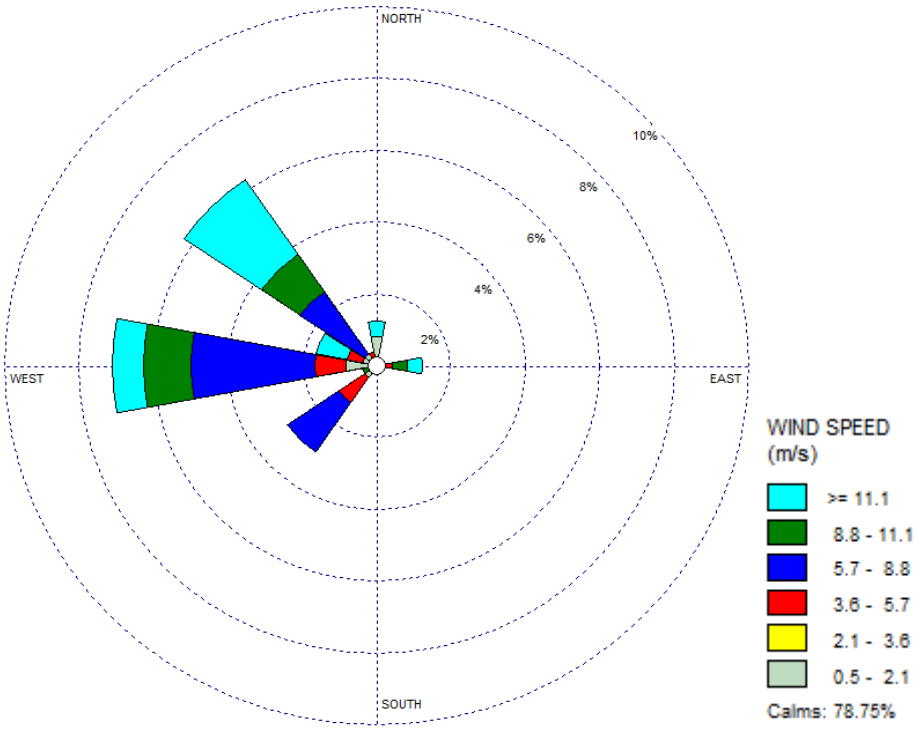


Figure 2: Wind rose during the month of November 2008.

METHOD AND METHODOLOGY

The air parameters included during the study period were RSPM, SO_2, NO_2, NH_3, H_2S, $CH_4$and CO. RSPM (<10 µm) was measured using Respirable Dust samplers by using cyclonic separator of particles. Gaseous parameters, viz. SO_2, NO_2, NH_3, and H_2S were collected in absorbing solutions placed in Midget impingers and analysed in the laboratory using standard wet chemical techniques. CO samples were collected at sites in tedlar bags of 10L capacity using low-volume air pumps of SKC make. CO was analysed with CO analyser model APMA-370 of Horiba Ltd., Japan based on NDIR method. Monitoring was carried out at four sites round the clock on 12 days spaced over four weeks during November. RSPM samples were collected on 24 hourly, and CO was collected on 8 hourly basis. Percent Exceedance' values for different parameters have been computed as the percentage of number of observations for which the concentration of a parameter exceeds the limit prescribed for that parameter in NAAQS 2009. The air quality index (AQI) of selected locations were estimated using IND-AQI (Sharma et al., 2003, 2001) with the formula as given below

$$\boldsymbol{IP} = [(\boldsymbol{IHI} - \boldsymbol{ILO})/(\boldsymbol{BPHI} - \boldsymbol{BPLO})]\, \boldsymbol{x}\, (\boldsymbol{CP} - \boldsymbol{BPLO}) + \boldsymbol{ILO},$$

Where IP is AQI for pollutant "P" (Rounded to the nearest integer),

CP the actual ambient concentration of pollutant "P"

BPHI the upper end breakpoint concentration that is greater than or equal to

CPBPLO the lower end breakpoint concentration that is less than or equal to CPILO the sub index or AQI value corresponding to BPLO IHI the sub index or AQI value corresponding to BPHI

There are six AQI categories, namely Good, Satisfactory, Moderately polluted, Poor, Very Poor, and Severe. The proposed AQI will consider eight pollutants (PM_{10}, $PM_{2.5}$, NO_2, SO_2, CO, O_3, NH_3, and Pb) for which short-term (up to 24-hourly averaging period) National Ambient Air Quality Standards are prescribed. Based on the measured ambient concentrations, corresponding standards and likely health impact, a sub-index is calculated for each of these pollutants. The worst sub-index reflects overall AQI.

RESULTS AND DISCUSSION

A four-week short-term study was conducted with a view to assess the ambient air quality around the aerobic waste processing plant (Compost Plant) at Okhla, Delhi. Assessment of the air quality data revealed that the 24 hourly concentration of respirable particulate matter (RSPM) exceeded the standard limits on all the monitoring days at almost all monitoring locations (Figure3). The main emission sources expected to be domestic sources, auto exhaust and waste processing activities of compost plant. The movement of traffic on the road, adjoining the compost plant seems to be significantly contributing the dust and smoke in association with emissions from stacks of biomedical waste incinerator (Mandal et.al.2011).

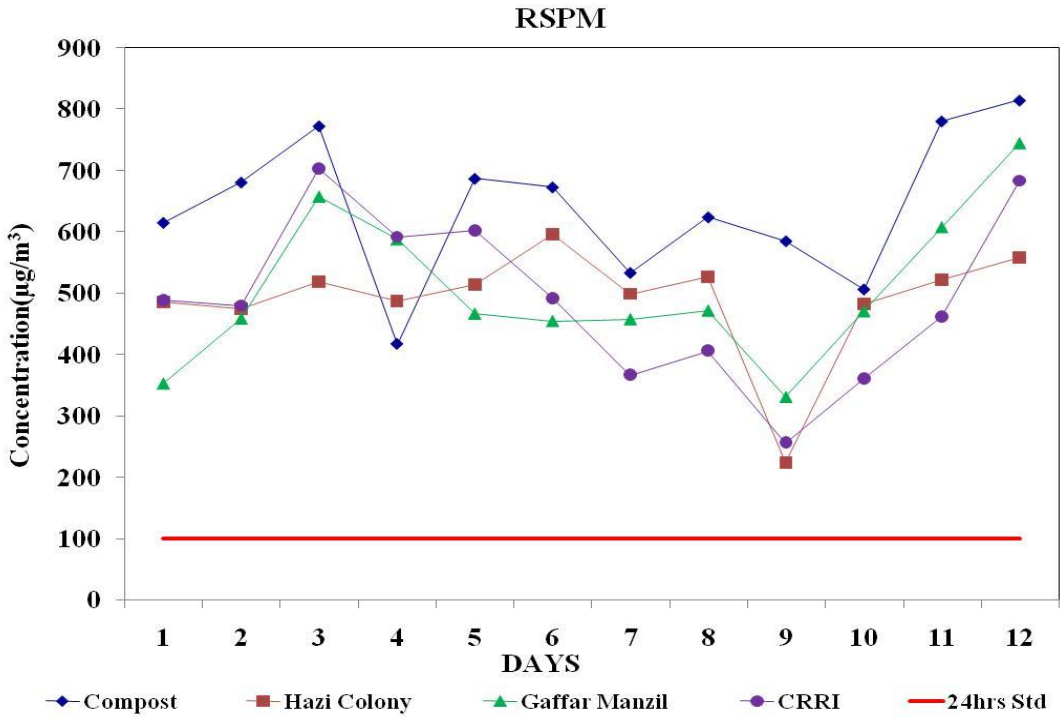
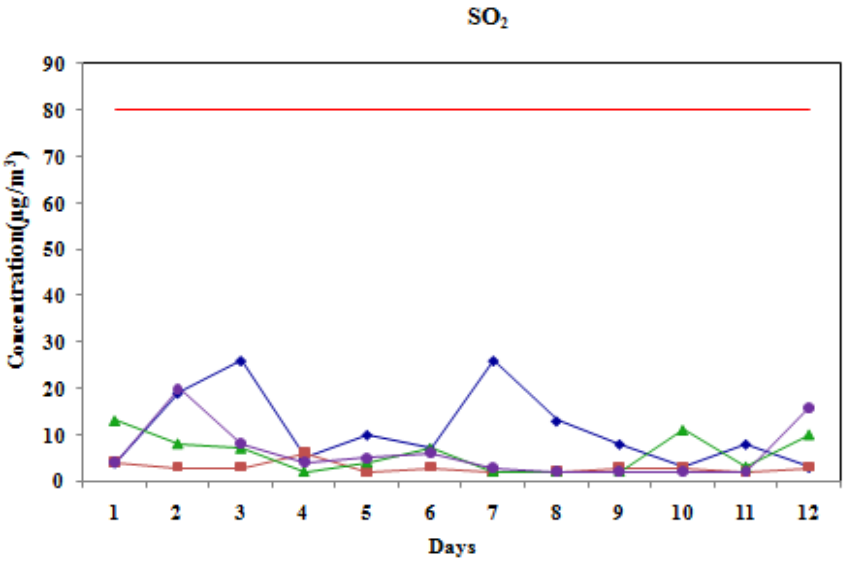


Figure3: Concentration of RSPM at different locations in and around compost plant.

The 24 hourly average concentrations of SO_2 and NH_3 were within the permissible limits prescribed by NAAQS (Figure4). This could be attributed to non-existence of any major source contributing these pollutants significantly. Low sulphur fuels such as LPG was mainly used for cooking in nearby surrounding residential localities. The 24 hourly average NO_2 concentration exceeded the NAAQS at all selected stations, with % - exceedance ranging from 67% to 75%.The burning of domestic LPG gas, auto-exhaust emissions on busy Delhi- Mathura road, incinerator stack gases and diesel operated electric generator could be major cause for high concentration of NO_2. In general low C: N ratio of prepared compost and alkaline pH might accelerate the formation of ammonia or nitrous oxides in the ambient air, resulted in odour problem in the surrounding area of compost plant. The increase in concentration of ammonia trace gas (>27 ppm) emission to the ambient air, correspond to an increase in the compost pile temperature (35 - 60^oC) and alkaline pH levels (7 - 8.8) (Omrani et al. 2004).

The 24 hourly concentrations of H_2S ranged between 1.0-5.1µg/m^3 with an average of 2.02 µg/m^3 ±1.13 at compost plant location; 1.2-2.0 µg/m^3 with an average of 1.6µg/m^3 ±0.3 at CRRI ; 1.0-13.0 µg/m^3 with an average of 4.6 µg/m^3 ±3.8 at Hazi colony and 1.0-13.0 0 µg/m^3 with an average of 6.4 µg/m^3 ±4.1 at Gaffar Manzil locations respectively.



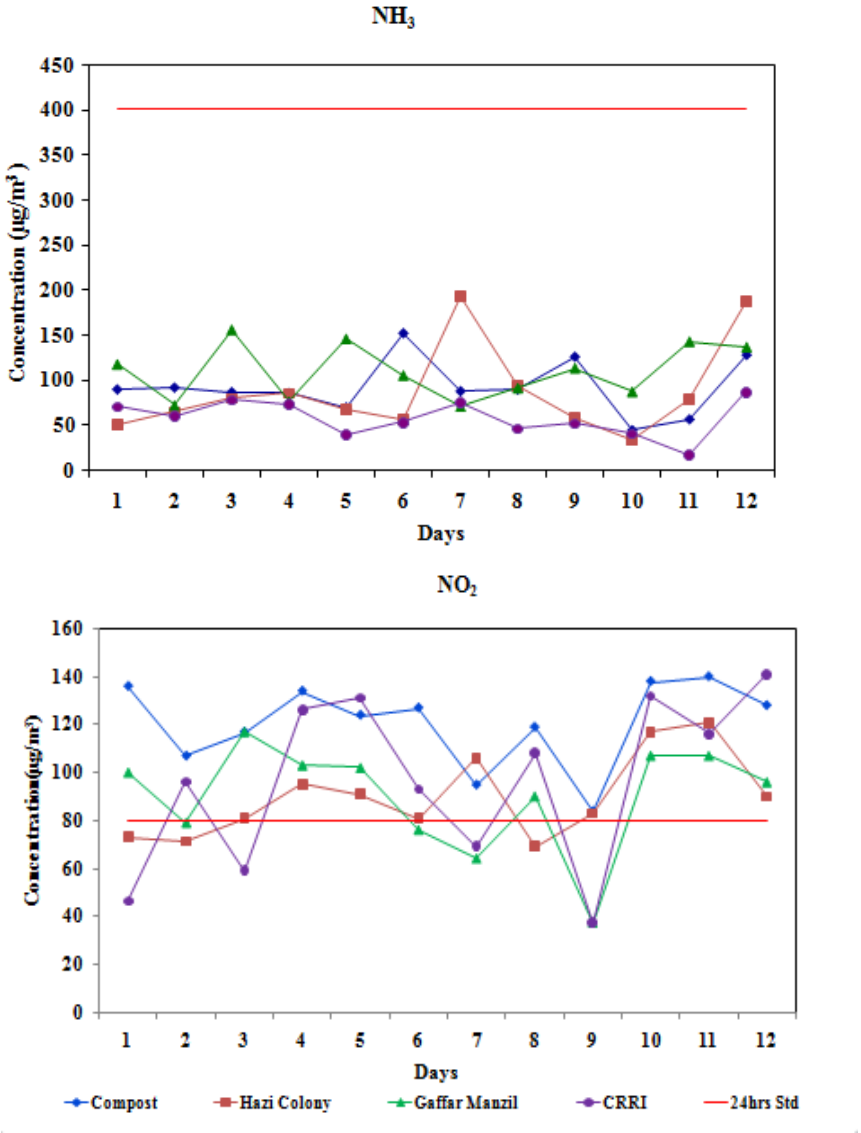


Figure 4: Concentration of SO_2, NH_3, & NO_2at different locations in and around compost plant.

The average concentration of H_2S was very low as compared to EPA standards (401 KAR 53:010) could be due to efficiently working of aerobic composting plant viz., Okhla compost plant (OCP), Delhi. However, the nearby Okhla sewage treatment plant could contribute to H_2S concentration occasionally. Concentration of H_2S at Hazi colony and Gaffar Manzil locations were observed to be higher as compared to OCP, Delhi could be due to open drains carrying wastewater and unhygienic sanitary conditions prevailing in those areas and meteorological condition.

The 8 hourly average concentrations of CO exceeded the NAAQS at all the three monitoring locations (Figure5). Percent of exceedance of CO concentration at CRRI, Hazi Colony and Gaffar Manzil were observed higher ranged in between 83% - 86% of NAAQS. The exceedance of CO probably due to localized emission of CO in the surrounding areas.

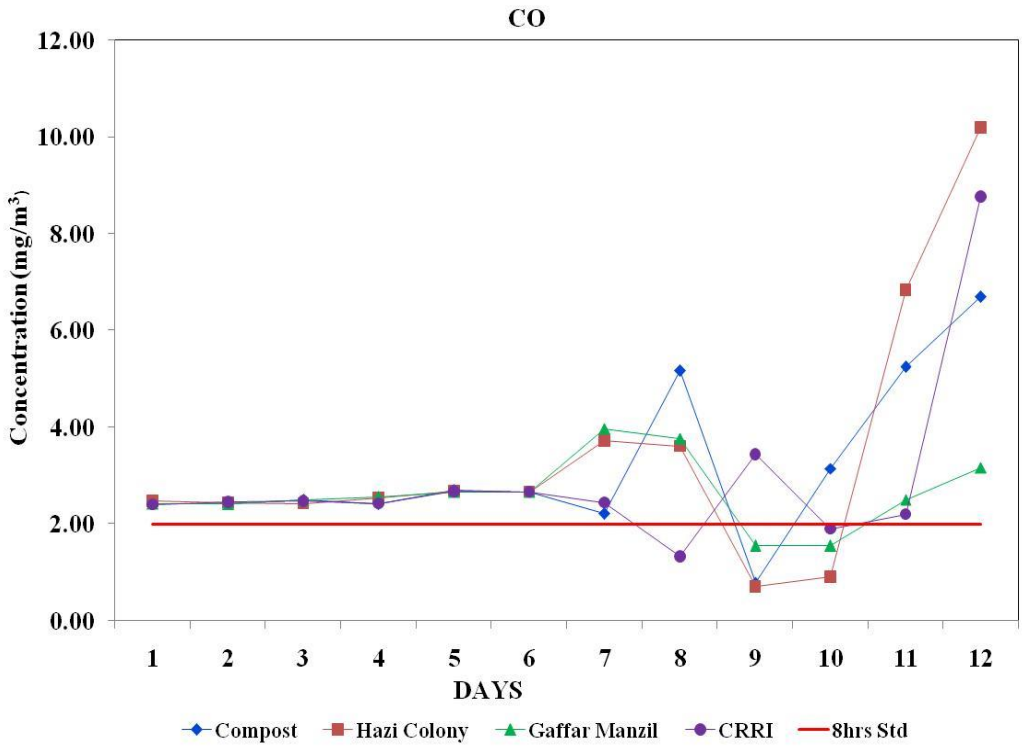


Figure5: Concentration of CO at different locations in and around compost plant.

Air quality index (AQI) for all the locations were estimated for 24 hourly average concentrations of selected parameters RSPM, SO_2, NO_2, $NH_3$and 8 hourly average concentration of CO (Figure6). It was observed that the AQI values with respect to gaseous parameters i.e. SO_2andNH_3fell under the category of good; $NO_2$and CO fell under the category of good to moderate respectively at all locations. RSPM showed AQI values in the category of severe in the maximum days during the study period. The category of severe varied between 8-11 days at all monitoring locations in case of RSPM. The overall assessment of the air quality during the study period at selected locations indicated that the maximum contribution of pollutant responsible for critical Air Quality Index (AQI) values was the respirable particulate matter (RSPM) which fell under the category of severe on majority of the days.

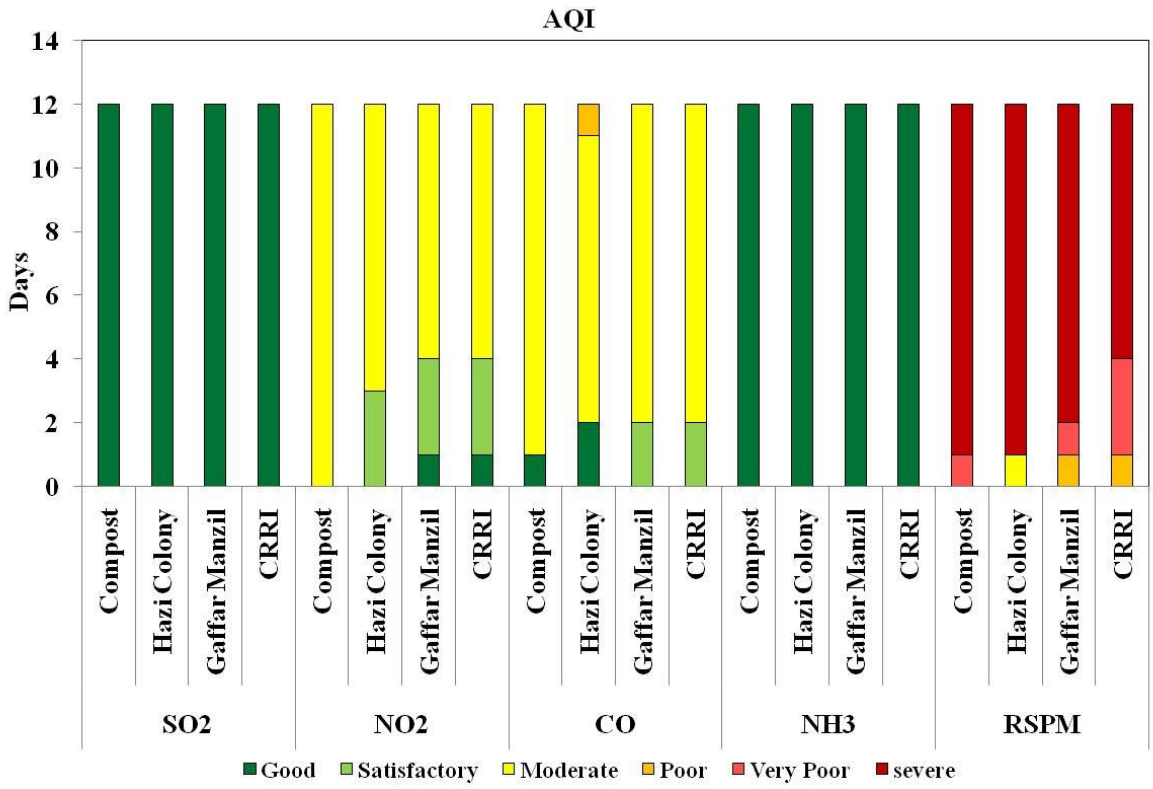


Figure6: Summary of AQI Values for different locations in and around compost plant

CONCLUSION

The assessment of ambient air quality with respect to AQI at surrounding areas of OCP, Delhi India indicates that air quality was severe, during the study period, due to emissions of high particulate matter. It is a grave problem in Delhi city due to arid climatic condition. Improving hygienic sanitary condition, development of adequate green belts with dust capturing plant, frequently sprinkling of water on local roads will improve the ambient air quality in the surrounding areas of compost plant.

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