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Assessment of Ambient Air Quality Status of Industrial Complex, Balasore City, Orissa

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Abstract

The district Balasore holds a key place in Odisha's economic arena. Ambient air quality with respect to SPM, SO_2 and NO_2 are monitored in different areas of industrial zone of Balasore. The parameters were monitored during 2012 and 2015in three different seasons except rainy season and concentrations of these gaseous pollutants were analyzed. Maximum, minimum, values along with standard deviations and mean deviation were calculated for the monitoring parameters for each station and the results were discussed in the present study. In most of cases it was observed that the SPM concentration was higher than the permissible limits of AAQ standard and SO_2 and NO_2 concentrations were found to be an alarming state. In the post monsoon and summer season the concentrations were lower than winter season. The data indicates how concentrations were increasing day by day. The data revels that Balasore city is under the alarm state of air pollution. Mostly various industrial activities as well as vehicular pollution causes increasing air pollution in Balasore town. The present study will help for a better environmental management practice to control air pollution load in the city of Balasore.

Keywords: SPM; SO_2; NO_2; AAQ: Ambient Air Quality Standard

Abbreviations: NEDA: 1-Nephtyl Ethylene Diamine Dihydro-Chloride; ESP: Electrostatic Precipitation; GCT: Gas Clearing Plant; NGO: Non Government Organization; AAQ: Ambient Air Quality Standard

Introduction

Now a day the ambient air quality is gradually detoriated due to growing population and increasing urbanization. Air pollution is an increasing problem that affecting the health of human beings and animals causing damage to vegetation and materials. This needs to be the proper control technology to minimize air pollutant concentrations, so that they are within the threshold limit and pose no threat to human health [1,2]. A World Bank report (May1992) has warned that as many as many city dwellers in developing countries will be exposed to unhealthy and dangerous levels of air pollution by the end of the century. Air pollution is posing disastrous health problems in some of the biggest cities of the world and has now become an inescapable part of urban life everywhere [3,4]. Due to the complicity of the industry and manmade activities a lot of pollution is being generated in the township areas and is increasing day by day with the density of township [5]. In urban areas with the constant increase in high grade highway mileage and the significant improvement in production technology of the high speed diesel engine and increasing need for heavy duty trucks for transportation, the number of diesels vehicles is increasing which resulted the increase in smoke emission to vehicular pollution in township areas. Here the present study was proposed to estimate the air pollution load in term of SPM, oxides of Sulphur and oxides of nitrogen at different stages inside the Balasore town which are heavily crowded and one of the major city in Odisha [6,7].

Objectives of the Study

a) To investigate the air quality of the industrial area of Balasore

b) To examine the pollution load of the Balasore.

c) To examine the comparative study of the air pollutants and its correlation with national ambient air quality standard to evaluate the degree of pollution.

Study Area

The area selected for the study is Balasore city which is situated in the state of Orissa in eastern part of India. Balasore is one of the coastal district of Orissa lies on the northern part of the state. The region is bounded by latitude 21º32'30''N and longitude 8º49'37''E. Balasore city started industrialization after 1980 and the rapid industrialization is due to the easy availability of land, communication, manpower, water and moreover very nearer to Kolkata city which is one of the major business center of India. The town is divided into four industrial sectors such as

Balgopalpur, Ganeshwarpur, Chhanpur and Somanathpur. Some major industries like ISPAT Alloys, Oriplast, Emami paper mill, Gas bottling plant etc. are growing in the industrial estate along with the number of medium and small scale industries. The study area experiences moderate type of monsoon climate. Rainfall is observed between June to September. Normal rainfall was reported to be 1500mm; the relative humidity is 55% during June to September, 28% in October to March and 20% during April to May. The highest temperature in the summer season is 45ºC and lowest temperature is 15ºC in the month of January. The soil quality of Balasore is reported as transported alluvial soil. The soil is highly suitable for paddy cultivation. Hence the main crop of the area is paddy (Table 1).

Table 1: Location of monitoring stations.

Sl No	Site	Nature of Area	Location
A1	Somnathpur	Residential	This study area is 8km distance from the epicenter with south directed. The population is about 4,200. Ground water is the source of water resources. The pollution contributing activities are vehicular, commercial, industrial and domestic activities.
A2	Ispat Alloys	Industrial	8kms distance from the epicenter with south direction. Total population of the area is 3800. This area is also a pollution contributing site; the pollution contributing factors are unpaved roads, vehicular, commercial and industrial activities. Environmental settling: industrial, residential and stone crushers.
A3	Emami paper mill	Industrial	10kms distance from the epicenter with south direction. This area is an industrial as well as residential area. The total population of this area is 3200. The pollution generating sources are unpaved roads, vehicular, commercial and industrial activities.
A4	Remuna Chhak	Residential	5kms distance from the epicenter with SSE direction. The population is about 2,300. Ground water is the main source of water resource. The polluting factors are unpaved roads, vehicular, commercial, agricultural and domestic activities.
A5	Birla Tyre	Industrial	2kms from the epicenter. This area is an industrial site. This industry used the carbon containing raw materials which exhausts polluting gases and this site is also a vehicular polluting site.

Materials and Methods

Air quality monitoring stations were selected keeping in view, point source of pollution generation and dominant wind direction prevailing in the area [8,9]. Monitoring is carried out to study the existing air quality status from selected monitoring stations. Continuous monitoring of SPM, SO_2 and NO_2 is done for a period of one month in three seasons (summer, monsoon and winter) in the year 2012 and 2015. During each season monitoring is carried out for 4 weeks at the rate of 24 hours per samples, twice in a week in the three seasons of the study period [7]. For monitoring of ambient air quality High Volume Air Sampler APM-460 (Enviro tech make) has been used. GF/4 glass micro filter paper has been used for monitoring of SPM (suspended particulate matter). The SO_2, NO_2 has been monitored through high volume air sampler, attached with gas sampler [10,11]. The SO_2 pollutant has been monitored through sodium- tetrachloromercurate and analyzed by adopting West Gaeke spectrophotometric method. Similarly, NO_2 has been monitored through Sodium Arsenate solution as absorbent and analyzed by spectrometers by using phosphoric acid sulphamlamide, hydrogen peroxide and NEDA (1-nephtyl ethylene diamine dihydro-chloride) through spectrophotometer [12,13].

Standard methods are used for analysis of pollutants. The collected data were compared with the CPCB ambient air quality standard [9]. The data identified and quantified the various pollutants present in the atmosphere in Balasore city. The results were compared by calculating maximum, minimum and standard deviation. Assessment of the result of SPM, SO_2 and NO_2 will explain the extent of pollution at Balasore city, which will enable us for thinking for alternative air pollution control strategies or pollution control measurement for a sustainable city [14,15].

Results

Ambient Air Quality Status at Different Sampling Stations During Different Seasons 2012 (Tables 2-4).

Table 2: Concentration of SPM in μg/m^3.

Sampling Station	Winter Season			Summer Season			Post Monsoon Season		
	Range	Mean	SD	Range	Mean	SD	Range	Mean	SD
A1	510.2-516.97	512.97	2.17	462.89-473.5	467.42	4.08	248.45-255.49	251.57	2.48
A2	82767-832.49	830.07	1.72	724.29-738.2	730.44	4.51	338.3-346.19	341.68	2.49
A3	763.48-773.43	786.36	3.39	621.87-633.3	627.71	3.96	310.3-324.68	314.84	4.26

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A4	437.78-448.58	442.48	3.47	422.78-430.54	427.06	2.48	306.53-312.34	309.13	2.13
A5	568.67-577.2	572.31	2.63	494.54-512.62	504.23	3.51	315.89-326.98	320.1	3.55

Table 3: Concentration of SO_2 in µg/m³.

Sampling Station	Winter Season			Summer Season			Post Monsoon Season		
	Range	Mean	SD	Range	Mean	SD	Range	Mean	SD
A1	21.78-27.68	24.28	2.04	9.32-20.11	14.75	3.54	4.72- 9	6	1.31
A2	31.39-39.65	35.02	2.81	33.84-40.65	37.26	8.18	5.88-11	8.79	1.51
A3	20.33-28.86	23.95	2.91	23.56- 36.22	23.56	8.76	5.34-10.55	7.01	1.60
A4	17.67-24.74	20.79	2.27	18.32-28	24	3.22	2.98-8.33	4.41	1.71
A5	33.18-40.68	37.77	2.44	38.22-49.93	43.92	3.64	6.33-14.33	10.32	2.45

Table 4: Concentration of NO_2 in µg/m³.

Sampling Station	Winter Season			Summer Season			Post Monsoon Season		
	Range	Mean	SD	Range	Mean	SD	Range	Mean	SD
A1	51.43-63.66	56.73	3.85	50.48-59.3	54.13	2.87	11.35-18.65	14.59	2.25
A2	54.77-64.32	59.13	3.20	50.46- 63.0	56.12	4.29	25.69-33.43	29.08	2.84
A3	43.2-49.33	47.22	2.20	44.72-57.32	50.98	4.64	17.57-28.45	22.28	3.80
A4	37.98-49.54	42.85	3.94	38.32-49.43	44.10	3.57	12.78-19.99	16	2.84
A5	34.6-46.67	40.27	3.93	44.76-55.5	50.46	3.71	16.43-29.76	22.12	4.36

Ambient Air Quality Status at Different Sampling Stations During Different Seasons of 2015 (Tables 5-7).

Table 5: Concentration of SPM in µg/m3.

Sampling Station	Winter Season			Summer Season			Post Monsoon Season		
	Range	Mean	SD	Range	Mean	SD	Range	Mean	SD
A1	545.3-556.19	551.34	3.87	448.89-476.5	462.54	5.73	325.45-355	340.23	4.95
A2	858.67-869.53	863.82	5.12	744.43-757.76	750.32	4.21	627.3-637.83	633.76	4.24
A3	783.41-797.33	790.42	5.35	627.81-639.5	633.54	3.98	550-562.53	556.84	5.14
A4	458.78-469.58	463.32	3.89	407.38-417.84	412.06	4.4	373.53-385.29	379.19	4.34
A5	622.67-649.32	637.31	5.76	609.75-619.97	615.59	4.25	515.89-526.98	520.3	6.36

Table 6: Concentration of SO_2 in µg/m³.

Sampling Station	Winter Season			Summer Season			Post Monsoon Season		
	Range	Mean	SD	Range	Mean	SD	Range	Mean	SD
A1	26.7-35.45	30.88	2.04	14.39-23.15	19.47	3.54	6.55- 12.0	6.33	2.21
A2	34.39-40.62	37	2.81	33.84-40.65	37.26	3.68	8.0-16.33	12.39	2.58
A3	22.44-29.96	26.98	2.91	23.56- 36.22	28.56	8.16	9.34-16.88	13.34	1.90
A4	22.89-29.74	25.79	2.27	18.32-28	24	4.13	5.98-9.33	7.49	1.76
A5	35.89-40.68	38.22	2.12	32.22-34.92	33.53	1.64	10.97-20.89	16.83	2.76

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Table 7: Concentration of NO_2 in μg/m³.

Sampling Station	Winter Season			Summer Season			Post Monsoon Season		
	Range	Mean	SD	Range	Mean	SD	Range	Mean	SD
A1	62.21-73.22	67.73	3.95	54.48-63.55	58.66	2.67	16.35-28.61	20.88	4.24
A2	65.71-77.39	71.44	3.32	59.46- 65	62.62	3.9	29.61-39.49	34.89	3.92
A3	58.2-70.33	64.31	3.20	49.44-60.65	55.78	4.64	23.57-34.41	29.22	3.41
A4	49.96-61.44	55.75	3.97	38.32-49.43	44.10	2.87	19.88-28.98	24.4	2.14
A5	46.6-59.98	53.46	3.73	44.76-55.5	50.46	3.77	24.56-35.70	30.10	3.86

Comparative Data of 2012 & 2015 (Tables 8-15).

Table 8:

Average Concentrations of SPM in Winter Season			
Places	2012 Concentrations	2015 Concentrations	% of Deviation
A1	512.97	551.34	+16.04
A2	830.07	863.82	+4.06
A3	786.36	790.42	+0.5
A4	442.48	463.32	+4.7
A5	572.31	637.31	+11.35

Table 9:

Average Concentrations of SO_2 in Winter Seasons			
Places	2012 Concentrations	2015 Concentrations	% of Deviation
A1	24.28	30.88	+27.6
A2	35.02	37.0	+5.6
A3	23.95	26.98	+12.65
A4	20.79	25.79	+24.0
A5	37.77	38.22	+1.2
Average Concentrations of NO_2 in Winter Seasons			
Places	2012 concentrations	2015 concentrations	% of Deviation
A1	56.73	67.73	+19.4
A2	59.13	71.44	+20.8
A3	47.22	64.31	+36.2
A4	42.85	55.75	+30.1
A5	40.27	53.46	+32.75

Table 10:

Average Concentrations of SPM in Summer Seasons			
Places	2012	2015	% Deviation
A1	467.42	462.54	-1.04
A2	730.44	750.32	+2.7
A3	627.71	633.54	+0.9
A4	427.06	412.06	-3.5
A5	504.23	615.59	+22.08

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Table 11:

Average Concentrations of SO_2 in Summer Seasons			
Places	**2012**	**2015**	**% of Variation**
A1	**14.75**	**19.47**	**+32**
A2	**37.26**	**37.26**	**0**
A3	**23.56**	**28.56**	**+21.22**
A4	**24**	**24**	**0**
A5	**43.92**	**33.53**	**-23.6**

Table 12:

Average Concentrations of NO_2 in Summer Seasons			
Places	**2012**	**2015**	**% of Deviation**
A1	54.13	58.66	+8.36
A2	56.12	62.62	+11.58
A3	50.98	55.78	+9.4
A4	44.10	44.10	+0.0
A5	50.46	50.46	+0.0

Table 13:

Average Concentrations of SPM in Post Monsoon Seasons			
Places	**2012**	**2015**	**% of Deviation**
A1	251.57	340.23	+35.24
A2	341.68	633.76	+85.5
A3	314.84	556.84	+81.94
A4	309.13	379.19	+22.66
A5	320.1	520.3	+62.54

Table 14:

Average Concentrations of SO_2 in Post Monsoon Seasons			
Places	**2012**	**2015**	**% of Deviation**
A1	6	6.33	+5.0
A2	8.79	12.39	+40.95
A3	7.01	13.34	+90.29
A4	4.41	7.49	+69.84
A5	10.32	16.83	+63.08

Table 15:

Average Concentrations of NO_2 in Post Monsoon Seasons			
Places	**2012**	**2015**	**% of Deviation**
A1	14.59	20.88	+43.11
A2	29.08	34.89	+19.97
A3	22.28	29.22	+31.14
A4	16.0	24.4	+52.5
A5	22.12	30.10	+36.07

Discussion

Three season's data were collected and analyzed in two different years (Tables 2-7). It shows the analytical data for SPM, SO2 and NO2 concentrations which ultimately provide the status of air pollution, observed during the year. The data for three seasons revealed that SPM concentration at almost all the monitoring stations exceeds the permissible limit specified by central pollution control board (CPCB) during winter, summer and post monsoon season [11]. The results of different monitoring station are discussed as follows. In the year of 2012 the concentrations of SPM have been tabulated in Tables 2-4. The

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maximum, minimum and mean value exceeds the permissible limits in summer and winter season but in case of post monsoon the concentration is below the CPCB standards. But in the year of 2015 the concentrations of SPM have been tabulated in Table 5-7. The minimum, maximum and mean values exceed the CPCB standards in all the three seasons. The data indicates that the concentration of SPM is increasing in rapid manner in Balasore. The particulate pollution is high in Balasore industrial complex as well as residential zones. The concentration is high mostly due to industrial activities and vehicular pollution. Similarly, the concentration of SO2 and NO2 is higher in 2015 than 2012 data.

In residential areas the concentrations of NO2 is higher than permissible limit so the data indicates that the NO2 pollution load is increased in Balasore city and the SO2 is an alarming state. Rapid industrialization in the developing country like India is inevitable & all these activities generally lead to localized environmental problems in the region which needs to be properly addressed. The Government of India as well as the state Government have been taking many control measures to prevent air Pollution including formulation of a new on revision of the existing policies/ legislations, criteria for setting emission standards for the industries, guidelines for the sitting of industries, Environmental Impact Assessment, Environmental Audits, Adoption of improved pollution control Technologies & Awareness Creation etc. The following recommendations are made to improve the air quality of the Balasore city.

Suggestions and Recommendations

Some of the suggestive features are given below which may be effective to make the environment of Balasore to be human friendly.

Technical Solution

a) Installation & Proper operation of highly efficient pollution control devices like electrostatic precipitation (ESP), Gas clearing plant (GCT) Pulse jet bag filters, cyclone separators etc. in mineral based metallurgical industries.

b) Installation of dry fog systems in crusher & screen house and transfer points of conveyors handling fines in mines & mineral processing units.

c) Adoption of best available clean technology and effective monitoring of the operational efficiency of pollution control equipment and up gradation from time to time.

d) Provision of highs suggestion & rise stalks for better dispersions of the particulate matter thereby resulting in equitable of participate pollutions over a significantly longer area through dilution effect.

e) The wastes should not be discarded directly to the environment because it may pollute air.

f) Reduction of particulate matter in the line source emissions viz, fugitive emissions due to transpiration of raw materials by road by adapting the following measures.

i. Widening & black/concreting the roads used for transportation.

ii. The tailpiece of the Silencer pipe of transporting Vehicle should not be directed towards the road which creates re suspension of road surface to avoid the settled dust of roads from being fugitive.

g) Proper maintenance of vehicles to ensure reduction of emission.

h) To undertake periodic environmental monitoring including source. Inventories for planning and monitoring.

i) Strict implementation of the regulatory mechanism by the statutory authority Vis-sa Vis AAQ monitoring as per the guidelines of the Central Pollution Control Board.

j) To conduct detailed health surveillance of people residing in the vicinity of industries with fixed priority to create baseline data and to establish correlation between air pollution and its impact on human health.

k) Adoption of air pollution management strategies to control the air pollution.

l) Identifying and evaluating alternative strategies.

m) Awareness programmers are arranged by non govt. organization (NGO) to create awareness among people, students and factory workers about the bad effects of air pollution.

n) Road connecting different sectors of the Balasore town and main road inside the industrial area as well as main road of the township should be the well build up either concrete or tarred or hard topped and should be maintained properly throughout the year which will reduce the dust pollution due to vehicular movement.

o) Road side drainage system properly maintained to avoid accumulation of water on the road. Because of accumulated water on the road is not only the cause of destruction of road but also cause of heavy pollution of air.

p) Dust suppression system with water spray and sprinkling systems and also regular cleaning and wetting of the ground within the premises.

q) The premises of industry should have boundary wall of adequate height i.e. shouldn't be less than 5 ft.

r) The crusher unit should be located at least 500m away from national highway and 100m from other roads.

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s) The aerial distance of the nearest point of boundary of the industry should 500m away from prominent public sensitive water body, prominent sensitive workshop/ school/ hospital/archeological monuments.

t) Burning of inorganic solid waste should be reduced, which is generating air pollution or improved the burning process.

u) Old vehicles must be banned which emitting more exhausts to the atmosphere.

Greenbelt Development

The plant species constituting Green Belt of Effective Dust capturing plant species should be developed around industrial units as the Trees can act as efficient biological filters, removing significant amounts of particulate pollution.

From Atmosphere

This is a cost effective technology for controlling air pollution.

Conclusion

Balasore town especially the industrial zones of the town are not safe with respect to air pollution and the high concentration of SPM causes various health problems. The high concentrations of SO2 & NO2 causes a number of health problems and also cause of acid rain nearby that area. Hence steps should be taken urgently to check the pollution load in the town. As suggested in the recommendation chapter the heavily pollution creating industries should be shifted to 25km away from the town to ideally located places. The heavy vehicles running inside the town in day time should be restricted as well as the old vehicles more than 10 years of old should be banned. Road should be made concrete properly. More and more plantation should be done along road sides as well as in vacant places of the town. The small scale and medium scale industries should strictly follow the standard norm of emission. Ambient air quality data reveals high air pollution potential in the concerned project area and surrounding locations. The data will be useful in developing an effective air pollution control strategy for township area as well as industrial area of Balasore town.

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