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Impact of Brick Kiln Emissions on Atmospheric Quality in Chohatta Bazar, Akola District

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Abstract: ***Brick production is a widespread traditional industry across various parts of Asia, and in India, the brick sector, albeit unorganized, holds a significant presence. This study focuses on brickfields in the Akola district's Chohatta Bazar, where over 400 active stack - less brick kilns operate, leading to substantial air pollution during the winter season from October to May. The research aims to monitor the emissions from brick kilns, specifically gaseous pollutants such as PM2.5, PM10, SOX, and NOX, during both operational and non - operational phases. The results revealed that the concentration of PM2.5 and PM10 exceeded the National Ambient Air Quality Standards (NAAQS) during brick kiln operation. However, the levels of SOX and NOX remained within permissible limits. To mitigate air pollution in the study area, the implementation of chimneys and other possible measures to reduce pollution are recommended.***

Keywords: Brick Kilns, Air quality, Particulate Matter, emission.

1. Introduction

Brick kilns play a significant role in the construction industry, providing the essential building material for countless structures around the world. However, their operations are often associated with severe air pollution, posing a considerable threat to both human health and the environment. The emission of pollutants from brick kilns has become a pressing global concern, necessitating urgent attention and action. At the brick kiln of Chohatta Bazar region the energy required for baking 10, 0000 bricks is estimated at 20tonns of coal with calorific value of 20 MJ/Kg and large amount of energy fulfilled by coal (80%) and used other biomass (20%).

Brick kilns mainly use coal, fuel wood, crop residues and animal dung for firing clay brick kiln in developing countries causing huge deforestation. (Syed and Starr 2009). The coal and fuel wood burning will release toxic fumes containing suspended particulate matter rich in carbon particles and high concentration of carbon monoxide (CO), oxides of sulphur (SO), nitrogen oxides (NO), carbon dioxide (CO), fluorides and small amount of carcinogenic dioxins if rubber tyres were used as fuel. These pollutants will create global warming, urban air pollution and series of in the health effects on children's and citizens.

The particulate matter consists of dust, smoke, fumes, and fly ash. They studied the pollutant load within the cluster region of the brick kilns in Bangladesh for SO2 and particulate matter. It was found that particulate matter was a major pollutant in that region (Ahmed and Hussain, 2008).

The brick kiln industry plays important role in the development of respiratory related diseases, there was a significantly higher prevalence of chronic cough (31.8%), chronic phlegm (26.2%), and chest tightness (24.0%) in exposed workers, compared with control workers (20.1, 18.1 and 0%) ($P < 0.05$) and this increased symptom frequency was also documented among non - smokers studied by age and by the length of employment (Zuskin*et. al.*, 1998), The present study aimed to evaluate the different types of air pollutants and identify the impacts in the entire environment around the kiln areas.

2. Materials and Methods

Chhohata Bazar is a village in Akottaluka of Akola District, Maharashtra State, India located at 20°54'57.9"N latitude and 77°00'23.3"E longitude with altitude of 267 meter. It belongs to Vidarbha region, Amravati Division.

To assess the air quality of area by using Portable Gas Sampler. The particulate matter (PM10 and PM2.5) were determined by gravimetric method i. e. air is drawn through a pre weighed glassfibre filter paper on 8 hourly basis for 24 hours. Gaseous pollutants (SO2 and NO2) were collected using an absorbing solution on4 hourly basis for 24 hours by drawing air at a flow rate of 1 LPM. These gaseous pollutants were analyzed by West and Geakemethod (for SO2) & Jacob and Hochheiser method (for NO2). The concentrations of these methods were expressed in µg/m3.

The recorded data were analyzed with scientific manner in Microsoft excel - 2010. Statistical tools applied on data like mean and standard deviation.

Plate No.1: Emission of Air Pollutant

Plate No.2: Coal used as fuel

3. Results and Discussion

After the study it shows that the SPM concentration from all brick kiln were compared and found to be exceeding NAAQS standard. Present investigation show that emission of black smoke in Chohatta Bazar brick kiln. Black smoke and SPM create respiratory problem in workers.

Table 1: Observation for SPM (PM_{10}) 2016 - 2018

S. N.	Year	December (ug/m^3)	January (ug/m^3)	February (ug/m^3)	March (ug/m^3)
1.	2016	163.030	193.110	193.820	184.900
2.	2017	201.160	196.440	195.470	227.900
3.	2018	187.160	184.490	206.620	208.930
Total		551.350	574.040	595.910	621.730
Mean		183.78	191.35	198.64	207.24
sd		19.2880	6.1671	6.9628	21.5496

Saha*et. al., (*2020) observed that the concentration of PM10 very high in Gazipur due to cause of brick manufacturing. An examination of Table No.1 reveals that the data collected on SPM (PM_{10}) among the months December to March during the years 2016 - 2018. It is evident that during these three years the mean SPM (PM_{10}) was found more than the standard value 100 $\mu g/m^3$ (Fig.1). The SPM (PM_{10}) values were continuously increasing from December to March. In the month March of every year the value of SPM (PM_{10}) was highest.

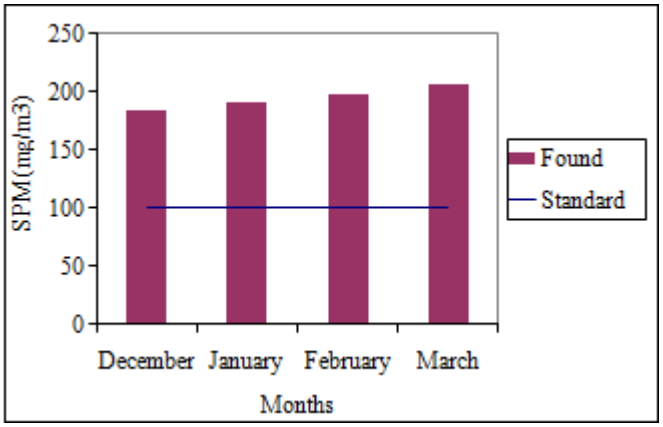

Figure 1: Mean SPM (PM_{10}) during the years 2016 - 2018 in the months December to March

Table 2: Observation for RSPM ($PM_{2.5}$) 2016 - 2018

S. N.	Year	December (ug/m^3)	January (ug/m^3)	February (ug/m^3)	March (ug/m^3)
1.	2016	155.880	143.910	156.350	142.340
2.	2017	160.790	196.580	221.130	189.400
3.	2018	188.980	168.320	183.270	169.660
Total		505.650	508.810	560.750	501.400
Mean		168.55	169.60	186.92	167.13
sd		17.8624	26.3584	32.5436	23.6315

Guttikunda *et. al., (*2013) studied that concentration of $PM_{2.5}$ increases during operational phases. Present result showed that $PM_{2.5}$ ranges between $160ug/m^3$ – $190ug/m^3$. Throughout the investigation it was reveal that values of $PM_{2.5}$ higher than NAAQS (fig.2)

It is observed that during these three years the mean RSPM ($PM_{2.5}$) was found more than the standard value 60 $\mu g/m^3$ (Fig.2). The highest RSPM ($PM_{2.5}$) value was observed in the month of February.

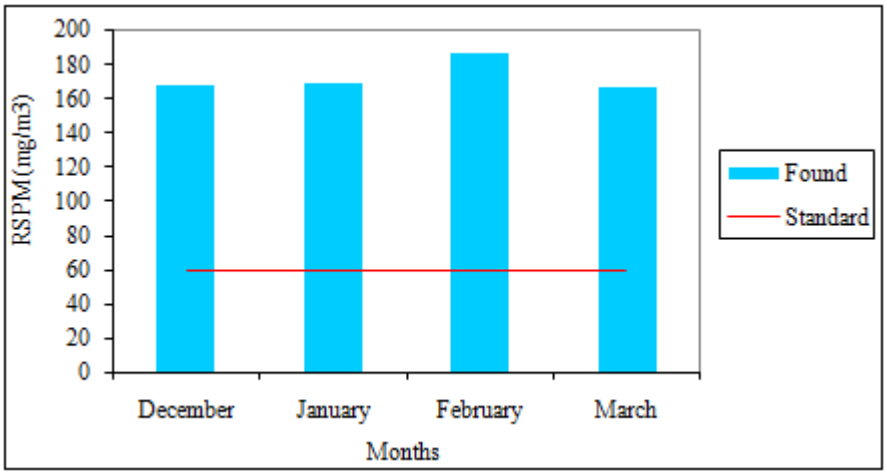

Figure 2: Mean RSPM ($PM_{2.5}$) during the years 2016 - 2018 in the months December to March

Table 3: Observation for SOx

S. N.	Year	December (ug/m^3)	January (ug/m^3)	February (ug/m^3)	March (ug/m^3)
1.	2016	13.451	17.795	10.611	7.421
2.	2017	13.744	15.948	10.584	8.294
3.	2018	16.721	19.953	13.412	10.021
Total		43.916	53.696	34.607	25.736
Mean		14.64	17.90	11.54	8.58
sd		1.8093	2.0045	1.6250	1.3232

The concentration of SOX in the atmosphere was observed at 8.58 $\mu g/m^3$–17.90 $\mu g/m^3$, which was found to be within the permissible limits of NAAQS (2020). It is observed that during these three years the mean SO_X were found more than the standard value 17.90$\mu g/m^3$ (Fig.3). The highest SO_X value was observed in the month of January.

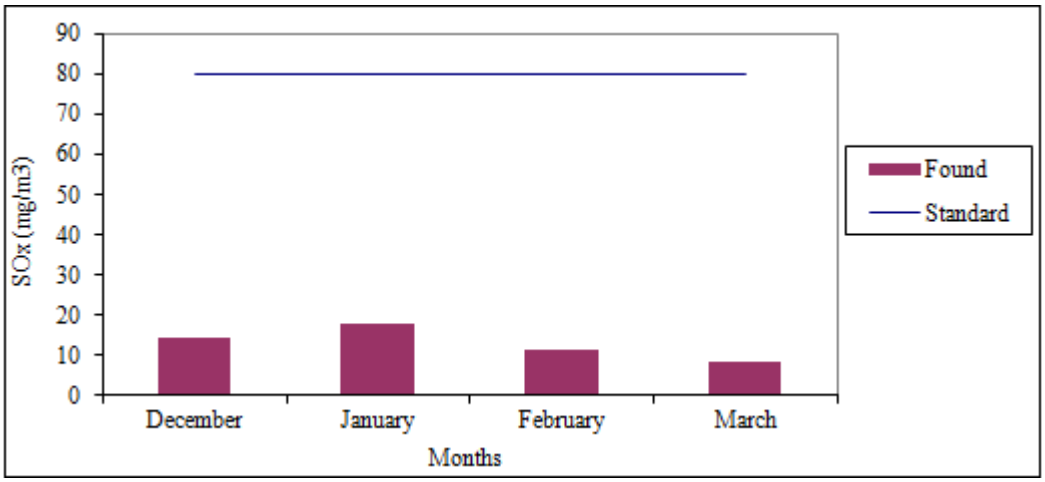

Figure 3: Mean SOx during the years 2016, 2017 & 2018 in the months December to March

Table 4: Observation for NOx

S. N.	Year	December (ug/m^3)	January (ug/m^3)	February (ug/m^3)	March (ug/m^3)
1.	2016	20.110	25.720	26.350	13.460
2.	2017	19.510	21.940	26.010	16.410
3.	2018	21.310	28.440	29.620	18.250
Total		**60.930**	**76.100**	**81.980**	**48.120**
Mean		**20.31**	**25.37**	**27.33**	**16.04**
sd		**0.9165**	**3.2644**	**1.9933**	**2.4163**

At present study showed the concentration of NOX were found to be 16.04 (ug/m^3) – 27.33 (ug/m^3), which shows under in National Ambient Air Quality Standard (2020).

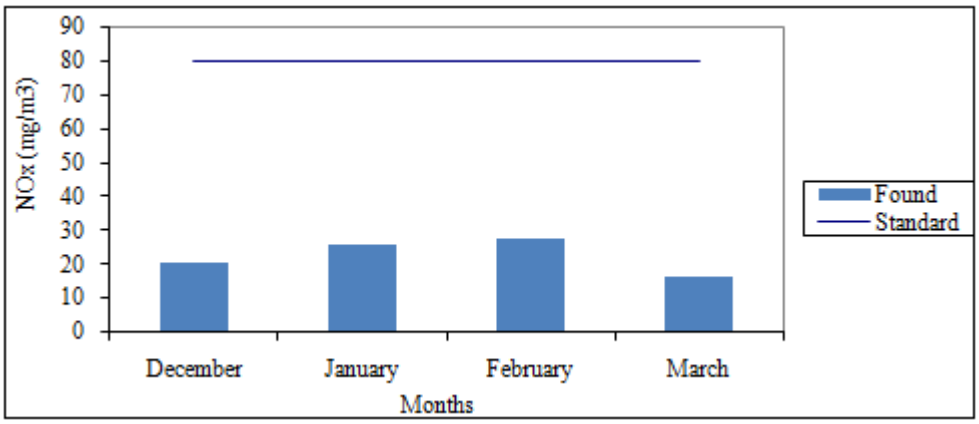

Figure 4: Mean NOx during the years 2016, 2017 & 2018 in the months December to March

4. Conclusion and Recommendation

Based on the study conducted in Chohatta Bazar village, district Akola, the following conclusions can be drawn:

The brick kilns in Chohatta Bazar village are major sources of air pollution, impacting both the environment and human health. While the concentrations of SOX and NOX were found to be within permissible limits, the levels of SPM were significantly high, posing a risk for respiratory problems among workers. The study underscores the need for immediate intervention to mitigate these effects. Recommendations include the use of chimneys in kilns, better fuel usage, adoption of new technology, and governmental awareness programs. These findings have significant implications for environmental policymaking, particularly in regions with a high concentration of brick kilns.

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