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Monitoring and Impact Assessment of Gaseous Pollutant in Ambient Air of BSCIC, Bagerhat, Bangladesh

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ABSTRACT

Air pollution is one of the major environmental problems in Bangladesh. Exposure to high concentration of gaseous pollutant has a potential impact on human health. The present study dealt with the concentration of gaseous pollutants emitted by the Bangladesh small cottage industries and Corporation (BSCIC), Bagerhat. The air samples were collected by grid sampling from fourteen monitoring stations during the dry season (October, November, and December) in 2015. The concentration of SO_x and NO_x in the ambient air is analyzed by the following laboratory methods – (a) Modified West and Grek method for determination of Sulphur dioxide, (b) Sodium Arsenite method for determination of Nitrogen oxides in ambient air. A questionnaire survey was randomly carried out to know the health status of the worker in the BSCIC, Bagerhat. Assessment data showed that average concentration of SO₂ (764.448 µg/m³) was higher than the standard limit and the average concentration of NO_x (80.04 µg/m³) was within the limit according to WHO. Concentrations of oxides in the air are strongly influenced by the emissions taking place from the burning of bio fuels (shell, coir, and rice husk), improper design of combustion chamber and low height of the stack. It is observed that high concentration of SO_x and NO_x adversely affects human health. As a consequence, workers are suffering from the respiratory problem, eye irritation cough, and chronic bronchitis.

1. Introduction

Air pollution is the world's deadliest environmental issue. Exposure to air pollution is the main environmental threat to human health in towns and cities [1-3]. Since the industrial revolution, there has been a steady change in the composition of the atmosphere, environmental problems have also increased. Different industrial activities are degrading various environmental components like water, air, soil and vegetation [4-7]. Bangladesh Small and Cottage Industries Corporation (BSCIC) is the prime mover organization entrusted with the responsibility of development of Small and Cottage Industries (SCI) in Bangladesh [8]. Like Bagerhat BSCIC, this type of small industrial area is always deprived of Air quality assessment, but these industries are a remarkable contributor to air pollution. The air, we breathe is a mixture of gases and small solid and liquid particles. Some substances come from natural sources while others are caused by human activities such as the use of motor vehicles, domestic activities, industry, and business. Air pollution occurs when the air contains substances in quantities that could harm the comfort or health of humans and animals, or could damage plants and materials [9-11]. Epidemiological study on the effect of air pollution has revealed that gaseous pollutants and particulate matter have enough potential to cause severe health effects like respiratory, cardiovascular diseases and cardiopulmonary mortality [12-17].

2. Experimental Methods

2.1 Site Selection

For gaseous pollutant (SO_x and NO_x) emission estimation, particular site Bangladesh Small and Cottage Industries Corporation (BSCIC) was selected for this study because it is an agriculture-based industry. BSCIC is the prime mover organization entrusted with the responsibility of development of Small and Cottage Industries (SCI). The Small and Medium Enterprises (SMEs) are also the prime movers of any economy around the

globe. Bagerhat, BSCIC is a cluster of coconut oil manufacturing mill, rice mill, and tin mill.

2.2 Study Area

Bangladesh Small and Cottage Industries Corporation (BSCIC) provide a package of services to private sector entrepreneurs in Bangladesh. It was developed in 1957. Bagerhat BSCIC lies between latitude 22038'41.6"N and longitude 89047'54.6" E. Total area covered by BSCIC is 20 acre of land comprised with fortyfour mills. Among them, fortythree were running during research time (October –December). Shell, coir, coconut pickle, rice husk as ammunition of boilers are used in the rice mill and coconut oil mill. Every day each coconut oil mill uses about 4-5 sacks of coir, shell as the fuel of boiler [18]. The number of coconut oil mill is twentyfour, five rice mill, three tin container mill and three charcoal mill in BSCIC, Bagerhat. The study was conducted in October to December 2015 with the average temperature 26 °C. Relative humidity 76%, and average pressure wind pressure was 1045 kPa was determined by using Barometer (PCE-THB38).

2.3 Status of Department of Environment (DoE) in BSCIC, Bagerhat

Under the Bangladesh environment conservation rules, 1997 industries for grinding or husking of rice, rice mill and coconut oil mill fall in Orange-A category. Fish feed mill; automatic rice mill industries fall in Orange-B category [19]. The BSCIC administration record showed that each of the mills had the initial ECC, but they were merely renewed and poorly monitored.

2.4 Methodology

The study was performed by using both qualitative and quantitative technique through primary and secondary data collection.

2.4.1 Air Sampling and Analysis for Gaseous Pollutant Estimation

Fourteen air samples of each gas were collected by Indoor/Outdoor Air Quality Monitoring Envirotech APM433 through short term sampling from selected stations. For the SO_x concentration (µg/m³) determination Modified West and Grek method and NO_x concentration (µg/m³) determination sodium arsenite method was used.

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2.4.2 Evaluating Health Risk by Questionnaire Survey

Questioner survey assesses the impact of air quality on health. Random sampling was done for assessment of health condition of the workers. A detailed survey was undertaken to fulfill the research objectives. Simple random sampling technique had been applied, and the sample size was screen by 50 workers among 130 permanent employees (employment period minimum six days a week for one year).

3. Results and Discussion

3.1 Sources of Gaseous Pollutant in the Study Area

Coconut oil and rice mill BSCIC mainly use shell coir, rice husk as fuel. Coir contains more moisture than rice husk. When these are burned in industrial boilers, the sulfur combines with Oxygen to form Sulfur dioxide (SO₂). Nitrogen dioxide (NO₂) also produced because of incomplete combustion of fuels. Furthermore, these mills use the stack for discharging gaseous pollutant. The stacks of the mills were only about 25 feet height, where it should be at least 50 feet, as recommended by DoE.

3.2 Status of Gaseous Pollutant in Different Industrial Unit

Table 1: Concentration of SO_x and NO_x in Bagerhat, BSCIC

Sample ID	Conc. of SO _x (µg/m ³) (24 hours)	Standard SO _x (µg/m ³) (24 hours)	Conc. of NO _x (µg/m ³) (Annual)	Standard Conc. for NO _x (µg/m ³) (Annual)
Office (O)	365.811		91.17	
Alamin rice mill (AR)	387.43		84.245	
Tilasila rice mill (TSR)	340.64		69.3	
Amanatsah rice mill(ASR)	693.02		89.26	
Alamgir rice mill (ALR)	660.3		81.216	
Borkot rice mill (BR)	646.06	365	65.61	
Papon coconut oil Mill (PCO)	340.63		127.287	100
Cachavatiza coconut oil mill (CCO)	793.7		93.15	
Jahan coconut oil mill (JCO)	844.04		60.36	
Rani coconut oil mill (RC)	743.36		75.213	
Borkot auto coconut mill (BC)	918.2		81.99	
Shuvo coconut oil mill (SC)	990.03		120.492	
Nurjahan agro-processing industries (N)	962.34		69.057	
Ahmed agro industries (AA)	987.43		85.68	

3.2.1 Statutes of SO_x in Different Industries in BSCIC, Bagerhat

Fig. 1 shows that the concentration of SO_x at monitoring stations O, AR, TSR, CCO is within the limit compared with standard and the remaining ten monitoring stations show the higher level of SO_x concentration. It is found that the average concentration of SO_x is 764.448 µg/m³ but the standard concentration of SO_x is 365 µg/m³. As a consequence, higher concentration SO_x can causes irritation, reduction of visibility, respiratory diseases.

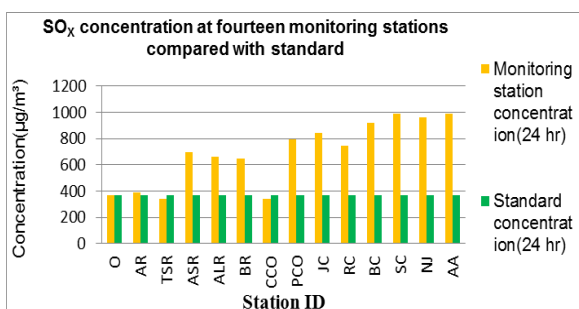


Fig. 1 concentration of SO_x at various monitoring stations compared with the standard in Bagerhat, BSCIC

3.2.2 Statutes of NO_x in Different Industries in BSCIC, Bagerhat

It is observed that the concentration of NO_x at most of the monitoring stations is within the standard limit (100 µg/m³). Therefore, only two

stations CCO and SC indicate higher concentration and they are 127.287 µg/m³ and 120.492 µg/m³. Also, we found that the average concentration of NO_x is 87.06 µg/m³ within the limit (100 µg/m³).

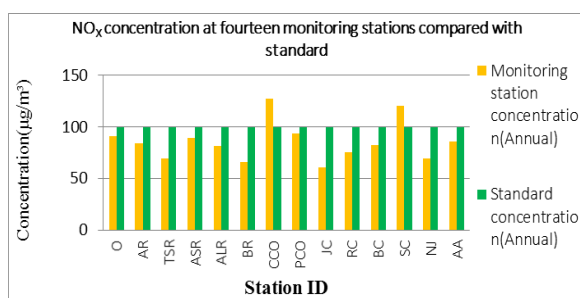


Fig. 2 concentration of NO_x at various monitoring stations compared with the standard in BSCIC, Bagerhat

3.3 Personal Protective Equipment (PPE)

Most of the workers are not used to use mask, spectacle. However, workers hardly use the mask in BSCIC, Bagerhat. The below chart shows the survey results regarding protective gear.

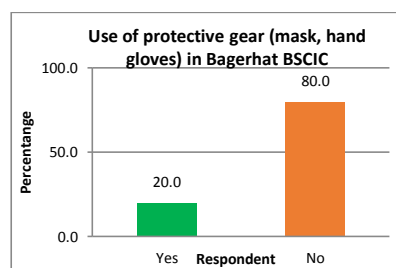


Fig. 3 Comparison of protective gear (mask, spectacle) user and non-user in BSCIC, Bagerhat

Survey results illustrated that only 28.6% workers used the safety dress while 71.4% labors neglected the protection during the work in the stations. This may cause serious health problems among the worker.

3.4 Health Status of Workers

The health condition of the worker was estimated by multiple analyses in SPSS software. Air pollution poses serious threats to the health of exposed communities. Air pollution can cause drowsiness, eye irritation, throat irritation, persistent cough, asthma, nose blockage, respiratory infections, bronchial infections, colds and headaches in a human being. Among the worker 19% people have eye irritation, 21% people have are respiratory problem, 11% people suffer from cardiovascular disease, 10% people suffer from a cough and 5% people have sneeze problem and 34% people do not have any problem (survey results has provided below).

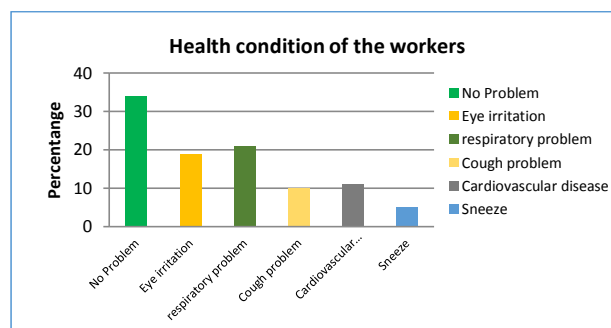


Fig. 4 Health condition of the respondent in BSCIC, Bagerhat

3.4.1 Comparison between Respiratory and Eye Irritation and Cough Problem among Coconut Oil Mill Workers and Rice Mill Workers

The respiratory problem and eye irritation problem is higher among the coconut oil mill workers. Since coir is mostly used in coconut oil mill showed in Figure 5. Gases like CO, NO_x and SO_x produced because of incomplete combustion of coir. The common phenomenon is that the rice husk is used in the rice mill, and the amount of dust is higher in the rice mill. As a result, rice mill workers suffer more from cough problem than coconut oil mill workers.

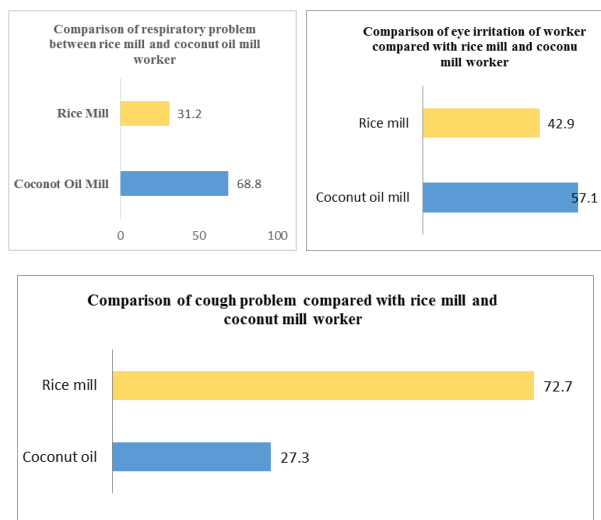


Fig. 5 Comparison between respiratory, eye irritation and cough problem among coconut oil mill worker and rice mill worker

3.4.2 Respiratory Problem of the Employee Relationship with Working Period

The air in BSCIC, Bagerhat contains SO_x and NO_x which causes respiratory problem. The respiratory issue of the worker depends on working period. Workers face respiratory and eye irritation problem at the early stage. Workers become habituated with the environment over time. However, 62 % workers suffered from the respiratory problem who are working one to three years.

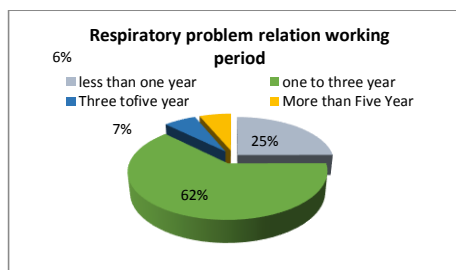


Fig. 6 Worker respiratory problem in comparison with working period in BSCIC

4. Conclusion

Bangladesh small and cottage industries corporation (BSCIC), Bagerhat is one of the robust agro-processing industries in the south western region

in Bangladesh. The studies have revealed the levels of air pollutants for NO_x and SO_x . It has been observed that the SO_x concentration in BSCIC is higher in comparison with the WHO standards for the industrial area, and the concentration of NO_x is within the WHO standards for the industrial area. To minimize gaseous pollution stack height should be increased and air quality should be monitored and reported regularly.

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