"AMMONIA GAS INCREASED INAMBIENT AIR BYINSTALLATION OF SNCR SYSTEM AT HEIDELBERGCEMENT INDIA LIMITED (HCIL),

Bhim Singh[1], Rajesh Kumar[2]
[1,2]Guru Kashi University, Talwandi Sabo

ABSTRACT

India is the second-largest producer of cement in the world, behind only China. All around India, cement factories may be found. To reduce NOx emissions from Cement Kiln stacks, certain Indian Cement Industries have used SNCR systems Only the reaction temperature range known as the "SNCR temperature window of 870-1090oC" yields optimal SNCR efficiency. A water and molecular nitrogen product is formed when NH3 reacts with NOx. Because ammonia is more likely to escape from the process at temperatures above 700 degrees Celsius and less likely to do so at lower ones, it is oxidised as NOx at higher ones. During loading and unloading of Ammonia tankers and the emission of nonreacted ammonia from cement kiln stacks, ammonia is released into the ambient air. This ammonia gas is raising the nearby environment's concentration of ambient ammonia.

Keywords: *Cement Industries, Selective Non Catalytic Reduction (SNCR), Ammonia (NH3), Ministry of Environment, Forest & Climate Change (MoEFCC), Central Pollution Control Board (CPCB)*

INTRODUCTION

According to the Ministry of Environment, Forests and Climate Change (MOEF&CC), the NOx emission limits for cement plants in India are 600/800/1000 mg/Nm3 dependent on the technology employed in the plant (MOEFCC Notification, 2016). Selective

Noncatalytic Reduction (SNCR), which uses ammonia to reduce NOx emissions, has been implemented by several cement factories in India in order to fulfil Indian emission limits. During loading and unloading and through the kiln stacks, ammonia is released into the ambient air. It is impossible for NH3 gas to settle in low-lying areas because it is lighter than air. NH3 gas becomes ammonia vapours when it combines with moisture, however, and these vapours are heavier than air (The Fact about Ammonia, 2004).

Research is being conducted in order to determine the real rise in ammonia content in ambient air as a result of ammonia emissions from kiln stacks and the role they play in this process.

I. REVIEW OF LITERATURE

NH3 is a colourless, pungent-smelling gas that may corrode metal and other metal alloys. More and more people are concerned about how ammonia (NH3) is affecting the quality of the air and the health of those who breathe it (Xu, R.T. et al, 2018). There are two basic forms of environmental harm that may be caused by Ammonia gas if it is deposited in water and soils (Agriculture - ammonia emission, 2017). Many atmospheric processes depend on ammonia. Ammonia (NH3) is a significant contaminant that contributes to a number of the world's most pressing environmental issues (Wu ShiangYuh et al., 2008; Sun et al., 2016; Skjth, 2012). A interaction in the atmosphere with acidic substances results in the deposition of ammonia as a gas or as ammonium salts, which may be used to enrich soils deficient in nutrients, such as heath land, with nitrogen and so alter the vegetation that grows there. In aerosols, ammonium ions can travel for long distances before depositing on the ground and contributing to acid rain (Pain Brian Jarvis Steve, 1999). Ammonia emissions are a major factor in a number of well-known environmental problems. Nitrogen, especially ammonia, may create nutritional imbalances and eutrophication in ecosystems when deposited in large quantities (Pinder R.W. et al, 2008).

Because it is the first component to produce aerosols in the atmosphere, ammonia pollutes the cardiovascular and respiratory systems of humans, reduces visibility, and causes regional haze across Asia (Pinder et al., 2007; Seinfeld &Pandis, 1998). Haze days in China are caused by secondary inorganic aerosols generated by NH3 (Fu et al., 2015).

Because surplus NH4+ returns to aquatic and terrestrial ecosystems as the quantity of ammonia in the atmosphere increases, it causes problems for the global nitogen and carbon cycles.

To manufacture ammonia, an important industrial intermediary for nitrogen fertilisers, almost 100 million metric tonnes of atmospheric nitrogen are removed from the air each year. 12% of the world's energy usage and 35% of the world's natural gas production are attributed to Haber-Bosch (Baltrusaitis Jonas, 2017). Ammonia emissions from agricultural systems are associated with an increase in reactive nitrogen (N) in southern Asia (SA), where roughly 60 percent of the world's population lives, raising concerns about the impact on air quality and human health (Food and Agriculture Organization of the United Nations, 2016).

In addition to causing ammonia leaks, ammonium bisulphate and other ammonium salts may cause problems such as plugging and corrosion of the air heater and other downstream components, the formation of a white ammonium chloride plume above the stack, and the detection of an ammonia odour around the plant (White Paper, ICAC, 2008).

II. MATERIALS AND METHODOLOGY

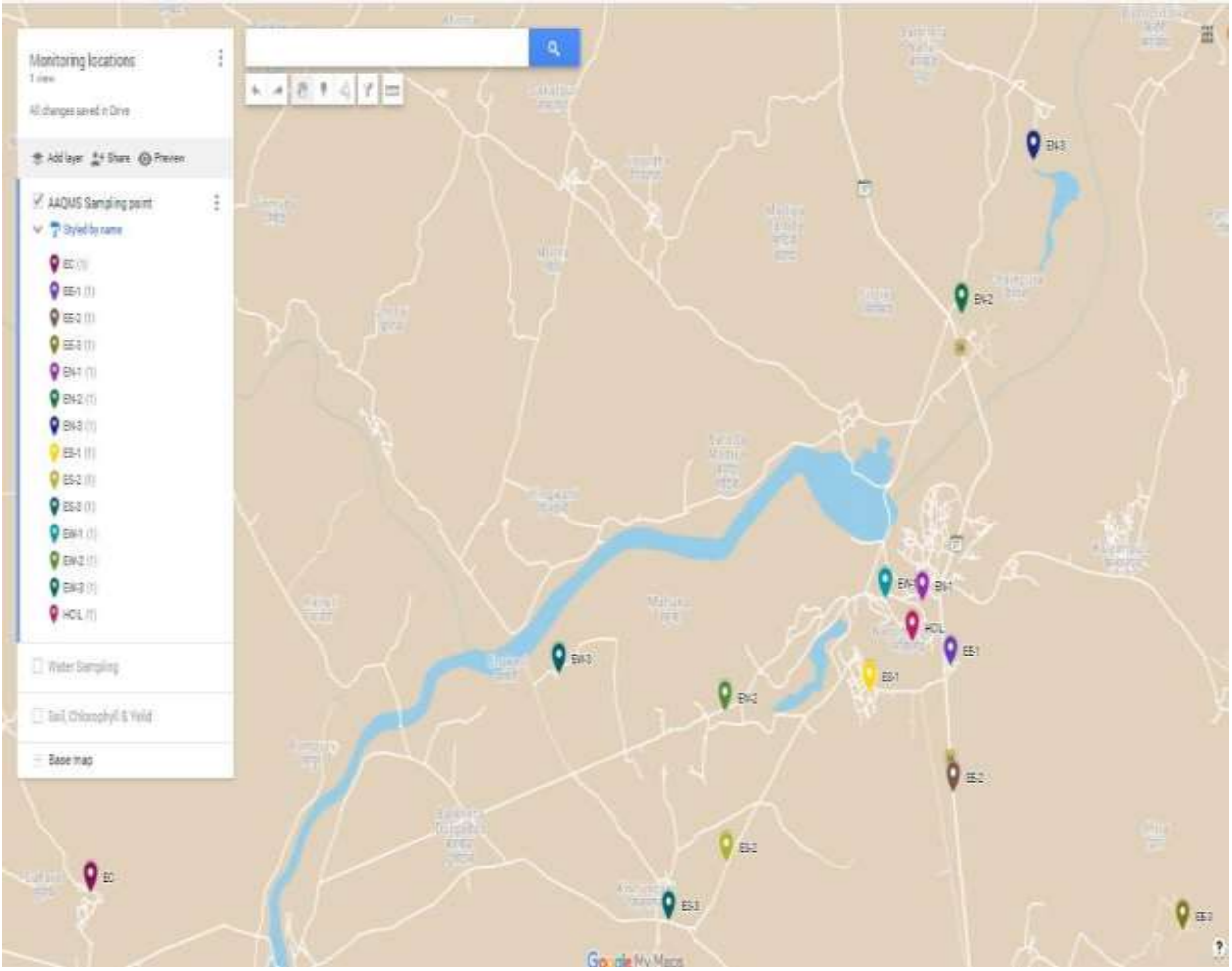
A. Monitoring Location

HeidelbergCement India Limited (HCIL), a cement mill in the hamlet of Narsingarh in the district of Damoh in Madhya Pradesh, has been chosen to monitor ambient air concentrations of ammonia gas.

Fig-1: HCIL, Narsingarh Plant Location on India Map & Plant Snap

We have selected three sampling points each in the four directions of the plant Reference point Line-I (Pre-heater) of HCIL, Narsingarh Plant first within 1 Km, second within 1 to 3 Km and third within 3 to 5 Km distance and set a Controlled area at approximately 10 Km far from Plant in upwind direction for ambient air quality monitoring and analysis (West). This means that there are now 13 integers in total for the number of sample points.

I've categorised these addresses as EE for east, including EE-1 (one kilometre), EE-2 (1 to 3 kilometres), and EE-3 (three to five kilometres) (3 to 5 Km) Each direction has its own set of coordinates: EW-1 (1 Km), EN-1 (1 Km), EN-2 (1 to 3 Km), and EN-3 (3 to 5 Km). ES-1 (1 Km), ES-1 (1-3 Km), and ES-2 (1-3) are the coordinates for the control area, and EC is the code for the control area.



uality Monitoring Stations near HCIL, Narsingarh marked onGoogle Map

B. Ammonia sampling & analysis

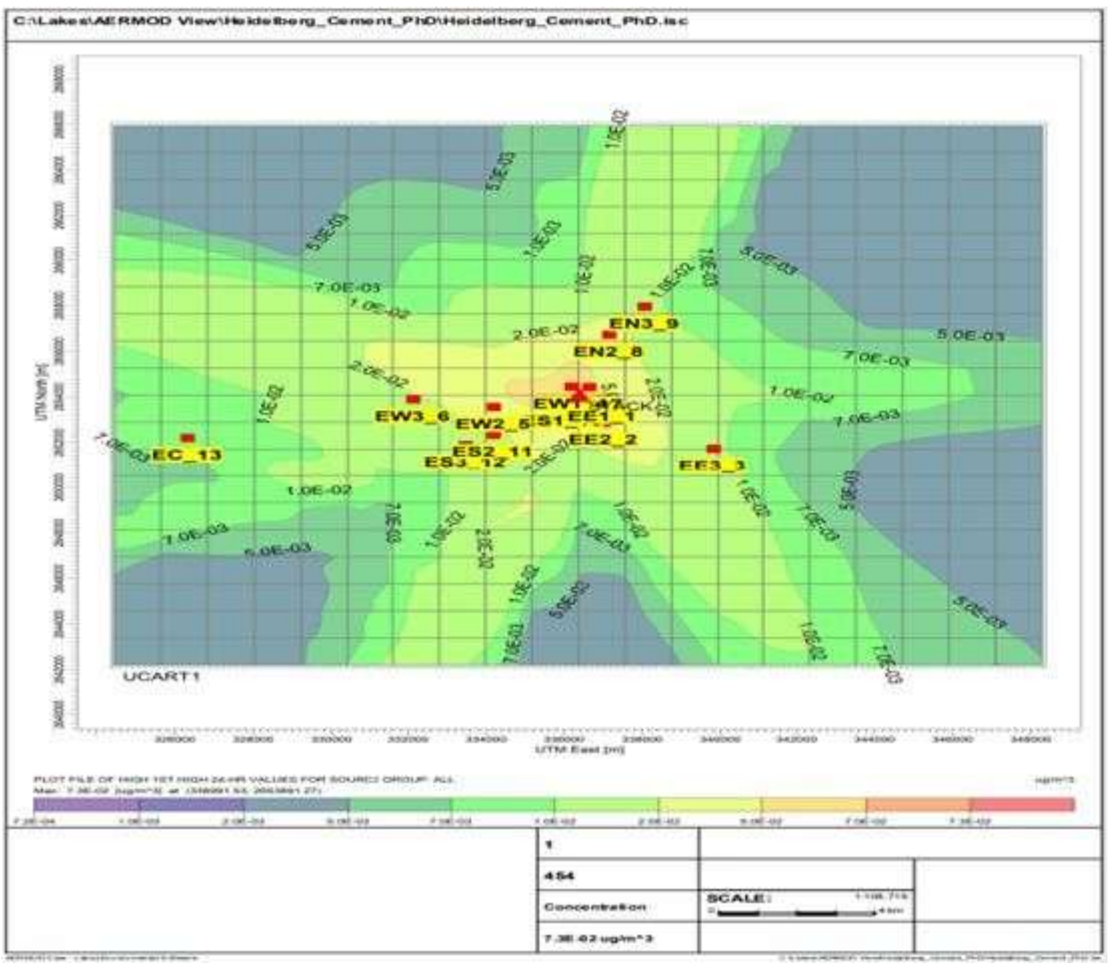
In order to collect data, we utilised the Fine Dust Sampler (FDS) with gaseous attachment and CPCB-NAAQS Guidelines, 2013 Manual Volume – 1 for sampling. Sulphuric acid is used to collect ammonia gas from the environment by bubbling it through an ammonium salt solution, and the ammonium sulphate is then analysed for ammonia in the ambient air using the Indophenol Method. Sodium hypochlorite and phenol react to generate indophenols, a blue colour, from ammonium sulphate produced in the sample. It is possible to speed up the process by using sodium nitroprusside as a catalyst in the mix.

C. Analysis of Ammonia increased in Ambient air through data modeling

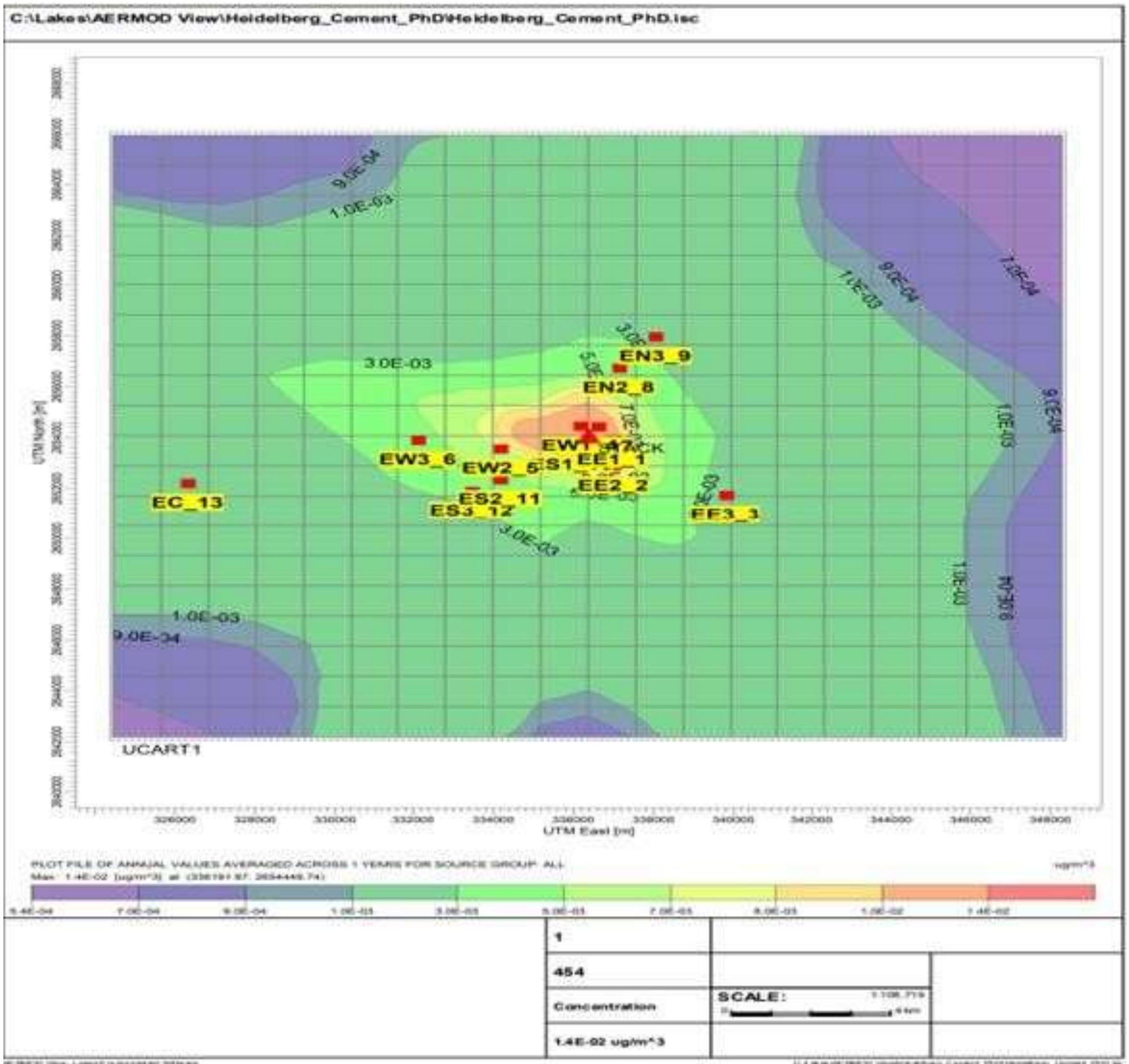
Clinkrisation Line-III at Narsingarh is a newer line that uses coal and Pet coke as feedstocks, which means that the NOx emission level for Line-III exceeds MoEFCC standards, hence an SNCR system was constructed and is currently operational. Ammonia gas concentrations in the ambient air have been calculated using NOx emission data from stacks and ammonia concentration data from 13 chosen sample locations.

III. RESULT OF DATA MODELLING

We used data modelling to examine the distribution of NH3 near the HCIL, Narsingarh Plant in relation to the Controlled area and estimate the amount of Ammonia enhanced by the HCIL, Narsingarh's contribution.



distribution in nearby area of HCIL, Narsingarh through data modellingfor 24 hr basis in year 2020



Ammonia distribution in nearby area of HCIL, Narsingarh through datamodelling for Annual basis in year 2020

IV. RESULT DISCUSSION& CONCLUSION

Ammonia samples were collected and analysed during the winter, summer, and rainy seasons of the 2020-21 year cycle, which ran from August to July of that year. NH3 concentrations ranged from 8.8 to 9.5 g/m3 in the controlled region, with an average of 9.2 g/m3. In contrast, NH3 measurements in other regions ranged from 9.8 to 17.5 g/m3, with a mean value of 12.8 g/m3. We used data modelling to examine the NH3 distribution in a five-kilometer radius surrounding the HCIL Narsingarh Plant in relation to the Controlled area and estimate the real quantity of Ammonia created by the Plant's contribution.

Only 0.073 g/m3 of ammonia was added to the ambient air on a 24-hour basis and 0.014 on a yearly basis, according to data modelling. Ammonia gas concentrations in ambient air discharged from kiln stacks are found to rise just little as a result of this study.

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BIBLIOGRAPHY

[1].Agriculture - Ammonia emission statistics (2017).*Eurostat Statistics explained.*

[2].Baltrusaitis, Jonas. (Nov-2017). Sustainable Ammonia Production, ACS Sustainable Chemistry & Engineering, *ACS Sustainable Chem. Eng*. 2017, 5, 9527−9527.

[3]. CPCB Guidelines (2013). Guidelines for the Measurement of Ambient Air Pollutants, Guidelines for Manual Sampling & Analyses Volume-I National Ambient Air Quality Series:NAAQMS/36/2012-13.

[4].Food and Agriculture Organization of the United Nations (2016). *FAOSTAT* online database http://faostat.fao.org/.

[5].Fu, X.; Wang, S.; Ran, L., Pleim, J.; Cooter, E.; Bash, J.; Hao, J. (2015). Estimating NH3 emissions from agricultural fertilizer application in China using the bi-directional CMAQ model coupled to an agro-ecosystem model. *Atmospheric Chemistry and Physics*, 15(12),

6637–6649. https://doi.org/10.5194/acp-15-6637-2015.

[6].Lü, C.;& Tian, H. (2007). Spatial and temporal patterns of nitrogen deposition in China:

Synthesis of observational data. Journal of Geophysical.

[7].MoEFCC Notification(2016).G.S.R. 497 (E) Environment (Protection) Third amendment Rule, 2016.

[8].Pain, Brian.; Jarvis, Steve. (1999). Ammonia Emissions From Agriculture, *IGER Innovations,* Page 48 to 51.

[9].Pinder, R. W.; Adams, P. J.;&Pandis, S. N. (2007). Ammonia emission controls as a cost-effective strategy for reducing atmospheric particulate matter in the eastern United States. *Environmental Science & Technology*, 41(2), 380–386. https://doi.org/10.1021/es060379a.

[10]. Pinder, R.W.; Gilliland, A.B.; and Dennis, R.L.; (2008). Environmental impact of atmospheric NH3 emission under present and future conditions in the Eastern United States, *Geophysical Research letters*, 2008.Vol. 35, L12808, doi: 10.1029/2008/GL033732,

[11]. Seinfeld, J.;&Pandis, S. (1998). Atmospheric chemistry and physics (p. 1326).

Hoboken, NJ: John Wiley.

[12]. Skjoth, C. A.; and C., Geels C. (June 2012). The effect of climate and climate change on ammonia emissions in Europe, Published by *Copernicus Publications* on behalf of the European Geosciences Union.

[13]. Sun. Kang.; Tao, Lei.; Miller, David J.; Pan, Da.; Golston, Levi M.; Zondlo, Mark A.; Griffin, Robert J.; Wallace, H W.; Leong, Yu Jun.; M Melissa 4, Yang, Yan Zhang.; Mauzerall, Denise L.; Zhu, Tong. (2016). Vehicle emission as an important urban ammonia source in the United States and China. *Environment Science & Technology*, 51(4), 2472-2481.

[14]. The Fact about Ammonia (2004), General information, DOH, *New York State Department of Health*.

[15]. Tian, H.; Melillo, J. M.;Kicklighter, D. W.; Pan, S.; Liu, J.; McGuire, A. D.;& Moore, B. (2003). Regional carbon dynamics in monsoon Asia and its implications for the global carbon cycle. Global and Planetary Change, 37(3), 201–217.

https://doi.org/10.1016/ S0921-8181(02)00205-9

[16]. White Paper (2008), Selective Non catalytic Reduction (SNCR) for controlling NOx emission, *Institute of Clean Air Companies Inc*.

[17]. Wu,ShiangYuh.;Krishnanb, Srinath.; Zhangb, Yang; Anejab, Viney. (2008) Modelling atmospheric transport and fate of ammonia in North Carolina-Part-II: Effect of ammonia emissions on fine particulate matter formation, Elsevier, Atmospheric Environment 42 2008 pp3437-3451.

[18]. Xu, R. T.; Pan, S. F.; Chen, J.; Chen, G. S.; Yang, J.; Dangal, S. R. S.; Tian, H. Q.
(2018). Half-century ammonia emissions from agricultural systems in southern Asia: Magnitude, spatiotemporal patterns and implications for human health. GeoHealth, 2, 40–53. https://doi.org/10.1002/2017GH000098