**Air Quality Index Analysis on a Cement Plant in Nigeria**

**ABSTRACT**

This study investigated the air quality index (AQI) and the associated environmental health risks in the vicinity of the Dangote Cement Plant, Obajana, Kogi State, Nigeria. Ambient concentrations of key air pollutants emitted from the plant including particulate matter (PM₂.₅, and PM₁₀,), sulphur dioxide (SO₂), nitrogen dioxide (NO₂), ammonia (NH₃), carbon monoxide (CO) and ozone (O₃) were monitored across multiple sampling stations over a six -months period, covering both the wet (August–October) and dry (November–January) seasons. AQI was computed using the Central Pollution Control Board (CPBP) method, and environmental risk was assessed by comparing pollutant levels to national and international standards. The results revealed that PM 2.5 concentration in December fell within the hazardous category, while ozone (O₃) levels were consistently in the very in the very unhealthy category throughout the six- months period. Carbon monoxide (CO) recorded unhealthy level category in December but remained in the good category from August to November and in January. Sulphur dioxide (SO₂) remained in the category of unhealthy for sensitive group throughout the study period. Ammonia (NH₃) and nitrogen dioxide (NO₂) were within the moderate category for August, September and October. Several pollutants exceeded recommended limits during the months. The findings underscore significant environmental and public health risks posed by emissions from the cement production process at Dangote cement factory Obajana, and highlighted the need for targeted mitigation strategies and stricter regulatory enforcement.

**Keywords:** Pollution, Air, Quality, Index, Concentration, Pollutants**.**

**1.0 Introduction**

Air Quality Index (AQI) is defined as an overall scheme that transforms the weighed values of individual air pollution-related parameters (the pollutants measured during sampling) into a single number or set of numbers. Air quality index is also known as Air pollution index (Bishoi *et al.,*2009; Bhola, Bajpai,Jain,and Koul (2024); Ingole and Dharpal, 2016). It is a standardized summary measure of ambient air quality used to express the level of health risk related to particulate matter and other pollutants (Kowaiska *et* *al.*, 2009). An air quality index (AQI) is a number used by the government agencies to communicate with public how much pollution is there currently or how predictable it is. It is a measurement of air pollutant concentrations in ambient air pollution and their associated health risks.As the Air Quality Index increases, an increasingly large percentage of the population is likely to experience increasingly serious health consequences (Ingole and Dharpal, 2021).

Depending upon the method of calculation, the AQI majorly communicates a number starting from 0 to 500. It is worthy to note that Air quality index is a crucial metric for assessing air quality. It gives the account of the changes in air pollution level in the atmosphere (Bisho *et al*., 2009; Hemavani and Rao, 2020). The computation of the AQI is based on the average air pollutant concentration over a specified period, which is obtained from air monitoring. The AQI increases because of an increase in the emission of air pollutants; for example, during heavy traffic or forest fire, an industrialized area a high value of AQI is observed. In addition, due to anticyclone or temperature inversion, Stagnant air leads to high concentrations of pollutants in the air. This results in chemical reactions between air pollutants and hazy conditions, thus increasing the AQI. Air Quality Index AQI is acquired by measuring emissions of major pollutants present in the air: Particulate matter (PM2.5, PM5 and PM10), these are fine particles with a diameter of less than 2.5 microns, 5 microns and 10 microns respectively; Ozone (O3) formed by chemical reactions involving sunlight and pollutants; Carbon monoxide (CO) a colourless, odourless gas produced by incomplete combustion ; Nitrogen dioxide (NO2) a gas produced by combustion process; Sulphur dioxide (SO2), emitted from burning fossil fuel and Ammonia (NH3) commonly found in agricultural and industrial emissions,(https://byjus.com/air-quality-index.

**Table 1: AQI category of pollutants and health break points**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **AQI category (range)** | **PM10 (24hr)** | **PM2.5 (24hr)** | **NO2 (24hr)** | **O3 (8hr)** | **CO (8hr)** | **SO2 (24hr)** | **NH3 (24hr)** | **Pb (24hr)** |
| Good (0- 50) | 0–50 | 0-30 | 0-40 | 0-50 | 0-1.0 | 0-40 | 0-200 | 0-0.5 |
| Moderate (51–100) | 51–100 | 31-60 | 41-80 | 51-100 | 1.1-2.0 | 41-80 | 201-400 | 0.5-1.0 |
| Unhealthy for sensitive group (101-150) | 101–250 | 61 - 90 | 181-180 | 101-168 | 2.1-10 | 81-380 | 401-800 | 1.1-2.0 |
| Unhealthy (151 -200) | 251–350 | 91–120 | 181 -280 | 169 -208 | 10 - 17 | 381-800 | 801 – 1200 | 2.1 – 3.0 |
| Very unhealthy (201 -300) | 351–430 | 121–250 | 281–400 | 209–748 | 17–34 | 801–1600 | 1200–1800 | 3.1 – 3.5 |
| Hazardous (401 - 500) | 430+ | 250+ | 400+ | 748+ | 34+ | 1600+ | 1800+ | 3.5+ |

**Source:** *Technical Regulation on Ambient Air Quality Indexr (*From Wikipedia, the free encyclopedia.

In this research work, the linear segmented principle method also known as the Central Pollution Control Board (CPCB Method) was used in calculating the Air Quality Index (AQI) ( Hemavani & Rao 2020). The formula is given as:



Cement producing industries have contributed significantly to global economic development, notwithstanding its production is a major contributor to air pollution. Cement production involves the emission of PM2.5, PM10, NO2, SO2, CO, NH3, and O3 which have adverse health effect on humans. Respiratory sicknesses such as bronchitis, asthma and emphysema are connected to the inhalation of gases emitted during cement production, Etim, Babaremu, Lazarus and Omole (2021). This study therefore aimed to assess air quality at Dangote cement plant Obajana by analysing the Air Quality Index (AQI) and evaluating potential environmental risks associated with pollutant exposure.

**2.0 Materials and Methods**

**2.1 Study Area**

The study was conducted around the Dangote Cement Plant located in Obajana, Kogi State, Nigeria. Obajana lies between longitude 6°10°E and 6°30’ East of the Greenwich meridian and Latitude 7°40’N and 8°00’N north of the equator of the Oworo region of the Lokoja local government area. The Oworo district is a mountainous region bordered on the north by IgbiraIgu (Egbura), on the northwest by Kakanda, on the west by the Abinu, and on the south by Ebira land, (infoguidenigeria.com). The people that live in the area speak Yoruba and are known as the Okun Nation. Dangote cement factory, Obajana is one of the largest cement manufacturing plants in sub-Saharan Africa, with a production capacity exceeding 13 million metric tonnes per annum, (www.dangotecement.com). The area experiences a tropical climate characterized by two distinct seasons: the wet season (April–October) and the dry season (November–March), with significant variations in temperature, humidity, and wind patterns. Surrounding the plant are residential settlements, farmlands, and road networks, which are potentially affected by emissions from cement production and associated activities.

**2.2 Sampling Locations**

Sampling and measurement of the specific air quality parameters were measured at the different selected sampling locations, including both outdoor and indoor locations. The sampling locations are listed as follows:

**Table 2: Sampling locations and their coordinates.**

|  |  |  |  |
| --- | --- | --- | --- |
| Sampling Locations | Coordinate | Sampling environment | Elevation (m) |
| Code | Designation | Northing | Easting |
| S1 | GATE (Line 1 & 2) | 07⁰55`34.0” | 006⁰25`47.5” | Outdoor | 205m |
| S2 | Packing plant (Line 1&2) | 07⁰55`35.5” | 006⁰25`41.6” | Indoor | 188m |
| S3 | Cement mill (Line 1&2) | 07⁰55`33.9” | 006⁰25`35.6” | Indoor | 210m |
| S4 | Kiln (Line 1&2) | 07⁰55`35.3” | 006⁰25`26.0” | Outdoor | 206m |
| S5 | Raw mill (Line 1&2) | 07⁰55`34.5” | 006⁰25`21.4” | Outdoor | 255m |
| S6 | Coal mill (Line 182) | 07⁰55`34.3” | 006⁰25`20.6” | Indoor | 260m |
| S7 | Weigh feeder (Line 1&2) | 07⁰55`34.0” | 006⁰25`18.9” | Indoor | 269m |
| S8 | Mix storage (Line1&2) | 07⁰55`40.6” | 006⁰25`19.1” | Indoor | 218m |
| S9 | Gypsum crusher (Line 1&2) | 07⁰55`48.2” | 006⁰25`37.9” | Outdoor | 205m |
| S10 | Power-plant (Line 1&2) | 07⁰55`22.7” | 006⁰25`44.7” | Outdoor | 218m |
| S11 | Central workshop (Line 1&2) | 07⁰55`31.4” | 006⁰25`33.9” | Indoor | 203m |
| S12 | CCR (Line 1&2) | 07⁰55`32.2” | 006⁰25`26.0” | Indoor | 223m |
| S13 | CCR (Line 3) | 07⁰55`35.1” | 006⁰25`09.1” | Indoor | 216m |
| S14 | Kiln (Line 3) | 07⁰55`36.4” | 006⁰25`11.0” | Outdoor | 245m |
| S15 | Raw mill (Line 3) | 07”55`37.3” | 006⁰25`14.4” | Indoor | 239m |
| S16 | Weigh feeder (Line 3) | 07⁰55`36.7” | 006⁰25`15.2” | Indoor | 221m |
| S17 | Coal mill (Line 31) | 07⁰55`36.7” | 006⁰25`13.9” | Indoor | 245m |
| S18 | Mix storage (Line 3) | 07⁰55`43.8” | 006⁰25`15.5” | Indoor | 315m |
| S19 | Cement mill (Line 3) | 07⁰55`42.9” | 006⁰25`01.1” | Indoor | 216m |
| S20 | Packing plant (Line 3) | 07⁰55`39.8” | 006⁰25`01.3” | Indoor | 200m |
| S21 | Mix storage (Line 4) | 07⁰55`56.4” | 006⁰25`38.7” | Indoor | 216m |
| S22 | Raw mill (Line 4) | 07⁰55`56.2” | 006⁰25`31.4” | Indoor | 292m |
| S23 | Kiln (Line 4) | 07⁰55`53.7” | 006⁰25`26.7” | Outdoor | 232m |
| S24 | Weigh feeder (Line 4) | 07⁰55`51.2” | 006⁰25`21.8” | Outdoor | 236m |
| S25 | Coal mill (Line 4) | 07⁰55`48.8” | 006⁰25`19.6” | Indoor | 238m |
| S26 | CCR (Line 4) | 07⁰55`55.6” | 006⁰25`22.7” | Indoor | 260m |
| S27 | Cementmill(Line 4) | 07⁰55`48.2” | 006⁰25`00.9” | Indoor | 226m |
| S28 | Packing plant (Line 4) | 07⁰55`42.2” | 006⁰25`56.9” | Outdoor | 225m |
| S29 | Cement mill (Line 5) | 07⁰55`48.7” | 006⁰25`01.8” | Indoor | 272m |
| S30 | Packing plant (Line 5) | 07⁰55`43.0” | 006⁰24`54.4’ | Indoor | 200m |
| S31 | Mix storage (Line 5) | 07⁰56`17.2” | 006⁰25`07.5” | Indoor | 232m |
| S32 | Weigh feeder (Line 5) | 07⁰56`14.3” | 006⁰25`18.3” | Indoor | 203m |
| S33 | Raw mill (Line 5) | 07⁰56`09.3”  | 006⁰25`14.0” | Indoor | 209m |
| S34 | Coal mill (Line 5) | 07⁰56`06.2” | 006⁰25`13.3” | Indoor | 244m |
| S35 | Kiln (Line 5) | 07⁰56`04.8” | 006⁰25`12.3” | Outdoor | 232m |
| S36 | Tippler 1 & 2 | 07⁰55`22.5” | 006⁰25`17.8” | Outdoor | 236m |
| S37 | Tippler 3 & 4 | 07⁰55`26.4” | 006⁰25`17.7” | Outdoor | 221m |
| S38 | Life camp kitchen | 07⁰56`00.7” | 006⁰25`53.9” | Outdoor | 196m |
| S39 | Life camp gate | 07⁰56`01.3” | 006⁰25`51.6” | Outdoor | 182m |
| S40 | Colony gate | 07⁰56`19.6” | 006⁰26`05.5” | Outdoor | 203m |
| S41 | New admin building | 07⁰56`20.4” | 006⁰26`06.1” | Outdoor | 202m |
| S42 | Colony clinic | 07⁰56`22.4” | 006⁰26`12.6” | Outdoor | 197m |
| S43 | Colony S-Blocks | 07⁰56`20.2” | 006⁰26`7.6” | Outdoor | 200m |
| S44 | Colony kitchen | 07⁰56`15.7” | 006⁰26`5.5” | Outdoor | 194m |
| S45 | GM block | 07⁰56`12.5” | 006⁰26`00.7” | Outdoor | 184m |
| S46 | Colony M-Blocks | 07⁰56`07.2” | 006⁰25`57.5” | Outdoor | 180m |
| S47 | Obajana community junction | 07⁰55`14.4” | 006⁰25`53.1” | Outdoor | 213m |
| S48 | Obajana community market | 07⁰55`07.1” | 006⁰26`03.8” | Outdoor | 202m |

**Source: Field survey 2025**

**2.3 Sampling Duration and Frequency**

Sampling was conducted over a six-month period, covering both the wet season (August–October) and the dry season (November–January) in 2023–2024. The daily monitoring was done between 8am to 2pm and 10pm to 2am

**2.4 Measurement of Gaseous Pollutants**

The methods used for sampling and data collection are approved by the National Environmental Standards and Regulations Enforcement Agency (NESREA) and Kogi State Environmental Protection Board (KOSEPB). Air quality sampling for the presence of pollutants at the different sampling points was carried out with portable automated gas analyzers. Particulate matter (PM 2.5 and PM10) was measured using CASELLA Micro dust Pro**,** Nitrogen dioxide (NO2), Sulphur dioxide (SO2), Carbon monoxide (CO) were measured using Altair 5X Multiple gas Detector. Ammonia (NH3) was measured using Eagle 2 Multigas Dictator.

**2.5 Computation of Air Quality Index (AQI)**

AQI was calculated using, the linear segmented principle method also known as the Central Pollution Control Board (CPCB Method) which normalizes pollutant concentrations into a scale from 0 to 500. The sub-index for each pollutant was calculated, and the overall AQI was determined based on the highest sub-index value.

**2.6 Environmental Risk Assessment**

Health risk was evaluated by comparing measured concentrations with WHO and Nigerian Ambient Air Quality Standards. Environmental impact was assessed qualitatively based on pollutant type, concentration, exposure duration, and ecological sensitivity of the area.

**3.0 Results and Discussion**

The result of the computed Air Quality Index (AQI) is presented in the table below.

**Table 3: Monthly variations for AQI Gaseous pollutants and particulate matter.**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  | **AQI PM 2.5** | **AQI PM10** | **AQI CO** | **AQI NO2** | **AQI NH3** | **AQI SO2** | **AQI O3** |
| **August** | 85.0 | 55.71 | 45.0 | 57.7 | 73.5 | 112.8 | 270.4 |
| **September** | 126.7 | 82.21 | 50.0 | 71.1 | 93.9 | 106.4 | 270.4 |
| **October** | 86.5 | 68.02 | 45.0 | 57.0 | 72.3 | 105.9 | 270.4 |
| **November** | 127.3 | 89.49 | 30.0 | 34.6 | 18.075 | 126.5 | 270.4 |
| **December** | 304.0 | 132.2 | 175.9 | 53.1 | 118.6 | 106.6 | 270.4 |
| **January** | 377.9 | 243.4 | 15.0 | 0.0 | 0.025 | 107.3 | 270.4 |

PM2.5 levels have the highest AQI value in January 377.9, followed by December 304.0 indicating severe air quality, while the lowest value was observed in August 85.0 followed by October 86.5 indicating moderately being polluted. September 126.7 and November 127.3 are very poor. For PM10, January 243.4, December 132.2 are moderately polluted, August 55.71, October 68.02, September 82.21 and November 89.49 are satisfactory. For CO, August 45. September 50.0, October 45.0, and December 175.9 are in the severe category. November 30.0 is very poor while January 15.0 is poor. For NO2 , November (34.6) is good ,October (57.0), December (53.1),August (57.7) are satisfactory.

**Table 4: Colour code representation of monthly variations for AQI of Gaseous pollutants and particulate matter.**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  | **AOI PM2.5** | **AQI** **PM10** | **AQI CO** | **AQI** NO₂ | **AQI** NH₃ | **AQI** SO2 | **AQI ozone** O₃ |
| **August** | **85.5** | 55.71 | 45.0 | 57.7 | 73.5 | 112.8 | 270.4 |
| **September** | **126.7** | 82.21 | 50.0 | 71.1 | 93.9 | 106.4 | 270.4 |
| **October** | **86.5** | 68.02 | 45.0 | 57.0 | 72.3 | 105.9 | 270.4 |
| **November** | **127.3** | 89.49 | 30.0 | 34.6 | 18.075 | 126.5 | 270.4 |
| **December** |  | 132.2 | 175.9 | 53.1 | 118.6 | 106.6 | 270.4 |
| **January** |  | 243.4 | 15.0 | 0.0 | 0.025 | 107.3 | 270.4 |

Good

moderate

Unhealthy for sensitive group

Unhealthy

Very unhealthy

Hazardous

The Air Quality Index (AQI) values for the assessed pollutants at Dangote cement plant Obajana, both gaseous pollutants and particulate matters exhibited clear seasonal trends, influenced by meteorological parameters such as temperature, wind speed, and humidity. The AQI values for the various pollutants in this study as seen from Tables 3, 4 and Figure 1 to Fig 7 provided key insights into the air quality status around Dangote Cement Factory, Obajana, and the potential environmental and health implications.

**AQI PM2.5 and PM10**

During the wet season (August to October), AQI for PM₂.₅ ranged from 85.0 –126.7, while AQI for PM₁₀ varied from 55.71–82.21. These values indicated a moderate to unhealthy for sensitive group’s air quality classification. The moderate AQI values during this period can be attributed to increased rainfall, which promotes wet deposition of airborne particles, reducing their atmospheric concentration. In dry season (November to January), there was a significant increase in AQI for PM₂.₅ (127.3–377.9) and PM₁₀ (89.49–243.4). The highest AQI for PM2.5 and PM10 were PM₂.₅ in January 377.9 being Hazardous, with maroon colour as the colour code; PM₁₀ in January 243.4, being Very Unhealthy, with purple colour as the colour code. These high values, suggested that cement production and associated activities (e.g., clinker production, raw material handling, and transportation) contributed significantly to airborne particulate matter. This findings disagree with Adeniran et al., (2019) who reported that the AQI values for all their sampling locations were in general good except for one location where it was of a moderate quality. But the findings is in agreement with Ubuoh et al., (2023) who reported the AQI values for PM10 for twelve months assessment to be in such a concentration that was hazardous or unhealthy, Chukwu et al., (2021). The unhealthy and hazardous AQI in January indicated severe air pollution from severe dust emulsion from the cement plant activities. Exposure to such high PM levels poses serious respiratory and cardiovascular risks to workers and residents. Mitigation measures such as improved dust control technologies, wet suppression systems and continuous monitoring should be put in place, Chaurasia and Tiwari (2016).

**Fig 1: Chart for AQI PM 2.5 and PM10 for the period of six months**

**AQI Carbon monoxide (CO)**

In wet season (August to October), AQI for CO was relatively low, between 45.0–50.0, (good being the level of health concern, and green as the colour code) suggesting minimal pollution risks as indicaed in Tables 3, 4 and Figure 2. This could be due to effective dispersion and oxidation of CO in the presence of sufficient atmospheric moisture. This finding aligned with Adeniran et al., (2019) and Ubuoh et al., (2023) respectively who reported the AQI values for CO to be in Good category. During dry season ( November to January), a sharp increase was observed in December, with AQI value of 175.9 (unhealthy being the level of health concern and red as the colour code), followed by a drastic drop in January to 15.0 (good being the level of health concern and green as the colour code). The December peak suggested a seasonal increase in combustion activities such as fuel burning in cement kilns, power generators, and vehicle emissions from haulage trucks. The sharp drop in January to 15.0, Good AQI could indicate changes in operations or meteorological factors favouring pollutant dispersion, Adeniran et al., (2019). Notwithstanding, mitigation measures such as Improved kiln efficiency, use of alternative fuels, and regular maintenance of combustion systems can help control emissions, Omulami (2023).

Fig 2: Chart of AQI for Carbon mono oxide (CO) for the period of six (6) months

**AQI Nitrogen Dioxide (NO₂)**

In wet season, NO₂ AQI ranged from 57.0–71.1, the peak being 71.1 in September falling within the moderate air quality category with yellow as the colour code as shown on Table 3, 4 and figure 3. This finding disagreed with Chaurasia and Tiwari (2016) who reported the AQI value for NO₂ to be within Good category for all the sampled locations. The wet season contributed to NO₂ removal via wet deposition. During the dry season (November to January), a decreasing trend was observed, with NO₂ AQI falling from 34.6, good category in November to 0.0 in January. This suggested a reduced NO₂ emissions from combustion sources or enhanced dispersion and oxidation processes in the dry season. The near-zero NO₂ AQI in January suggested enhanced dispersion due to stronger winds or reduced combustion activities, this in contrast to Ubuoh et al., (2023) but agreed with Adeniran et al., (2019) who reported the AQI NO2 in a cement company to be good at all sampling locations. Nevertheless, NO₂ control can be improved with low-NOx burners and selective catalytic reduction (SCR) systems, Fernandes et al., (2021).

Fig 3: Chart of AQI for Nitrogen dioxide (NO2) for the period of six (6) months

**AQI Ammonia (NH₃)**

Air quality Index AQI for NH₃ during the wet season (August to October) was relatively high 72.3–93.9, moderate category with yellow as colour code showing no threat to human health and the environment. Nevertheless, the AQI level indicated contribution from industrial emissions, as a by-product of kiln reactions or used in NOx reduction systems, Rahman and Hatefi (2023). During the dry season, NH₃ AQI dropped drastically in November to 18.075, good category (green colour code), peaked again in December 118.6, unhealthy for sensitive groups category (Orange colour code), and then became nearly negligible in January 0.025, good category (green colour code). The December peak suggested increased emissions from either chemical process within the cement plant or industrial waste disposal, David Perilli (2025). The rapid decline in January indicated that NH₃ pollution was sporadic, likely linked to specific operational activities. Continuous monitoring and optimization of emissions from kiln processes could help mitigate NH₃ spikes, contributing to a healthy, sustainable environment (Jiang et al., 2020; Behera et al., 2013).

Fig 4: Chart of AQI for Ammonia for the period of six (6) months

**AQI Sulphur dioxide (SO₂)**

Air quality Index for SO₂ remained relatively stable for both wet and dry seasons, with values between 105.9 and 126.5 throughout most months, being in the category of unhealthy for sensitive groups with orange colour code, indicating the presence of pollution by SO2 (Table 3, 4, Figure 5). The findings are in contrast to Adeniran et al .,(2019), Chaurasia and Tiwari (2016), Sadhana et al., (2013 )who reported AQI for SO₂ as good at all the sampled locations in their various studies. Also, this finding is in disagreement with Ubuoh et al., (2023) who reported AQI SO₂ to be in the range of Very unhealthy to hazardous for all the assessed months. SO₂ is primarily emitted from the burning of sulphur-containing fuels in cement production and from raw materials handling. The November peak suggested an increase in fuel combustion or material processing activities that release sulphur compounds, Bada et al., (2021). This showed that Dangote cement plant Obajana is a significant SO₂ emitter, likely from high-sulphur fuels or raw materials. The use of low-sulphur fuels and flue gas desulfurization systems could help reduce emissions, Isaiah et al., (2021), Roy and Sardar (2015).

Fig 5: Chart of AQI for Sulphur (iv) oxide (SO2) for the period of six (6) months

**AQI Ozone (O₃)**

Unlike primary pollutants, O₃ is formed through photochemical reactions involving NO₂ and volatile organic compounds (VOCs), Jacob and winner (2009). AQI values for both wet and dry season remained constant at 270.4 Very Unhealthy category with purple colour code. The persistently high levels suggested continuous ozone formation from cement-related emissions. High ozone levels pose significant respiratory health risks and indicated an ongoing secondary pollution issue at Dangote cement Obajana, Kogi state. To mitigate O₃ pollution, reducing NOx and VOC emissions, alongside the promotion of green infrastructure, can be effective., Azee et al (2016).

Fig 6: Chart of AQI for Ozone (O3) for the period of six (6) months

Fig 7: Graph of monthly variation of the various pollutant AQI for the period of six (6) months

**4. 0 Conclusion**

This study revealed that air pollution levels at the Dangote Cement Plant in Obajana Kogi state as seen from the computed Air Quality Index (AQI). The computed Air Quality Index (AQI) data for the six-month period (August–January) revealed persistent air pollution around and noticeable seasonal variation around the Obajana Cement Factory, with critical implications for both public health and environmental sustainability. During the wet season (August–October), AQI levels for most pollutants remained within moderate to unhealthy-for-sensitive-groups categories, particularly for pollutants such as PM₂.₅, PM₁₀, and SO₂. However, from November through January being the dry season, AQI levels worsened considerably, with several pollutants reaching "unhealthy," "very unhealthy," and even "hazardous" levels, particularly in December and January. Based on the findings of this study, which revealed significant Air Quality Index variations across the monitored locations and seasons around the Dangote Cement Industry, it is recommended that iimmediate interventions such as dust suppression, stack emission controls, continuous air monitoring, and public health awareness be put in place. Policy enforcement by environmental agencies is vital to mitigate long-term impacts. The cement factory should upgrade their air pollution control system. Continued academic and institutional research should be supported to monitor long term trends in pollutant concentration and AQI. The urban planning and land use regulation bodies should restrict residential development and schools from being sited 3-5 km radius of the cement production factory. Dangote cement industry should adopt the use of alternative fuels and low-emission raw materials to reduce reliance on high carbon inputs.

**REFERENCES**

Azeez, L., Oyedeji, O. A., Adewuyi, S. O., Tijani, K. O., Adebisi, S. A., & Olaogun, M. A. (2016). Precursors Influencing Tropospheric Ozone Formation and Apportionment in Three Districts of Ilupeju Industrial Estate, Lagos. American Journal of Chemistry, 6(3), 65-73.

Adeniran, J. A., Yusuf, R. O., Fakinle, B. S., and Sonibare, J. A. (2019). Air quality assessment and modelling of pollutants emission from a major cement plant complex in Nigeria. *Atmospheric Pollution Research*, *10*(1), 257-266.

Bada, B. S., Olatunde, K. A., & Oluwajana, A. (2013). Air quality assessment in the vicinity of Cement company. International Research Journal of Natural Sciences, 1(2), 34-42.

Behera, S. N., Sharma, M., Aneja, V. P., & Balasubramanian, R. (2013). Ammonia in the atmosphere: a review on emission sources, atmospheric chemistry, and deposition. Atmospheric Environment, 80, 1-19.

Bhola, J., Bajpai, A., Jain, S., Jain, D., & Koul, M. (2024). Insights into the Air Quality Indices and its Linkage with Diwali Festival Celebrations in Delhi, India in November 2023: A Case Study. *INTERNATIONAL JOURNAL OF PLANT AND ENVIRONMENT*, *10*(01), 61-68.

Bishoi, B., Prakash, A., and Jain, V. K. (2009). A comparative study of air quality index based on factor analysis and US-EPA methods for an urban environment. *Aerosol and Air Quality Research*, *9*(1), 1-17.

Chaurasia, S., & Tiwari, A. (2016). Assessment of ambient air quality in the vicinity of cement industries. International Journal of Applied Research and Technology, 1(1), 39-46.

Chukwu, E. O., Adaji, J. I., Okoro, A. D., and Faluyi, M. O. (2021). Health and Environmental Impacts of Industrialization (A case study of Dangote Cement Factory on Obajana Community, Kogi state, Nigeria). *International Journal of Research and Innovation in Applied Science*, *6*(8), 28-40.

David Perilli (2025). Update on Ammonia in cement production

Etim, M. A., Babaremu, K., Lazarus, J., & Omole, D. (2021). Health risk and environmental assessment of cement production in Nigeria. *Atmosphere*, *12*(9), 1111.

Fernandes, A. P., Rafael, S., Lopes, D., Coelho, S., Borrego, C., & Lopes, M. (2021). The air pollution modelling system URBAIR: how to use a Gaussian model to accomplish high spatial and temporal resolutions. Air Quality, Atmosphere & Health, 14(12), 1969-1988.

Ingole, N. W., and Dharpal, S. V. (2016). Diagnostic Analysis and Modelling of Air Quality for Medium Sized City.

Jiang, K., Yu, H., Chen, L., Fang, M., Azzi, M., Cottrell, A., & Li, K. (2020). An advanced, ammonia-based combined NOx/SOx/CO2 emission control process towards a low-cost, clean coal technology. Applied Energy, 260, 114316.

Hemavani, B., and Rao, G. S. (2020). A comparative study on seasonal variations of air quality index (AQI) in sanathnagar area of hyderabad city, india. *ILO*, *7*(01).

Kowalska, M., Ośródka, L., Klejnowski, K., Zejda, J. E., Krajny, E., & Wojtylak, M. (2009). Air quality index and its significance in environmental health risk communication. *Archives of Environmental Protection*, 13-21.

Omulami, J. O. (2023). Atmospheric Dispersion Modelling of Particulate Matter and Gaseous Emissions from Selected Cement Factories in Athi River Machakos County Kenya (Doctoral dissertation, University of Nairobi).

Rahmani, H., and Hatefi, O. (2023). Investigation of environmental gases and suspended particles in the environment around Sepahan Cement factory. Journal of Environmental Science Studies, 8(2), 6501-6509.

Roy, P and Sardar, A. (2015). SO2 emission control and finding a way out to produce sulphuric acid from industrial SO2 emission. J Chem Eng Process Technol, 6(2), 1000230.

Ubuoh, E. A., Nwogu, F. U., Ogbaji, E. E., Kanu, C., & Nwawuike, N. (2023). Effect of Cement Production Processes on Dry Atmospheric Chemistry in South-South Nigeria.

Sadhana, C., Ashwani, K., and Dev, G. A. (2013). Air Pollution and air quality index of Kodinar Gujrat, India. *Int. Res. J. Environment Sci*, *2*(5), 62-67.