International Journal of Multidisciplinary Research and Technology
ISSN 2582-7359, Peer Reviewed Journal, Impact Factor 6.325
www.ijmrtjournal.com

# AIR QUALITY PARAMETER OF PALI PROJECT UG COAL MINE JOHILLA AREA BIRSINGHPUR PALI, UMARIA, MADHYA PRADESH

*[1]Laxmi Saket, [2]Mamta Prajapati, [3]Varsha Jaiswal*

[1,2,3]Department of Chemistry, Pandit S.N. Shukla University , Shahdol, MP, India

**Abstract**

The Pali Project Underground (UG) Coal Mine, located in the Johilla Area, Birsinghpur, Pali, Umaria, Madhya Pradesh, is a pivotal economic asset for the region. However, coal mining activities can potentially introduce air pollutants that pose risks to both the environment and human health. This research project focuses on comprehensively evaluating the Air Quality parameter in the proximity of the Pali Project UG Coal Mine to understand the implications of mining on air quality. The SPM, PM10, PM2.5, SO2, NO2 and heavy metals are monitoring in summer, monsoon and winter season in industrial and residential zone. The primary objectives of this study are to establish baseline air quality data, monitor variations over time, assess the impact of mining activities, evaluate potential health risks, and provide recommendations for mitigation if necessary. The research methodology involves the installation of air quality monitoring stations, continuous data recording, long-term monitoring, impact assessment through source identification and health risk analysis, and the formulation of mitigation recommendations.

**Keywords:** Air, quality, SPM, PM10, PM2.5, SO2, NO2, and heavy metals

## Introduction

Air quality is a critical environmental concern that has profound implications for the well-being of both ecosystems and human populations. In regions where industrial activities, such as mining, are prevalent, the management of air quality becomes even more crucial**[1-10]**.When undesired or hazardous substances are present in the air, it is referred to as air pollution. These substances can have a negative effect on the environment, human health, and the general wellbeing of living things. These pollutants can come from a variety of sources, including industrial processes, transportation, agriculture, building, and natural processes **[11-15]** The Pali Project Underground (UG) Coal Mine, situated in the Johilla Area of Birsinghpur, Pali, Umaria, Madhya Pradesh, is a significant economic asset for the region due to its coal mining operations. However, these operations have the potential to release various pollutants into the atmosphere, thereby impacting air quality in the surrounding areas.

The Air Quality Index (AQI) serves as a standardized tool for quantifying air pollution levels and providing a comprehensive measure of overall air quality. Monitoring the AQI in the vicinity of the Pali Project UG Coal Mine is of paramount importance as it enables us to assess the potential health risks posed by exposure to airborne pollutants and to make informed decisions regarding environmental management and public health**[16-20]**.

This research project is designed to comprehensively evaluate and monitor the AQI near the Pali Project UG Coal Mine. By establishing baseline air quality data, tracking variations over time, assessing the impact of coal mining activities, evaluating potential health risks, and proposing mitigation measures, this study seeks to provide essential insights into the state of air quality in the region.

Understanding the dynamics of air quality in this context is not only vital for protecting the health and well-being of the local population but also for promoting sustainable mining practices and minimizing adverse environmental effects. This research project endeavors to shed light on the complex relationship between coal mining activities and air quality, ultimately contributing to evidence-based decision-making and environmental stewardship in the Johilla Area.

## Methodology

### Study Area

Birsinghpur Pali is located in Umaria district, Madhya Pradesh. The town of Umaria is the district headquarters. The district is part of Shahdol Division.

The total geographical area of the district sums up to 4548 square kilometers and has a population of 6,44,758. Umaria is enriched with its vast resources of forests and minerals. The coal mines are a steady source of revenue for the district.

The most important mineral found in the district is coal and as a result 8 mines are being operated by South Eastern Coalfields Limited (Nowrozabad) in the district. The Bandhavgarh National Park (Tala) and Sanjay Gandhi Thermal Power Station at Mangthar (Pali) are located in the district. Umaria was formerly the headquarters of the South Rewa District and thereafter the headquarters town of the Bandhavgarh tehsil. It is situated at a distance of about 69 km. from Shahdol, the parent district. Metalled roads connect the town with Katni, Rewa, Shahdol, etc., on which regular buses ply. Umaria is also a railway station on the Katni-Bilaspur section of the South East Central Railway zone.


**Figure 1: Umaria District**

**Collection of sample**

The samples will be collected in different seasons (winter, summer and Monsoon) of the year, 2021 from the Pali UG coal mine Johilla area and residential zone, Umaria, Madhya Pradesh, India. Some results will be recorded in the laboratory.

**Result and discussion**

**Suspended Particulate Matter (SPM) Analysis**

Suspended Particulate Matter (SPM) analysis is a critical component of assessing and monitoring air quality in regions where industrial activities, including coal mining, can significantly contribute to airborne particulate matter concentrations. SPM consists of solid particles or liquid droplets suspended in the air and is typically categorized into different size fractions, including PM10 (particles with a diameter of 10 micrometers or smaller) and PM2.5 (particles with a diameter of 2.5 micrometers or smaller). Analyzing SPM levels is essential because these particles can have adverse effects on human health and the environment. The SPM levels in industrial zone are 445, 306 and 454 (µg/m$^3$) for summer, Monson and winter respectively which are under permissible limit. The SPM levels in residential zone are 152, 126 and 154 µg/m$^3$ for summer, Monson and winter respectively which are under permissible limit. The PM10 levels in industrial zone are 220, 155 and 178 (µg/m$^3$) for summer, Monson and winter respectively which are under permissible limit. The PM10 levels in residential zone are 72, 55 and 75 µg/m$^3$ for summer, Monson and winter respectively which are under permissible limit. The PM2.5 levels in industrial zone are 40, 45 and 50 (µg/m$^3$) for summer, Monson and winter respectively which are under permissible limit. The PM2.5 levels in residential zone are 55, 30 and 34 µg/m$^3$ for summer, Monson and winter respectively which are under permissible limit.

**Table 1: Permissible Limit of SPM**

| Permissible Limit (µg/m$^3$) | | | | | |
|---|---|---|---|---|---|
| | **SPM** | **PM10** | **PM2.5** | **SO2** | **NO2** |
| **Industrial Zone** | 600 | 300 | 60 | 120 | 120 |
| **Residential Zone** | 200 | 100 | 60 | 80 | 80 |

**Table 2: SPM levels in industrial and residential zone**

| Industrial Pali PIT Office (mine site) | | | |
|---|---|---|---|
| **Season** | **SPM (µg/m$^3$)** | **PM10 (µg/m$^3$)** | **PM2.5 (µg/m$^3$)** |
| **Summer** | 445 | 220 | 40 |
| **Monson** | 306 | 155 | 45 |
| **Winter** | 454 | 178 | 50 |
| **Pali Colony** | | | |
| **Season** | **SPM (µg/m$^3$)** | **PM10 (µg/m$^3$)** | **PM2.5 (µg/m$^3$)** |
| **Summer** | 152 | 72 | 55 |
| **Monson** | 126 | 55 | 30 |
| **Winter** | 154 | 75 | 34 |

**Sulfur Dioxide (SO2) Analysis**

Sulfur dioxide (SO2) is a significant air pollutant often associated with industrial processes, including coal mining. Monitoring SO2 levels in the vicinity of the Pali Project UG Coal Mine is essential for assessing its impact on air quality and the potential health risks associated with exposure to this gas. SO2 is a corrosive gas that can irritate the respiratory system and contribute to the formation of acid rain when it reacts with other atmospheric components.

Therefore, thorough SO2 analysis is crucial for environmental management and public health. The SO2 levels in industrial zone are 32, 25 and 33 (µg/m$^3$) for summer, Monson and winter respectively which are under permissible limit. The SO2 levels in residential zone are 19, 19 and 25 µg/m$^3$ for summer, Monson and winter respectively which are under permissible limit.

**Table 3: $SO_2$ levels in industrial and residential zone**

| **Industrial Pali PIT Office (mine site)** | |
|---|---|
| **Season** | **SO2 (µg/m$^3$)** |
| **Summer** | 32 |
| **Monsoon** | 25 |
| **Winter** | 33 |
| **Pali Colony** | |
| **Season** | **SO2 (µg/m$^3$)** |
| **Summer** | 19 |
| **Monsoon** | 19 |
| **Winter** | 25 |

**Nitrogen Dioxide (NO2) Analysis**

Nitrogen dioxide (NO2) is a key air pollutant that can have significant health and environmental impacts. Its presence in the atmosphere is often associated with industrial processes, transportation emissions, and combustion activities, all of which are relevant to the operations of the Pali Project UG Coal Mine. Monitoring NO2 levels in the vicinity of the mine is essential for assessing air quality and potential health risks. NO2 is known to contribute to respiratory problems and can react in the atmosphere to form other secondary pollutants, making its analysis critical for public health and environmental management. The NO2 levels in industrial zone are 42, 34 and 43 (µg/m$^3$) for summer, Monson and winter respectively which are under permissible limit. The NO2 levels in residential zone are 29, 28 and 34 µg/m$^3$ for summer, Monson and winter respectively which are under permissible limit.

**Table 4: $NO_2$ levels in industrial and residential zone**

| **Industrial Pali PIT Office (mine site)** | |
|---|---|
| **Season** | **NO2 (µg/m$^3$)** |
| **Summer** | 42 |
| **Monsoon** | 34 |
| **Winter** | 43 |
| **Pali Colony** | |
| **Season** | **NO2 (µg/m$^3$)** |
| **Summer** | 29 |
| **Monsoon** | 28 |
| **Winter** | 34 |

**Heavy Metal Analysis**

Heavy metal analysis is a vital component of environmental monitoring, especially in regions with industrial activities like coal mining. Heavy metals, such as arsenic (As), lead (Pb), nickel (Ni), chromium (Cr), cadmium (Cd), and, selenium (Se)are known for their toxic properties and potential environmental and human health risks. In the context of the Pali Project UG Coal Mine, heavy metal analysis aims to assess the presence and concentrations of these metals in various environmental media, including air, water, soil, and potentially biological samples. The

heavy metals (As, Pb, Ni, Cr, Cd and Se) are found at below detection line (BDL) in residential zone in all season. Pb metal in Monson and winter season in industrial are 0.10 and 0.9 µg/m$^3$respectively. As, Ni, Cr, Cd and Se are found at below detection line (BDL) in industrial zone in all season.

**Table 5: Heavy metal in industrial and residential zone**

| Industrial Pali PIT Office (mine site) | | | | | | |
|---|---|---|---|---|---|---|
| **Season** | **As(µg/m$^3$)** | **Pb(µg/m$^3$)** | **Ni(µg/m$^3$)** | **Cr(µg/m$^3$)** | **Cd(µg/m$^3$)** | **Se(µg/m$^3$)** |
| **Summer** | BDL | BDL | BDL | BDL | BDL | BDL |
| **Monson** | BDL | 0.10 | BDL | BDL | BDL | BDL |
| **Winter** | BDL | 0.9 | BDL | BDL | BDL | BDL |
| **Pali Colony** | | | | | | |
| **Season** | **As(µg/m$^3$)** | **Pb(µg/m$^3$)** | **Ni(µg/m$^3$)** | **Cr(µg/m$^3$)** | **Cd(µg/m$^3$)** | **Se(µg/m$^3$)** |
| **Summer** | BDL | BDL | BDL | BDL | BDL | BDL |
| **Monson** | BDL | BDL | BDL | BDL | BDL | BDL |
| **Winter** | BDL | BDL | BDL | BDL | BDL | BDL |

## Discussion

In both industrial and residential zones, maintaining acceptable air quality is paramount for the well-being of residents and the sustainable operation of industries. Monitoring and understanding the levels of various air pollutants, including Suspended Particulate Matter (SPM), PM10, PM2.5, Sulfur Dioxide (SO2), Nitrogen Dioxide (NO2), and heavy metals, is crucial for ensuring that air quality remains within safe and regulatory limits. Here, we discuss what can be considered normal or acceptable levels of these pollutants in industrial and residential areas. All the parameters are found in normal levels shown in **Figure 2**.

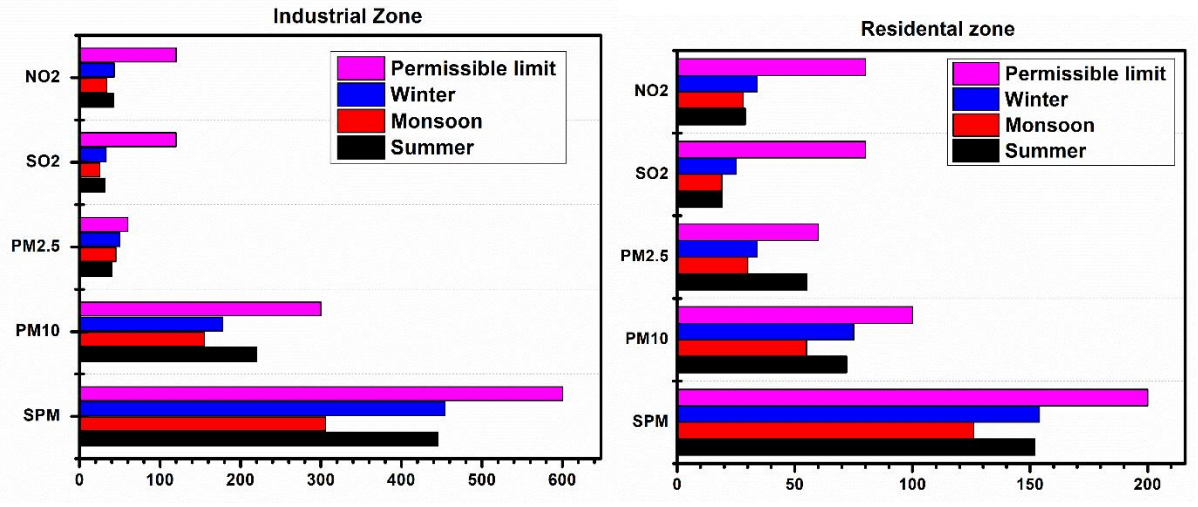


**Figure 2: Air quality parameter in industrial zone (left) and residentials zone (right)**

## Conclusion

In this paper, we monitoring the air quality in Pali Project UG coal mine Johilla area Birsinghpur Pali, Umaria, Madhya Pradesh. The air quality monitoring by using different parameters like SPM, PM10, PM2.5, SO2, NO2 and heavy metals in all seasons (summer, monsoon and winter). We also monitoring these parameters in industrial and residential zone. Moreover, we compared with permissible limit in industrial and residential zone. SPM, PM10, PM2.5, SO2, NO2 and heavy metals in industrial and residentials are lesser than permissible limit.

## References

1. Acid Rain 2000 (2001) The Acid Rain 2000 project in the UK. Available fromhttp://www.brixworth.demon.co.uk.
2. APHA (1998) Standard methods for examination of water and wastewater. AmericanPublic Health Association, 19th ed, Washington (DC).
3. Anwar MN, Shabbir M, Tahir E, Iftikhar M, Saif H, Tahir A, Murtaza MA, Khokhar MF, Rehan M, Aghbashlo M, Tabatabaei M, (2021) Emerging challenges of air pollution and particulate matter in China, India, and Pakistan and mitigating solutions. Journal of Hazardous Materials, 416, p.125851.
4. Bodhaine BA (1983) Aerosol measurements at four background sites. J Gophys Res88:10753-10768.
5. Burnett RT, Cakmak S, Raizenne ME, Stieb D, Vincent R, Krewski D, Brook JR,Philips O, Ozkaynak H (1998) The association between ambient carbonmonoxide levels and daily mortality in Toronto, Canada. J Air Waste ManageAssoc 48: 689–700.
6. Cohen DD (1998) Charaterization of atmospheric fine particle using IBA techniques.NuclInstrum Methods 136: 14-22.
7. Dasilva FJJR, Williams RJP (1991) The biochemistry of elements. Clarendon Press,Oxford.
8. Fergusson JE (1990) The heavy elements: Chemistry, environmental impact andhealth effects. Pergamon Press, Oxford.
9. Goyal P, Sidhartha (2002) Effect of winds on SO2 and SPM concentrations in Delhi.Atmos Environ 36: 2925–2930.
10. Goyal P, Singh MP (1990) The long-term concentration of sulphur dioxide at TajMahal due to the Mathura Refinery. Atmos Environ Part B 24: 407–411.
11. Guttikunda SK, Nishadh KA, Jawahar P, (2019) Air pollution knowledge assessments (APnA) for 20 Indian cities. Urban Climate, 27, pp.124-141.
12. Hakkim H, Sinha V, Chandra BP, Kumar A, Mishra AK, Sinha B, Sharma G, Pawar H, Sohpaul B, Ghude SD, Pithani P, (2019) Volatile organic compound measurements point to fog-induced biomass burning feedback to air quality in the megacity of Delhi. Science of the total environment, 689, pp.295-304.
13. Mohanraj R, Azeez PA, Priscilla T (2004) Heavy metals in airborne particulate matterof urban Coimbatore. Arch Environ ContamToxicol 47: 162–167.
14. Mouli PC, Mohan SV, Reddy SJ (2003) A study on major inorganic ion compositionof atmospheric aeorosols at Tirupati. J Haz Mat B 96:217-228.
15. Puescel RF, Van Valin CC, Castillo RC, Kandlech RC, Ganor E (1986) Aerosols inpolluted versus non polluted air masses: long range transport and effects onclouds. J Clim Appl Meteo 25: 1908-1917.
16. Rao CS (1991) Environmental Pollution Engineering, Wiley Eastern Limited, NewDelhi.
17. Rao ND, Kiesewetter G, Min J, Pachauri S, Wagner F, (2021) Household contributions to and impacts from air pollution in India. Nature Sustainability, 4(10), pp.859-867.
18. Rizzio E, Giaveri G, Arginelli D, Gini L, Profumo A, Galorini M (1999) Traceelements total content and particle sizes distribution in the air particulatematter of a rural residential area in north Italy investigated by neutronactivation analysis. Sci Total Environ 226:47–56.
19. World Health Organization (WHO) (2005) WHO air quality guideline update. Reportof the working group meeting, WHO, Bonn, Germany.
20. Wu YS, Fang GC, Fu PP, Yang CJ (2002) The measurements of ambient particulate(TSP, PM2.5, PM2.5-10); Chemical component concentration variatirx andmutagennicity study during 1998-2001 in central Taiwan. J Environ SciHealth C Environ CarcinogEcotoxicol Rev 20 (1): 45-49.