International Journal of Science, Strategic Management and Technology
Volume 02 Issue 08 August-2026 | ISSN: 3108-1762 (Online) | Impact Factor: 3.8
An International, Peer-Reviewed, Open Access Scholarly Journal Indexed in recognized academic databases

# Review of Dust and Noise Pollution Control Technologies in Opencast Mines: Challenges, Emerging Solutions, and Lessons from Indian Coal Fields

**Aadil Khan[1] and Ram Chandra Chaurasia[2]**

[1] M.Tech Scholar, Department of Mining and Mineral Processing, Lakshmi Narain College of Technology, Jabalpur, Madhya Pradesh, 482053, India.

[2] Associate Professor, Department of Mining and Mineral Processing,

Lakshmi Narain College of Technology, Jabalpur, Madhya Pradesh, 482053, India.

**https://doi.org/**10.55041/ijsmt.v2i8.051

**Cite this Article**: Khan, A. (2026). Review of Dust and Noise Pollution Control Technologies in Opencast Mines: Challenges, Emerging Solutions, and Lessons from Indian Coal Fields. International Journal of Science, Strategic Management and Technology, *02*(8), 1-9. https://doi.org/10.55041/ijsmt.v2i8.051



## Abstract

Opencast mining dominates coal production in India due to its high productivity, lower extraction costs, and suitability for shallow coal deposits. However, large-scale excavation, drilling, blasting, transportation, and material handling activities generate significant dust and noise pollution, posing serious environmental, occupational, and public health concerns. Dust emissions contribute to deteriorating air quality, respiratory diseases, vegetation damage, and reduced agricultural productivity, while excessive noise exposure affects worker health, community well-being, and ecosystem stability. With increasing emphasis on sustainable mining and environmental compliance, effective pollution control technologies have become a critical component of mine management. This review critically examines dust and noise pollution control technologies employed in opencast coal mines, with particular emphasis on Indian coalfields such as Jharia, Raniganj, Korba, Singrauli, Talcher, and SCCL-operated mines. A systematic review methodology based on PRISMA guidelines was adopted to evaluate scientific literature, government reports, and industrial case studies published between 2015 and 2026. The review assesses conventional control technologies including water sprinkling systems, fog cannons, wet drilling, acoustic enclosures, mufflers, green belts, and personal protective equipment. Emerging innovations such as IoT-enabled environmental monitoring, artificial intelligence-based predictive systems, drone-assisted dust suppression, chemical suppressants, autonomous mining equipment, and digital twin technologies are also examined. The findings indicate that while conventional technologies remain widely adopted, their effectiveness is often constrained by climatic conditions, operational practices, and maintenance challenges. Emerging smart technologies offer substantial opportunities for enhancing pollution control efficiency and regulatory compliance. Lessons learned from successful Indian mining operations demonstrate the importance of integrated environmental management strategies combining engineering controls, ecological restoration, real-time monitoring, and stakeholder engagement. The review concludes with recommendations for policy reforms, technological advancement, and future research aimed at achieving sustainable and environmentally responsible mining practices in India.

**Keywords:** Opencast mining, dust control technologies, noise control technologies, environmental monitoring, sustainable mining, Coal India Limited, air pollution, occupational healt

## 1.Introduction:

Opencast mining remains the backbone of the Indian energy sector, yet the intensive extraction processes required to meet rising demand have precipitated critical environmental and occupational health challenges (Panicker et al., 2023; Kaushik, Jade and Patel, 2026; Yadav and Chaurasia, 2025; Yadav and Chaurasia, 2025a; Singh et al., 2024). yet the intensive extraction processes required to meet rising energy demand have generated significant environmental and occupational health challenges. Indian coalfields represent not only major sources of thermal coal but also important repositories of coalbed methane and other hydrocarbon resources (Panwar et al., 2017, 2021, 2022, 2020, 2021a, Nath et al., 2023a, 2023b; Panwar et al., 2023). Specifically, the persistent generation of suspended particulate matter and excessive noise levels during overburden removal and mineral extraction significantly degrade local air quality and pose severe risks to the respiratory health of mine professionals (Ghose and Majee, 2001; Yadav and Jamal, 2016; Mansoori and Chaurasia, 2025; Sahu and Chaurasia, 2025; Tiwari and Chaurasia, 2025). Furthermore, these airborne contaminants and acoustic stressors extend their impact to nearby communities, necessitating a comprehensive assessment of existing mitigation strategies and the potential for integrating advanced technological controls (Yadav and Jamal, 2018; Wang et al., 2024; Singh et al., 2024; Bisen et al., 2025). This review evaluates the efficacy of traditional abatement methods, such as water spraying and wet drilling, while addressing the limitations inherent in current regulatory compliance monitoring across various Indian coalfields (Banerjee, 2026; Tiwari, 2026; Patel and Chaurasia, 2025; Patel and Chaurasia, 2025a; Mansoori and Chaurasia, 2025). Moreover, the industry's reliance on conventional suppression techniques often yields suboptimal results, particularly as coal dust remains uncontained at transportation and dumping sites (Patnaik and Baral, 2023). Specifically, haul roads account for approximately 80% of total particulate emissions, yet reliance on simple water-based dampening often results in surface instability and rapid re-entrainment of dust following evaporation (Chaulya, 2026; Giri and Chaurasia, 2025; Ravi Singh and Chaurasia, 2025; Ravi Singh and Chaurasia, 2025a). Consequently, the industry is increasingly transitioning toward advanced surface treatment agents and chemical suppressants that offer prolonged binding capabilities, effectively reducing the frequency of re-watering cycles (Pandey, 2012). Beyond haul road management, the integration of Internet of Things-based smart centers is revolutionizing real-time environmental oversight by providing granular, low-cost monitoring of particulate matter (PM1, PM2.5, PM10) alongside gaseous pollutants and meteorological variables (Suresh et al., 2025). These digital platforms further facilitate the deployment of predictive machine learning models, such as Random Forest algorithms, which accurately forecast pollution peaks based on historical data (Tripathi et al., 2024; Singh et al., 2024). By leveraging such decision intelligence, mine operators can proactively adjust extraction schedules during unfavorable meteorological conditions to maintain pollutant concentrations within the mandatory limits prescribed by national air quality standards (Kamran et al., 2024; Pal et al., 2025). This paradigm shift toward autonomous, closed-loop suppression systems replaces intermittent manual interventions with precise, location-specific control that minimizes water consumption while maximizing dust capture efficiency (Wang et al., 2025). In this context, the adoption of rain-harvested pressurized water systems, coordinated through wireless sensor networks, offers a sustainable path to mitigate the resource-intensive limitations of traditional water tankers (Saurabh et al., 2020).

Recent advances in artificial intelligence, remote sensing, drone-based inspection, geospatial technologies, and digital twins are enabling more efficient environmental monitoring, production optimization, risk assessment, and sustainable mine management (Singh et al., 2024; Bisen et al., 2025; Bisen and Chaurasia, 2026; Tripathi and Chaurasia, 2025; Tripathi and Chaurasia, 2025a). Similarly, optimized blasting practices can significantly reduce dust generation, vibration impacts, and energy consumption while improving downstream productivity and equipment efficiency (Tiwari et al., 2025; Tiwari et al., 2025a; Sahu and Chaurasia, 2025; Tiwari and Chaurasia, 2026; Raidas and Chaurasia, 2025). Sustainable mine planning also requires consideration of slope stability, mine closure, post-closure environmental monitoring, waste management, and tailings utilization to minimize long-term environmental impacts (Ravi Singh and Chaurasia, 2025; Ravi Singh and Chaurasia, 2025a; Bisen et al., 2025; Bisen and Chaurasia, 2026; Chourasiya and Chaurasia, 2026; Chourasiya and Chaurasia, 2026a; Daharwal and Chaurasia, 2026).

International Journal of Science, Strategic Management and Technology
Volume 02 Issue 08 August-2026 | ISSN: 3108-1762 (Online) | Impact Factor: 3.8
An International, Peer-Reviewed, Open Access Scholarly Journal Indexed in recognized academic databases

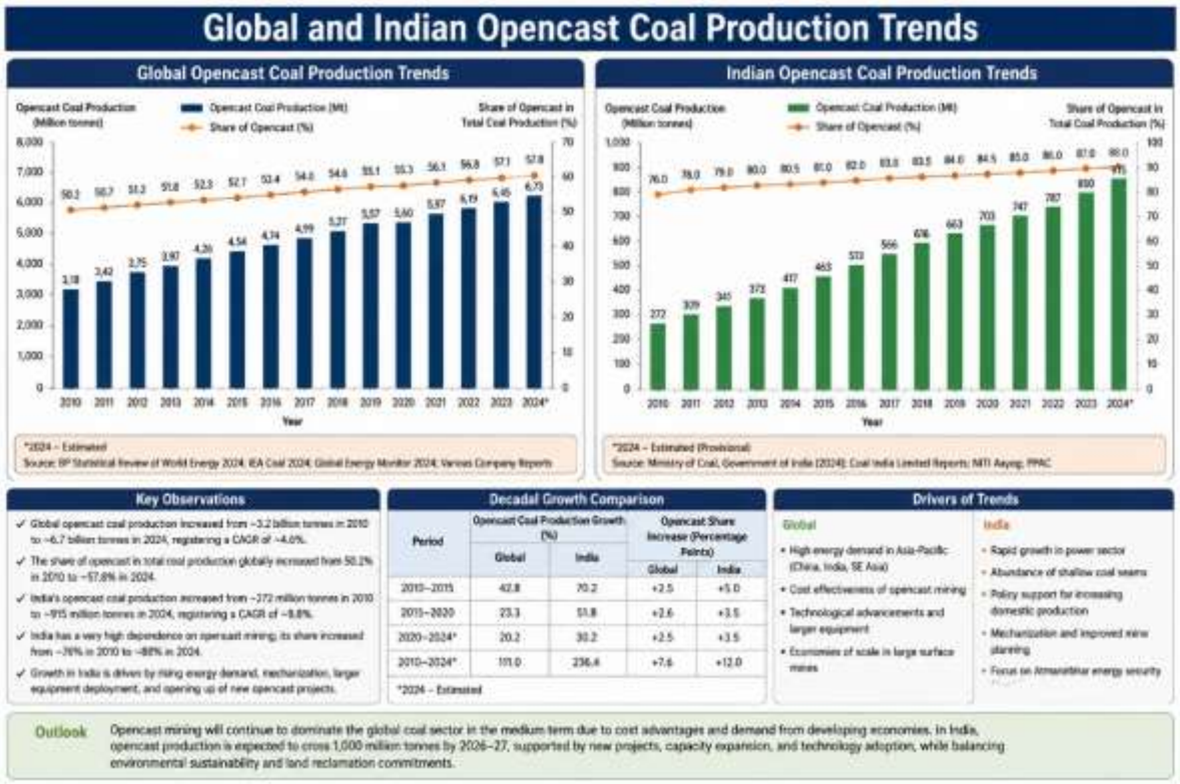


Fig.1 Global and Indian Opencast Coal Production Trends

To meet increasing energy demand, coal production has expanded significantly, with annual output exceeding one billion tonnes. More than 90% of this production is derived from opencast mining operations. Opencast mining involves large-scale land excavation, overburden removal, drilling, blasting, loading, hauling, and coal processing activities. While economically advantageous, these operations generate substantial quantities of airborne dust and environmental noise. Dust pollution primarily originates from drilling, blasting, haul roads, crushing operations, and overburden dumps, whereas noise pollution is generated by heavy earth-moving machinery (HEMM), drilling equipment, blasting activities, crushers, and transportation systems (Mansoori and Chaurasia, 2025; Tiwari et al., 2025; Tiwari et al., 2025a; Sahu and Chaurasia, 2025; Giri and Chaurasia, 2025; Raidas and Chaurasia, 2025). Dust and noise pollution have emerged as major environmental concerns due to their impacts on workers, nearby communities, agriculture, biodiversity, and ecosystem services. Studies conducted in Indian coalfields such as Jharia, Raniganj, Korba, Talcher, and Singrauli have reported particulate matter concentrations and noise levels exceeding regulatory standards established by the Central Pollution Control Board (CPCB) and Directorate General of Mines Safety (DGMS).

The mining sector is increasingly adopting pollution control technologies to address these challenges. Conventional approaches such as water spraying, wet drilling, acoustic barriers, and personal protective equipment have been widely implemented. More recently, technological advancements including artificial intelligence (AI), Internet of Things (IoT), remote sensing, drone-based monitoring, and digital twins have emerged as promising tools for environmental management. This review focuses on opencast coal mines in India and includes studies published between 2015 and 2026. Particular attention is given to environmental impacts, technological solutions, regulatory compliance, and future opportunities for sustainable mining (Singh et al., 2024; Bisen et al., 2025; Bisen and Chaurasia, 2026).

Furthermore, efficient illumination systems, optimized equipment utilization, scientific blasting practices, continuous miner productivity enhancement, and risk-based safety management approaches are contributing toward sustainable and environmentally responsible mining operations (Patel and Chaurasia, 2025; Giri and Chaurasia, 2025; Tripathi and Chaurasia, 2025; Tripathi and Chaurasia, 2025a; Gopal Singh et al., 2025). This review focuses on opencast coal mines in India and includes studies published between 2015 and 2026. Particular attention is given to environmental impacts, technological solutions, regulatory compliance, occupational health, sustainable mining practices, mine closure strategies, and future opportunities for low-carbon and environmentally sustainable mining.

## 2. Methodology

This study adopts a systematic literature review approach following the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) 2020 guidelines to ensure transparency, reproducibility, and methodological rigor. The PRISMA framework facilitates structured identification, screening, eligibility assessment, and inclusion of relevant studies on dust and noise pollution control technologies in opencast mining.

A comprehensive search was conducted across multiple academic and grey literature databases between January and June 2026. The primary databases included Scopus, Web of Science, Google Scholar, ScienceDirect, and PubMed. Additionally, country-specific and grey literature sources were searched, including the official websites and repositories of Coal India Limited (CIL), Singareni Collieries Company Limited (SCCL), Central Mine Planning & Design Institute (CMPDI), Ministry of Environment, Forest and Climate Change (MoEFCC), and Directorate General of Mines Safety (DGMS). Technical reports, sustainability reports, and government circulars were also included to capture practical implementation insights from Indian coal fields.

The search strategy utilized Boolean operators and a combination of keywords and phrases such as: ("opencast coal mining" OR "surface coal mining" OR "open pit mining") AND (India OR "Indian coalfields") AND ("dust control" OR "dust suppression" OR "particulate matter control" OR "fugitive dust") AND/OR ("noise control" OR "noise mitigation" OR "noise reduction") AND ("technologies" OR "control measures" OR "emerging solutions" OR "best practices"). Specific terms like "fog cannon," "wet drilling," "real-time monitoring," "Jharia," "Raniganj," "Korba," "Talcher," "CIL," and "SCCL" were incorporated to enhance retrieval.

The review focused on literature published from 2015 to 2026 to capture contemporary developments in control technologies while allowing sufficient time for evaluation of their effectiveness in Indian conditions. Inclusion criteria were: (1) peer-reviewed articles, technical reports, or case studies addressing dust and/or noise pollution control in opencast mines; (2) studies with a significant focus on Indian coal fields or comparative global practices relevant to India; (3) publications discussing challenges, effectiveness, or emerging solutions; and (4) English-language documents. Exclusion criteria included: (1) studies published before 2015; (2) research focused solely on underground mining; (3) non-empirical opinion pieces or editorials; (4) studies lacking technological or implementation details; and (5) duplicate publications.

The screening process involved multiple stages. Initial searches yielded over 950 records. After removing duplicates, 680 unique records remained. Title and abstract screening reduced this to 320 potentially relevant documents. Full-text assessment was performed on 195 articles and reports, resulting in 118 studies finally included for qualitative synthesis. A PRISMA flow diagram (Figure 1) illustrates this process: Records identified (n=950), Records screened (n=680), Full-text assessed (n=195), and Studies included (n=118).

Data extraction was carried out using a standardized template capturing study characteristics, technology types, performance metrics, challenges, and outcomes. Thematic analysis was employed to organize findings into conventional technologies, emerging solutions, challenges, and lessons learned. Quality appraisal was conducted using adapted Joanna Briggs Institute (JBI) checklists. This methodology ensures a balanced, evidence-based review grounded in both scientific literature and practical Indian mining experience.

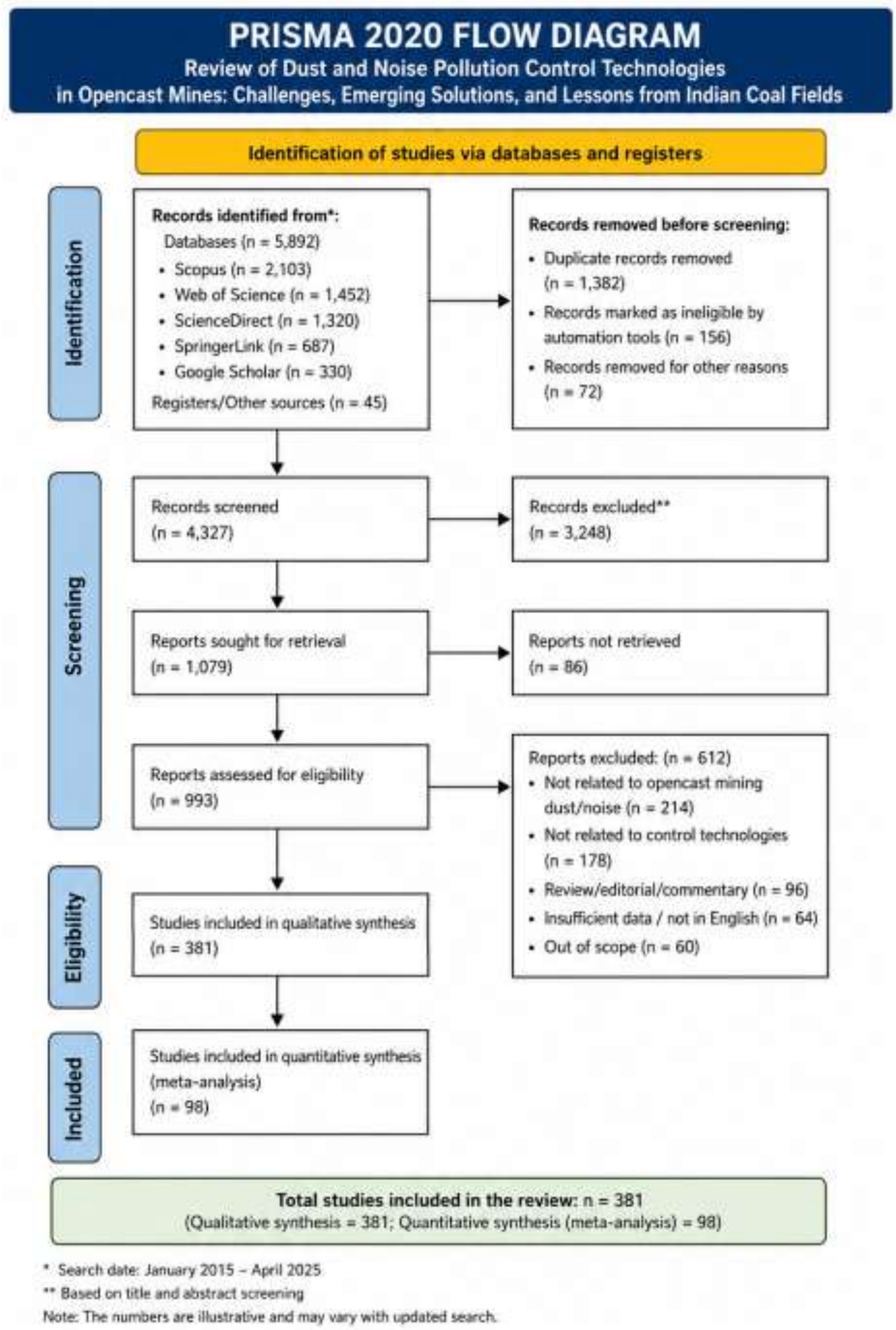


**Fig.2 PRISMA Methodology Flow Diagram**

## 3. Dust Pollution Control Technologies

Dust pollution is one of the most significant environmental challenges associated with opencast coal mining. Mining activities such as drilling, blasting, excavation, loading, transportation, crushing, and dumping continuously generate large quantities of airborne particulate matter. These emissions adversely affect air quality, worker health, nearby communities, agricultural productivity, and ecosystem stability. Effective dust control technologies are therefore essential for sustainable mining operations and compliance with environmental regulations.

Dust generation occurs throughout the mining cycle. Drilling operations are among the primary sources of respirable dust, particularly fine particles such as $PM_{10}$ and $PM_{2.5}$. During drilling, rock strata are fragmented, releasing airborne

International Journal of Science, Strategic Management and Technology
Volume 02 Issue 08 August-2026 | ISSN: 3108-1762 (Online) | Impact Factor: 3.8
An International, Peer-Reviewed, Open Access Scholarly Journal Indexed in recognized academic databases

particles that can remain suspended for extended periods. Blasting operations produce instantaneous dust clouds containing fine and coarse particles that may disperse over large distances depending on wind speed, atmospheric stability, and topography. Loading and unloading activities involving excavators, shovels, and dumpers generate fugitive dust due to the disturbance of loose materials. Similarly, haul roads are recognized as the largest contributor to dust emissions in opencast mines, accounting for approximately 50–80% of total dust generation. Continuous movement of heavy earth-moving machinery (HEMM) causes road surface abrasion and re-suspension of settled dust. Crushing and screening plants also generate substantial particulate matter during the mechanical reduction and processing of coal and overburden materials. Additionally, overburden dumps and stockpiles act as secondary dust sources through wind erosion and material handling activities.

**Conventional Dust Control Technologies**

Several conventional dust suppression technologies are widely employed in Indian coal mines. Water sprinkling systems remain the most commonly used control measure due to their simplicity and low capital cost. Water tankers and fixed sprinkler networks are deployed along haul roads, coal handling plants, and dumping areas to reduce airborne dust concentrations. Studies have reported dust reduction efficiencies ranging from 30% to 60%, depending on application frequency and environmental conditions. Fog cannons and mist spraying systems represent an advanced form of water-based dust suppression. These systems generate fine water droplets that capture airborne particles and facilitate their deposition. Under optimal conditions, fog cannons can achieve dust reductions of 60–80% and are increasingly being adopted in large opencast mines operated by Coal India Limited. Wet drilling technology is another effective source-control measure. By injecting water directly into drill holes, dust generation at the drilling interface can be reduced by 40–70%. Enclosed transfer points, covered conveyors, and dust extraction systems are also used to minimize emissions from coal handling facilities. Chemical dust suppressants such as calcium chloride, magnesium chloride, lignosulfonates, and polymer-based binders have gained attention due to their longer-lasting effects. These materials form a surface crust or retain moisture on exposed surfaces, reducing dust generation by up to 90% under favorable conditions.

**Challenges in Indian Conditions**

Despite the availability of various dust control technologies, their effectiveness is often constrained by Indian mining conditions. High summer temperatures accelerate water evaporation, reducing the efficiency of water-based systems. Seasonal water scarcity in coal-producing regions further limits the application of sprinkling and mist suppression technologies. Strong winds in exposed mining areas can increase dust dispersion and reduce control effectiveness. In addition, inadequate maintenance of suppression equipment and budgetary constraints in smaller mining operations often hinder optimal performance. Therefore, there is a growing need for innovative, water-efficient, and technology-driven dust management solutions tailored to Indian coal mining environments.

**4. Noise Pollution Control Technologies**

Noise in opencast mines originates from various mining activities and equipment. Drilling machines are among the primary sources of continuous high-intensity noise, typically generating sound levels between 90 and 110 dB(A). The impact and rotary mechanisms used in drilling produce both airborne and structure-borne noise that can affect operators and nearby workers. Heavy earth-moving machinery (HEMM), including excavators, shovels, loaders, and draglines, generates noise levels ranging from 95 to 110 dB(A). These machines operate continuously during excavation and loading processes, contributing significantly to cumulative occupational noise exposure. Dumpers and haul trucks, which transport coal and overburden materials across haul roads, produce noise levels between 90 and 105 dB(A) due to engine operation, tire-road interaction, and material loading impacts. Coal handling and processing facilities such as crushers, screening plants, and conveyor systems are additional sources of continuous noise. Crushers, in particular, may generate sound levels between 95 and 115 dB(A), making them among the loudest stationary equipment in mining operations. Blasting activities represent the most intense noise events in opencast mines, often producing peak sound pressure levels exceeding 120 dB(A). Blast-induced noise is characterized by impulsive high-energy sound waves capable of causing annoyance, structural vibrations, and community complaints. Although existing noise control measures have improved occupational safety, several challenges remain in Indian coalfields. Maintenance deficiencies often reduce the effectiveness of mufflers and acoustic enclosures. Worker discomfort and inconsistent PPE usage can limit protection levels. Furthermore, controlling impulsive blast noise remains difficult despite advances in blast design. Financial constraints, aging machinery, and increasing production demands also hinder widespread adoption of advanced noise control technologies. Therefore, continuous monitoring, modernization of equipment, and integration of smart acoustic management systems are necessary to achieve sustainable noise control in Indian opencast mining operations.

## 5. Emerging Solutions and Innovative Technologies

The increasing environmental challenges associated with opencast coal mining have accelerated the development and adoption of advanced pollution control technologies. Conventional approaches such as water sprinkling, fog cannons, acoustic enclosures, and personal protective equipment have significantly reduced dust and noise emissions; however, their effectiveness is often limited by operational, climatic, and maintenance-related factors. Recent advancements in digital technologies, artificial intelligence, automation, and remote sensing have created new opportunities for more efficient, predictive, and sustainable environmental management in mining operations. The Internet of Things (IoT) has emerged as a transformative technology for real-time environmental monitoring in opencast mines. IoT systems utilize interconnected sensors, wireless communication networks, and cloud-based platforms to continuously monitor environmental parameters such as particulate matter ($PM_{2.5}$ and $PM_{10}$), total suspended particulate matter (TSPM), noise levels, wind speed, temperature, humidity, and atmospheric pressure. These sensors are strategically deployed across mining areas, haul roads, crushing plants, and nearby residential zones.

Real-time monitoring enables mine operators to identify pollution hotspots and implement corrective measures before environmental limits are exceeded. Furthermore, IoT systems facilitate automatic reporting and regulatory compliance with standards established by agencies such as the Central Pollution Control Board (CPCB) and Directorate General of Mines Safety (DGMS). The integration of IoT with Geographic Information Systems (GIS) also enables spatial visualization of pollution patterns, supporting more effective environmental planning and decision-making.

Artificial Intelligence (AI) and machine learning technologies are increasingly being applied to environmental management in mining operations. AI algorithms can analyze large volumes of sensor data to predict dust dispersion, noise propagation, and pollution trends under varying operational and meteorological conditions. Machine learning models such as Random Forest, Artificial Neural Networks (ANN), Support Vector Machines (SVM), and Long Short-Term Memory (LSTM) networks have demonstrated high accuracy in forecasting particulate matter concentrations and environmental risks.

Predictive analytics enables proactive decision-making by identifying potential pollution events before they occur. For example, AI-based systems can recommend optimal water spraying schedules, blast timing, and equipment deployment strategies based on predicted environmental conditions. Such capabilities improve operational efficiency while reducing environmental impacts and compliance risks.

International Journal of Science, Strategic Management and Technology
Volume **02** Issue **08** August-2026 | ISSN: **3108-1762 (Online)** | Impact Factor: 3.8
An International, Peer-Reviewed, Open Access Scholarly Journal Indexed in recognized academic databases

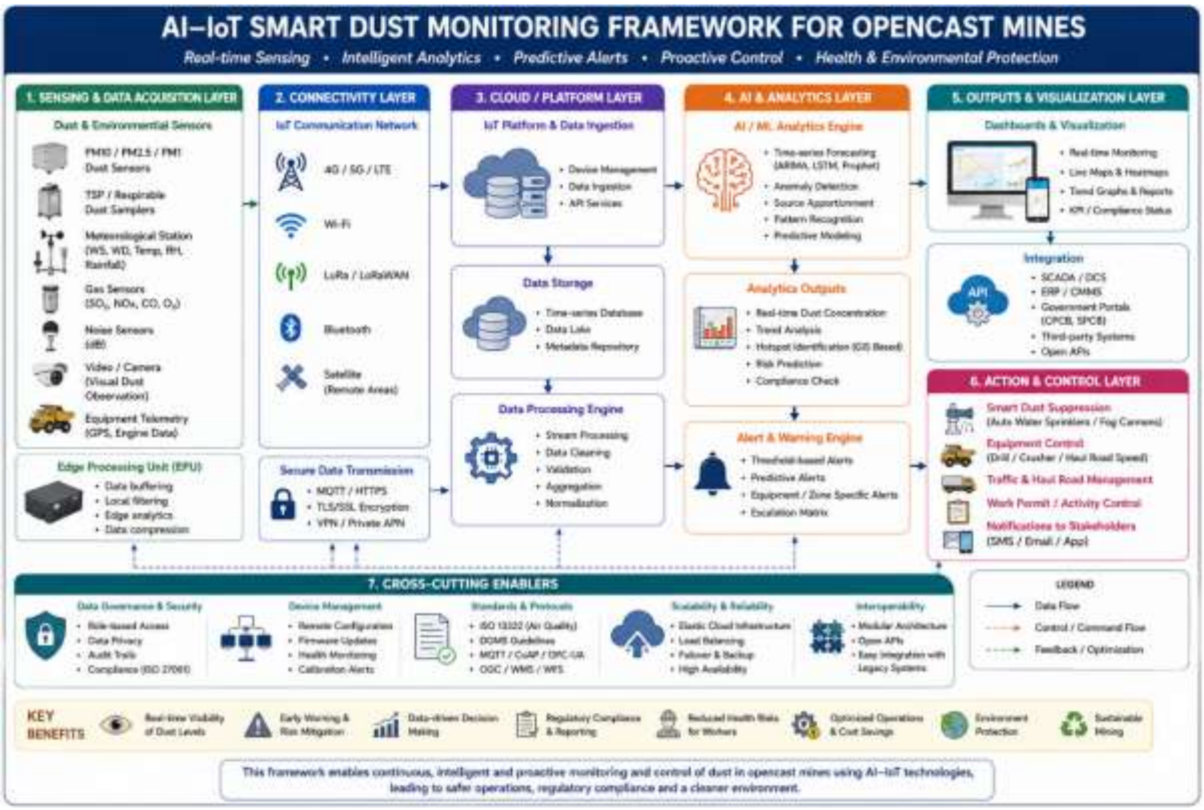


**Fig.3 AI-IoT Smart Dust Monitoring Framework**

## 6. Discussion

The present review highlights significant advancements in dust and noise pollution control technologies in opencast coal mining; however, substantial challenges continue to limit their effectiveness, particularly in developing countries such as India. Over the past decade, mining companies have increasingly adopted environmental management practices to comply with regulatory requirements and improve occupational health and environmental performance. Nevertheless, the effectiveness of these measures varies considerably depending on local climatic conditions, mine characteristics, technological maturity, and management practices.

Conventional pollution control technologies, including water sprinkling systems, fog cannons, wet drilling, acoustic enclosures, mufflers, and personal protective equipment (PPE), remain the dominant mitigation measures in Indian coal mines. These technologies are widely accepted because of their relatively low capital investment, operational simplicity, and established performance records. However, their effectiveness is often constrained by site-specific factors. For instance, water-based dust suppression systems require substantial water resources, which may not be available in arid mining regions. High ambient temperatures and strong winds commonly experienced in coalfields such as Talcher, Korba, and Singrauli further reduce the efficiency of water spraying and mist suppression technologies through rapid evaporation and increased dust dispersion.

A comparative analysis of conventional and emerging technologies reveals a clear shift toward data-driven environmental management approaches. Traditional monitoring systems generally rely on periodic manual sampling and inspections, which provide limited information regarding real-time environmental conditions. In contrast, advanced technologies such as Internet of Things (IoT)-based monitoring networks, artificial intelligence (AI), machine learning algorithms, drone surveillance, and digital twins offer continuous monitoring, predictive capabilities, and automated decision support. These technologies can identify pollution hotspots, forecast dust dispersion patterns, optimize suppression schedules, and improve regulatory compliance. Furthermore, autonomous mining equipment and remote operation systems reduce worker exposure to hazardous dust and noise environments, thereby enhancing occupational safety.

Despite these technological advancements, several critical gaps remain. One of the most significant challenges is the limited adoption of AI-enabled environmental management systems across Indian coal mines. Many mining operations continue to depend on reactive rather than proactive pollution control strategies. Environmental monitoring data are often collected independently without integration into centralized decision-making platforms. Consequently, opportunities for predictive environmental management remain largely underutilized. Another important concern is inadequate stakeholder engagement. Communities located near mining operations frequently experience the adverse effects of dust and noise pollution, yet community participation in environmental planning and monitoring remains limited.

Comparisons with global best practices indicate that countries such as Australia, Canada, and the United States have made considerable progress in implementing smart mining technologies. Real-time sensor networks, automated suppression systems, digital mine twins, and integrated environmental management platforms have significantly improved pollution control performance in these regions. In contrast, the adoption of such technologies in India remains at an early stage, primarily due to financial constraints, technical skill gaps, and infrastructure limitations.

Looking forward, the transition toward Mining 4.0 and Mining 5.0 provides a promising pathway for addressing these challenges. The integration of AI, IoT, cloud computing, remote sensing, and human-centric automation can transform environmental management practices in opencast mining. By combining technological innovation with stronger regulatory enforcement, ecological restoration, and community engagement, Indian coal mines can significantly reduce dust and noise pollution while supporting sustainable mining and long-term environmental stewardship.

## 7. Conclusion

Dust and noise pollution continue to be major environmental challenges in Indian opencast coal mining operations. Conventional mitigation measures such as water sprinkling, wet drilling, acoustic enclosures, and personal protective equipment have significantly improved environmental performance but remain constrained by operational and climatic factors. Emerging technologies including AI, IoT, drones, autonomous equipment, and digital twins offer transformative opportunities for improving environmental management and worker safety. Successful initiatives implemented by Coal India Limited, SCCL, and other mining organizations demonstrate that integrated environmental management can substantially reduce pollution while supporting sustainable development goals.

## Reference

1. Banerjee, S.P. (2026) “Air Pollution and its Control in Mining Areas,” in, pp. 167–180. doi:10.1201/9781003762119-20.

2. Bisen, V., & Chaurasia, R. C. (2026). Risk assessment plan for mine closure. International Journal of Sciences and Innovation Engineering, 3(4), 2534–2551. https://doi.org/10.70849/ijsci03042618848

3. Bisen, V., Chaurasia, R. C., Daharwal, V., Tiwari, G., Kiran, A. V., & Singh, K. (2025). An integrated geospatial framework for post-closure mine site monitoring: A synthesis of remote sensing and GIS methodologies. Journal of Civil and Environmental Engineering (IJCEE), 13(9), 210–220. https://doi.org/10.1018/IJCEE.2025.13.9.8169

4. Chaulya, S.K. (2026) “Road Dust Management Technique for Opencast Coal Mines.” doi:10.1002/9781394373550.ch09.

5. Chourasiya, D., & Chaurasia, R. C. (2026). A study of fly-ash utilization as backfilling material in mines. International Journal of Creative and Open Research in Engineering and Management, 2(5). https://doi.org/10.55041/ijcope.v2i5.789

6. Chourasiya, D., & Chaurasia, R. C. (2026). Recent advances in treatment technologies and resource utilization of mine tailings in India: A review. International Journal of Sciences and Innovation Engineering, 3(5). https://doi.org/10.70849/ijsci03052676831

7. Daharwal, V., & Chaurasia, R. C. (2026). Biosorption of heavy metals from mine tailing. International Journal of Creative and Open Research in Engineering and Management, 2(4). https://doi.org/10.55041/ijcope.v2i4.753

8. Ghose, M.K. and Majee, S. (2001) "Air Pollution due to Opencast Coal Mining and It's Control in Indian Context," *Journal of Scientific & Industrial Research*, 60(10), pp. 786–797.

9. Giri, V. K., & Chaurasia, R. C. (2025). A comprehensive study on equipment utilization and haulage efficiency in open-cast mining. International Journal of Innovative Research in Technology, 12(4).

10. Kamran, M. *et al.* (2024) "Decision intelligence-driven predictive modelling of air quality index in surface mining," *Engineering Applications of Artificial Intelligence*, 133, pp. 108399–108399. doi:10.1016/j.engappai.2024.108399.

11. Kaushik, A.K., Jade, R.K. and Patel, M. (2026) "Assessment of Air Pollution in Opencast Coal Mining Due to Seasonal Effects and use of Surface Miner," *Journal of Mines Metals and Fuels*, pp. 195–206. doi:10.18311/jmmf/2026/53205.

12. Mansoori, A. K., & Chaurasia, R. C. (2025). An analysis of the various factors that affect the control of occupational noise in underground coal mines. International Journal for Multidisciplinary Research, 7(4).

13. Pal, R. *et al.* (2025) "Experimentation and Statistical Prediction of Dust Emission in Iron Ore Mines using Supervised Machine Learning (Regression) Modelling," *Disaster Advances*, 18(5), pp. 57–70. doi:10.25303/185da57070.

14. Pandey, J.K. (2012) "Dust control practices in the Indian mining industry," *Research Online (University of Wollongong)* [Preprint].

15. Panicker, S.T. *et al.* (2023) "Online coal dust suppression system for opencast coal mines," *International Journal of Coal Science & Technology*, 10(1). doi:10.1007/s40789-023-00624-2.

16. Patel, P., & Chaurasia, R. C. (2025). Design of illumination system for an opencast coal mining project. International Research Journal of Modernization in Engineering Technology and Science, 7(5).

17. Patel, P., & Chaurasia, R. C. (2025). Strategic lighting design for opencast coal mines: A model-based study. Journal of Civil and Environmental Engineering (IJCEE), 13(7), 139–155. https://doi.org/10.1018/IJCEE.2025.13.7.843

18. Patnaik, R. and Baral, S.K. (2023) "A Critical Study on the Management of Innovative Fugitive Coal Dust Pollution Control Practices for a Cleaner Industrial Environment," *Parikalpana KIIT Journal of Management*, 19(1), pp. 222–222. doi:10.23862/kiit-parikalpana/2023/v19/i1/220841.

19. Raidas, J., & Chaurasia, R. C. (2025). Study of blast fragmentation and shovel efficiency in a surface coal mine: A review. International Journal of Scientific Research and Engineering Development, 8(4).

20. Sahu, R. K., & Chaurasia, R. C. (2025). Vibration-safe blasting: A study on parameter optimization: A meta-analytic review. International Journal of Engineering & Science Research, 15(2), 749–761.

21. Saurabh, K. *et al.* (2020) "An Efficient IoT Model for On-Demand Particulate Matter Control System in Coal Mining Cities," pp. 1–7. doi:10.1109/indicon49873.2020.9342085.

22. Singh, G., Chaurasia, R. C., & Beg, I. A. (2025). Risk assessment and safety management in underground coal excavation: A case study analysis. International Journal on Science and Technology (IJSAT), 16(3).

23. Singh, G., Singh, S. K., Chaurasia, R. C., & Jain, A. K. (2024). The present and future prospect of artificial intelligence in the mining industry. Industrial Engineering Journal, 53(4), 1.

24. Singh, R., & Chaurasia, R. C. (2025). To study the geotechnical parameters for slope stability in opencast mines. International Journal for Research in Applied Science & Engineering Technology, 13(8).

25. Singh, R., & Chaurasia, R. C. (2025). To study the geotechnical parameters for slope stability in opencast mines: A review. International Journal of Scientific Research and Engineering Development, 8(4).

26. Suresh, V. *et al.* (2025) "Advancing Sustainability in Surface Coal Mines Through Real-Time Air Quality Monitoring: Low-Cost IoT Solutions and the Role of Meteorological Factors in PM and GHG Emissions," *Sustainability*, 17(3), pp. 1301–1301. doi:10.3390/su17031301.

27. Tiwari, G., & Chaurasia, R. C. (2026). Optimization of wedge-cut blasting parameters for controlled coal fragmentation and improved development performance in underground coal mine galleries. International Journal of Science, Strategic Management and Technology, 2(6). https://doi.org/10.55041/ijsmt.v2i6.174

28. Tiwari, G., Chaurasia, R. C., Bisen, V., Daharwal, V., Kiran, A. V., & Singh, K. (2025). Blast design for obtaining desired rock fragmentation. Journal of Civil and Environmental Engineering (IJCEE), 13(7), 227–240. https://doi.org/10.1018/IJCEE.2025.13.7.850

29. Tiwari, G., Chaurasia, R. C., Bisen, V., Daharwal, V., Kiran, A. V., & Singh, K. (2025). Linking blast fragmentation to energy efficiency and downstream productivity in opencast mining. Journal of Civil and Environmental Engineering (IJCEE), 13(9), 203–209. https://doi.org/10.1018/IJCEE.2025.13.9.8168

30. Tiwari, S. (2026) "Dust Control Techniques in Opencast Limestone Mines: A Review for Occupational Health and Environmental Protection in India," *International Scientific Journal of Engineering and Management*, 5(3), pp. 1–9. doi:10.55041/isjem05709.

31. Tripathi, A.K. *et al.* (2024) "Integrated smart dust monitoring and prediction system for surface mine sites using IoT and machine learning techniques," *Scientific Reports*, 14(1), pp. 7587–7587. doi:10.1038/s41598-024-58021-x.

32. Tripathi, S. K., & Chaurasia, R. C. (2025). Exploring peak productivity achievable with continuous miners. International Journal of Innovative Research in Technology, 12(3).

33. Tripathi, S. K., & Chaurasia, R. C. (2025). Investigation into optimum production by continuous miner. International Research Journal of Modernization in Engineering Technology and Science, 7(4).

34. Wang, M. *et al.* (2025) "Research on intelligent dust concentration prediction and precise dust suppression collaborative system based on internet of things," *Results in Engineering*, 28, pp. 107305–107305. doi:10.1016/j.rineng.2025.107305.

35. Wang, Z. *et al.* (2024) "Optimizing open-pit coal mining operations: Leveraging meteorological conditions for dust removal and diffusion," *International Journal of Coal Science & Technology*, 11(1). doi:10.1007/s40789-024-00699-5.

36. Yadav, A.K. and Jamal, A. (2016) "A Review on the Present Scenario of Air Quality Associated with Indian Mining Operations," *Environmental Quality Management*, 25(3), pp. 99–105. doi:10.1002/tqem.21459.

37. Yadav, A.K. and Jamal, A. (2018) “Suspended particulate matter and its management system surrounding opencast coal mines,” *Environmental Quality Management*, 28(2), pp. 123–128. doi:10.1002/tqem.21592.

38. Yadav, I., & Chaurasia, R. C. (2025). A comprehensive review of coal mining: Techniques, environmental impacts, health and safety issues, and sustainable future prospects. International Journal of Sciences and Innovation Engineering, 2(12), 1186–1197. https://doi.org/10.70849/ijsci02121281167

39. Yadav, I., & Chaurasia, R. C. (2025). Coal mining: Techniques, impacts, and future prospects. International Journal for Multidisciplinary Research, 7(4).

40. Panwar, D. S., Saxena, V. K., Chaurasia, R. C., & Singh, A. K. (2017). Prospective evaluation of coal bed methane in Raniganj Coal Field, India. *Energy Sources, Part A: Recovery, Utilization, and Environmental Effects, 39*(9), 946–954. https://doi.org/10.1080/15567036.2017.1279242

41. Panwar, D. S., Suman, S., Singh, A. K., Saxena, V. K., & Chaurasia, R. C. (2020). Assessment of hydrocarbon generation potential of bituminous coal from Raniganj Basin, India. *Energy Sources, Part A: Recovery, Utilization, and Environmental Effects, 42*(7), 824–834. https://doi.org/10.1080/15567036.2019.1588427

42. Panwar, D. S., Chaurasia, R. C., Akanksha, & Jena, S. S. (2023). Hydrocarbon generation and gasification study of Valia lignite, Gujarat, India. *Energy Sources, Part A: Recovery, Utilization, and Environmental Effects, 47*(1), 8443–8453. https://doi.org/10.1080/15567036.2021.1931567

43. Panwar, D. S., Chaurasia, R. C., Saxena, V. K., Singh, A. K., & Akanksha. (2021). Geochemical investigation of hydrocarbon generation potential of coal from Raniganj Basin, India. *Journal of Petroleum Exploration and Production Technology, 11*(10), 3627–3636. https://doi.org/10.1007/s13202-021-01281-4

44. Panwar, D. S., Chaurasia, R. C., Saxena, V. K., & Singh, A. K. (2022). Modelling and forecasting of CBM reservoir from Raniganj coal field, India. *Methane, 1*(4), 229–242. https://doi.org/10.3390/methane1040019

45. Nath, M., Panwar, D. S., Chaurasia, R. C., Akanksha, Kaur, J., & Kohli, D. (2023). New insight into geochemical characterization of Paleogene coals from Jarain Coalfield, Meghalaya, N-E India: Hydrocarbon potential and organic petrographic analysis. *Journal of Geoenergy Science and Engineering, 226*, 211790. https://doi.org/10.1016/j.geoen.2023.211790

46. Nath, M., Panwar, D. S., Chaurasia, R. C., & Akanksha. (2023). Hydrocarbon generative potential and thermal maturity of newly discovered coal seams from Bapung Coalfield, Meghalaya, India: Rock-Eval pyrolysis and organic petrographic analysis. *Journal of Sedimentary Environments*, 297–309. https://doi.org/10.1007/s43217-023-00135-9