International Journal for Modern Trends in Science and Technology
Volume: 09, Issue No: SI02, March 2023
ISSN: 2455-3778
http://www.ijmtst.com

Noise Mapping in Opencast Mines

Shaik. Khadar Basha | Shaik. Baba Shareef | Thatituri. Chandra Mouli | Mohamed Suhail K | Amrites Senapati

Department of mining Engineering, Godavari institute of Engg &Technology,Rajamahendravaram, Andhra Pradesh, INDIA

To Cite this Article
Shaik. Khadar Basha, Shaik BabaShareef, ThatituriChandra Mouli, Mohamed Suhail K,Amrites Senapati"Noise mapping in opencast mines", Vol. 09., Issue SI02, March, 2023, pp.-39-45.

ABSTRACT

In this paper, we introduce a noise mapping in opencast mines So far mining industry playing a major role in all industries. In mining industries noise pollution is generated from Operation of equipment, transportation of mineral from one place to another place by the conveyor or by using dumpers, And Excavation, which affects mine employees. Although in the Recommendations of Tenth Conference on Safety in Mines, noise mapping has been made mandatory in Indian mines still mining industry are not giving proper importance on producing noise maps of mines. Noise mapping is preferred for visualization and its propagation in the form of noise contours so that preventive measures are planned and implemented. The study was conducted in Dalmia Cement Bharat Limited Chinnakomerla village, Kadapa district, Andhra Pradesh. Sound sources were identified, and noise measurements were carried out according to national and international standards. With the help of SL-1352 Sound level meter. Noise maps were generated by QGIS 3.28 Firenze software (Quantum Geographic Information System) QGIS functions as geographic information system (GIS) software, allowing users to analyze and edit spatial information, in addition to composing and exporting graphical maps. QGIS supports raster, vector, and mesh layers. Vector data is stored as either point, line, or polygon features. By these data we made noise mapping and found some precautions to control the noise production like, upgrading of all engine silencers, Sound-absorptive material should be installed on the walls and roof of the operator's compartment, plantation around the mine, water usage at the time of drilling, conveyor maintenance, using earmuffs, control blasting etc.

KEYWORDS:*QGIS, HEMM, OPENCAST, SLM, MAPPING.*

I. INTRODUCTION

All the unit operation in surface mining, example drilling, blasting, excavation loading, transportation, reclamation are processing that involve numerous noise-generating activities. Introduction of mechanization and large-scale machinery has undoubtedly accentuated the problem in recent years. The availability of large diameter, high capacity of pneumatic drills, bulk blasting, etc. are identified as noise prone activities. In-pit crushing system with mobile crusher and large capacity materials handling plants are being installed to facilitate speedy handling of large quantities. All these activities are major sources of noise in and around surface mining complexes. Noise as an environmental factor has important implications for the exposed population. The obvious implication is, of course, the potential for noise-induced hearing loss. In addition, noise produces other health effects, influences work performance, and makes communications more difficult. Besides, the wildlife in the forests and other areas surrounding the mines/industrial complexes are being affected by the noise generated due to mining activities. In order to combat this, many countries and communities have introduced laws and regulations making it a legal requirement to measure occupational and community noise levels in and around mining/industrial complexes

for maintaining acceptable noise environment. In the mining condition the equipment locations and environment continuously change as the mining activity progress. The mining industry, therefore, must have access to techniques and prediction systems to assess the noise levels associated with their activities, and to have the ability to design their operations with due consideration to noise environment. Unlike other major countries practically no work has been done in Indian mines for effective noise management in the working environment although noise limits have become increasingly stringent over the years. Responding to such environmental stressor Director General of Mine Safety (DGMS) have issued specific directives and recommended prescribed. noise limits based on ILO code of practice. DGMS has circulated Recommendations of 10th national conference on safety in Mines (2007) where it has been stipulated that Noise Mapping should be made mandatory of various places in the mine premises based on the various machines being used in concerned mines along with personal noise dosimetry of individual workmen exposed to noise level above 85 dB(A) [8]. Under this circumstances, Necessary efforts has been initiated to evaluate noise mapping in a large surface mine so as to pinpoint appropriate measures for noise measurement in surface mining. To create noise mapping we have used the software of QGIS 3.28 version, QGIS (previously known as Quantum GIS) is a free and open-Source cross platform desktop Geographical Information System (GIS) software, allowing users to analyze and edit spatial information, in addition to composing and exporting graphical maps. QGIS supports both Raster and Vector layers. DGMS Circular No. 18 (Tech), 1975 A warning limit of 85-dB (A) may be set as the level below which very little risk to an unprotected ear of hearing impairment exists for an eight-hour exposure. The danger limit value shall be 90-dB (A) above which the danger of hearing impairment and deafness may result from an unprotected ear. A worker should not be allowed to enter, without appropriate ear protection, an area in which the noise level is 115-dB (A) or more Personal protective equipment shall be worn, if there are single isolated outbursts of noise, which can go above 130-dB (A) "Impulse", or 120-dB (A) "Fast". No worker shall be allowed to enter an area where noise level exceeds 140-dB(A). according to various national and international standards. For example ISO 6395:2008 was used for noise measurements of shovel, drill machine and dozer machine, ISO 3028:1998 for dumpers, ISO 8297:1994 for crusher plant and other standards like ISO 1996- 1:2003, ISO-2:2007, ISO 9613-1:1993& ISO 9613-2:1996 were used.

II. OBJECTIVE OF THE PAPER

To conduct noise survey of some HEMM (Heavy Earth Moving Machineries) in few opencast mines. Conducting noise mapping in different sources in mines. To study and understand in depth about noise pollution, Control measures to reduce noise pollution in mines.

III. METHODOLOGY

The study was conducted in the mechanized opencast mine named as Dalmia cements Bharat limited in Chinnakomerla village, Kadapa district, Andhra Pradesh. The mining lease area comprises of about 120.49 ha. All the mining operations are done by deployment of Heavy earth moving machineries like dumpers, shovels, excavators, drill machines, dozers, Present mine is operating in Three shifts beginning from 6.00am to 2.00pm and 2.00pm to 10.00pm and 10.00pm to 6.00am.In additional there is general shift which is from 9.00AM to 5.00PM Daily input requirements of plant is about 10000T.On an average the mine has 6 dumpers, 2 shovels, 1 drilling machine, 1 dozer, 1 road header. There exist a village surrounding the mine. As such, inhabitants of these villages are directly or indirectly affected by the noise coming out from various operation sources of the mine. And there exist a running conveyor belt carrying limestone ore and passing through 3 KM of mine.

The machineries which are producing noise in the mine are categorized as 4 sources, they are:

Point source, Line source, Area source, Moving source. In those sources we have given different machineries to different sources, like as shown in the table below.

sources	Equipment	Total Nos.
Point source	Shovel	2
	Breaker	1
	Drilling machine	1
	EX-600	1
Line source	Conveyor belt	1
Area source	Crusher plant	1
	Garage	1
Moving source	Dumpers	6

	Dozer	1

Table 1: Noise Sources In Study Area.

Fig 1: Dalmia Cements Bharat Limited, Opencast Mine FromGoogle View.

A. Point Source

i *Shovels:*

We have started the collection of reading that is Noise levels by using Sound Level Meter SL-1352. At first we have taken the position with Point source of Shovel that is doing the operation of loading into the dumper, when this operation is going on the dumper also produces noise, to avoid this we have started taking readings after the dumper gets to rest position. we have perfectly positioned in the distance of 5 Meters from thecenter of the shovel by holding the Sound Level Meter, Power on the instrument(SOUND LEVEL METER) by holding the long press of power button and then set the Level that instrument range about 30-130 dB or any range we can set in Level but not lesser than 30dB and not more than 130dB.After that the instrument automatically senses noise and reading fastly will vary from produced noise by source and we have took the stance for 4-5 minutes, the SLM will gives automatically maximum and minimum readings by pressing the button of Max/Min that we have noted down. After noting down the readings in the position of 5 meters from the source then we have extended to the 10 meters and have taken same procedure as 5 meters stance, as like we have moved to 15 meters with same procedure.

There are two shovels present in the mine, that's the same process is carried out.

Range, in (meters)	SOUNI LEVEL IN dB	Range, in (meters)	SOUND LEVEL IN dB
5	84-87dB	5	84-87dB
10	77-80 dI	10	76-80 dB
15	74-77 dI	15	73-76 dB

Table 2: Readings OfNoise Levels With Shovels

ii *Breaker*

At next we have taken the position on point source equipment i.e., breaker. the area which is surrounded by Agriculture crops And Village with population. For that they completely avoid the secondary blasting to avoid fly rocks and reducing the noise pollution. Here we carried the instrument sound level meter to correct position on point source where breaker is in process. We safely handled the instrument without any negligence and then the process to be carry out as to the shovels.

Range, in (meters)	SOUND LEVEL IN dB
5	84 - 86 dB
10	80 - 83 dB
15	76 - 79 dB

Table 3: Readings OfNoise Levels With Breaker

At extra we have collected the same procedure readings to the places of Viewpoint, joint of conveyor belt, the readings are as shown below.

iii Viewpoint

For this point we had not taken extended lengths like 5 meters 10 meters and 15 meters. Because viewpoint is not a source of producing noise, the point that receives the produced noise, from the mine. The maximum and minimum readings are noted at center of the viewpoint. are 58-64 db.

iv Joint Of Conveyor Belt

The same procedure has carried out as shovel.

Range, in (meters)	SOUND LEVEL IN dB
5	66-68dB
10	63-65dB
15	62-64dB

of

R in (meters)	dB
5	79-86dB
10	72.5-83.2dB
15	69.3-82.4dB

Table 4: Readings ofNoise Levels With Joint Conveyor Belt.

v Drilling Machine

Ra in (m	Range, in (meters)	SOUND LEVEL IN dB
5	5	101-111dB
10	10	94.7-102.3dB
15	15	68-90.2dB
		55- 58.2dB

Table 5: Readings of Noise Levels WithDrilling Machine.

vi EX-600

The same procedure of collection of readings from center of the source as shovel.

POINTS	SOUND LEVEL IN dB
1	68
2	65.3
3	64.2
4	60.3
5	65.8
6	67.5

Table 6: Readings OfNoise Levels With EX-600

B. Area Source

i *Crusher*

In area source we have also positioned near the crusher plant, and we have taken down the maximum and minimum readings. The input transport of limestone to the crusher is conveyor. The conveyor will carry the limestone from the mine to crusher, the distance between the crusher and the mine with the conveyor is 3KM.As the same procedure of collection of readings by sound level meter of point source.

Table 7: Readings ofNoise Levels WithCrusher

ii *Garage*

The procedure which is carried to point source of shovel ad breaker, here also sameprocedure.
carries as like 5 meters, 10 meters and 15 meters.

Range, in (meters)	SOUND LEVEL IN dB
5	84 - 86 dB
10	80 - 83 dB
15	76 - 79 dB

Table 8: Readings ofNoise Levels WithGarage.

C. Line Source

i *Belt Conveyor*

Line source i.e., conveyor, At the conveyor we have positioned. sound level meter at man way side of the conveyor and taken down reading.

POINTS	SOUND LEVEL IN dB
1	74
2	75
3	76
4	74
5	75
6	76
7	77
8	78
9	74
10	75

Table 8: Readings ofNoise Levels WithBelt Conveyor.

D. Moving source

i. Dumper

We have collected the readings inside the dumper that has been travelling from shovel point to the crusher. And Between the EX - 600 and crusher there will be haulage roadway, in that roadway there will be bumps, due to that bumps the engine sound varies from place to place, so that the noise levels are monitored for 6-10 points from inside the dumper cabin and have been noted down.
We have only taken two dumper readings among the 6 dumpers. Dumper1 and Dumper2:

Table 9: Readings ofNoise Levels With Dumper 1.

POINTS	SOUND LEVEL IN dB
1	80
2	78
3	76
4	75
5	75

Table 9: Readings ofNoise Levels With Dumper 2.
After the collection of the data from the different parts of the mine we converted the data into attribute table by using the QGIS 3.28 software.by the following steps.

E. QGIS

i *GEO REFERENICING*

1. Open QGIS and click on Rasterto Georeferenced to open the tool.
2. Now we will open our JPG image. Go to File ‣ Open Raster. Browse to the downloaded image of the scanned map and click Open.
3. Now we need to assign coordinates to some points on this map.
4. Before adding Ground Control Points (GCP), Click on the gear icon in georeferencing window to open the Transformation settings dialog.
5. Name your output raster as MINE GEOREF, Choose LGW as the Compression. Check the Save GCP points to store the points as separate file for future purpose. Make sure the Load in QGIS when done option is checked. Click OK.
6. Now we can start adding the Ground Control Points (GCP). Click on the Add Point button.
7. You will notice the GCP table now has a row with details of your first GCP.
8. Similarly, add more GCPs covering the entire image. The more points you have, the more accurate your image is registered to the target coordinates.
9. Once you are satisfied with the GCPs, click the Start Georeferencing button. This will start the process of warping the image using the GCPs and creating the target raster.

ii *DIGITILIZATION*

1. In QGIS, let's load the image file. Go to Layer ‣ Add Layer ‣ Add Raster Layer.
2. Image map from device and click Open. Then click Add.
3. Now we are ready to start digitizing. Click Layer ‣ Create Layer ‣ New GeoPackage Layer… icon from Panels.
4. In the New GeoPackage Layer dialog, click the … button and save a new GeoPackage database named Digitalization of (Point Source) Choose the Table name as CRUSHER and select POINT STRING as the Geometry type. The base topographic map is the CRS: EPSG:3857 –WGS 84.
5.Attribute Table opens and allot column names as per like Name, Noise level, Description.

iii *BUFFER ZONES FOR POINT SOURCES*

In Digitalization process we have allotted Buffer Zones to the Point Sources like 5 Meters ,10 Meters and 15 Meters, Process: Vector >Geo processing >Buffer >Distance>Save file >Run.

iv *INTERPOLATION*

1.Open QGIS and drag the "A5(1)" the layer to canvas.
2.The layer will be added, now drag the "Boundary (1)" layer to canvas.
3. Select the Identify tool and click on a point. You will see the Identify Results panel show up on the left with the attribute value of the point. In this case, the "NOISE LEVEL"
4.From the Processing Toolbox, search and locate the Interpolation ‣ IDW Interpolation tool. Double-click to launch it.
5.In the IDW (Interpolation dialog box, select "A5(1)"as the Vector layer, noise level as the Interpolation attribute. Then click on the Add icon.
6. Now change the Type of the layer as points.
7. In Extent click on the … and select the BOUNDARY (1).
8.In Output raster size, automatically sets the Pixel size X and Pixel size Y. Then click on the …

under Interpolated to save the layer as INTERPOLATED. prj, click run.

9.In Clip raster by mask layer dialog box, select INTERPOLATED, as the Input layer, BOUNDARY (1), as the Mask layer. Then click on the … under Clipped (mask) to save the layer as INTERPOLATED IDW CLIPPED , click run.

10.Now a new layer INTERPOLATED IDW CLIPPED, will be added to the canvas. Click on the Open the Layer styling panel icon.

11.Set the Symbology to SINGLEBAND PSEUDOCOLOR, click on the arrow in Color ramp and select INVERT COLOR RAMP, enter 0(zero) in Label precision. Click Classify.

12. In the Contour dialog box, select INTERPOLATED, as the Input layer, enter 5.000 in the Interval between contour line. Then click on the … under Contours to save the layer as INTERPOLATED CONTOUR Click Run.

IV. RESULT AND DISCUSSION

The noise level at the crusher and drilling was maximum (111 dB and 86dB) were as at the control room minimum (70.8dB) the noise level at the dumper, drill machine and shovels were less than 90 dB A which is maximum permissible limit for 8hr working period. While coming to noise mapping here we will see the color grade of crusher point where it can be seen in red color that leads to high noise level exposure. And also, that total mine boundary noise mapping has created successfully by using QGIS.

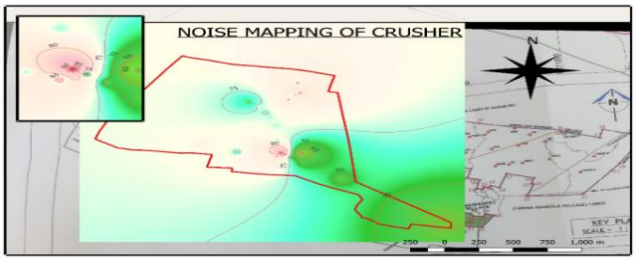

Fig 2: Noise mappingof crusher

Fig: Boundary layer of Dalmia cements Bharat Limited mine

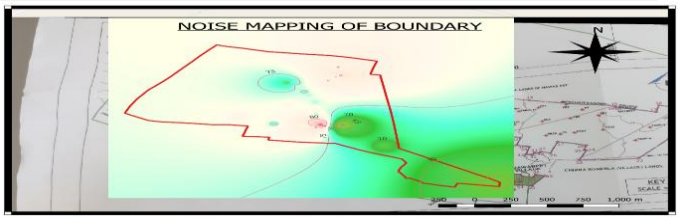

Fig: Noise mapping of Boundary

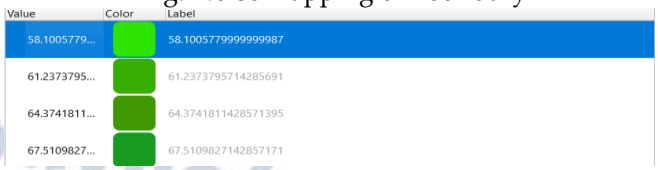

Fig: Colour of value of noise levels

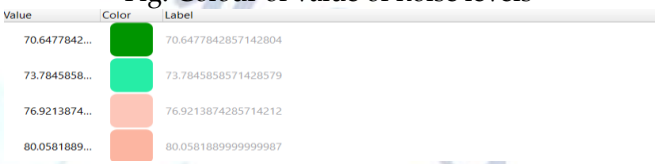

Fig: Colour of value of noise levels.

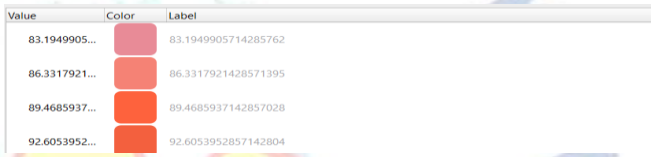

Fig: Colour of value of noise levels.

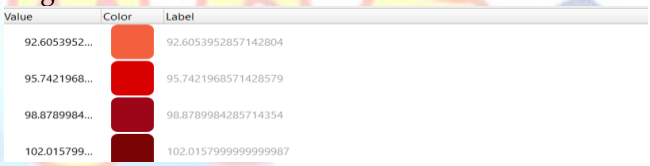

Fig: Colour of value of noise levels.

V. CONCLUSION

The research study was conducted in a mechanized open cast limestone mine i.e., Dalmia Cements Bharat Limited located in chinnakomerla village, Kadapa district, Andhra Pradesh., it was observed that".

The noise level at the crusher and drilling was maximum (111 dB and 86dB) were as at the control room minimum (70.8 dB). the noise level at the dumper, drill machine and shovels were less than 90 dB A which is maximum permissible limit for 8hr working period. Were as the noise level at load station, shovel, and control room was below the permissible limit 90 db. hence, we can say that the worker of the open cast mine, Dalmia Cements Bharat Limited are working under the regulation levels only. So, the noise control measures to be undertaken for the health of human beings and well beings of surrounding areas.

VI. REFERENCES

[1] Md Iltaf Zafar, Rakesh Dubey, Open Access Article, GIS Based Road Traffic Noise Mapping and Assessment of Health Hazards for a Developing Urban Intersection.

[2] Priyanka Das A, Swapan Talukdar B, Sustainable Cities and SocietyVolume 46, Noise mapping and assessing vulnerability in meso level urban environment of Eastern India, April 2019.

[3] Veena D. Manwar, B. B. Mandal, A. K. Pal, Environmental Science, Application of noise mapping in an Indian opencast mine for effective noise management.

[4] W. Alam, Environmental Science, GIS based Assessment of Noise Pollution in Guwahati City of Assam, India, 2011.

[5] Oyedepo SO, Environmental Study, Development of noise map for Ilorin metropolis, Nigeria, 2013.

[6] Alam W, Environmental Science, GIS based assessment of noise pollution in Guwahati city of Assam, India.2011.

[7] Bruel&Kjaer, Predictor V9.10, Software for Noise Prediction.

[8] Veena Dhammanand Manwar Bibhuti, Full -text available, Environmental Propagatio -n of Noise in Mines and Nearby Villages: A Study Through Noise Mapping,2016.

[9] Veena D. Manwar, B. B. Mandal, Environmental Science, Application of noise mapping in an Indian opencast mine for effective noise management.

[10] Nanda, S.K., Tripathy, Noise ControlEngineering, Development of an artificial neural network-based noise prediction model for opencast mines, 2010.

[11] Mohalik NK, Pal AK, Noise Vib Worldwide, Development of a noise model with respect to sound propagation and its application to a mining complex, 2003.

[12] Bhagwat Singh Chauhan, Mapan - Journal of Metrology Society of India, Evaluation and Analysis of Environmental Noise Levels in NCT of Delhi, India, January 2023.

[13] Jorge Castilla, Universidad Politécnica de Madrid, Noise pollution in mining operations: Prediction of noise impact on environment caused by mining machinery January 2014.

[14] Bhagwat Singh Chauhan National PhysicaL Laboratory - IndiaSaurabh Kumar Evaluation and Analysis of Environmental Noise Levels in NCT of Delhi, India January 2023.

[15] Ujaval Gandhi, QGIS Tutorials and Tips, September 2013.