B.Tech Thesis on

Modelling the dispersion of dust generated from open pit mining

For partial fulfillment of the requirement for the degree of

Bachelor of Technology

In

Mining Engineering

Submitted by: JITESH KUMAR MITTAL

Under the guidance of: **Prof NIKHIL PRAKASH**

Department of Mining Engineering,

National Institute of Technology, Rourkela

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National Institute of Technology Rourkela

CERTIFICATE

This is to certify that the thesis entitled "**Modelling the dispersion of dust generated from open pit mining**" submitted by **Jitesh Kumar Mittal** Roll No.-111MN0020 in partial fulfillment of the requirement for the award of degree of Bachelor of Technology in Mining Engineering at National Institute of Technology Rourkela, is an authentic work carried out by him under my supervision and guidance.

To best of knowledge, the matter included in this thesis has not been submitted to any other university or institute for the award of any degree.

Nikhil Prakash.

Prof Nikhil Prakash,

Department of Mining Engineering,

National Institute of Technology,

Rourkela-769008

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Jitesh Kumar Mittal

111MN0020

Department Of Mining Engineering

National Institute of Technology, Rourkela-769008

ABSTRACT

Dust particles are a source of air pollution generated by mining activities. It has a property to remain suspended in air for a long tenure on account of their small size. Moreover, particulates with size less than 10 microns have the potential of creating respiratory and chronic health problems. Mining industries generate large amount of dust particles on day to day basis. The high concentration of dust can be very harmful to people involve in mining operation as well as the population living around. Here dust modeling becomes an important as the concentration of dust in and around the mine area can be identified. This will ensure the safety of people by marking the areas of high dust concentrations.

A dust generated from a hypothetical mine has been modeled in this project with seven emission sources. AERMOD air dispersion modeling package was used for this purpose and 24-hr average concentration plots were generated. These plots were further analyzed to identify the potential areas with high dust concentration.

Key words: Particulate matter, AERMOD, Air dispersion modelling

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List of Abbreviations

HEMM	Heavy earth moving machinery
COAD	Chronic obstructive airways diseases
EPA	Environmental Protection Act
PM	Particulate Matter
LULC	Land use land cover
GIS	Geospatial information system
SPM	Suspended particulate matter
FTIR	Fourier transform infrared spectroscopy
ARD	Airborne respirable dust
MEL	Maximum exposure limit
GMT	Greenwich mean time
LST	Local standard time
UTM	Universal transverse Mercator

CHAPTER 1

INTRODUCTION

A physical, chemical or biological modification to the air which results in a negative impact to the environment can be termed as pollution. “Air pollution can be described as any contaminate of the atmosphere that disturbs the natural composition and chemistry of the air. This can be in form of particulate matter such as dust, or excessive gases like carbon dioxide or other vapors. These pollutants can occur naturally, or are the product of human activities” (Boorse and Wright, 2011). Dust, smoke or harmful gases when released in excess quantity into the atmosphere will affect the flora and fauna of the region.

Before urbanization and industrialization, nature kept the air clean with a cycle of processes as wind blends and scatters the gases, rain washes the dust and other small particles to the ground and plant ingested carbon dioxide giving fresh oxygen to air. This natural cycle has been disturbed as a result of anthropogenic activities which are releasing excessive amount of pollutants without proper treatment. Yet more pollutants are constantly being added to the atmosphere by industrial and household sources.

Sources of air pollution can be classified into two major categories as Natural sources and anthropogenic sources. Volcanoes, geysers, digestive, dust, sea salt, radioactive decay, forest fires, plants and trees, wet lands, termites, lightning, soil outgassing are some examples of natural sources of air pollution. Gases burning of fossil fuels, agricultural activities, exhaust from factories and industries, mining operations are the important anthropogenic sources of air pollution.

Depending upon the emission of pollutant to the atmosphere, air pollutants can be divided as primary pollutant and secondary pollutant. The pollutants that are emitted directly in to the atmosphere are called primary pollutants. An example of primary pollutant would be sulfurdioxide transmitted from industries. Secondary pollutants are those which are created by various physical process and chemical reactions that take place in the atmosphere. It can also be defined as the consequences of primary pollutants. For example smog, ozone formations, oxidation of NO to NO_2, oxidation of hydrocarbons are secondary pollutant.

Air pollution has an adverse impact on society as it is often linked with various respiratory and cardiac diseases including cancer. Another direct but often ignored impact of air pollution is global warming.

Mining industry has been a major contributor to atmospheric air pollution. Mining involves processes like drilling, blasting, handling and re-handling of large volume of materials by HEMM's, mineral processing which creates large amount of harmful pollutants making the local area polluted. Hence, people living in a mining region are susceptible to diseases like pneumoconiosis, asbestosis, silicosis, fluorosis and other heart diseases.

The principal pollutant of concern emitted from open cast mining is dust. Toxicity of dust can be defined by the type and size of a dust particle. However the possible harm dust may cause to human health can be determined by the amount of dust present in the air and how long someone has been exposed to it. Dust particle may cause coughing, irritation to eyes, sneezing, hay fever, asthma attacks and chronic obstructive airways disease (COAD).

According to Environmental Protection Act (EPA), particulate matter is a mixture of extremely small particles and liquid droplets. Particulate matter has been classified in to two types based on size, as coarse particulate matter (PM_{10}) and fine particulate matter ($PM_{2.5}$). PM_{10} is less than 10 micrometers in diameter where as $PM_{2.5}$ is less than 2.5 micrometer in diameter. In this project modeling is done taking PM_{10}. The meteorological factors like inversion, rain fall and wind speed highly influence the dispersion of dust.

Therefore, to ensure that the ambient air pollutant concentration doesn't cross the standards laid by the environmental laws, a continuous monitoring is essential. This will also enable us to initiate a proper action whenever the concentration of pollutants crosses its maximum permissible value. This is done using air pollution modeling.

"Air pollution modeling is a numerical tool used to describe the causal relationship between emissions, meteorology, atmospheric concentrations, deposition, and other factors. Air pollution measurements give important, quantitative information about ambient concentrations and deposition, but they can only describe air quality at specific locations and times, without giving clear guidance on the identification of the causes of the air quality problem. Air pollution modeling, instead, can give a more complete deterministic description of the air quality problem, including an analysis of factors and causes (emission sources, meteorological processes, and physical and chemical changes), and some guidance on the implementation of mitigation measures. Air pollution models are the only method that quantifies the deterministic relationship between emissions and concentrations/depositions, including the consequences of past and future scenarios and the determination of the effectiveness of abatement strategies." (Daly and Zannetti, 2007)

1.1 Objective

(i) Understand the factors affecting the dispersion of dust generated from an open cast mine

(ii) Model the dispersion of dust generated from an hypothetical mine for a particular atmospheric and metrological conditions

CHAPTER 2

LITERATURE REVIEW

S. K. CHAULYA (2005) analyzed the ambient air quality of an open pit coal mining area of Orissa for a period of one year. Drilling, blasting, loading, unloading, transport roads, haul roads, coal handling plants, over burden dumps are the major air pollution sources in mine. Suspended particulate matter and respirable particulate matter are the major pollutants in mining areas. The author determined a 24-h average concentrations of suspended particulate matter, respirable particulate matter, oxides of nitrogen (NOx) and sulphur dioxide (SO2) at regular interval throughout a year at four stations in mining area and 13 monitoring stations in residential area. In the open cast mining activities, suspended particulate matter and respirable particulate matter were found to be the major sources of emission. Emissions of SO2 and NOx were negligible. The 24-h and annual average suspended particulate matter and respirable particulate matter concentrations were found to be more than the standards set in the Indian ambient air quality standard in most of the industrial and residential areas. But the 24-h and annual average concentrations of SO2 and NOx were found to be within the limits prescribed by Indian ambient air quality standard in both the residential and industrial areas. As per the linear regression analysis a good correlation existed between suspended particulate matter and respirable particulate matter and it fitted polynomial trends perfectly. In the Lakhanpur area air quality exceeded the standard limit of environmental control measures. Serious actions are required to control the generation of particulate matters at source by developing a green belt around the polluting sources.

Afshar and Delavar (2007) developed a prediction model on air pollution in 2004 using the data of 2002 and 2003. Also the monthly concentration of CO and NO2 for six highways of Tehran and for each vehicle was calculated. The prediction model developed is a geospatial information system (GIS) based model that takes geometry of the streets and vehicle numbers. GIS is a computer based tool which is related to mapping and analyzing spatially distributed phenomena related to earth. The program and software used were MATLAB and ArcGIS. As compare to other information system GIS has high power of analyzing spatial data and also it can handle large spatial database. The present and future air quality can be assessed in this modelling which helps in informed policy decision making. Street canyon model focused on the pollutants whose dispersion model does not involve chemical or photochemical reactions. The available data for 2002 was related to the second half of the year and the results of the calibration coefficients for CO in 2002 were found to be different from the results of 2003 and 2004.

Chakraborty et al. (2001) developed empirical formulae to calculate emission rates of various open cast mining activities. Considering the geographical location, accessibility, resource availability and working condition, they selected three iron ore mines and seven coal mines. For the Suspended particulate matter (SRM) generated from various mining activities like drilling, blasting, loading and unloading, coal handling plant, over burden dump, they developed 12 empirical formulas. These formula were used to estimate the NOx and SO2. Rajpura open cast coal mine was selected to verify universal applicability of the formulae and the accuracy between the calculated value and measured value found to be varied from 77.2 % to 80.4%. With this study they concluded that suspended particulate matter is the main constituent of emission and emission due to NOx and SO2 are negligible.

Kumari et al. (1995) used Fourier Transform Infrared Spectroscopy (FT-IR) spectrometer to determine the concentration of quartz present in airborne respirable dust (ARD) with quartz double peak at 800 and 700 cm-1. Quartz causes silicosis and cancer. Personal dust sampler was used for taking samples from different locations of mine. GLA-5000 PVC membrane filter was used to collect sample. The sampler was attached with different workers working in the shifts and also from certain selected dust generating sources where dust samplers can be kept safely. Concentration of quartz in respirable dust was found to be less than 1 % which is less than Maximum exposure limit (MEL). Drilling, haulage and crusher house were found to be the high risk zone for silicosis. They suggested to use wet drilling and improved ventilation to control air borne dust as well as silicosis.

Roy et al. (2012) did source **apportionment of ambient PM_{10}.** They collected samples of particulate matter of 10 micron size from six sites in Talcher, Orissa. Sampling was done twice a week during the month of June 2008, November 2008 and January 2009. They found severe air pollution levels in Talcher as the annual average concentration of PM_{10} samples at each sites were 144 ± 29 μg/m^3, 191 ± 61 μg/m^3, 90 ± 28 μg/m^3, 60 ± 15 μg/m^3, 106 ± 35 μg/m^3, and 150 ± 36 μg/m^3 respectively. Atomic absorption spectrophotometer was used to analyze the elemental concentration of particulate matter. To identify the sources of PM_{10} and quantified trace element for source apportionment principle component analysis was used. Four factors those were isolated by principal component analysis are soil dust or fugitive dust from mining associated activities, emissions from automobiles, emissions from thermal power plant and non-ferrous smelter, and identified as possible sources. They also observed variation of particulate matter with the changes in meteorological parameters like relative humidity, wind speed and temperature. It was observed that with the rise of wind speed above 1 m/s the concentration of particulate matter drops substantially

Kar and Mukherjee (2012) studied the interrelation between SO_2, NO_2 and PM_{10} concentration and also their future level of concentration in the ambient air of Kolkata. They have used MATLAB software to develop second degree, third degree and fourth degree polynomial equation using the data collected from West Bengal Pollution Control Board. They replaced the curve piece in the small interval by line segments during the months January-April, May-august and September-December. Among these three parameters, multiple regression equations has been established to predict the value of a parameter using the remaining two. Finally they have predicted the value of each parameter in terms of only one dependent variable.

Ghose and Majee (2001) conducted a survey to keep a track upon local atmospheric impact by taking emission data. This was used in finding dust generation due to various mining activities. They observed that 70 % of total coal production in India is from open pit mines which is an important causes to air pollution. They noticed that air pollutants generated from mines had high pollution potential and numerous negative impacts on human health. A lot of control measures to deal with air pollutants has been given by them. They have discussed the importance of trees in environment. To control the air pollutants coming out from haul roads they have emphasized on use of different chemicals.

CHAPTER 3

GAUSSIAN PLUME MODEL

Pollutants when released from a source as a plume is observed to typical shape as described by the Gaussian plume model in Figure 3.1. This model is the most widely used approach for calculating the ground level concentration due to tall stack emissions.

The ground level concentration X (in g/m^3) at the point (x, y), after considering all the assumption using the Gaussian plume equation is given in Equation 3.1.

$$X(x, y, z, H_e) = \frac{Q\ F}{2\pi U \sigma_y \sigma_z}\ (g_1 +\ g_2 + g_3) \tag{3.1}$$

Where,

$X =$ Concentration of emissions, g/m^3

Q = source pollutant emission rate, g/s

U = horizontal wind velocity along plume centerline, m/s

H_e = height of emission plume centerline above ground, m

σ_z= vertical standard deviation of the emission distribution, m

σ_y = horizontal standard deviation for emission distribution, m

$F = exp\left(\frac{-y^2}{2{\sigma_y}^2}\right)$, crosswind dispersion parameter

g = ($g_1 +\ g_2 + g_3$), vertical dispersion parameter

$g_1 =\ exp\left(\frac{-(z-H)^2}{2{\sigma_z}^2}\right)$, Vertical dispersion with no reflections

$g_2 =\ exp\left(\frac{-(z+H)^2}{2{\sigma_z}^2}\right)$, vertical dispersion for reflection from the ground

g_3 = vertical dispersion for reflection with an inversion aloft

L = height from ground level to bottom of inversion aloft, m

For ground level concentration at $z = 0$ and assuming no inversion layer, Equation 3.1 simplifies to Equation 3.2.

$$X(x, y, 0, H_e) = \frac{Q}{\pi U \sigma_y \sigma_z} exp\left(\frac{-y^2}{2{\sigma_y}^2}\right) \; exp\left(\frac{-H^2}{2{\sigma_z}^2}\right) \tag{3.2}$$

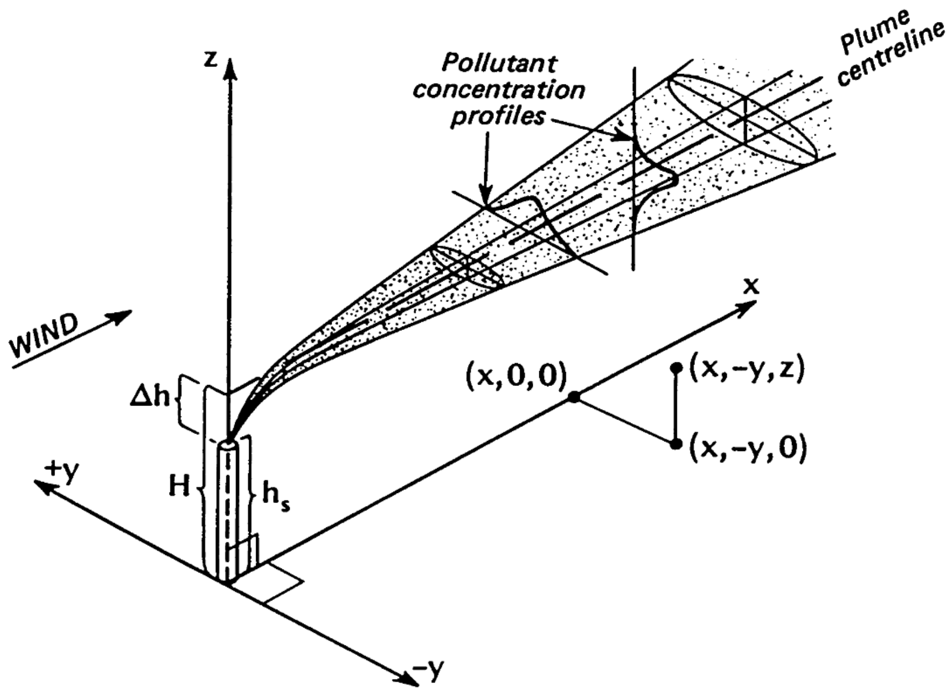


Figure 3.1: A typical plume from an elevated point source *(*National Institute of Water and Atmospheric Research, Aurora Pacific Limited and Earth Tech Incorporated for the Ministry for the Environment, June 2004*)*

The Gaussian dispersion modeling equation not only includes upward reflection of pollution plume from the ground, it also includes downward reflection from the bottom of any temperature inversion lid present in the atmosphere.

3.1 Plume rise:

The Gaussian air pollutant dispersion equation discussed above requires the input of pollutants plumes centerline height above the ground level known as effective plume height denoted by H_e (Equation 3.3).

$$H_e = H_s + \Delta H \tag{3.3}$$

Where

H_s = the actual physical height of the pollutant plumes source point

ΔH = the plume rise due to the buoyancy

Briggs has developed many air dispersion models to determine the value of ΔH and he divided air pollution plumes in to the following four general categories:

- Cold jet plumes in calm ambient air conditions
- Cold jet plumes in windy ambient air conditions
- Hot buoyant plumes in calm ambient air condition
- Hot buoyant plumes in windy ambient air condition

Briggs (1971) considered the trajectory of cold jet plumes to be dominated by their initial velocity momentum and the trajectory of hot buoyant plumes to be dominated by their buoyant momentum to the extent that their initial velocity momentum was relatively unimportant. The author discussed various equations to calculate ΔH for different conditions which are given in Equation 3.4 and Equation 3.5.

$$\Delta H = 1.6\ (F^{\frac{1}{3}})\ (X_F^{\frac{2}{3}})\ (U^{-1}) \quad \text{if } X \text{ is less than } X_F \tag{3.4}$$

$$\Delta H = 2.4\ (\frac{F}{U\ S})^{\frac{1}{3}} \quad \text{if } X \text{ is less than 1.84} \tag{3.5}$$

Where

ΔH = plume rise, m

F = Buoyancy factor, $m^4/_{S^3}$

X = Downwind distance from plume source, m

X_F = Downwind from plume source to point of maximum plume rise, mm

U = wind speed at actual stack height, m/s

S = stability parameter

3.2 Stability classes:

The ability of atmosphere to enhance or to resist atmospheric motions is known as atmospheric stability. If the air parcel tends to tend to sink back to their initial level after the lifting acted on stops, the atmosphere in known to be stable where as if the parcel tries to rise vertically on their own when the lifting stops it is known to be unstable condition. The neutral condition is when the parcel tends to remain in the same position after lifting stops.

Stability depends on thermal turbulence, static stability and mechanical turbulence. Static turbulence is related to change in temperature with variation in height and mechanical turbulence is due to function of wind speed and also surface roughness.

Lapse rate can be defined as the rate at which atmospheric temperature decreases or increases with increase in height. It helps in determining the atmospheric stability. If the environmental lapse rate is more than the adiabatic lapse rate the atmosphere is considered as unstable and it is stable when environmental lapse rate is less than adiabatic lapse rate. The neutral condition is when both the adiabatic and environmental lapse rate are same.

Pasquill and Gifford (1961) developed the most commonly used method for categorizing the amount of turbulence present in the atmosphere. The author categorized the atmospheric turbulence in to 6 stability classes named as shown in Table 3.1 and Table 3.2.

The most turbulent or unstable class is class A and most stable or least turbulence class being the class F. It influence the vertical motion of air.

Table 3.1: Pasquill – Gifford stability category. Source: Pasquill and Gifford (1961)

Surface Wind Speed (m/s)	***Daytime Insolation***			***Night-time cloud cover***	
	Strong	Moderate	Slight	Thinly overcast or 4/8 low cloud	3/8
< 2	A	A – B	B	-	-
2 – 3	A - B	B	C	E	F
3 – 5	B	B – C	C	D	E
5 – 6	C	C – D	D	D	D
> 6	C	D	D	D	D

Table 3.2: Pasquill Stability Classes. Source: Met Monitoring Guide

Class	Definition
A	Extremely unstable
B	Moderately unstable
C	Slightly unstable
D	Neutral
E	Slightly stable
F	Moderately stable

Pasquill stability classes with ambient temperature changing with height is shown in Table 3.3.

Table 3.3: Pasquill Stability Classes with ambient temperature change with height. Source: Regulatory guide; office of nuclear regulatory research

Stability Classification	Pasquill Stability Category	Ambient Temperature Change With Height (°C/100m)
Extremely unstable	A	$\Delta T \leq -1.9$
Moderately unstable	B	$-1.9 < \Delta T \leq -1.7$
Slightly unstable	C	$-1.7 < \Delta T \leq -1.5$
Neutral	D	$-1.5 < \Delta T \leq -0.5$
Slightly stable	E	$-0.5 < \Delta T \leq 1.5$
Moderately stable	F	$1.5 < \Delta T \leq 4.0$
Extremely stable	G	$\Delta T > 4.0$

Wind Rose diagram provides the graphical summary of frequency distribution of the wind direction and speed of wind during a period of time.

CHAPTER 4

CASE STUDY

As a case study, a hypothetical dataset was generated to simulate the condition of an operation open-pit mine and attempts were made to model the dispersion of dust. The modeling software used is AERMOD as it gives the maximum concentration at different locations.

The input data files required to model the dust dispersion are:

- Hourly surface data file: This file is generated by a nearly weather station or airport. This sort of data file contains composite surface map and weather report at the surface level. This file is generated in ".ish" format.

- Upper air data: This data file is generated by the nearly airport or weather station. This data file contains wind conditions such as wind direction, temperature etc. of a particular location. This data are measured using an anemometer and the files are in ".fsl" format.

- Land use land cover: this is the land use land cover data which contains well classified and tabulated data of the land use pattern of a certain location and land cover data in to a grid system.

- Mine sources (".vls" file): It is a manually generated excel file which contains the different sources in a mine and their locations.

- Particle data: this is also a manually generated excel file which contains different types of particle present in the dust generated by the different sources along with their sizes and mass fraction.

- Boundary data: boundary data is also a manually generated excel file that contains the coordinates of the boundary of the mine area.

The projection system used in this project is Universal Transverse Mercator (UTM) and the boundary data for the mine area is given in Table 4.1.

Table 4.1: boundary data used for this model

Point	Coordinates
A	(522173.2, 3522567)
B	(522016.8, 3521593)
C	(522074.2,3521119)
D	(523423.9,3520452)
E	(524492.3,3520665)
F	(525065.5,3521280)
G	(525023.8,3522797)
H	(523960.7,3522990)
I	(522407.7, 3522885)

First of all AERMET was used to create the required file in proper format. The surface data reported is in Local Standard Time (LST). The surface station location is defined as 39.5° N and 119.783° W. Base elevation is taken as 1341 m.

The upper air data is given in standard AERMET mode. The upper air data file is in .fsl format and was in Greenwich Mean Time (GMT). The upper air station has location as 39.57° N and 119.8° W.

After this sector part is processed. The instrument to measure wind velocity is anemometer and is kept at a height of 33 ft. the randomize wind direction is considered. Land use land cover data has been inserted to define the sectors of mine area. Land cover data file is in USGS NLCD92 (BIN) format. The area is divided in to 12 sectors.

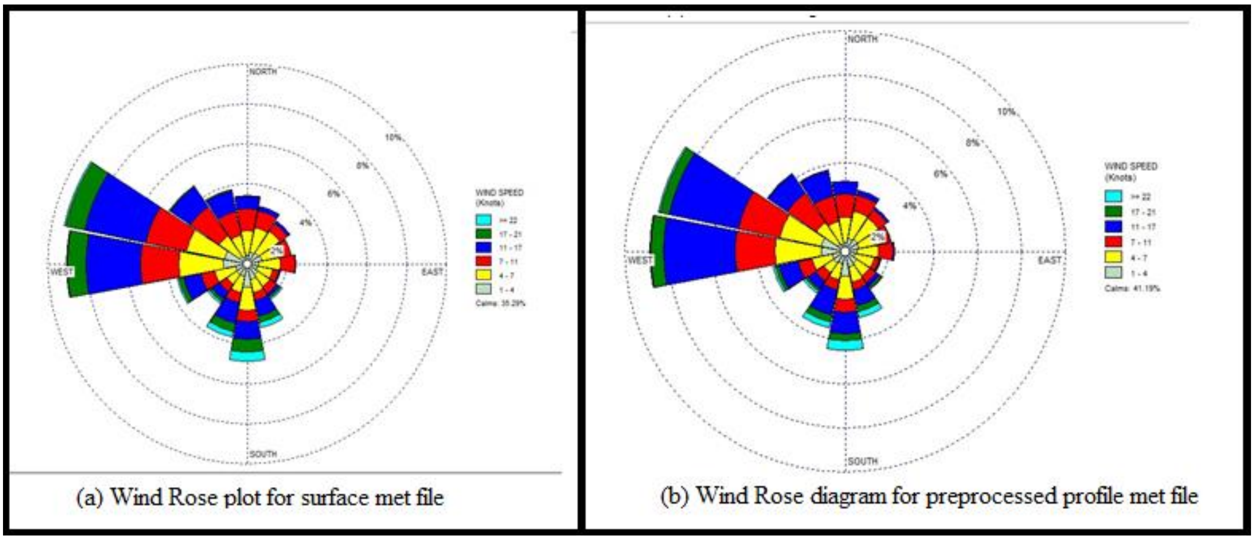
Now the aersuface output file for surface is generated which gave the result shown in Table 4.2. Albedo is the surface reflectance and surface roughness is the roughness of the surface.

Table 4.2: Surface parameters (Albedo, Bowen ratio and surface roughness) after LULC

	Albedo	Bowen ratio	Surface roughness
January	0.19	1.49	0.07
February	0.19	1.49	0.07
March	0.18	1.04	0.074
April	0.18	1.04	0.074
May	0.18	1.04	0.074
June	0.18	1.21	0.076
July	0.19	1.21	0.076
August	0.19	1.21	0.076
September	0.19	1.49	0.076
October	0.19	1.49	0.076
November	0.19	1.49	0.076
December	0.19	1.49	0.07

Now the AERMET processing is done to generate the output file, one for surface met data as aermet1.sfc and one for profile met data as aermet1.pfl. The result after processing is shown in the figure below for both surface met data file and profile met data file.

Also the Wind Rose diagrams are generated for better understanding of wind flow which is shown in Figure 4.1.



(a) Wind Rose plot for surface met file

(b) Wind Rose diagram for preprocessed profile met file

Figure 4.1(a): Wind Rose plot for surface met file (b) Wind Rose of preprocessed profile met file

After the files generated from AERMET that is being used in CASEMINING in AERMOD. The reference point taken has location (523675, 3521929) in UTM. The reference point is taken in the center of the study area. The area modelled has a radius of 10 m.

In this project only the PM_{10} concentration particles are considered and a 24 hour averaging is done.

Seven sources have been considered out of which two are point source, three volume sources, one open pit source and one line volume source (haul road). The details about the sources are given in Figure 4.2.

Source Summary

#	Source ID	Source Type	X Coord. [m]	Y Coord. [m]	Base Elevation	Release Height [m]	Description
1	SCRB01	POINT	524076.40	3521780.60	1539.69	7.3	Scrubber
2	DC01	POINT	524114.23	3521822.86	1528.7	6.1	Dust Collector
3	BLST01	VOLUME	522517.60	3521978.60	1639.1	10	
4	BLST02	VOLUME	522753.40	3521978.60	1603.88	10	
5	BLST03	VOLUME	522510.10	3521788.40	1622.61	10	
6	PIT01	OPEN PIT	522319.90	3521271.10	1732	0	Open Pit Mine
7	ROAD01	LINE VOLUME	524300.32	3521941.41	0		

Figure 4.2: Details of sources taken for modeling

For the line volume source (Haul roads), certain parameters have been considered which are:

Vehicle height (VH) = 7.62 m

Factor = 1.7

Plume height (PH) = 12.95 m (PH= factor * VH)

Release height (RH) = 6.48 m (RH = 0.5 * PH)

Initial sigma Z= 6.03 m (Z = PH/2.15)

Lane type = two lane

Road width = 12 m

Plume width = 18 m (PW = RW + 6m)

Emission rate = 19.53 g/s

Different nodes has been taken for haul roads which is shown in Table 4.3 and the details of the particle data (that is particle diameter, mass fraction and particle density) is given in Table 4.4.

Table 4.3: Details of nodes taken in this case study

X	Y	Base Elevation	Release Height
524300.3	3521941	0	6.48
524271.3	3521896	0	6.48
524261.7	3521838	0	6.48
524271.3	3521763	0	6.48
524252	3521717	0	6.48
524201.3	3521673	0	6.48
523979	3521579	0	6.48
523879.9	3521625	0	6.48
523802.6	3521654	0	6.48
523650.3	3521579	0	6.48
523647.9	3521577	0	6.48
523524.7	3521509	0	6.48
523449.8	3521427	0	6.48
523377.3	3521284	0	6.48
523295.1	3521212	0	6.48
522964.1	3521059	0	6.48
522906.1	3521117	0	6.48
522695.9	3521117	0	6.48
522577.5	3521180	0	6.48
522521.9	3521265	0	6.48

Table 4.4: Details of the particle data taken

#	*Particle diameter (microns)*	Mass fraction (0 to 1)	Particle density (g/cm^3)
1	*2.20*	0.317	2.44
2	*3.17*	0.103	2.44
3	*6.10*	0.292	2.44
4	*7.82*	0.158	2.44
5	*9.32*	0.13	2.44

After this, building inputs is done. Rectangular shaped building with a height of 5 m has been taken.

Modelling is done for four days from 1st January, 2011 to 4th January, 2011. Gridding is done with grid origin (523675.00, 3521929.00) with three numbers of tiers. Plant boundary specification and terrain processing is done afterwards and an overview of this is shown in Figure 4.3.

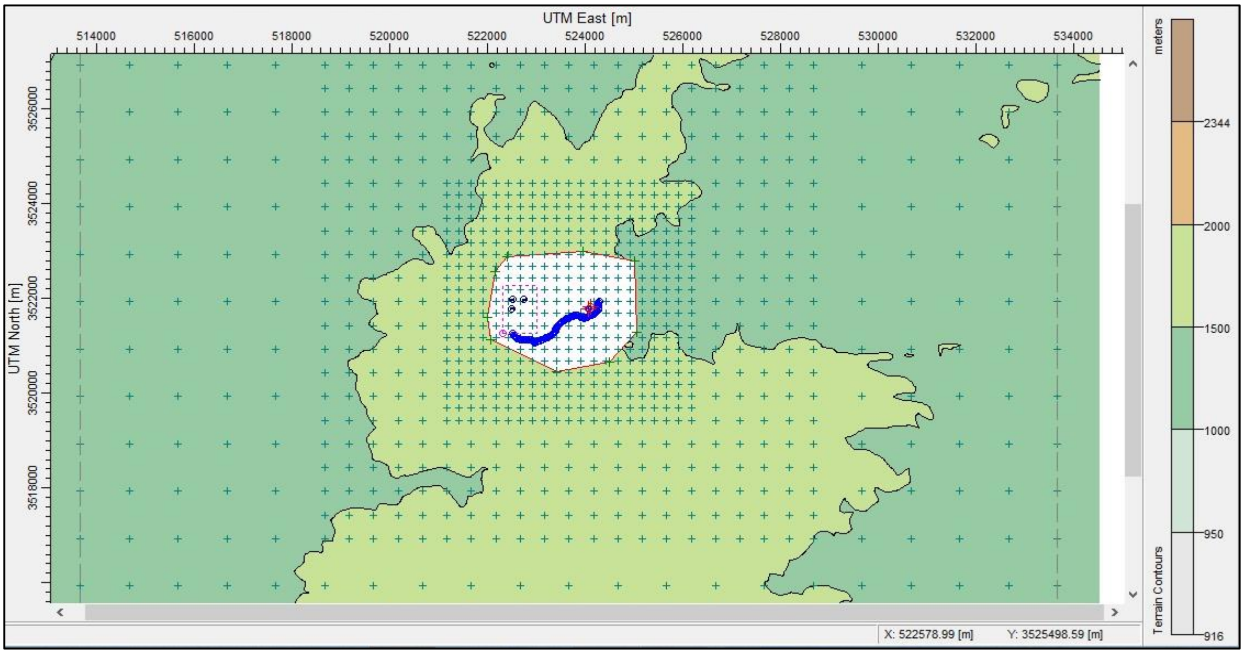


Figure 4.3: An overview of modelling area after boundary specification and terrain processing

4.1 Conclusion and Result:

The output processing is done by running AERMOD. Concentration of dust at different locations were calculated. The final result is the maximum concentration at the point having coordinates (523925.00, 3521679.00) is found to be 98.79802 (μg/m^3).The output result is shown in the Figure 4.4.

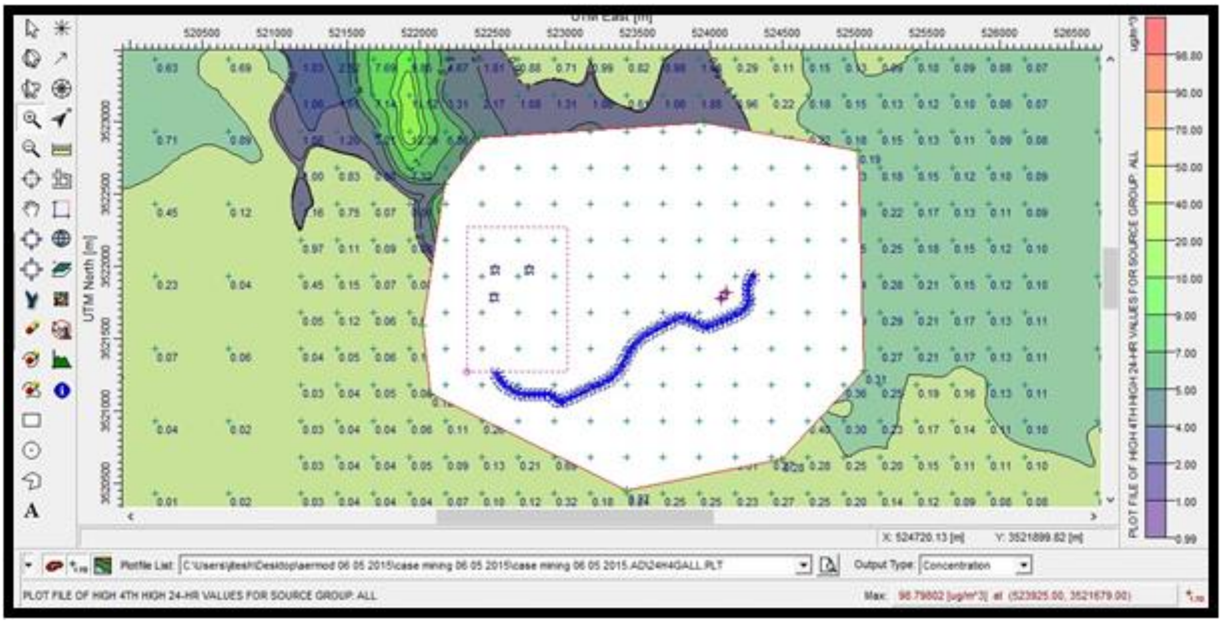


Figure 4.4: Concentration of all grid points along with maximum concentration

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