Bitlis Eren Üniversitesi Fen Bilimleri Dergisi
BİTLİS EREN UNIVERSITY JOURNAL OF SCIENCE
ISSN: 2147-3129/e-ISSN: 2147-3188
VOLUME: 13 NO: 4 PAGE: 1205-1215 YEAR: 2024
DOI: 10.17798/bitlisfen.1540768

Environmental Problems in Mining Quarries and Theoretical and Practical Comparison of Dust Emissions

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Keywords: Mine Quarry, AERMOD, PM10, Settled Dust, Emission.

Abstract
This study reveals that the development of the country is only possible through meticulous analysis of regional potentials and sustainable use of natural resources. The aim of this study is to evaluate the environmental impacts arising from the site selection of mining operations and to put forward the necessary measures for the efficient and controlled use of natural resources within the scope of sustainable development. In this context, the importance of factors such as expropriation, topography, environmental conditions and energy and water access in the site selection of mines is emphasized.
In the study, the AERMOD model developed by the United States Environmental Protection Agency for air quality modeling was used to estimate the environmental impacts of dust emissions that may occur during mining activities. In the modeling process, data on pollutant sources such as mass flow rate, source height and gas outflow rate were combined with meteorological data and calculated according to the Regulation on the Control of Industrial Air Pollution. In addition, in-plant PM10 measurements were performed and analyzed by gravimetric method.
As a result, the modeling studies and the data obtained serve as a basis for the environmental permitting process of the facilities that will be put into operation and provide guidance to decision makers for air quality management. The study also emphasizes the importance of assessing the cumulative air quality impacts of existing facilities and demonstrates that verifying these impacts with reliable laboratory studies will contribute to sustainable development targets.

1. Introduction

The environment is an environment in which living things maintain their relations during their lifetime in mutual interaction and is defined as the environment in which living things sustain their lives. At the same time, the environment is directly and indirectly affected by air, soil and water pollution that occurs because it is in social, economic, cultural as well as physical, chemical and biological interaction. Changes in air composition can disrupt the environmental balance and threaten the lives of humans and other living things [1]. Environmental pollution can be caused by a wide variety of reasons and has negative effects on the ecosystem. There are many pollution sources that create complex and multidimensional pressure on the ecosystem. Urbanization, industrialization, mining and agricultural activities are among these sources [2].

When environmental problems reach crisis proportions, negative impacts on human health occur. Environmental crises occur when the saturation capacities of receiving environments are exceeded and the balances in the natural environment are disrupted. These balances are especially disrupted by the unconscious consumption of natural resources by humans [3]. With the increase in these problems day by day;

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Received: 29.08.2024, Accepted: 30.11.2024

two ways of taking measures against environmental problems have emerged. The first one is to eliminate the problems after they occur (restorative policies) and the second one is to prevent them before they occur (preventive policies) [4].

Strategic documents (strategies, policies, legislation) and specific procedures for decision-making for specific activities have been developed by many countries since the 1980s [5]. However, environmental assessment systems have some problems because they are limited to the study scale [6].

Environmental Impact Assessment (EIA) is used to comprehensively determine the positive or negative impacts that a planned activity may have on the environment. The EIA aims to prevent or minimize potential damages with the help of assessments. At the same time, the goal of EIA is to ensure that all negative environmental impacts that may be caused by planned activities are identified in advance and necessary measures are taken without hindering economic and social development [7]. This method has been widely used especially in industrialized countries since the 1970s [8].

EIA reports are prepared to prevent environmental pollution before and during the operations of the investments within the scope of the regulation. In this context, these reports help investors to develop methods to prevent environmental pollution [9]. Environmental management, which is the key to sustainable production in mining and industry, although costly at first, provides a competitive advantage to mining companies and reduces the environmental impacts of mining activities with the help of legislation [10].

Mines that start to operate without taking the necessary precautions into consideration pose a great danger to public health and environmental quality [11]. The magnitude of the problems defined in this context varies according to some variables (types of minerals extracted, mining methods used, types of waste materials to be generated, geological structure of the selected area, soil structure and vegetation in the mining area, size and depth of the sites, hydrological and hydrogeological characteristics and climatic conditions, etc.) [12].

According to the 2023 data of the General Directorate of Mining Affairs of the Ministry of Energy and Natural Resources, a total of 14.763 mining licenses were granted, of which 4.693 were exploration licenses and 10.070 were operating licenses [13]. Mining operations create various negative impacts that lead to the depletion of non-renewable natural resources, pollution of air, water and soil, noise and vibrations, deterioration of topography and destruction of vegetation [14].

The extent of harmful effects on the environment in open pit mines varies depending on hydrology-hydrogeological characteristics, geological structure, capacity (size and depth) of the mining areas, existing soil properties, vegetation of the region, climatic conditions, etc. [15]. Open pit mining method can be generally defined as the removal of the top layer consisting of topsoil and stripping material (rock mass ore-free zone) over the ore underground or in outcrop and bringing the ore to the surface [16]. In this method of operation, the noise-vibration problem caused by construction machinery and step drilling-blasting operations in production and dust emissions released during pickling (top cover) operations can be considered as other major environmental problems [17].

The effects of pollutant emissions, which can cause serious health problems in living organisms and pose environmental problems, can manifest themselves as respiratory irritation, allergic reactions such as asthma and, in the long term, serious diseases such as cancer. These health problems can vary depending on the type of dust exposure and the risk is particularly high when small particles enter the body. The health risks are directly linked to particle size, and particles smaller than 10 μm in particular are known to cause serious health problems by penetrating the lungs and entering the bloodstream. Similarly, studies have found that dust contact with plant leaves and dust accumulation have negative effects on plant growth and inhibit photosynthesis, respiration and evaporation from leaves. Quarry dust negatively affects the functionality of the ecosystem due to loss of vegetation and damage to agricultural and forest lands [18].

Various legal regulations have been developed in our country and other developed countries in order to prevent and control the pollution that occurs during the production activities of industrial facilities and causes environmental pollution by exceeding the limit values when they are not adequately controlled. These regulations include measures to reduce environmental impacts.

The Environmental Law (No. 2872), which entered into force in 1983 within the scope of environmental legislation, is the first legal regulation for the protection of the natural environment and the prevention of environmental pollution in our country. This law imposes the obligation to treat and dispose of wastes generated as a result of production and consumption activities in accordance with the standards specified in the relevant regulations. According to the Environmental Permit and License Regulation (EPLR), mines above certain capacities must obtain an environmental permit and are obliged to take necessary measures to control dust emissions. Accordingly, according to the EIR [19], quarries with a mine production capacity of 150 tons/day or more and quarries where minerals in group I (a and b), group II including limestone, group IV and group V, and mines where explosive materials are used are subject to environmental permits. The quarries within this scope are obliged to take dust preventive measures for dust emissions generated during the operation phase and to meet the limit values mentioned in the Regulation on the Control of Industrial Air Pollution (RCIAP) and to obtain an environmental permit for emissions.

This study covers the comparison of the emission results of the gypsum stone quarry and crushing and screening plant within the borders of Güblüce village, Zile district, Tokat province during the planning and operation phase and the ways to be followed according to the results.

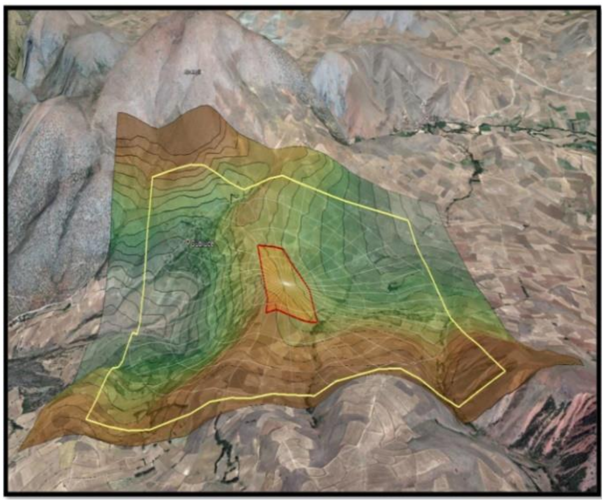

Figure 1. Facility Impact Area Map (40,140576-35,667532)

This research is a comparison of the data of the Project Introduction File made in 2012 with the regulation limit values for 2024.

2. Material and Method

In this study, the emission measurement results of a blasted gypsum quarry and crushing and screening plant, which operates 8 hours a day and has a production capacity of 62.53 tons per hour, were evaluated. The facility is located in Güblüce Village, Zile district of Tokat province. The quarry operates with open pit method and production operations are carried out by blasting and drilling methods. Air quality control can be considered at three different levels: global, regional and local. The most important of these is local air quality control and the air quality management applied for this purpose. [20]. The concept defined as air quality management covers all detection, monitoring and improvement works carried out to ensure that emissions released into the atmosphere without treatment are kept at levels that will not harm human and environmental health or reduced to these levels. This process aims to implement the necessary measures to control emissions and protect air quality [21]. In our country, limit values for 13 pollutants (SO_2, PM_{10}, NO_X) related to air quality management are determined by the Air Quality Assessment and Management Regulation (AQAMR) [22].

Modeling is used to express an event mathematically using numerical data in terms of the factors on which the event depends [23]. In modeling, many factors affecting dispersion and transport and possible effects of pollutants are calculated. There are multiple models that can be used to calculate atmospheric pollutants [24, 25]. These modeling methods are useful and economical for the analysis of dispersion and dilution behavior [25]. One of these models, AERMOD, was developed in 1991 as a result of a joint effort by AMS and EPA (Environmental Protection Agency) scientists. In 2005, the AERMOD model was officially recognized by the EPA. AERMOD is a steady-state dispersion model designed for short-range (maximum 50 km) dispersion of air pollutant emissions from stationary industrial sources [26].

AERMET is a three-stage meteorological data preprocessor. In the first stage, surface and upper layer data are extracted, processed together and quality checked. In the second stage, all data are merged into a single file with a 24-hour period. In the final stage, this combined meteorological data and the calculated layer data are prepared for use in the AERMOD dispersion model. The PFL and SFC files produced by AERMET are used by AERMOD. With the help of these data, atmospheric parameters are included in the simulation [26].

Emission factors (given in Table 1 of Annex-12 of the same regulation) were used to calculate the mass flow rates of dust emissions (resulting from the operations to be carried out at the mine site) in accordance with the article "Hourly mass flow rates of emissions discharged from the facilities to the atmosphere are determined by taking measurements from the stacks for existing facilities and by using emission factors for non-stack sources and new facilities to be established." in Annex-2 (Article 1, subparagraph a) of the Regulation on the Control of Industrial Air Pollution. [27].

Table 1. Emission Flow Rate of Dust According to Source Definitions

Source	No	Process	Controlled Dust Emission flow rate (kg/hour)	Controlled Dust Emission flow rate (kg/hour)
Vegetal Soil Excavation	1	Excavation	0.04	0.08
	2	Loading	0.016	0.0325
	3	Transportation	0.018	0.036
	4	Unloading	0.0007	0.0014
	5	Storage	0.0145	0.029
		TOTAL	**0.09**	**0.18**
Quarry Activities (Ore Production)	6	Excavation	0.78	1.56
	7	Loading	0.312	0.625
	8	Transportation	0.35	0.7
	9	Unloading	0.312	0.625
Quarry Activities (Minepass Production)	10	Loading	0.031	0.0625
	11	Transportation	0.03	0.06
	12	Unloading	0.031	0.0625
		TOTAL	**1.846**	**3.695**
Mineral Storage	13	Storage	0.07	0.14
		TOTAL	**0.07**	**0.14**
Waste Storage	14	Storage	0.0676	0.135
		TOTAL	**0.0676**	**0.135**
Final Transportation	15	Transportation	0.5075	1.015
		TOTAL	**0.5075**	**1.015**
Explosion	16	Explosion	0.7425	62.53
		TOTAL	**0.7425**	**---**
TOTAL		**TOTAL**	**2.5**	**5**

AERMOD View program developed by USEPA was used in the air quality modeling study. The AERMOD Modeling System is a flexible modeling tool for linear and steady-state plume modeling with Gaussian plume characteristics. It can be applied to various emission sources, such as point, volumetric and areal source types. AERMOD evaluates new or steady-state dispersion scenarios with sophisticated algorithms that include vertical profiles of winds, turbulence effects, penetration of rising inversion layers, Plume rise, surface levels and heat at buoyancy sources, and terrain effects. The program optimizes its performance according to the characteristics of the terrain and different emission sources, allowing to obtain the most realistic results at high concentrations. The AERMOD modeling system consists of two core components, AERMAD for processing terrain information and AERMET for processing meteorological data. It is also designed to model various types of sources such as multiple point sources, areal, linear and volumetric sources, structures, concentrations and deposition. [28].

The areas where the AERMOD Modeling System is used are as follows:

- Complex Industrial Sources: It can be applied on single or multiple point, areal, linear and volumetric sources. However, structures and impacts from structures are not considered in this model.
- Particulate and Gas Deposition: Used to assess the accumulation of gases and particles released into the atmosphere.
- Constant and Variable Emissions: Both constant and time-varying emission sources can be analyzed.
- Rural and Residential Areas: Applicable in both rural and urban areas.
- Transport Up to 50 km from Source: The transport of emissions up to 50 kilometers from the source can be modeled.
- Concentration Estimation for All Terrain: Concentration estimates are made by considering different terrain structures. [28].

The modeling study for estimating the values of dust and gaseous pollutants in ambient air by mathematical methods includes the following steps:

- Determination of the Dispersion Region of the Sources: In the first step, the dispersion region where the pollutant sources will be effective is defined.
- Mapping the Dispersion Region: The defined dispersion region is divided into squares of certain dimensions in the Cartesian coordinate system and latitude, longitude and elevation data are obtained. Alternatively, in the polar coordinate system, the region can be mapped angularly according to latitude, longitude and altitude values.
- Collecting Information on Pollutant Sources: In this step, basic information such as mass flow rate of pollutant sources, source height, source diameter, gas outflow rate, gas temperature are collected.
- Collection of Meteorological Data: Hourly meteorological data (such as hourly temperature values, wind speeds and directions) for a representative year are collected
- Analysis of Meteorological Data: Using the collected meteorological data, hourly stability classes are determined and mixing heights are calculated. [29].

After transferring the data listed above to the modeling program, the program is run to estimate the hourly, daily, monthly and annual probable ground level concentration values of the pollutants in the ambient air. This modeling study was carried out to estimate the air pollution that may occur in the quarry operation. In the study, particulate matter - dust (PM) pollutant parameter resulting from quarry operations was modeled. Before the plant starts operations, the environmental permitting process for emissions of mines is evaluated within the scope of the RCIAP and the EPLR. The purpose of environmental permits is to encourage activities and facilities that may have a polluting impact on the environment to take the necessary measures to protect the environment during their operations. Environmental permit is a tool to prevent environmental pollution and provides legal intervention of the state against polluting activities. [30].

In the study, PM 10 measurements were made at 6 points within the facility. In addition, the modeling results were examined and settled dust measurements were made for a total of 2 months in 1-month periods at two points within the investigation area of the facility with high model results.

Table 2. Emission sources and measured parameters

No/ Code	Emission Source	Parameter						
		CO	NO_x	SO_2	Powder		VOC	Other
					PM10	Settling Pewder		
1	Sieve Side	-	-	-	X	-	-	-
2	Crusher Side	-	-	-	X	-	-	-
3	Stock Area	-	-	-	X	-	-	-
4	Quarry (Blasting Moment)	-	-	-	X	-	-	-
5	Bunker Side	-	-	-	X	-	-	-
6	On-site Road	-	-	-	X	-	-	-
7	Facility Inspection Are (2 Points)	-	-	-	-	X	-	-

Emission sources are indicated in Table-2. It has been determined what kind of measurements will be made at these emission sources.

PM10 measurements are made by gravimetric measurement method (TS EN 12341) by keeping particles smaller than 10 microns in diameter on filter paper. For these measurements, MCZ LVS 1 measuring device is used because the air vacuum time and volume can be adjusted. First, the filter papers to be used in the method are weighed by conditioning at 20 °C (±1 °C) temperature and 50% (±5%) relative humidity for 48 hours. The weighing results are recorded and placed in clean petri dishes to avoid exposure to air, moisture and contaminants until the sampling point. The measuring device, which is transported to the appropriate sampling point, is placed on a flat area (at least 30 cm away from the obstacle) where there is no obstacle that may prevent sampling from the air to be analyzed, and measurement and sampling are performed according to the relevant procedure. After the sampling process is completed, the filter paper is placed in a clean petri dish with the help of tweezers and sent to the laboratory for weighing and the weighing results obtained are recorded.

Determination of settled dust is carried out by gravimetric method in the plant inspection area and with a four-way ambient air sampling device in accordance with TS 2342 standard. The sampling system, consisting of a base plate (1 piece), tripod (1 piece) and dust collection container (4 pieces), collects settled dust from 4 main directions and can determine the source of dust at a certain point.

In the study, Air Quality Dispersion Model was carried out during the production planning phases of the gypsum quarry and crushing and screening plant by applying the blasting method with a capacity of 62.53 tons per hour, in accordance with the Air Quality Dispersion Model in Mining Projects guideline published in 2018 by the General Directorate of EIA Permit and Inspection of the Ministry of Environment, Urbanization and Climate Change [31]. After the facility became operational, dust emissions causing air pollution were taken under control within the scope of SDGPLR and the dust measurement results were measured to be the basis for the environmental permit on emission required to be obtained in accordance with the EPLR.

3. Results and Discussion

In mines, dust is generated at different stages of the production process, during drilling, blasting, machine excavation of the main mass, transportation and storage. These dust emissions adversely affect air quality by disturbing the composition of the air as an areal source. AERMOD model was used for the dust emissions to be generated within the scope of the research and PM10-Precipitated Dust emissions were calculated as annual-monthly-hourly in the Long-Short Term based on controlled and uncontrolled operations during blasting and production phases. The results were evaluated within the scope of Air Quality Assessment and Management Regulation.

After the site became operational, PM10 was measured at 6 points with MCZ LVS 1 PM 10 particulate matter measurement device within the scope of environmental permits and settled dust was determined by Gravimetric Method with Four-Way Ambient Air Sampling Device within the facility area. The results were evaluated within the scope of Air Quality Assessment and Management Regulation.

As a result of the evaluations, the data in Table 3 were obtained by using the AERMOD model in the study phase (theoretical) and operation phase (practical) of dust emissions generated outside the blasting operations.

Table 3. Comparison of PM10 and settled dust results outside blasting operations

Parameter	**Period**	**Model Result Value [μg/m³]**		**Limit Values by Year**		
				2018	**2019-2023**	**2024 onwards**
PM 10 (AERMOD)	STL Daily	Scenario 1	32	**60**	**50**	**50**
		Scenario 2	233			
	LTL Anual	Scenario 1	6	**44**	**40**	**40**
		Scenario 2	45			
PM 10 (Measuring)	STL Daily	Field Measured	92,65	**60**	**50**	**50**
	LTL Anual	Field Measured	5,33	**44**	**40**	**40**
Parameter	**Duration**	**Limit Value [mg/m² day]**		**Limit Values by Year**		
				2018	**2019-2023**	**2024 onwards**
Settling Dust (AERMOD)	STL Monthly	Scenario 1	298	**390**	**390**	**390**
		Scenario 2	2168			
	LTL Monthly	Scenario 1	24	**210**	**210**	**210**
		Scenario 2	178			
Settling Dust (Measuring)	STL Monthly	Field Measured	287,06	**390**	**390**	
	LTL Anual	Field Measured	47,85	**210**	**210**	

Short Term Value (STV): The maximum daily average values or, statistically, the value that corresponds to 95% of the measurement results when all measurement results are ranked according to their numerical magnitude.

Short Term Limit Value (STLV): It is the limit value that statistically corresponds to 95% of all measurement results when the maximum daily average values or numerical values are arranged in order of magnitude and should not exceed the value specified in of Annex-2 of the RCIAP

Long Term Value (UVV)**:** The value calculated as the arithmetic average of all measurement results.

Long Term Limit Value (**LTL*****)*****:** It is the arithmetic average of all measurement results and is the limit value that should not exceed the value specified in Annex-2 of the RCIAP.

The calculations required for the AERMOD model are made according to the guidelines published by the Ministry of Environment, Urbanization and Climate Change. Certain formulas are applied to calculate PM10 (Particulate Matter less than 10 micrometers) values based on field measurements. These formulas allow the data obtained under real conditions to be converted into standard conditions. The following formulas are utilized in the calculation of PM10 values.

Formulas:

$V_{std}= V_{act} \times (P_{act}/P_{std}) \times (T_{std}/T_{act})$

$V_{act}= 60 \times Q_{act} \times t_{hr}/1000$

$PM_{std}= M_{PM}/ V_{std}$

$PM_{act}= M_{PM}/ V_{act}$

P_{std}: Standard Pressure (760 mmHg)
P_{act}: Actual Pressure (mmHg)
T_{act}: Actual Temperature (Kelvin)
t_{hr}: Measurement Duration (hours)
PM_{std}: Standard PM10 Concentration
PM_{act}: Actual PM10 Concentration
V_{act}: Actual Volume
T_{std}: Standard Temperature (273 Kelvin)
V_{std}: Standard Hacim
M_{PM}: Mass of Particulate Matter Collected on Filter

When the modeling and measurement results in Table 4 are examined, it is seen that PM and settled dust concentrations resulting from production activities are below all limit values. However, in the modeling study, it is understood that there are cases where PM concentrations exceed 50 µg/m³, which is the limit value of the RCIAP. The RCIAP states that PM10 “cannot be exceeded more than 35 times in a year”.

As can be seen in Table 3, modeling studies for dust emissions generated outside of blasting operations are controlled dust modeling called “Scenario-1” and uncontrolled dust modeling called “Scenario-2”. Based on the controlled dust modeling, the Daily STL PM10 value is 32 µg/m3 and the annual LTL value is 6 µg/m3. However, the Daily STL PM10 value measured in the field is 92.65 µg/m3 and the annual LTL value is 5.33 µg/m3. As a result, when the results measured in the modeling study and in the field are compared, it is observed that the PM10 Annual LTL values are very close to each other and work in harmony. However, it is observed that there is approximately a 3-fold difference in the model and measurement results for the daily PM10 STL value. Similarly, when the results of the controlled dust modeling are compared with the settled dust values, the Monthly Short Term Limit (STL) value is 298 mg/m² and the Annual Long Term Limit (LTL) value is 24 mg/m² per day. In the field measurements, the Monthly STL value was recorded as 287.06 mg/m² and the Annual LTL value as 47.85 mg/m².

Due to the limited number of modeling results and field measurement values, a small variation was added to the measurement data to calculate the estimated correlation coefficient. This triangulation was done in order to enable correlation analysis in a limited data set.

4. Results

The correlation coefficient for PM10 and settled dust data is as follows:

1. PM10 Daily (STLV): r=-1.0r = -1.0r=-1.0r=-1.0
2. PM10 Annual (LTL): r=1.0r = 1.0r=1.0
3. Settled Dust Monthly (STLV): r=1.0r = 1.0r=1.0
4. Settling Dust Annual (LTL): r=-1.0r = -1.0r=-1.0r=-1.0

These results show high positive or negative correlation due to the limited number of data. The negative correlation in PM10 daily and annual values shows that the model results have an inverse relationship with the field data, whereas the positive correlation in PM10 annual and monthly values shows that there is a consistent relationship between modeling and measurement data.

In a study by Demirel et al. (2019), the differences between dust emission modeling and field measurements were discussed [32]. In this study, it was observed that modeling results were in good agreement with field measurements with annual average values, but model results were lower than field values in short-term, daily measurements. Similarly, in this study, deviations between model results and measurements were found in short-term values. In another study by Kocak and Cetin (2020), dust emissions at mining sites were estimated using the AERMOD model [33]. In Kocak and Çetin's study, it was observed that the modeling results did not exceed the daily limit values, but these values were exceeded in field measurements. This is similar to the limitation of modeling in not being able to fully reflect the variability in field conditions, as in the present study. Yılmaz and Kara (2018) compared controlled and uncontrolled dust modeling scenarios [34]. In the controlled scenario, it was reported that short-term PM10 concentrations were reduced below the limit values by measures such as irrigation systems and anti-dust coatings. Similarly, in this study, lower PM10 and settled dust concentrations were obtained in the controlled dust modeling scenario. The findings of Yılmaz and Kara emphasize the effectiveness of control measures and are consistent with the results of this study.

As a result, when the results of the modeling study and the results measured in the field are compared, it is observed that the monthly CVS values of the precipitated dust are very close to each other and work in harmony. However, it is observed that there is approximately a 2-fold difference in the model and measurement results for the annual settled dust UVS value. At the same time, the theoretical and practical dust emissions caused by production in the mine were compared and it was determined that some values of the results were very close and there were differences in some values.

5. Conclusion and Suggestions

In order to minimize the damages that may be caused by the pollutants and emissions generated during the production phase of the mines to the topography, vegetation, living creatures and habitats, surface waters, groundwater, water resources, settlements, atmosphere, the planning of the mines should be done perfectly and after the production activities are started, they should be inspected according to whether they are working properly according to the planned methods.

In this context, as can be seen in Table 3, when we consider the modeling studies in dust emissions other than blasting operations, the Daily Short-Term Limit Value PM10 value is 32 µg/m3 and the annual Long-Term Limit Value is 6 µg/m3, while the Daily Short-Term Limit Value PM10 value measured in the field is 92.65 µg/m3 and the annual Long-Term Limit Value is 5.33 µg/m3.

Likewise, when controlled dust modeling results are compared with settled dust values, the Monthly Short Term Limit Value is 298 mg/m² and the Annual Long Term Limit Value is 24 mg/m² per day. In the field measurements, the Monthly Short Term Limit Value was 287.06 mg/m² and the Annual Long Term Limit Value was 47.85 mg/m². As a result, when the results of the modeling study and the results measured in the field are compared, it is observed that the Monthly Short-Term Limit Values of the Precipitating dust are very close to each other and work in harmony. However, it is observed that there is approximately a 2-fold difference in the model and measurement results for the annual Long-Term Limit Value.

Considering the results of the research, the wastes generated after the start of the activity should be minimized and disposal should be ensured in accordance with the laws and regulations in force.

In this context, the relevant institutions and organizations should work more sensitively and work to increase awareness by organizing sectoral training and seminars.

It is possible to make predictions based on receptor models for facilities that have not started operations and therefore cannot be measured, and by using the data of dispersion models used for the operating facilities in the region, it is possible to make predictions about the air pollution that will be created together (cumulative effect) by the facilities in the region (active or not yet operational). With the help of modeling, it is possible to detect the pollution coming to the region from long distances. With these features, models are of great importance in determining air quality management and provide significant support to decision-makers.

The differences between the selected models and the fact that the same model produces different predictions under different tuning and validation conditions make the reliability of the results questionable. Guidance in the legal regulations in Annex-2 of the Regulation on Control of Industrial Air Pollution can have a significant impact on this reliability.

In air quality management, model data are very significant sources for competent authorities in determining the extent to which existing conditions and planned new activities will affect air quality. It is very critical to determine the accuracy and reliability of the model data and to determine the representation rates of the pollution that will be caused by the activities in the current area. It is possible that the data to be obtained by determining the boundaries of the models to be selected correctly represent the actual measurement data. The use of model data with low margin of error in the calculation of total air pollution will increase the decision-making speed of the competent authorities and the accuracy of these decisions. For this aim, it is necessary to increase the use of appropriate models, to use the relevant models by accredited organizations and to carry out the necessary studies to increase the precision of the data.

It is estimated that a modeling unit will be established in the Air Quality Assessment Units by the Ministry of Environment, Urbanization and Climate Change, Provincial Directorates of Environment, Urbanization and Climate Change, and a database will be created by evaluating the submitted files down to mining groups, production methods, capacities, provinces, districts and villages, and the files submitted will be compared in the databases created and definite results will be reached about their accuracy and validity.

If this system is implemented, it will play a major role in the cumulative evaluation of the effects of the facilities on air quality throughout the country and in achieving the target air quality standards in the coming years.

It will also be valid for the dust emission measurement data carried out during the aforementioned study, and in the same way, it will be possible to establish a database and ensure self-control by establishing a laboratory within the Provincial Directorates of Environment, Urbanization and Climate Change or by working in cooperation with the University laboratories in the relevant province to carry out confirmation measurements and to compare the accuracy and reliability of the results.

Currently, the Ministry of Environment, Urbanization and Climate Change and Provincial Directorates play an important role in the planning and implementation of environmental projects. However, the lack of a systematic inventory for monitoring and evaluation of planned projects reduces the effectiveness of projects and makes the reliability of results questionable.

The current situation does not allow for the evaluation of planned projects based on concrete data. This negatively affects the success rate of environmental projects and reduces the effectiveness of future planning. Therefore, the establishment of a project inventory system will provide more accurate and concrete data, which will increase the validity of environmental projects.

For the effective management of environmental projects, the Ministry of Environment, Urbanization and Climate Change and the relevant Provincial Directorates need to ensure the monitoring and evaluation of planned projects by establishing a systematic inventory. This will contribute to increasing environmental sustainability and achieving more effective results. The findings of the present study are in line with the model and measurement discrepancies observed in similar studies in the literature, the negative impacts of uncontrolled dust emissions and the effects of particulate matter such as PM10 on short and long-term limit values. Studies in the literature emphasize that field measurements may not always be in full agreement with theoretical models and the influence of environmental factors. It is also emphasized in the literature that discrepancies in short-term values, variability in field conditions and modeling limits should be taken into account, as in the present study.

Contributions of the Authors

Volkan SEREN: Methodology, Data Collection, Data Analysis, Writing - Review & Editing.
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Acknowledgment

I would like to thank Dr. Rıfat YILDIRIM.

Conflict of Interest Statement

There is no conflict of interest between the authors.

Statement of Research and Publication Ethics

The study is complied with research and publication ethics.

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