Assessing Environmental Impacts of a Cement Industry during its Operation Phase

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Abstract— **Environmental pollution is a very serious issue of the present world. A rapid industrialization is going on around the globe and hence all types of pollution are seen around us. Most importantly, water and air are getting highly contaminated. The construction industry is one of the leaders in deterioration of environment by depleting resources and consuming energy and creating a lot of waste. Also a considerable amount of emissions of greenhouse and acidifying gases has the origin in this industry. Cement belongs to the most often used building materials and its production is increasing over the world. At the same time, the cement industry is an enormous energy intensive industry and it produces many harmful emissions, like gases, odours and noise. An assessment of environmental impacts has been made in terms of water, air and noise pollution in a cement manufacturing plant Manglam Cement Limited at Morak, Kota, Rajasthan, which is under operation for a period of about 30 years. During the study, the ambient air quality parameters like PM10, PM2.5 SO_2, NO_x, physio-chemical parameters of water namely pH, total hardness, total alkalinity, total dissolved solids (TDS), conductivity, total chlorides and measurement of noise levels as well as health and safety measures for the workers have been evaluated. Zero discharge approach is examined in Manglam Cement Limited where no liquid/solid waste is generated from the plant; which indicates that significant environmental regulations are being maintained. It is found that the industry is working according to the standards and norms defined by the Central Pollution Control Board of India.**

Keywords— **Cement industry; environmental impact assessment; water pollution; air pollution; noise pollution**

I. INTRODUCTION

A. Cement Industry

India is the second largest producer of cement in the world. India's cement industry is a vital part of its economy, providing employment to more than a million people, directly or indirectly. India has a lot of potential for development in the infrastructure and construction sector and the cement sector is expected to largely benefit from it. Some of the recent major government initiatives such as development of 98 smart cities are expected to provide a major boost to the sector. A significant factor which aids the growth of this sector is the ready availability of the raw materials for making cement, such as limestone and coal.

The production of cement involves the consumption of large quantities of raw materials, energy and heat. Cement production results in the release of a significant amount of particulate matter (PM) and the gaseous emissions. The manufacturing process is very complex, involving a large number of materials (with varying material properties), pyro-processing techniques (e.g. wet and dry kiln, preheating, recirculation) and fuel sources (e.g. coal, fuel oil, natural gas).

The cement industry is one of the primary producers of carbon dioxide. The main environmental issues associated with cement production are consumption of raw materials and energy use as well as emissions to air. Waste water discharge is usually limited to surface run off and cooling water only and causes no substantial contribution to water pollution. The storage and handling of fuels is a potential source of contamination of soil and ground water. Additionally, the environment can be affected by noise and odours.

B. Environmental Impact Assessment

The environmental impact assessment (EIA) process is an interdisciplinary and multistep procedure to ensure that environmental considerations are included in decisions regarding projects that may impact the environment. Simply defined, the EIA process helps identify the possible environmental effects of a proposed activity and how those impacts can be mitigated.

In order to assess the adverse possible effects of a proposed project on the environment surrounding the proposed project, a detailed analysis is required to be made. This report is known as the Environmental Impact Assessment (EIA). Environmental Impact Assessment (EIA) is an important management tool for ensuring optimal use of natural resources for sustainable development.

Looking to the fast growing problem in environment, a study has been made compulsory to overcome the expected problem of any development project by which we may reduce the possible harmful effects and better risk management. Therefore, both negative and positive impacts on the environment will be considered.

C. Study Area: Manglam Cement Limited

Mangalam Cement Limited was established in the year 1981 Shri B. K. Birla Group, the most eminent and illustrious industrialist of the country. Mangalam Cement Limited (MCL) is engaged in cement manufacturing and limestone mining, having wide experience in the field of cement manufacturing and has two cement plants accredited with many ISO certifications. The company is producing cement in

43 grades, 53 grades and Portland Pozzolana Cement (PPC) using the dry process and marketing under the brand name of "Birla Uttam Cement". MCL is operating 6.10 Million Tonnes Per Annum (MTPA) cement plant at village Morak in RamganjMandi tehsil of Kota district in Rajasthan, India. Present clinker production capacity of the plant is 4.06 MTPA. The cement plant is supported by captive limestone mine i.e., Morak limestone mine spreading over an extent of 895.42 ha. The cement plant is in an area of 167 ha.

The Birla Uttam Cement project site is situated near the intersection of latitude 24°43'21.73" to 24°42'51.76" N and 26°16'16" N and longitude 75°56'32.29" to 75°57'32.78" E at an elevation of 372 m above the mean sea level. The site is benefited with well-developed infrastructural facilities and is well connected by the roads. All the units of the company are located at Adityanagar, Morak, Kota, Rajasthan. Morak is 65 Km away from Kota towards Mumbai on main Delhi-Mumbai railway route. The nearest railway line connecting Kota - Bhawanimandi of western railway is at a distance of 0.9 km ESE. The nearest railway station, Morak is at a distance of 2.4 Km in NNE direction.

II. OBJECTIVE OF THE STUDY

Environmental impact assessments are generally carried out before the execution of a project to assess the possible impacts on the environment including water, air, noise, wildlife, flora and fauna etc. and corrective measures are suggested so as to minimize the adverse impacts on the environment. During and after execution of the project, the governmental authorities responsible for keeping watch on the industries, regularly monitor and take action against the defaulting industries. However, sometimes, the industries do not give proper attention towards the remedial measures once the project is sanctioned, completed and is under running stage. Therefore, the objective of the present study was to assess the environmental impacts of a cement industry during its operation phase with an aim to review whether the environmental protection measures are followed or not as per the guidelines.

III. METHODOLOGY

To carry out the research work, standard methods for measurement of physico-chemical parameters of water, ambient air quality and noise levels were adopted. The health and safety measured were also evaluated based on observations and through a questionnaire distributed among the employees and staff of the industry.

A. Ambient Air Quality Parameters

The assessment of major ambient air quality parameters like PM10, PM2.5, SO2 and NOx was carried out during the months August–September 2016 at four different locations within the plant site i.e. near security gate, railway gate, rack loading area and workshop. The APM 550 Fine Particulate

Sampler was used for monitoring the fine suspended particles in ambient air conditions along with other instruments like spectrophotometer, hot air oven, glass fiber filters, impingers and electronic balance etc. The assessment was carried out as per the guidelines for ambient air quality monitoring issued by the Central Pollution Control Board, India, 2003.

B. Water Quality Parameters

The assessment of physico-chemical parameters of water like pH, turbidity, hardness, total alkalinity, electrical conductivity, total dissolved solids and chlorides was carried out during the months October–November 2016 according to the Standard Methods for the Examination of Water and Wastewater; APHA, AWWA, and WEF, 21st Edition, 2005.

C. Noise Levels, Health & Safety Measures

The assessment of noise levels in the premises of the plant at eight different locations was carried out for five weeks with the help of Quest 199/2900 sound level meter. The assessment of health and safety measures was done by physical observation of the equipments and facilities in the premises as well as by conducting personal interviews with the employees and staff regarding their level of satisfaction towards the medical and health facilities. A questionnaire was developed to collect data in this regard.

IV. RESULTS AND DISCUSSION

A. Ambient Air Quality Parameters

TABLE I
Ambient Air Quality Measurement

S. N.	Location	Parameters (in µg/ m^3)			
		PM_{10}	$PM_{2.5}$	SO_2	NO_x
1	Near Security Gate	90	52	4	13
2	Near Work Shop	47	41	6	14
3	Near Rack Loading Area	82	42	6	12
4	Near Railway Gate	64	39	4	13

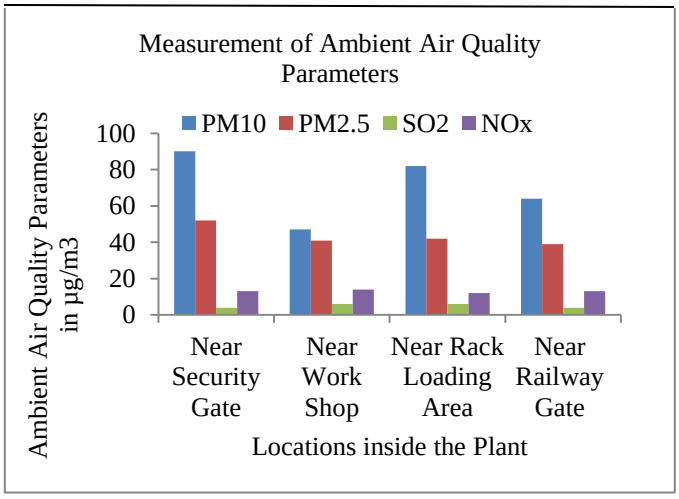

Chart 1: Measurement of Ambient Air Quality Parameters

It has been observed that the concentration of PM10 for all the four locations ranges between 57 μg/m3 to 90 μg/m3 whereas the concentration of PM2.5 for all the locations ranges between 39 μg/m3 to 52 μg/m3. As far as the gaseous pollutants SO2 and NOx are concerned, the promulgated CPCB limits of 80 μg/m3 for industrial, residential and rural areas has never surpassed at any locations. The SO2 concentrations are in the range of 4 μg/m3 to 6 μg/m3 and the NOx concentration in the range of 12 μg/m3 to 14 μg/m3 for all the locations. Hence, we can see that air quality found here is under safe limits. The obtained values of PM10, PM2.5, SO2 and NOx are within permissible limits as prescribed by the CPCB, India for ambient air quality. The table II shows the national ambient air quality standards according to the CPCB, India.

TABLE II
National Ambient Air Quality Standards (As per CPCB, India)

S. No.	Pollutant	Time Weighted Average	Concentration in Ambient Air	
			Industrial Area, Residential Rural & Other Areas	Ecologically Sensitive Area (Notified by Central Govt.)
1	Sulphur Dioxide (SO_2), μg/m^3	Annual Average 24 hours	50 80	20 80
2	Oxides of Nitrogen as NOx, μg/m^3	Annual Average 24 hours	40 80	30 80
3	Particulate Matter (size less than 10μm) or PM_{10}, μg/m^3	Annual Average 24 Hours	60 100	60 100
4	Particulate Matter (size less than 2.5μm) or $PM_{2.5}$, μg/m^3	Annual Average 24 Hours	40 60	40 60

B. Water Quality Parameters

It can be observed from the table III given below that the physical and chemical parameters of water collected from different locations around the cement plant are within the permissible limits as prescribed by the Indian Standards and only exceed at two locations which are within the plant. This water is recycled within the plant and not used for drinking purposes or disposal on land etc., so it has no harmful impacts on the environment.

TABLE III
Assessment of Water Quality Parameters

S. No.	Parameters	Water Sampling Locations					Standard limits as per IS:10500
		Plant Site	Mine Site	Birla Mandir (100 mt)	Village Morak (400 mt)	Village Morak (500 mt)	
1	pH (at 25 ^{0}C)	7.9	7.85	7.25	7.45	7.3	6.5 to 8.5
2	Turbidity (NTU)	2	2	1	1	1	5
3	Conductivity (μSiemens/cm)	1093	1071	796	635	352	-
4	Total Hardness as $CaCO_3$ (mg/l)	242.60	230.60	151.40	152.20	144.60	300
5	Alkalinity as $CaCO_3$, (mg/l)	293.92	280.02	177	188.97	129.98	200
6	Chloride as Cl (mg/l)	223.93	232.93	155.63	141.54	157.90	250
7	Total Dissolved Solids (mg/l)	994	954.1	412	356	213	500

C. Noise Level Parameters

TABLE IV
Measurement of Noise Levels in the Cement Plant (in dBA)

Area/ Location	Week 1	Week 2	Week 3	Week 4	Week 5
Main Gate	70	71	70	70	70
Compressor House	82	83	81	85	85
Raw Mill Section	72	71	72	74	73
Coal Mill	72	75	74	74	73
Kiln Area	71	70	73	73	71
Cooler Fans	76	74	77	80	78
Cement Ball Mill	72	75	73	74	73
Packing plant	71	70	73	73	71

Ambient noise levels were measured at eight locations in and around the project site. It has been observed that noise levels vary from 70 to 85 Leq dB(A) during day time, which is within the prescribed limits as prescribed by the CPCB, India i.e. 75dBA for daytime and 70dBA for nighttime. Due to operation of machinery, there is likelihood of some increase in noise. It was noticed that proper noise abatement measures have been taken and persons working just close to machines are provided with personal protective equipments viz. ear plugs/ear muffs etc.

D. Health and Safety Measures

It was observed that provisions for fire extinguishers, emergency kits including ladder, fire helmet, gloves, mask, hydrant box key and first aid box, smoke detectors and regular health checkup system for all workers and training programs for different health and safety consideration are being made in the plant. The outcome of a questionnaire and personal interviews revealed that most of the employees, workers and staff members are satisfied with the arrangements made for their health and safety purposes.

V. CONCLUSIONS

The study carried out for assessing environmental impacts of Manglam Cement Limited (MCL) Morak during its operation phase revealed that harmful gases and substances were not found in the ambient air during the study period. Important air quality parameters like PM10, PM2.5, SO2 and NOx were within the permissible limits. The water used in the chemical

processes is recycled / reused in the plant and hence no wastewater is discharged from the industrial activity and there was no significant environmental impact on the nearby ground water quality. Noise level was permissible at most of the locations in the industry premises and tolerable at other places, within the permissible limits. It was noticed that all necessary health and safety measures were being taken care of at the industry site and workers/employees were satisfied with the provisions made.

In nutshell, we can conclude that the MCL is not causing any significant environmental impacts on the ecology of the area, as adequate preventive measures are being adopted to contain the various pollutants within permissible limits. Green belt development around the area has also been taken up as an effective pollution mitigation technique, as well as to control the pollutants released from the premises of MCL.

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