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STUDY OF ENVIRONMENTAL HEALTH STATUS IN VICINITY OF ACC CEMENT PLANT BARMANA, BILASPUR DISTRICT (H.P.)

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Abstract:-

This paper presents the qualitative impairment of ambient air due to sulphur dioxide, oxides of nitrogen, particulate matters and carbon monoxide which are emitted from ACC Cement Factory in Barmana city. Barmana is situated at 31° 25.022' N latitude and 76° 49.789' E longitude. Barman is about 18 km north of Bilaspur on National Highway NH-21 connecting Ambala and Mandi, Passes through ACC Gagaj and its colony. The raw material for the cement factory comes from the place kowari which is located at 31° 24.490' N of 680m. The ill effect of these ambient air pollution on human health such as hypertension, diabetes, hyperlipidemia and Ischemic heart disease and other diseases occur by cement are (respiratory diseases, gastrointestinal diseases, blood pressure diseases, dental diseases, eye diseases, skin diseases). Cement industry is a potential anthropogenic source of air pollution. It is a major contributor to dust, nitrogen oxides (No), sulfur oxides (SOx), and carbon monoxide (CO) in metropolitan areas. In cement industries, dust is emitted from stock piles, quarrying, and transportation of raw materials, kilns operation, clinker cooling and milling. Therefore the study on air pollution and related impacts on human health have a special consideration today. The human populations of all selected sites were surveyed for prevalence of various diseases such as common diseases occur by cement are (lung cancer, eye irritation, cough, cold, T.B., dental problem, skin diseases, asthma etc.), hypertension, diabetes, hyperlipidemia and Ischemic heart disease from the result and observation.

Key Words:-*Environmental health, ACC Barmana, Air Pollution*

INTRODUCTION

It is impossible to envisage a modern life without Cement. Cement is an extremely important Construction material used for housing and infrastructure development and a key to economic growth. Cement demand is directly associated to economic growth and many growing economies are striving for rapid infrastructure development which underlines the tremendous growth in Cement Production. The cement industry plays a major role in improving living standard all over the world by creating direct employment and providing multiple cascading economic benefits to associated industries. The cement industries are an energy intensive and significant contributor to climate change. Air pollution is a mixture of substances, including volatile organic compounds, nitrogen oxides, sulphur dioxide, carbon monoxide and particulate matter. The environment is an integral part of human life, the quality of which plays a critical role in human health. Air pollution has its own peculiarities, due to its transboundary dispersion of pollutants over the entire world. Air pollution is related to serious health problems such as respiratory diseases, gastrointestinal diseases, blood pressure diseases, dental diseases, eye diseases, skin diseases and other diseases. Air pollution continues to receive a great deal of interest worldwide due to its negative impacts on human health and welfare. Several studies reported significant correlations between air pollution and certain diseases including shortness of breath, sore throat, chest pain, nausea, asthma, and bronchitis and lung cancer. One of the most critical impacts of cement manufacturing is the dust generated during transport, storage, milling, packing etc. Atmospheric dust is an important source of air pollution particularly in dry climates. Mineral dust contains high concentrations of many metals known to have toxic effect not only on plants and animals but also on humans. According to the World Health Organization (WHO), air pollution is responsible for increase in outpatient visits due to respiratory and cardiovascular diseases, hospital admissions and mortality. This paper presents the qualitative impairment of ambient air due to sulphur dioxide, oxides of nitrogen, particulate matters and carbon monoxide which is emitted from ACC Cement Factory in Barmana city. The ill effect of these ambient air pollution on human health such as hypertension, diabetes, hyperlipidemia and Ischemic heart disease and other diseases occur by cement are (respiratory diseases, gastrointestinal diseases, blood pressure diseases, dental diseases, eye diseases, skin diseases). Cement industry is a potential anthropogenic source of air pollution. It is a major contributor to dust, nitrogen oxides (NO_x), sulfur oxides (SO_x), and carbon monoxide (CO) in metropolitan areas. Furthermore, it contributes about 5% of the global CO₂, the famous greenhouse gas. In cement industries, dust is emitted from stock piles, quarrying, and transportation of raw materials, kilns operation, clinker cooling and milling. Therefore the study on air pollution and related impacts on human health have a special consideration today.

Study area

Bilaspur district is situated 31° 12' 30" to 31° 35' 45" N latitude and 76° 23' 45" to 76° 50' 40" E longitude and is bounded north by Mandi and Hamirpur districts. On the west by Hamirpur and Una districts. The average annual rainfall in Bilaspur is 175.6mm. the annual average maximum temperature is 44° c and minimum is 15° c. Most of the soil of the Bilaspur district is somewhat sandy. The study area Barmana is situated at 31° 25.022' N latitude and 76° 49.789' E longitude. Barmana is about 18km north of Bilaspur on National Highway NH-21 connecting Ambala and Mandi. Passes through ACC Gagal and its colony. The raw material for the cement factory comes from the place kowari which is located at 31° 24.490' N of 680m. Besides the ACC Cement factory (Gagal Cement workers) there are two Hydropower projects one is NTPC

Koldam project of 800 megawatt capacity situated at village Harnoda at about 10 km away from Barmana region, and the second is Dehar Hydro Power Project of 96 Megawatt capacity at about 5 km away from the Barmana region. The nearby villages around Barmana are 15 (*Panjgain Bhataed – Uparli, Khataed, Nalag, Langat, Harkhar, Punnahana, Roopa – Gandhiya, Deegar, Baeri – Ranjadnya, chadool – Ranjadnya, Dargaoin, Judaani, Kohnala*). The total population of Barmana region and nearby villages is 7,930.

Methodology

Primary as well as secondary information regarding health status, diseases and impact are collected from house to house survey and secondary information collected from Hospital Located in the vicinity of ACC plant Area. Environmental Data are collected from ACC Environmental Division and authenticated from Govt. Agency of Himachal Pradesh.

Result and discussion

It is well known that Air pollution is hazardous to human health. WHO also estimates that worldwide, at least two million peoples die every year due to air pollution? Air is the basic necessary of human life but the quality of air is deteriorating continuously and it is being constantly polluted from different sources. One of the major sources of air pollution is automobiles and industries, as per estimates vehicular pollution is the primary cause of air pollution in urban areas. Numbers of industries in India is increasing in air pollution. Cement industry is one of the most important sources of pollution. The discharge of cement factories generally consist of particulate matter, sulphur dioxide and nitrogen oxides producing continuous visible clouds with ultimately settle on the surroundings as a result the whole ecosystem around the cement factory is subjected to extraordinary stress and neglect. Huge clouds of cement dust have been from generations in the area right from the establishment of these factories this dust has been settling in the area around the cement factory to a considerable distance.

Table 1.2: - Showing Ambient Air Quality Monitoring 2011- 2014 Galgal Cement Work

YEARS	Particulate Matter (PM 10) Mg/m ³	Particulate Matter (PM 2.5) Mg/m ³	No ₂ Mg/m ³	So ₂ Mg/m ³ Limit	Co Mg/m ³ Limit 2 Mg/m ³
2011	65.54	47.65	18.55	1.61	0.47
2012	46.16	42.27	16.48	1.41	0.43
2013	48.78	52.19	42.46	2.44	0.58
2014	33.24	43.41	37.17	3.14	0.54

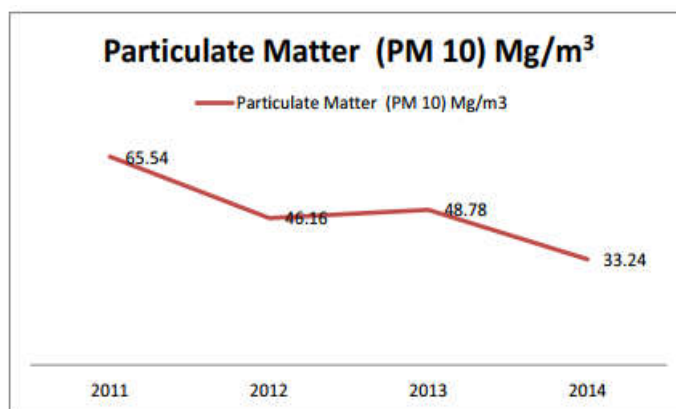
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Effects of PM10 and Pm 2.5 on Human Health

Particulate Matter (PM) is the term used for a mixture of solid particles and liquid droplets suspended in the air. These particles originated from a variety of sources, such as power plants, industrial processes, cement plants and diesel truck, and they are formed in the atmosphere by transformation of gaseous emissions. Coarse Particles (PM10) have an aerodynamic diameter between 2.5 um and 10 um. PM10 is composed of aluminosilicate and other oxides of crustal elements and major source including fugitive dust from roads, industry, construction and demolition, and fly ash from fossil fuel combustion. The lifetime of PM10 is from minutes to hours, and its travel distance varies from <1km to 10km>. Fine particles have an aerodynamic diameter less than 2.5um (PM2.5). They differ from PM10 in origin and chemistry. These particles are formed from gas and condensation of high-temperature. Vapors during combustion, and they are composed of various combinations of sulphate compounds, nitrate compounds, metals (Pb, Cd, V, Ni, Cu, Zn, Mn, and Fe) and particle bound water. Their lifetime is from days to weeks and travel distance ranges from 100s to > 1000s km.

Several epidemiological studies have linked both PM10 and PM 2.5 with significant health problems, including: Premature mortality, chronic respiratory disease, aggravated asthma, acute respiratory symptoms and decreased lung function. Like the other criteria pollutants, the elderly, whose Physiological reserves decline with age and who have higher prevalence of cardio respiratory conditions and children, whose respiratory system are still developing and who spend more time outdoors, are most at risk from exposure to particulate matter. Also, individuals with preexisting heart or lung disease and asthmatics are sensitive to PM effects. Five particulate pollution (PM2.5) is of specific concern because it contains a high proportion of various toxic metals and acids, and aerodynamically it can penetrate deeper into the respiratory tract.

Figure 1.1: - Showing yearly proportion of Particulate matter (PM 10)



It is observed that the concentration of air pollutants such as PM10 and PM 2.5 of the study period year 2011 result determined the concentration of PM10 and PM2.5 is the ambient air of the sampling sites varied 65.54 (PM10) Mg/m³ and 47.65 (PM2.5) Mg/m³. The concentration of air pollutants such as PM10 and PM2.5 of the study period year 2014 result determined the concentration of PM10 and PM2.5 is the ambient air of the sampling site varied 33.24(PM10)Mg/m³ and 43.41(PM12.5)Mg/m³. The concentration of PM10 was recorded highest in year 2011 i.e., 66.54 mg/m³ and lowest in year 2014 i.e., 33.24 mg/m³. (Shown in Figure 1.1 and 1.2). Fanan Ujoh and Frederck Terkuma Ujoh in 2014 were also observed that the average level of PM10 was 122.1 µg/m³ and monthly values was 168.4 µg/m³. In the study impact of cement plant Yadev, Nigeria.

Effect of Nitrogen Dioxide (NO₂) on Human Health

The NO₂ is one component of the complex mixture of different pollutants found in ambient air. NO₂ exposure in doors where its sources include unvented combustion appliances. NO₂ are emitted primarily by motor vehicles, making it a strong indicator of vehicle emissions (including other unmeasured pollutants emitted by their sources). NO₂ (and other nitrogen Oxides) is also a precursor for a number of harmful secondary air pollutants, including nitric acid, the nitrate part of secondary inorganic aerosols and photo oxidants (including ozone).

Mostly the oxides of nitrogen are not so dangerous but the role they play in the formation of photochemical oxidants etc. constitute the most harmful effect on human health and the atmosphere. NO₂ has irritating effects on mucous membrane. High doses of NO₂ causes bronchitis and respiratory problems. As exposure towards 150-200 ppm of NO₂ result in "Bronchiolitis Fibrosa Obliterans", a dangerous disease which occurs within 3 to 5 weeks after the exposure. 500 – 600 ppm of NO₂ for 2 to 10 days after result in death of the victim. Oxide of nitrogen are the second most abundant atmospheric pollutants. They are extremely dangerous to human health.

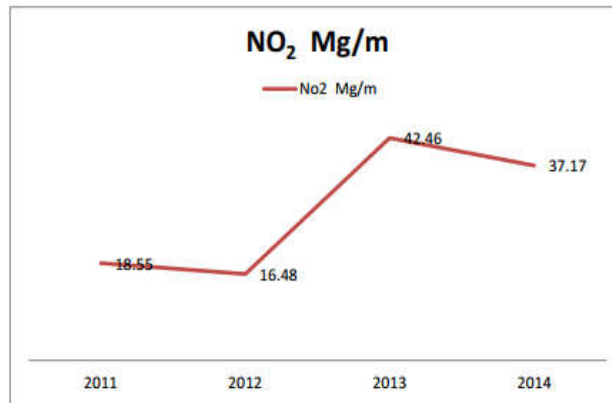


Figure 1.3: - Showing yearly proportion of Nitrogen oxide (NO₂)

It is observed that the concentration of air pollutants such as NO₂ of the study period year 2011. Result determined the concentration of NO₂ in the ambient air of the sampling sites varied 18.55 Mg/m³. Result determined the concentration of NO₂ in the ambient air of the sampling sites varied 37.17 Mg/m³. It is observed that the concentration of NO₂ was recorded highest in year 2013 i.e., 42.46 mg/m³ and lowest in year 2012 i.e., 16.43 mg/m³. Mehraj *et al* in 2013 observed that the average value of NO₂ 117.09 µg/m³ was found at the site. Monthly maximum and minimum values of NO₂ were 141.44 µg/m³ for the month of December and 97.56 µg/m³ for the month of March. At the Jammu and Kashmir cements plant at J & K.

Effects of Sulfur Dioxide (SO₂) on Human Health

SO₂ is a colorless, toxic gas. It is a precursor to sulfuric acid, a major constituent of acid rain. It is produced by the combustion of coal, fuel, oil, gasoline etc. SO₂ is the second most important contributor of air pollutants as it accounts for about 29% of the total weight of all pollutants. The burning of fossil fuel in thermal power plants, manufacture of sulphuric acid and fertilizers, smelting industries and other processes like electric power plants accounts for 75% of total SO₂ emission, while automobiles and cement plants contribute to the rest 25%.

SO₂ is a highly irritating gas, which adversely affects men, animals and plants etc. It is perhaps the most damaging among the various gaseous air pollutants. SO₂ this gas affects human health in various ways. It causes intense irritation, even at 2.5ppm level to eyes and respiratory tract. SO₂ is absorbed by the nasal system, leading to swelling and stimulated mucus secretion. It particularly hits severely the aged chronically ill person. Lung cancer is known to result due to raised SO₂ in the atmosphere, its inhalation causes the symptoms of bronchitis, emphysema and other lung disease. It is considered as the most serious single air pollutant causing health hazard, obstructing breathing.

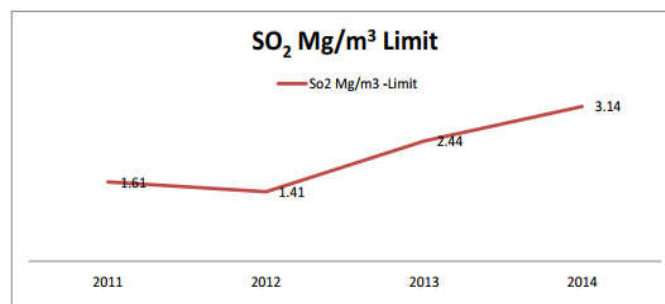


Figure 1.4: - Showing yearly proportion of Sulphur oxide (SO₂)

It is also +observed that the concentration of air pollutants such as CO of the study period year 2011 result determined the concentration of CO is the ambient air of the sampling sites varied 0.47 Mg/m³ Limit. It is observed that the concentration of CO was recorded highest in year 2013 i.e., 0.58 Mg/m³ Limit and Lowest in year 2012 i.e., 0.43 Mg/m³ Limit. Rai Priyanka, Mishra RM and Parihar Sarita in 2012 observed that the average value of CO₂ was 105.02 µg/m³. In Mahihar city, M.P, India.

Human Health Disease

As the most common route for pollutants to enter the human body is by in halation the most common effect of air pollution is damage to the respiratory system exposure to air pollutants can causing respiratory diseases (such as lung cancer, TB, asthma, bronchitis) Gastrointestinal diseases, BP, dental diseases, eye diseases skin diseases etc. may also suffer when the air is polluted. The resulting exposure to cement dust has led to impairment of respiration and a prevalence of respiratory symptoms amongst workers culminating in what has been described as a “Cement factory lung disease.” The severity of the impairment of respiratory function has been shown to depend on years of exposure.

It was observed that in yearly data collection i.e., 2011 to 2012 of the female employees of the cement plant from the above table 1.5 and figure 1.5, we conclude that in females from 2011 to 2014 the occurrence of **common disease** like (Cough, Cold, Asthma, Allergy Reaction, Eye irritation, lungs problems etc.) is increased. The percentage of **Hypertension** is increased from 2011 to 2012 i.e., 16% in 2011 and 6% in 2012, from year 2012 to 2013 is increases i.e., 6% in 2012 and 13% in 2013 and during 2013 to 2014 it is also increase i.e., 13% in 2013 and 22% in 2014. The percentage of **Diabetes** is decreases from 2011 to 2012 i.e., 16% in 2011 and no patent of diabetes in 2012, but from year 2012 to 2013 it is increased i.e., 16% in 2013 and after that it is decreased from 2013 to 2014 i.e., 16% in 2013 and 14% in 2014. The percentage of **Hyperlipidemia** is increases from 2011 to 2012 i.e., 21% in 2011 and 35% in 2012 in female employees, but from year 2012 to 2013 it is decreased i.e., 35% in 2012 and 18% in 2013, after that it is decreased from 2013 to 2014 i.e., 18% to 8%. The percentage of **Ischemic Heart Disease** is increase from 2011 to 2012 i.e., 4% in 2011 and no patent of IHD in 2012, but from year 2012 to 2013 it is increased i.e., 11% in 2013 and after that it is decreased from 2013 to 2014 i.e., 11% in 2013 and 8% in 2014. It was observed that in female employees the **Hypertension** is increased and **Diabetes, Hyperlipidemia** and **Ischemic Heart Disease** is decreased, and the **Common Disease Occurred by Cement** like (Cough, Cold T.B., Lung Problem, Allergic Reaction, Eye Irritation, asthma etc) it is constantly increases yearly in female employees, who are working in the ACC Cement Plant.

Table 1.5: - Showing annual health check-up of female employees from 2011-2014

Disease	Percentage Of The				%
	Years				
	2011	2012	2013	2014	
HYPERTENSION	16	6	13	22	15
DIABETES	16	0	16	14	13
HYPERLIPIDEMIA	21	35	18	8	17
ISCHEMIC HEART DISEASE	4	0	11	8	6
COMMON DISEASE OCCURRED BY CEMENT	43	59	42	48	49
Total	100	100	100	100	100

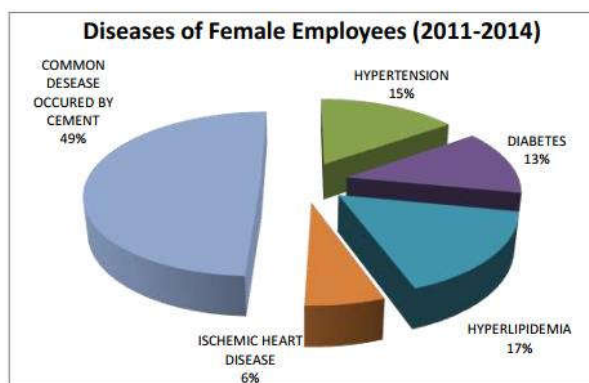


Figure 1.5: - Showing female health diseases from 2011-2014

It was observed that in yearly data collection i.e., 2011 to 2014 of the male employees of the cement plant from the table 1.6 and figure 1.6 we concluded that in males from 2011 to 2014 the occurrence of the **Common Disease Occurred by Cement** like (cough, cold, asthma, allergic reaction, eye irritation, T.B., lungs problem etc) is increases. The percentage of **Hypertension** is increases from 2011 to 2012 i.e., 12% in 2011 and 13% in 2012, it is also increase from 2012 to 2013 i.e., 13% to 14% and from year 2013 to 2014 it is also increase i.e., 14% to 20% in 2014. The percentage of **Diabetes** is increase from 2011 to 2012 i.e., 7% in 2011 and 16% in 2012, it is also increase from 2012 to 2013 i.e., 16% to 20% and from year 2013 to 2014 it is decreases i.e., 20% in 2013 and 10% in 2014. The percentage of **Hyperlipidemia** is decreases from 2011 to 2012 i.e., 31% in 2011 and 18% in 2012, from year 2012 to 2013 is also decreases i.e., 18% to 14% but in year 2013 to 2014 it is increases i.e., 14% in 2013 and 16% in 2014. The percentage of **Ischemic Heart Diseases** is increase from 2011 to 2012 i.e., 2% in 2011 and 8% in 2012. In year 2013 there is no patent of **Ischemic Heart Diseases** but in 2014 the percentage of **Ischemic Heart Diseases** is increase i.e., 6% in 2014. It was observed that in male employees the **Hypertension, Hyperlipidemia** and **Ischemic Heart Diseases** are increases. The **Diabetes** is decreases and the **Common Diseases Occurred by Cement** like (cough, cold, T.B., lung problem, Allergic reaction eye irritation, asthma etc.) it is continuously increase yearly but in 2014 it is decreases in male employees who are working in the ACC Cement Plant.

Most of the responses revealed high level of awareness of the health impacts of cement dust on human, plants and animals population within the study communities, it was clearly stated that a pattern of death occurrence involving a significant no. of those who has previously worked in factory's manual loading bay. These include ailments such as lung malfunction/impairment, chronic obstructive and restrictive lung diseases, pneumoconiosis and carcinoma of the lungs, stomach and colon, in addition to the fact that cement dust is capable of reaching all organs of body thereby affecting the different tissues such as heart, liver, spleen, bone, muscles and hairs and ultimately affecting their micro-structure and physiological performance. It was also understood that high incidence of air borne diseases are recorded within the study area.

The records of medical cases the common disease occur by cement are occur in primary level and hypotension, diabetes, hyperlipedemia and ischemic heart diseases are occur in secondary level. Medical record would only be obtained for 4 years (between 2011 to 2014) from the health centre. Although the trend occurrence of medical cases appear rather fluctuating (Rising in some years and declining in others) there ailments recorded are largely air born and have been linked to pollutants possibly arising from activities around plants as proven in other studies.

Table 1.6: -Showing annual health check-up of male employees from 2011-2014

Disease	Years				%
	2011	2012	2013	2014	
HYPERTENSION	16	6	13	22	15
DIABETES	16	0	16	14	13
HYPERLIPIDEMIA	21	35	18	8	17
ISCHEMIC HEART DISEASE	4	0	11	8	6
COMMON DISEASE OCCURRED BY CEMENT	43	59	42	48	49
Total	100	100	100	100	100

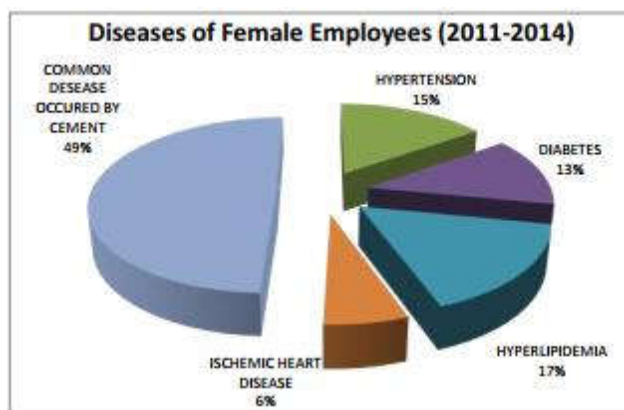


Table 1.6: - Showing annual health check-up of male employees from 2011-2014

Mitigation measures

The study has tried to evaluate the negative consequences of ACC Barmana Cement industry on the environment. The study reveals that though there have been efforts on the part of the industry to reduce their noxious impact, more still needs to be done especially in the areas of Environmental monitoring so that for example the emission of air dust enumerated earlier could be brought under control. For the point of view of an environment management practitioner, the need to significantly and painlessly reduce the volume of Carbon Dioxide emission resulting from ACC Cement plant Barmana cannot be over – emphasized considering the importance of carbon dioxide in the greenhouse gas effects in Global Warming. Considering the quantity of carbon dioxide produced per ton of cement, the use of mineral admixtures, which would otherwise, be land filled is a must for the environment and for the cement industry.

Considerable effort must also be geared toward preventing particulates from going into the atmosphere, as its effects in unpredictable in the environment, special devices to arrest and mop up particulates, should be provided. Since lots of noise would be generated as a result of the cement production and mining activities there is the need to find a way of muffing the noise and to shield the site. Moreover large volume of vehicles would be attracted to the cement factory and mining site resulting into soil surface compaction hence there is need to develop appropriate highway and widened to reduce hazards on the environment. Moreover the government, the industry progress. They can jointly be involved in monitoring Environmental resources depletion, especially the compliance level of the plant to minimum standards for sustainable and pollution free society. The government should look into the pollution contract policy and put into consideration on no occasion should any residential building be allowed for approval within 1km to any Cement factory in order to reduce the rate of inhalation harmful substances by the people.

Conclusion

It is well known fact that air pollution is hazardous to Environment and human health. Due to infrastructure developmental activities cement industry is growing and resulting in the environmental deterioration and in turn degradation of the human health worldwide. Recent studies and researches have listed the Cement industry as one of the major contributor in global warming and climate change. Literature reviewed in this study shows the clear picture of dire consequences of emissions from cement manufacturing for rapid infrastructure growth and economic development from this review it can be concluded that cement industry causes treatment harm to ecology and Human health. The main environment and health concerns identified are significant amount of fine dust and gaseous emissions. Gaseous Emissions can have major impact on surroundings and ecology resulting in deteriorated environment. The main environmental issues associated with cement production in the Study area of ACC Cement Plant Barmana, producing the emission of pollutants (PM₁₀, PM_{2.5}, SO₂, NO_x, CO₂) in the atmosphere. These air pollutants have long been associated with prevalence of various diseases in human beings. The human populations of all selected sites were surveyed for prevalence of various diseases such as common diseases occur by cement are (lung cancer, eye irritation, cough, cold, T.B., dental problem, skin diseases, asthma etc.), hypertension, diabetes, hyperlipidemia and Ischemic heart disease from the result and observation we concluded that in female employees health data 2011 – 2014 the percentage of hypertension is 15%, diabetes is 13%, hyperlipidemia is 17%, ischemic heart disease is 6% and common disease occurred by cement is 49%. Result indicated maximum female employees of selected sites suffering with common diseases occurred by Cement i.e. 49% and minimum female employees of selected sites suffering with ischemic heart disease i.e. 6%. In male employees health data 2011 – 2014 the percentage of hypertension is 16%, diabetes is 13%, hyperlipidemia is 19%, ischemic heart disease is 5% common disease occurred by cement is 47%. Result indicated maximum male employees of selected sites suffering with common disease occurred by cement i.e. 47% and minimum male employees of selected sites suffering with ischemic heart disease i.e. 5%. So we concluded that the maximum people are suffering from common disease occurred by cement and minimum people are suffering from ischemic heart disease. Whereas, Changes at the micro-climatic levels endanger human health, affecting all sections of society. The environmental consequences of climate change will affect human health directly and indirectly at local level and regional level. Addressing the effects of climate change on human health is especially challenging because both the surrounding environment and the decisions that people make influences health. The increasingly warm environment and presence of the cement and to also reduce drastically plume emissions through improved and cleaner cement production processes. Finally, it is indeed apparent that a standardized form of periodic but consistent investigation into the socioenvironmental status of the lost communities be instituted.

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