Monitoring of the Ground Water Around the Heidelberg Diamond Cement Factory, Jhansi District, Bundelkhand.

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ABSTRACT:

Jhansi is one of the important district out of the seven districts of Bundelkhand massif of Uttar Pradesh which occupies almost 70,000 sq. kilometers of the central plains in India . The district Jhansi lies in south-west portion of Jhansi division of Uttar Pradesh state of India ranging between 25^0 30' N to 25^0 57' N latitudes and 78^0 40'E to 79^0 25'E longitudes. This area come under semi arid region of Bundelkhand with low precipitation (900mm/yr) and high evaporation (1800mm/yr). So water is very much valuable resource particularly for this region. Water is the most important natural resource in the world, and having the unique property of dissolving and also it carrying as suspension with a huge variety of chemicals and hence water can easily become contaminated [3]. Water is one of the most indispensable and is the elixir of life .It is believed that ground water must possess degree of purity [2]. Both the quality and quantity of this resource is degraded due to industrialization, urbanization and landuse changing. In Jhansi, cement industry is one of the important sources of pollutant such as; cement dust, air pollution, water pollution, solid waste pollution, noise pollution, ground vibration and also resource depletion due to raw material extraction. The present investigation was determinate physico-chemical parameters of ground water quality around the Diamond Cement Industry. The aim of this paper is to determine the water quality, productivity, assess of nature or man's impact on the physico-chemistry of the ground water with a view to effective, utilization, better management, conservation by an sustainable way of exploitation of the water resources. Monthly change in physical and chemical parameters such as water temperature, turbidity, pH, hardness, amonia, iron, nitrate, magnesium, sulphate, arsenic, chromium, cadmium, copper, nickel, lead and zinc. were analyzed for a period of six months from January 2012 to June 2012. All parameters were within the permissible limits. The results indicate that the ground water show non- polluted nature and can be used mainly for domestic and irrigation purposes.

Key words: Physico-chemical parameters, Water quality, Cement industry and Bundelkhand region.

Introduction:

The cement industry is one of the oldest industries in India's developing economy as well as one of its greatest environmental polluters. The demand for cement has risen rapidly over the last 50 years with the need to upgrade urban, agricultural and community infrastructures such as roads, buildings, canals, houses, schools and dams as the part of India's economic development. Cement is considered one of the most important building materials around the world. It is mainly used for the production of concrete. Concrete is a mixture of inert mineral aggregates e.g. sand,

gravel, crushed stones, and cement. Cement consumption and production is closely related to construction activity and therefore to the general economic activity. The construction material, of the cement is fund as a geographic abundance of the main raw materials, i.e. limestone where cement is produced in virtually all countries. The widespread production is also due to the relative low price and high density of cement that limits ground transportation because of the relative high costs. India is the second largest producer of cement on the globe after China. In total, India's manufactures 251.2 million tonnes of cement per year. The cement industry in India has received a great impetus from a number of infrastructure projects taken up by the Government of India like road networks and housing facilities. While the Indian cement industry enjoys a phenomenal phase of growth, experts reveal that it is poised towards a highly prosperous future over the very recent years. The cement industry in the subcontinent is dominated by around 20 companies. These major industries plays alone account for about 70 percent of the total volume of cement produced in India. In the year 2009 alone, the Indian cement industry manufactured a total volume of 231 million tonnes .

Processing of Raw Materials

The main process steps will be discussed in Figure 1which shows the main unit Operations in the cement process.

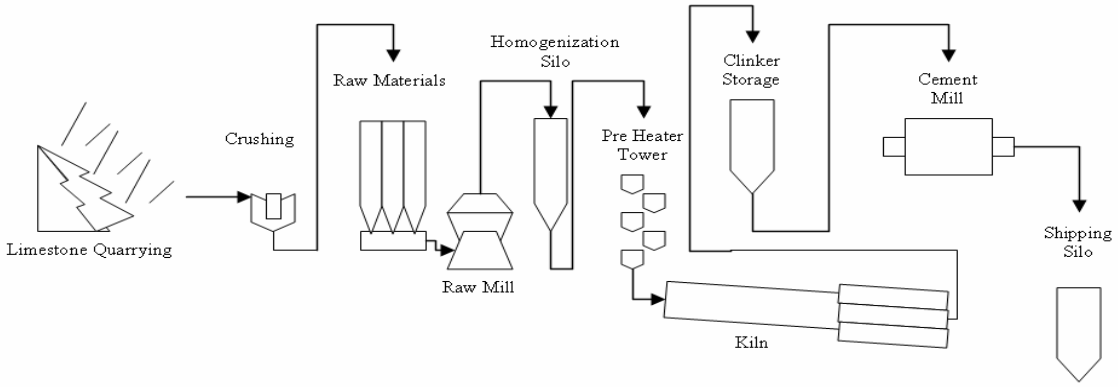

Fig 1.: Showing the General Cement Process Diagram

Limestone Quarrying and Crushing

Limestone is the most suitable source of $CaCO_3$ for cement production. Other raw materials are silica, alumina, and iron. Raw Feed consists basically of limestone; the typical limestone used in cement production has 75 to 90 per cent $CaCO_3$. The reminder is magnesium carbonate ($MgCO_3$) and impurities. Typically, cement plants are located close to the limestone source. The quarrying operations are done using the open mining process. Quarrying is done through drilling, blasting and using heavy earth moving equipment such as bulldozers and dump trucks. The quarried raw material is then transported to the cement plant using mechanical conveying equipment, such as conveyor belts. The main steps to produce crushed limestone are:

- Overburden removal – remove soil, clay, and loose material and vegetation;
- Blasting of the limestone deposit;
- Transport of the blasted limestone to the Primary Crusher; and,

- Crushing of the limestone at the Primary Crusher to reduce stone size to about 25 cm and then through the Secondary Crusher to reduce stones to approximate size of 5 to 10 cm).

The quarried limestone is normally in the form of large boulders, ranging from a few inches to several meters in diameter. These varying sizes of limestone need to be crushed to about 4 cm in order to be used in the next step for the raw feed preparation. Limestone quarrying will consume approximately 85 per cent of the total energy used in the mining process. The other 15 per cent will be consumed by the crushing process and the limestone transport system composed of a sequence of conveyor belts and dust collectors.

Impacts of Cement industries:

- **Impact on water**

Surface and ground water polluted by cement industrial effluent is a hazard to human beings, domestic animals and wildlife, and even agricultural field. The concern is the greatest at the concrete production phase. "Wash-out water with high pH is the number one environmental issue for the ready mix concrete industry," according to Richard Morris of the National Ready Mix Concrete Association. Water use varies greatly at different plants, but estimates water use at batching plants at about 500 gallons per truck per day, and the alkalinity levels of wash water can be as high as pH 12. Highly alkaline water is toxic to fish and other aquatic life .

- **Impact on Soil**

Dust produced by cement manufacturing process is considered one of the most hazardous pollutants, which affects the surrounding environment. This dust is produced as a by-product of the cement manufacturing process. It can be volatized at all manufacturing stages. From the previous finding, it could be concluded that the values of silica, potassium and calcium could be used as indication for the level of environment pollution of the area surrounding the cement factory.

- **Impact on vegetation**

The effect of Sulphur Dioxide (SO_2) on beans and tomatoes is very sever. Sulphur dioxides enter the stomata directly and the plant cells in the mesophyll. It converts to sulphite and later to sulphate. Nitrogen dioxide (NO_2) causes suppressed growth in beans and tomatoes.

- **Impact on Human beings**

There is a general consensus that industrial production and especially cement production causes a number of respiratory and cardiac diseases ranging from occupational lung diseases, asthma, lung cancer, chronic obstructive pulmonary disease (COPD), coronary artery disease, heart failure, heartrhythm problems to eye irritation. The respiratory system is sensitive to air pollution. The cardiovascular system can be affected as well. Health information reported by the Government of Canada and many other international agencies like the World Health Organization shows that air pollution from industrial production can lead to a range of respiratory and other diseases among the general population living within the range of deposition of effluent from such enterprises. The costs of this burden of illness would include lost years of life and income, health care costs, and quality of life related costs. Beyond the toll on human health, there will also be corresponding impacts on domestic animals and food production .Fresh

and clean drinking water is a basic need for all human beings on the earth, yet it has been observed that millions of people worldwide are deprived by the cement industrialization[6].
Freshwater resources all over the world are threatened not only by over exploitation and poor management but also by ecological degradation. The main source for the pollution of freshwater pollution can be attributed to discharge of untreated waste, dumping of industrial effluent, and run-off from agricultural fields. Industrial growth, urbanization and the increasing use of synthetic organic substances have serious and adverse impacts on freshwater bodies. It is a generally accepted fact that clean water is absolutely essential for healthy living. Adequate effluent water supply by the industries which countries suffer from problems of various toxic chemical discharge into the fresh water body mainly groundwater, while developing countries are facing various problems of agricultural run-off in water sources. Polluted water like chemicals in drinking water causes problem to health and leads to water-borne diseases which can be prevented by taking measures can be taken even at the household level[5].

Material Method

Study area

The Diamond Cement Industry is situated in village Madora district Jhansi of Uttar Pradesh. The distance of installation is about 16 km. From the district head quarter. Diamond cement is engaged in the production of cement. The installation was established on 1989.It was established for the utilization of fly ash which is a product by of Parichha Thermal Power Plant. This is situated near the installtion. The total area of Diamond Cement Industry is about 160 acres. The land use plan of the installation is as follows-

Table 1 : Landuse of the Installation

Plant facilities	37.75 Hectare
Railway siding	4.60 Hectare
Green belt designing	20.95 Hectare
Vacant land	6.70 Hectare
Total	**70 Hectare**

Source: EIA studies Diamond Cement Industry.

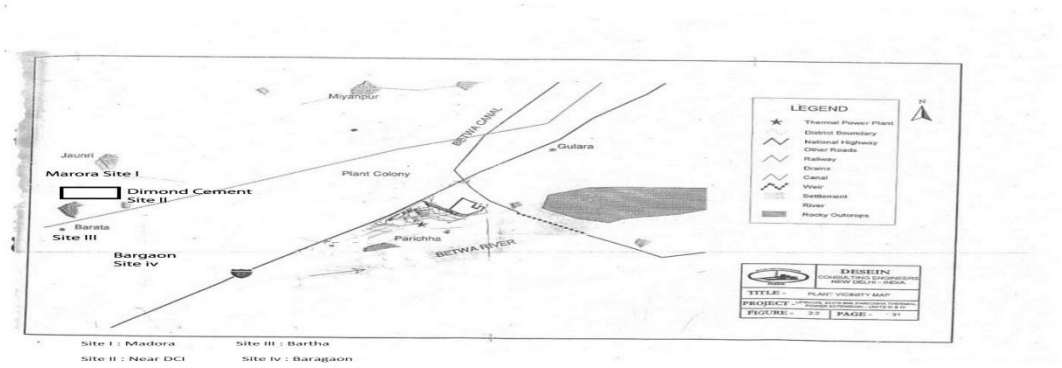

fig. 2: Location of the study area and their water sampling sites.

Location of the study area and their Sampling sites:

- S1-Madora (hand-pump)
- S2- Near cement industry(hand-pump)
- S3 -Near cement industry (well)
- S4 -Barata (hand-pump)
- S5- Baragaon (hand-pump)
- S6- Madora(pond)
- S7 -Madora,near cement industry(well)

Figure-3 : Sample 3 Near diamond cement industry (well)

Figure -4: Sample 6 area Madora (pond)

Analytical design:

Physical and chemical properties of water have been done according to standard methods (APHA, 2005)[1].

Result and Discussion:

The physico-chemical characteristics provide a fair idea of the water quality in any water body. The result of the physico-chemical characteristics of Ground water are summarized in Table-2 and discussed below.

pH is most important parameter for aquatic life .In ground water pH was recorded range from 7.30-8.28.Hardness is a measure of calcium and magnesium concentration ,it was recorded in range from 210-580 mg/l. Sulphate was recorded range from 39-430 mg/l. Nitrate levels in drinking water for humans and livestock are a major concern. In present study nitrate was recorded range from 10-45mg/l.Chloride was recorded range from 88.6 -354 mg/l. Fluoride and Ammonia was recorded range from .6-1.5 mg/l and 1-1.2 mg/l.

Table -2: Water Quality Around the Cement Industry.

SITES → / Parameter ↓	S1(M,H,P,)	S2(N,C,H.P)	S3(N,C,W)	S4(B,H,P)	S5(B,G,H,P)	S6(H,P)	S7(M,W)
Calcium (Ca)	157 mg/l	402 mg/l	271 mg/l	174 mg/l	154 mg/l	200 mg/l	137 mg/l
Magnesium(Mg)	63 mg/l	117 mg/l	89 mg/l	126 mg/l	150 mg/l	159 mg/l	130 mg/l
Sulphate (So4)	55 mg/l	288 mg/l	270 mg/l	39 mg/l	44 mg/l	430 mg/l	430 mg/l
Arsenic (As)	-	.087 ppm	.0688 ppm	-	-	0403 ppm	-
Chromium (Cr)	.0029 ppm	.0401 ppm	.011 ppm	.001 ppm	.002 ppm	.01 ppm	.006
Cadmium (Cd)	-	.007 ppm	.005 ppm	-	-	.0014 ppm	-
Copper (Cu)	-	.83 ppm	.788 ppm	-	-	.0516 ppm	-
Nickel (Ni)	-	.03 ppm	.006 ppm	-	-	.07054 ppm	-
Lead (Pb)	-	.001ppm	.0067	-	-	.001 ppm	-
Zinc (Zn)	-	.093	.0355	-	-	.002 ppm	-
Turbidity	<10	<10	10	<10	<10	10	<10
pH	7.56 mg/L	8.28 mg/L	7.72 mg/L	7.52m	7.50mg/L	7.30 mg/L	7.50 mg/L

Hardness	220 mg/L	580 mg/L	360 mg/L	400 mg/L	320 mg/L	315 mg/L	210 mg/L
Ammonia	1.2 mg/L	Nil mg/L	Nil mg/L	<1.0 mg/L	Nil mg/L	Nil mg/L	Nil mg/L
Iron	20.3 mg/L	0.3-1.0	<0.3 mg/L	<0.3 mg/L	<0.3 mg/l	1.0 mg/L	<0.3 mg/L
Nitrate	Nil mg/L	10-45 mg/L	Nil mg/L	Nil mg/L	Nil mg/l	Nil mg/L	Nil mg/L
Chloride	354.3 mg/L	106.3 mg/L	106.3 mg/L	152.4 mg/L	88.6mg/l	324.2mg/l	106.3mg/l
Fluoride	<0.6 mg/L	0.6-1.5	<0.6 mg/L	<0.6 mg/l	<0.6mg/l	1.5mg/l	<0.6mg/l
Coliform	Yes	Yes	Yes	yes	no	yes	No
COD	59.89 mg/L	67.4 mg/L	131.8 mg/L	38.5mg/l	44.7mg/l	94.5mg/l	74.6mg/l

Conclusions

This area comes under semi-arid region of Bundelkhand with low precipitation (900 mm/yr) and higher evaporation (1800 mm/yr). Therefore, ground water is ccur in small quantity and their ground water table goes down during summer month (mid April to June). Ground water is mostly taken out in excess quantity from wells, tube-well and pumps[4].

The temperature of all the seven sites was found to be progressively increases with the advancement of summer season. With the increase in temperature of air, there was automatically corresponding increase in water temperature. Chloride was not much significant mostly in all the sites except in site –V was little bit dominant in chloride concentration. The increase hardness f the ground water progressively from January to June. Nitrate was dominant at site-II which can be attributed due to high rate of decomposition and also anthropogenic activities in mines and agricultural sites.

The maximum COD in site-III is recorded which compare than other sites. The maximum fluoride concentration was recorded at site-III and also all heavy metals was found within range.

Thus it may be concluded that ground and surface water is slightly polluted and their main source of pollutions specially washing of raw material in cement Industry and also some anthropogenic activity.

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