



Impact of Stone Crushing Industries on Quality of Surface and Groundwater

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Abstract- Water is essential constituent of life supports systems. Nobody can live or even dream to stay without water. Maximum of our water bodies have become polluted because of industrial growth; urbanization and man-made issues specifically the result of population growth. Detection of unhygienic impurities in water is one of the important issues of human society. The detection of impurity in water isn't only critical for consuming water but also for water in commercial use. The form of impurity to be detected varies with the version of using water. The mining and stone crushing activities have great effects on the surroundings quality and human fitness. The dust emissions contaminate the air and water. Results on water analysis show decline in DO and excessive values of overall hardness, calcium, magnesium, chloride, overall solids and total dissolved solids. Stone crushing and associated activities particularly make a contribution to surrounding environment. Suspended solids are materials that aren't completely soluble in water and are present as particles. Those particles usually impart a visible turbidity to the water. Dissolved and suspended solids are present in maximum surface water.

Index Terms: Water Quality, Dust, Dust fall, Crushing Industries, Dust Pollution Control.

1. INTRODUCTION

Water is the maximum useful resources and ample compound on the planet's surface, masking greater than 70 percent of the planet.^[1] More than 70% of the fresh water in liquid form of our country is transformed into not worthy for consumption. Not only India, but different countries also affected by the equal hassle.^[2] on the average a person desires around 150-250 gallons of water each day. Even greater water is used by industries to generate energy, manufacture matters, and delivery human goods.^[1] Food and agriculture are the biggest customers of water, requiring a hundred times extra than we use for personal wishes. As much as 70% of the water we take from rivers and groundwater goes into irrigation, approximately 10% is used in domestic applications and 20% in industry. Currently, about 3600 km³ of freshwater of freshwater are withdrawn for human use. A few vital metallic and non-metallic impurities located in water may be summarized in in the table.

Table: Chemical characteristics of water

r.no.	Name of substances	Permissible limit (mg/l)
1	Iron	0.3
2	Copper	0.05
3	Lead	0.05
4	Fluoride	1
5	Arsenic	0.05
6	Mercury	0.001
7	Manganese	0.1
8	Aluminium	0.03
9	Zinc	5
10	Nitrite	3

Source: https://www.researchgate.net/figure/Permissible-limits-of-heavy-metals-in-drinking-water-63_tbl1_315786309

Stone crushing enterprises is an crucial industrial quarter engaged in producing crushed stone of diverse sizes relying upon the requirement which acts as raw fabric for diverse production activities including creation of roads, highways, bridges, buildings, and canals etc.^[3] It is counted that there are over 12,000 stone crusher units in India.^[4] These stone crushers even though socio-economically an crucial area, provide rise to significant quantity of exceptional fugitive dust emissions which create health hazards. However, like many other man-made activities, quarrying activities cause extensive impact at the environment.^[5] The enterprise, regrettably discharge dust that settles not only on land, vegetation and tress but also on surface waters used for consuming and different domestic chores through the community.^[6] The mineral content of cement dirt slows down plants growth rate while the alkalinity and mineral content material of dusts increases water pH.^[7]

Dust and other small air borne contaminants can change the pH degree tons for the equal motive as rocks and soil. Fine particles may incorporate chemical or natural compounds that after dissolved in water can rework into mild acids or compounds with alkaline properties. Turbidity of water is one of important results at the quality and aquatic environment both in terms of consuming and in phrases of aquatic ecosystem. Turbidity can be arisen from, or a booster of microbiologic contaminates.^[8] Sulphide minerals found in excavated rocks which are present in massive portions interact with oxygen and water to form acids. Because of those acids in water the pH of water is decreased and because it flows it dissolves an increasing number of metals in it ensuing in a very poisonous and low pH water. Evidently occurring heavy metals like Co, As, Cd, Hg, Cu, Pb, Zn and so on, are contained within the rock can also leach out and get carried downstream by water.^[9]

2. LITERATURE REVIEW

The quality of any surface or ground water body is a function of either or both natural affects and human activities. Without human impacts, water high-quality could be determined via the weathering of bedrock minerals, atmospheric strategies, deposition of dust and salt by means of wind, natural leaching of natural remember and nutrients from soil. As a result, water in the natural environment consists of many dissolved materials and non-dissolved particulate matter. Dissolved salts and minerals are important components of excellent nice water as they assist to maintain the fitness and power of the organisms that depend on (Stark et al., 2000). Water also can incorporate substances which might be dangerous to lifestyles. These include metals which include mercury, lead and cadmium, pesticides, natural pollutants and radioactive contaminants. Water from natural assets almost carries residing organisms which can be fundamental components of the biogeochemical cycles in aquatic ecosystems. But, a number of those, especially micro-organism, protists, parasitic worms, fungi and viruses, may be harmful to people if present in consuming water.^[11]

Surface mining operations present dynamic and quite variable silica dust sources. Dust particles underneath 10µm are known as respirable dusts and are commonly airborne(Farmer,1999). This cement production procedure generates lot of dust, which is captured and recycled to the technique (Partha,2008). Cement dusts are poisonous; sometimes containing chromium which is carcinogenic (Fabbri et al.,2002). The mineral content of cement dusts increases water pH. Mines and other operations that contain the excavation of massive quantities of rock (Ex. Highway construction) have the capability to create critical environment damage. The publicity of rock that has formerly not been uncovered to air and water can lead to oxidation of sulphide-bearing minerals, this kind of pyrite (FeS₂), within the rock. The combination of pyrite, Water, Oxygen, And a unique kind of bacteria (Acidithiobacillus ferrooxidase) that prospers in acidic situations leads to the era of acidity, in some instances to pH less than 2. Water that acidic is hazardous by way of itself, but the low pH additionally has the property of increasing the solubility of positive heavy metals. The water that is generated with aid of this manner is referred to as acid rock drainage (ARD).

The presence of dust inside the air is extra perilous for human fitness than ozone and different pollutants consisting of carbon monoxide. The chemical constituting factors of the dust are various which include Nitrate, Sulphate, organic and elemental carbon, organic compounds (multi-cycle aromatic hydro carbons), organic and steel compounds like (iron, copper, nickel, zinc and vanadium). (Kim et al., 2015). Along with the growing of deserts levels the water sources grow to be more restrictive, in order that the manage and preserving of them matters more. An important impact of the dust may additionally be the high-quality of surface water assets being in danger. Air pollutants may also be transferred into water sources in different approaches such as dissolving in rain droplets or sedimentation of suspended debris in surface waters. In every other research, the impact of the dirt on red sea changed into studied and it became shown that dirt phenomenon reasons air coolness in addition to heating of the water after absorbing of the sun's energy. (brindley 2015) Limestone dust might also affect the optical properties of leaves. Utility of various white dusts has been investigated for the motive of reducing the transpiration/photosynthesis ratio of vegetation through the manner of increasing their albedo (Serginer, 1967; Abou Khaled et al., 1970).

3. METHODOLOGY

The study area for water quality test is the southernmost part of Pune. Study was conducted in four different locations which are situated near Yewalewadi. Yewalewadi is around 7-8 Km from Katraj next Khadi machine chowk. The study stations were divided in four parts as follows:

- A. Station No.1: Khadi Machine Chowk
- B. Station No. 2: ISKCON Temple
- C. Station No. 3: East Yewalewadi
- D. Station No. 4: TAE College Campus

All the chosen stations were used to achieve samples of surface water and groundwater. List of water sampling is as shown in table no.1

Table 1: Sample of water in study area

Study Station No	Area	Samples Collected	
		Groundwater	Surface water
1	Khadi machine chowk	3	NIL
2	ISKCON Temple	3	1
3	East Yewalewadi	1	2
4	TAE College Campus	1	2
Total Number of Samples Collected		8	5

To study distinct water parameters, 13 sampling places have been decided on within four study stations. Eight sampling places were of ground water sources and the last five sampling places had been representing surface water. The resources of groundwater in the selected study region are artificial wells having massive openings. The massive round rim of wells works as a large jar which lets in the access of huge or huge dust fall within the well. The dust falling through the huge mouth of well is liable for contamination of ground water for a few existent.

The natural and artificial lakes in the region being examined are the sources of surface water and groundwater. The naturally formed lakes with a large surface open to the sky receive from all directions the great fall of dust. In natural lakes the water stage suffers from annual rainfall. Station 2 has one lake which was formed naturally, i.e. St.2 Sw.1 (2 Surface Water Station 1) in Katraj. Lake St.2 Sw.1 lies the longest distance from the crushing unit of stone. Station 3 has two lakes, one of them is naturally formed (i.e. lake St.3 Sw.2) and one other is an artificial lake (i.e. lake St.3 Sw.3). St.3 Sw.3 Water is greenish in coloration. It is far away in the east direction of Yewalewadi, at a distance of one km. Crushing units torment himself. Compared with the remaining stations, the dust fall charge in this region is maximum.

Two lakes present at “Station four” do occupy a huge catchment area accompanied by hilly region. A supply of groundwater i.e. lake St.4 Sw.4 (Station 4 Surface water 4) is an artificial lake form because of quarrying activities. The breaking of parental rock at the bottom of the hill formed lake St.4 Sw.4 that is the source of groundwater. The water percolates from rock cuts and lake St.4 sw.4 is being recharged. The water of lake St.4 Sw.4 is transported with the aid of tankers to fulfil the water demand of neighboring society. Lake St.4 Sw.5 is formed by way of large catchment area which is supply of surface water. It's far adjacent and nearest supply of surface water to the crushing unit.

Determination of water quality

Water quality describes the water situation, which includes chemical, physical and biological characteristics, normally recognizing its suitability for specific purposes such as consumption or swimming. The water quality of surface water and groundwater were decided via experimentation. Several parameters such as pH, electrical conductivity, turbidity, alkalinity, total hardness and chloride of surface water and groundwater were examined time to time.

Determination of PH

pH is a measurement of hydrogen ions concentration in water. The pH scale generally levels from 0 to 14. Aqueous solution at 25°C with pH less than 7 are acidic, while those with a pH greater than 7 are basic or alkaline. It is the most common method used to decide the quality of water. Value of pH indicates variation with change in temperature of water. pH is decided by way of checking out the sample with pH indicator.

Determination of Electrical conductivity

Electric current is the flow of electrons through a material, and electric conductivity is the potential of electrical current to flow through an aqueous solution. It takes place because of dissolved ions in water. It is affected by temperature and shows higher value for increase in temperature. It could be measured in micro-ohms/cm². Electrical conductivity of surface water and groundwater have been decided by an electric conductivity meter.

Determination of Turbidity

Turbidity is the cloudiness or haziness of fluid due to the enormous number of individual particles that are usually invisible to the naked eye, just like smoke in the air. Turbidity calculation is a primary water quality test. Turbidity is nothing but the presence of soil or clay inside the water. Turbidity is measured in NTU i.e. Nephelometric turbidity unit. It is additionally expressed in JTU (Jackson Turbidity Unit). Higher value of turbidity indicates the higher content material of soil or clay material is present inside the water. Turbidity of water samples have been obtained by Nephelometer.

Determination of Alkalinity

It is the important chemical property of water to be examined to decide the water quality. Alkalinity is a measure of the water's capability to neutralize the acidity. An alkalinity check tests the levels of bicarbonates, carbonates, and hydroxides in water and control results are usually represented as "ppm of calcium carbonate (CaCO₃). The acceptable variety for irrigation is 0 to 100 ppm calcium carbonate.

Determination of Hardness

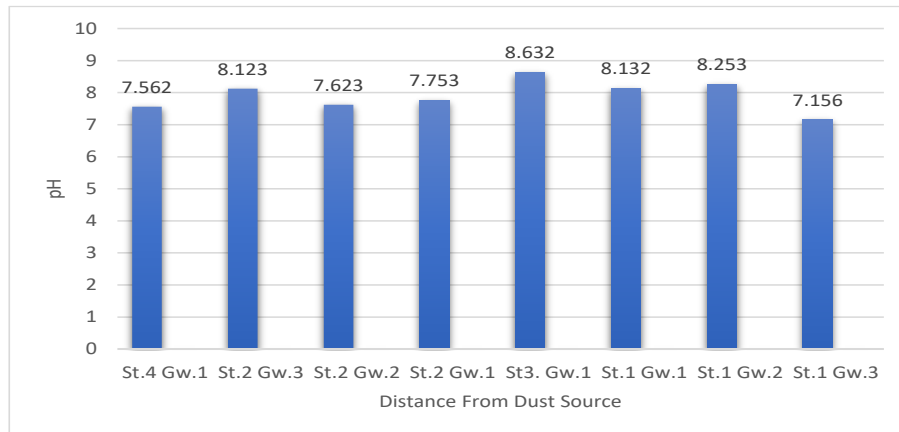
The two most important cations that cause water hardness are Calcium (Ca²⁺) and Magnesium (Mg²⁺). It is the important property of water which determines the water in terms of soft and hard water. The softness and hardness of water affects the desired intake of water in case of the usage of soap or detergent for laundry clothes. It is able to be expressed as CaCO₃ per mg/L.

4. RESULTS AND DISCUSSION

Dust Pollution effect on pH

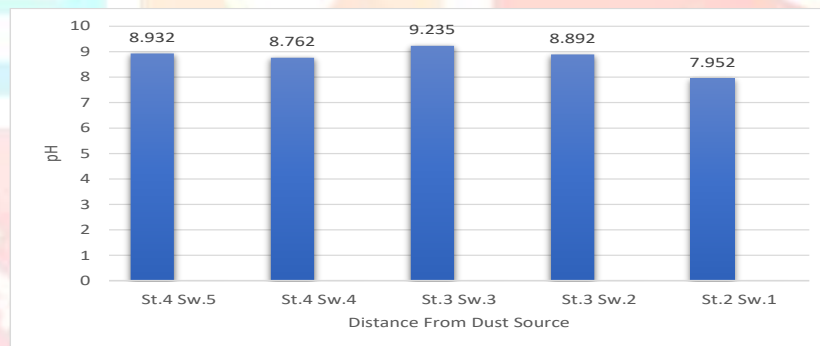
We recorded pH sampling from different stations. We observed that effect of dust on pH is less because, the source of ground water is located far away from the crushing unit. The pH value of groundwater is slightly reduced from St.4 Gw.1 to St.2 Gw.1 as shown in figure.1. St.3 Sw.1 has maximum value as Station 3 is under the effect of crushing activities. The pH value recorded for source of groundwater has exceeded pH limit. As per guidelines given by the WHO it should lie between 6-8.5.

Graph No.-01



The variations discovered were unpredictable when reading of pH taken on surface water. As the gap in surface water supplies increased from stone crushing industries, the reported pH value had shown upward thrust and fall on graph as shown in Figure 2. Lake St.4 Sw.5 has a large area of surface near crushing unit. The pH value is higher, showing the effect of falling dust on the field. The pH of the St.4 Sw.4 lake is much less than that of the St.4 Sw.5 lake because it is a good source of groundwater which supplied the specified demand for water for the neighboring society. The pH recorded for the St.3 Sw.3 is the highest of all readings. The higher pH value indicates the greater impact of falling dust on this region. Lake St.2 Sw.1 is located at the longest distance from the crushing unit, and has therefore been reported as lower pH value.

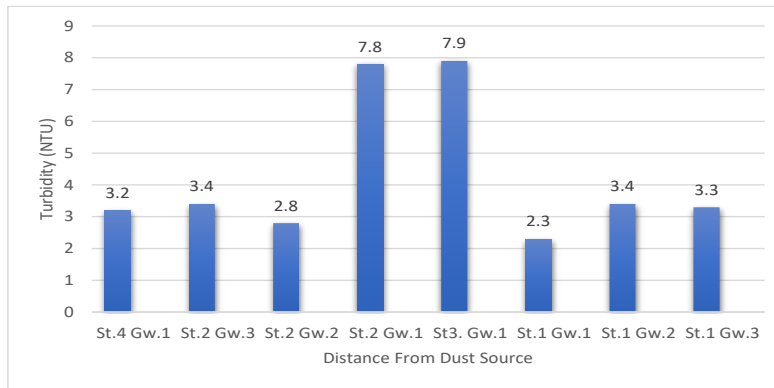
Graph No.-02



Dust pollution effect on Turbidity

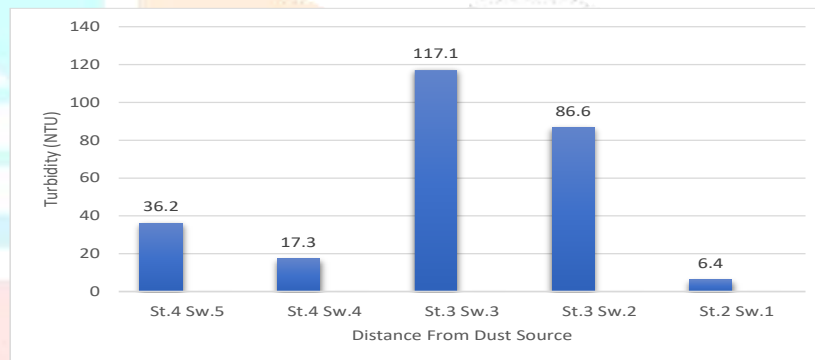
Water turbidity is obtained via Nephelometer and the maximum value for station 3 is given. Turbidity of St.4 Gw.1, St.2 Gw.3, St.2 Gw.2 became almost fairly similar. Groundwater turbidity is shown in Figure.3 which indicated increased or highest turbidity for St.2 Gw.1 because any other water sources present in the area recharge the properly. Water arriving at station 3 properly St.3 Gw.1 is below the impact of two crushing zones, one is within the South Trinity College and other within the North Trinity College, which results in significantly noticeable increases in the turbidity received from the location samples.

Graph No.-03



Determining surface water turbidity is a crucial task in finding the effect of dust dropping on surface water. After a certain period of time, dust fall attention in surface water no longer goes through dilution procedure which increases water turbidity. For some stations, as shown in Figure.4, the turbidity of surface water acquired from look at region became unpredictable. The turbidity recorded from crushing unit for lake St.4 Sw.5 has grown since it occupies the nearest affected area. The highest value of turbidity for lake St.3 Sw.3 has been reported which shows he effect of crushing units.

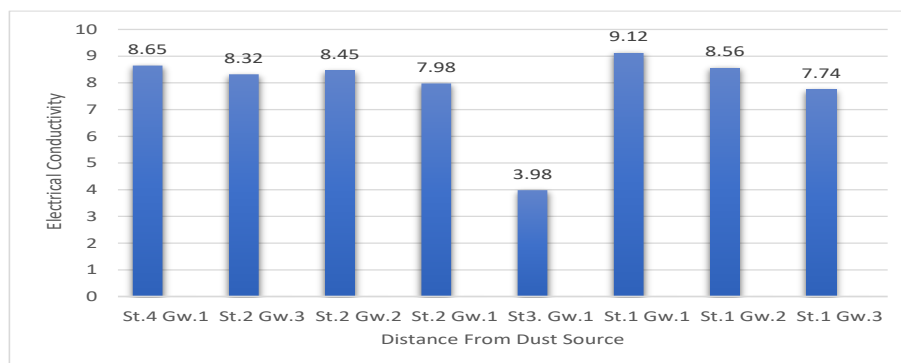
Graph No.-04



Dust pollution effect on Electrical Conductivity

As the distance of groundwater sources from the crushing device increased, the electrical conductivity of ground water samples is found to be decreasing. It is shown in figure.5. The electrical conductivity is dependent upon the concentration of dissolved ions present in water. St.3 GW.1 is markedly influenced by the falling dust which includes different metals. The amount of ion contained in water is higher, the electric conductivity value is higher. However, when the percentage of these ions increases above the limit, their charges cancel each other and electrical conductivity collapse again, as is observed for sample St.3 Gw.1

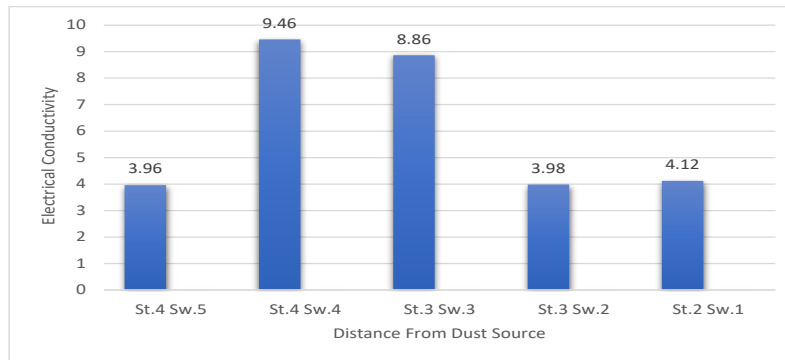
Graph No.-05



The electrical conductivity of lake St.4 Sw.4 surface water had shown the highest value because percolated water recharges the lake. It is a groundwater supply with salts hence the discovered electrical conductivity is greater. The higher percentage of

dust fall over lake St.4 Sw.5 and lake St.3 Sw.3 reduced the percentage of free ions and therefore the electrical conductivity had a distinctly low reading as the distance from the crushing unit's expanded surface water source is shown in figure 6

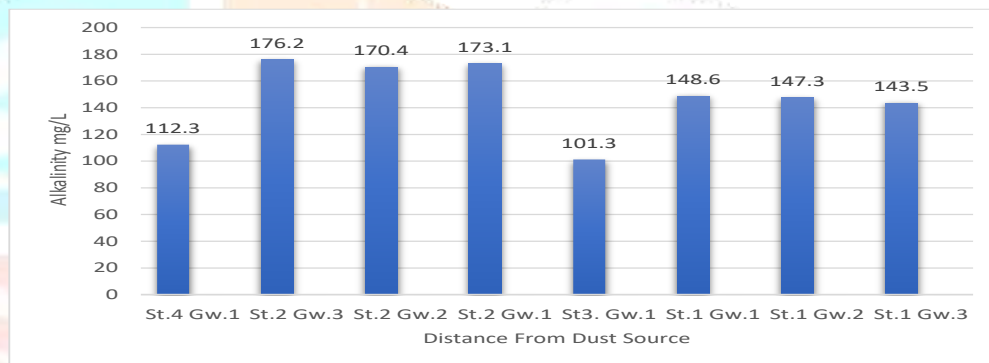
Graph No.-06



Dust Pollution effect on Alkalinity

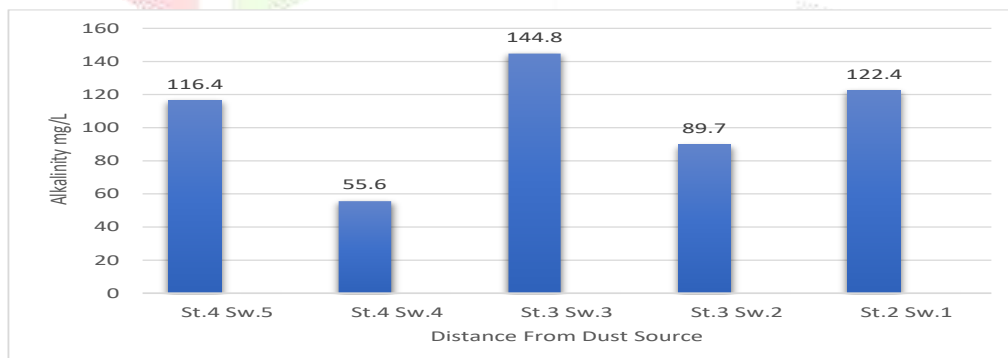
Total alkalinity of groundwater resources as shown in figure 7 was recorded within HDL.

Graph No.-07



In the examination region, overall alkalinity of surface water sources decreases for St.4 Sw.5 as the water is accumulated from a water percolation supply. For lake St.3 Sw.2 and St.3 Sw.4, total alkalinity once again increases as it has been impacted with the support of neighboring stone crushing zones.

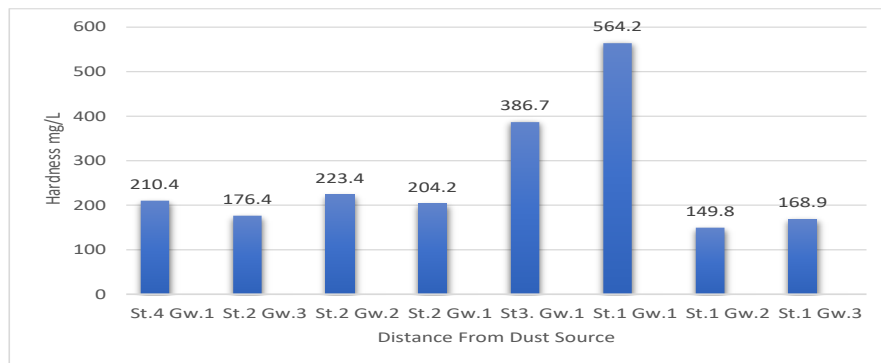
Graph No.-08



Dust pollution effect on Hardness

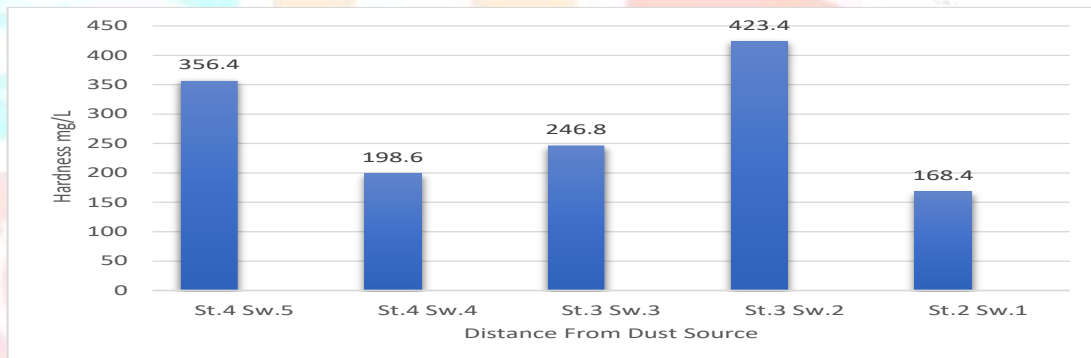
As the distance of groundwater source from the stone crushing unit St.2 Gw.1 increases, the total hardness for groundwater decreased. The hardness test listed all groundwater samples as hard water, as the average hardness value surpassed normal limits. The total durability obtained for St.1 Gw.1 was changed to a maximum hardness value as shown in the figure 9.

GraphNo.-09



The greater percentage of lake St.4 Sw.5 overall hardness proved the impact of dustfall on surface water supplies. The value of lake St.4 Sw.4 overall hardness is less than average, because it is a source of fresh groundwater. HDL was crossed by the hardness recorded for St.3 Sw.3 and is therefore called a source of very hard water present within the two stone crushing zone impact. Figure 10 shows the effect of dust fall on the hardness of surface water.

Graph No.-10



5. CONCLUSION

The loss of quality of water is said to indicate water deviations standard limits parameters from its use.

- 1) The pH of the water bodies was higher than the Standard limits (6-8.5 recommended by the WHO.)
- 2) Station 3 turbidity was estimated at 117.1 NTU for Surface water that is much larger than HDL (5 NTU)
- 3) Electrical conductivity was greater for all the study stations As the MPL.
- 4) The water samples studied were found from all lakes be as hard as HDL crossed.

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