ISSN: 2277-9655
Scientific Journal Impact Factor: 3.449
(ISRA), Impact Factor: 1.852

IJESRT

INTERNATIONAL JOURNAL OF ENGINEERING SCIENCES & RESEARCH TECHNOLOGY

Effect of Refuse Dump on Underground Water Quality

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Abstracts

The major source of water in EMENE, the study area is rain, streams and well water. Waste management has been a problem in Nigeria and so many developing nations. Most organic pollutant and pollute our underground waters. In this research, three wells were reported polluted in the compound of Adedoyin school of preliminary studies, this research was carried out to know if pollution was as a result of a dump site found inside the compound. Well B was more closer to the dump site, followed by Well C and Well A. The parameters analysed are: Turbidity, PH, electrical conductivity, Nitrate, sulphate, iron, calcium, chloride, coliform, total solids, magnesium, E-coli and Total dissolve solids. The results showed that the wells were actually polluted but most of the parameters fell within the permissible and desirable limit of WHO & NSDWQ. Coliform test exceeded the limits in all the three wells sampled with maximum value of 300per 100ml, 110per 100ml and 130 per 100ml for well A, B, C respectively. Well B showed a greater degree of pollutants within the days of sampling. Mathematical model performed showed that Well B also gave a better R value for most of the parameters..

Keywords: *coliform, sampling, WHO,NSDWQ*.

Introduction

The essence of water to humanity cannot be overemphasized. Solid wastes pose a threat to groundwater quality through the formation of polluting liquids known as leachates.

These form as water percolates through the waste, dissolving soluble compounds and the degradation products of chemical and biochemical reactions that take place in the waste. Domestic solid waste gives rise to a very polluting leachate. It decomposes under anaerobic conditions after a brief aerobic stage of a few months; a final stage leads to the production of methane, by which time the polluting strength of the leachate is reduced. The entire decomposition process can take decades, the rate being very much a function of the amount of water that can gain access to the waste.

Most activities of human being includes dumping of refuses near our wells, rivers and waterbodies. Most landfills are so close to our source of water. The importance of this research is to study the effect of some of this activities of human being on the qualities of our underground water. Refuse after degradation goes into our underground water polluting the water itself.

The exponential growth of the petrochemical and pharmaceutical industries in the 1950s introduced a wide range of complex organic wastes into the urban environment. A serious risk to groundwater quality has arisen from accidental spills or leaks from tanks and pipelines of petroleum products, phenols and chlorinated hydrocarbons. Some of these substances are soluble in water but many are only slightly soluble. The latter are referred to as non-aqueous phase liquids (or NAPLs) and they are divided into light and dense NAPLs according to whether they are less or more dense than water. Light NAPLs are mainly petroleum products and the dense variety include the chlorinated hydrocarbons widely used as industrial solvents. The concentration of these compounds allowed in drinking water is in the parts per billion range. Many are sufficiently soluble to make it possible to exceed these very low limits.

Environmental protection and rational use of natural resources and other industrial raw materials has become an important sphere of mankind's advancement in the 20th century. Mankind's demand for resources and raw materials has intensified the ecological and economic contradictions in the industries (Sen and Chakraborty, 2009). This wide spread industrialization in urban areas has drastically reduced land area for waste disposal. Disposal of untreated industrial and domestic wastes into the environment affects both soil and ground water quality. Soil and streams have been used for multifarious purposes including waste disposal. Our careless dumping of wastes has affected these precious

ISSN: 2277-9655
Scientific Journal Impact Factor: 3.449
(ISRA), Impact Factor: 1.852

resources (Quazilbash et al., 2006).

Actuality of ecological problems is emphasized by mankind's growing concern for the damage caused to the environment. The main aspect of this concern is linked with the preservation of living being on our planet (Kolomaznik et al., 2008). The industrial effluents consist of organic compounds along with inorganic complexes and other non biodegradable substances. These pollutants not only alter the quality of ground water and soil but also pose serious problems (Karthikeyan et al., 2010).

Environmental pollution has become a major concern of developing countries in the last few decades. There is a growing sense of global urgency regarding the pollution of our environment by an array of chemicals used in various activities (Palaniappan et al., 2009). Pollution of water and soils by heavy metals is an emerging problem in urbo industrialized countries. Since the advent of development through mining and smelting, metallurgical industries, sewage, warfare, and tanning the survival of plants and animals are much affected (Xi et al., 2009).

Soil, water and biodiversity are fundamental elements of ecosystem and are the subject of many agrarian, ecological, biological and hydrological studies. A high percentage of ecosystems consist of arable land which is treated with agrochemical products forms the upper layer of the soil. Large quantities of chemical elements infiltrate the water running off of the cultivated soils thereby entering the animal and human food chain (Nolten et al., 2005).

The quality of life on earth is inextractably linked to overall quality in the environment. Currently there are two fundamental pollution related problems, the disposal of large quantities of wastes that are continually being produced and the removal of toxic compounds that have been accumulating at dump sites in the soils and in water system over the last few decades (Hsua et al., 2006).

Research problem

One of the sources of water in enugu metropolis is duged well. Most of this source have been polluted due to non-point source pollutants. Most activities of the well users even help in polluting the water in which they took living from. It is therefore important to conduct a research that will help us to know if refuse dumps near well actually contribute to the pollution of the waters in them.

Research objectives

1. To determine the effect of refuse dump on the underground water quality.
2. To determine the effect of distance of dump sites on the polluting rate.

Limitation

The research is capital intensive due to high cost of the various reagents used for the determination of the parameters.

Results and discussions

This section examines and interprets the results obtained from the laboratory analysis from water lab. Of Enugu state ministry of water resources; the analysis was done to ascertain the physical, chemical and biological characteristics of the well water collected from the study area. Most of the parameters fell within the standards compared with (WHO & NSDWQ) . The results of the analysis was presented in tabular form in the appendix of this work according to the days of sample. The samples were represented with A,B,C, well B is closer to the Dump sites followed by C and A. the distance from the Dump site of the study area was equally measured to know if distance has a correlation with the pollutant.

Turbidity

Turbidity occurs in water as a result of substances like silt, clay, colloidal and organic matter. This always occurs in surface waters during dry season. Underground waters are always clean unless when they are polluted. The result carried out on the three wells showed that the wells are polluted. Graph of fig 4.1 showed that on day 3 of the sample period, all the well fell above the turbidty standard for both limits(WHO & NSDWQ), all other days 1,2,4,5,6,7,8 the samples recorded pollutant amounts that are within the standard limits. Temperature was a major cause for the high value recorded on the day 3 of the sample period. The maximum Turbidity level was at well A, followed by C and well B respectively. The minimum and maximum Turbidity level are 6.83NTU for well A and 1NTU for virtualy all the wells sampled.

P.H variations

Since P.H is a measure of the degree of acidity or alkalinity of a sample of water, results showed that the P.H value for all the wells fluctuated within the days of sample. All the wells showed a value that is acidic but is still within the limits (WHO & NSDWQ), it could be seen from fig 4.2 below that well B which is closer to

ISSN: 2277-9655
Scientific Journal Impact Factor: 3.449
(ISRA), Impact Factor: 1.852

the dump site has the maximum and minimum value of 6.67 and 5.25, well A has a value of 6.89 and 5.34 and well B 6.67 and 5.25 as its maximum and minimum values respectively. Although the results above does not show a strong indication that the wells closer to dump site are likely more polluted, The mathematical modeling of the parameters showed that well B which is closer to the dump site gave a better R value of 0.74 against well A and C which has 0.70 and 0.62 respectively when regressed against the days of sample.

Electrical conductivity

The result of the samples gotten from the three wells showed that the electrical conductivity values fell within the standard limit of 1000microhms/cm for both WHO & NSDWQ. It could be depicted from the graph of fig 4.3 that well B which is more closer to the dump site is more polluted with a maximum value of 171.7microhms/cm followed by well C of 155.7microhms/cm.

Alkalinty

It could depicted from the graph of fig 4.4 below that all the sample fell within the limit of 100mg/l $CaCO_3$ (WHO & NSDWQ). Well B is more polluted followed by well C and well A. well B,C,A has the maximum and minimum alkalinity value as 18 mg/l $CaCO_3$, 16 mg/l $CaCO_3$, 11 mg/l $CaCO_3$ and 10 mg/l $CaCO_3$, 6 mg/l $CaCO_3$, 6 mg/l $CaCO_3$ respectively.

Total solids

Total solids is amount of residue remaining when a sample of water is evaporated. Although fig 4.5 shows that well C has the highest value of 125mg/l, it can also be depicted that well B which is more closer to the dump site maintained an appreciable rise. Also well B gave a better R value 0.13 against well C which an R value of 0.12. this shows that as the days of sample increases, the amount of organic pollutants in well B will be found more than others. The results of total soilds in well C ranges from 48.94mg/l – 125.58mg/l while well B values ranges from 66.04 mg/l – 107.86mg/l. all the results fell within the desirable and permissible limit of 1000mg/l (WHO &NSDWQ).

Calcium concentration

Chemical analysis result obtained shows that well C has the highness amount of calcium concentrations of 6.8mg/l in it although this is within the desirable and permissible limit of 50mg/l. these high value of calcium pollutant in well C was as a result of its closeness to the dump site, the study area has a kitchen within the compound and most of the waste generated are mostly food items which always has salt in it. the values of calcium concentration in well ranges from 2.4mg/l – 8.0mg/l followed by well B of 2.4mg/l- 6.4mg/l. figure 4.6 shows a trend that satisfies the truth that although Well C has the highes t calcium content, Well B is often polluted more than all the wells sampled because of its closeness to the dumpsite. The values varied with a fluctuating temperature.

Magnesium concentration

Result of magnesium concentration showed that the values of all the wells ranges from 0.3mg/l -0.6mg/l. well B is more likely to be polluted from the graph of fig 4.7. all the samples collected from the wells fell within the standard limit of 50mg/l (WHO & NSDWQ) for magnesium concentration.

Total hardness

With the permissible and desirable value for total hardness , results obtained from well A, B, C shows that all they all fell within the limit of 100-200mg/l(WHO) and 150mg/l(NSDWQ). Well B has the repeated value of high total hardness.

Iron concentration

It could be depicted from the graph of fig 4.9 that all the wells maintained a certain value of iron concentration of 0.2mg/l, the graph shows a trend of contamination from the dump site as well B rose appreciably within the days sampled. The value of iron concentration in well B ranges from 0.08mg/l-0.2mg/l and 0.08-0.2mg/l, 0.10-0.2mg/l for well C and A respectively.well C gave a better R value of 0.25 against well A and B which has R value of 0.18 and 0.17 respectively.

Chlorides concentration

The trends of fig 4.10 shows that the chlorides concentration was high in the first day of sample and keep on depreciating along the days of sample. Well A rose to a certain value of 21.979mg/l on the 28day of sample but it could been seen that well B which is more closer to the dump site, maintained a significant height above other wells sampled throught the period of sample. The result showed that chloride concentration of well B ranges from 8.508mg/l – 33.490mg/l. The chloride concentration in the three wells fell within the desirable and permissible limit of WHO and NSDWQ.

Sulphate concentration

Chemical analysis results obtained showed that all the wells sampled felled within the limit for sulphate concentration in water samples. Sulphate are element of of sulphur which most commonly get into the water supply when sulfite ores are oxidized, although water that containing sulphur have been found not to pose a

ISSN: 2277-9655
Scientific Journal Impact Factor: 3.449
(ISRA), Impact Factor: 1.852

health rist especially when it is within the limit, it has also been found to unappetizing. Well A and well B has the highest sulphur concentration as shown in fig 4.11 while well B maintained a sulphate average of 9.150mg/l. the maximum and minimum values of sulphur concentration in well A and well B is 9.205mg/land 9.104mg/l, 9.105mg/l.

Nitrate concentration

Results gotten for Nitrate concentration showed that virtualy all the wells had an average of 0.15mg/l in nitrate concentration. Well C has a maximum value of 0.20mg/l followed by well B and well A which has same value of 0.13mg/l. the limit of nitrate concentration is 3mg/l (WHO & NSDWQ) it can been seen that the wells are actually polluted due to the dump site. A regressional analysis done showed that the nitrate is not directly proportional to days of sample as well B which is more closer has an R value of 0 from fig 4.12

Coliform concentration.

Coliform bacteria is a disease causing organism called pathogens. Water borne pathogens cause diseases such as hepatitis, giardiasis and dysentery. Fig 4.13 shows that all the wells were contaminated with coliform bacteria, a close observation of the study area showed that the dump site may not actually be the source of this pollutant since septic tank was seen built around the areas. The major sources of coliform bacteria are mostly human excreta. Well A has the highest value of 350per 100ml followed by Well C 130 per 100ml and well B 110 per 100ml. all the three wells sampled exceeded the desireable and permissible limit of WHO and NSDWQ which has a limit of 3 per 100ml and 10 per100ml respectively.

E- Coli concentration

The results obtained showed all negative for E- coli in the three wells sampled.

Effect of P^H on turbidity and magnesium concentration.

P^H is a measure of acidity or alkalinity of a water sample. Well A was chosen to know the relationship between **P^H** and magnesium concentration of the water sample. A weak correlation coefficient of 0.11(10%) was given. This indicates that the magnesium concentration was not in any way a function of the **P^H** or vice-versa. The maximum and minimum value of magnesium concentration and **P^H** are 6.83, 6.89m/l, and 1mg/l, 5.8 respectively. This study reveals that magnesium content of any water sample is not a function of the **P^H** of the sample.

It can also be seen from fig 4.14 below that a graph of **P^H** versus turbidity shows a similar trend as the case discussed above with similar correlation coefficient of 0.11(10%). This also an indication that the two parameters (magnesium and turbidity) is not a function of the **P^H** values. The maximum and minimum values of tubidity are 6.83NTU and 1 NTU respectively.

Relationship between: calcium, magnesium and total hardness

Hardness in water is caused by the presence of Ca, Mg compounds ($Ca(HCO_3)$) and $Mg(HCO_3)$. Permanent hardness is caused by the presence of sulphates, chlorides and nitrates of Ca and Mg. from the graph of fig4.15, it could be seen that both is purely dependent on the dosage of calcium and magnesium concentration. The values of calcium and magnesium concentration, when plotted with total hardness against the days of samples showed same trend in all the three wells sampled. The maximum and minimum values for calcium, magnesium and total hardness for well A,B,C are 4.8mg/l, 6.8mg/l, 8mg/l,0.6mg/l,0.6mg/l,0.6mg/l,14mg/lCaCo3, 22 mg/lCaCo3, and 2.8mg/l,2.4mg/l,2.4mg/l,0.3mg/l,0.3mg/l,0.3mg/l,8 mg/lCaCo3,7 mg/lCaCo3,7 mg/lCaCo3.

Total hardness and P^H of sample

Figure 4.19 shows a graph of total hardness versus p^H of sample, it could be seen that total hardness does not have a linear relationship with p^H of sample. A regression analysis gave an R value of 0.15 (15%) this shows that P^H can only contribute 15% of the total hardness found in water sample. The maximum and minimum value of total hardness and p^H were 14mg/l $CaCO_3$, 6.89 and 8mg/l $CaCO_3$, 5.34 respectively.

ISSN: 2277-9655
Scientific Journal Impact Factor: 3.449
(ISRA), Impact Factor: 1.852

GRAPHS

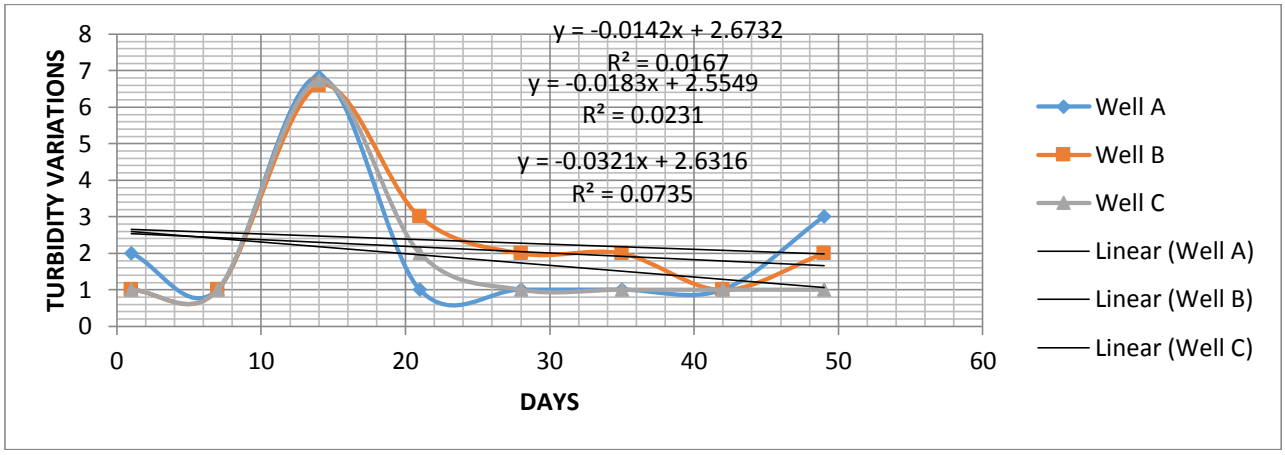

Figure 4.1. Turbidity variations versus Days of sample

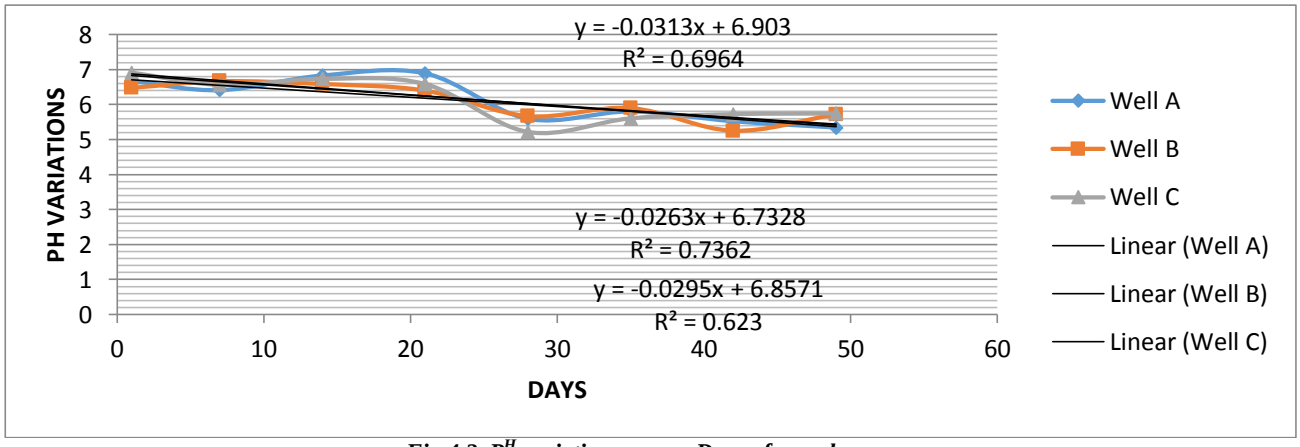

Fig 4.2. P^H variations versus Days of sample.

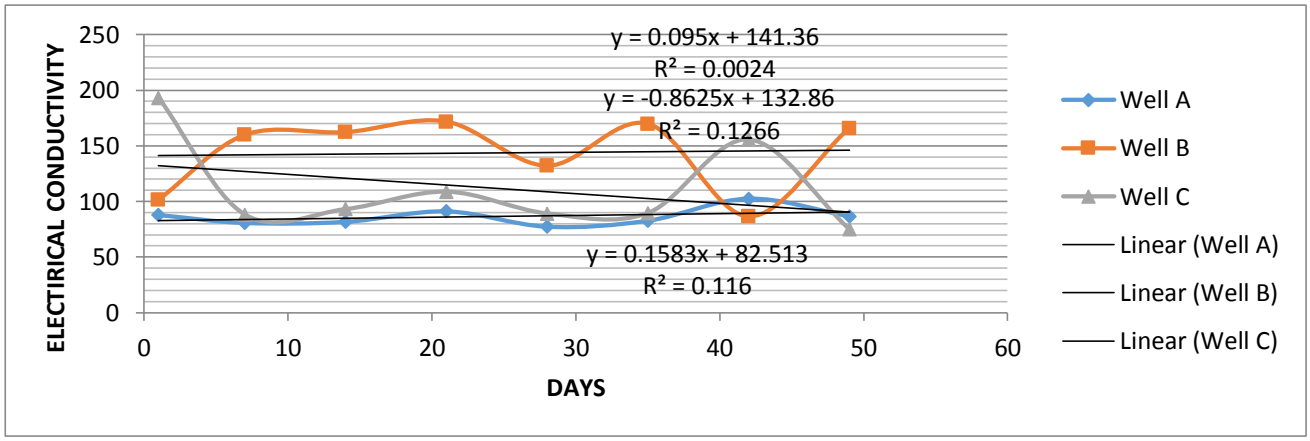

Fig 4.3 Electrical Conductivity variations versus Days of sample

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Scientific Journal Impact Factor: 3.449
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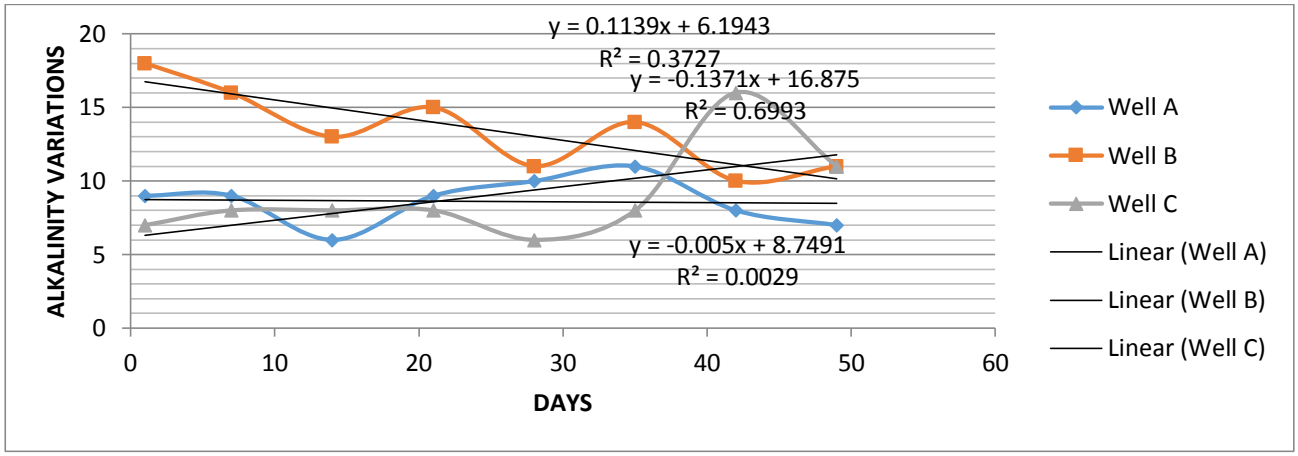

Fig 4.4. Alkalinity variations versus Days of sample.

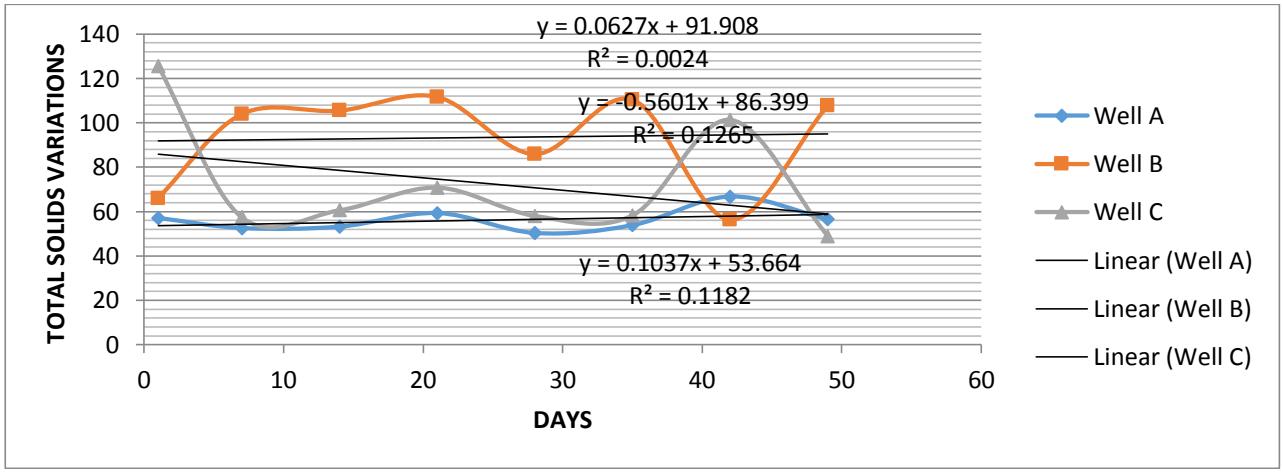

Fig 4.5. Total solids variations versus Days of sample.

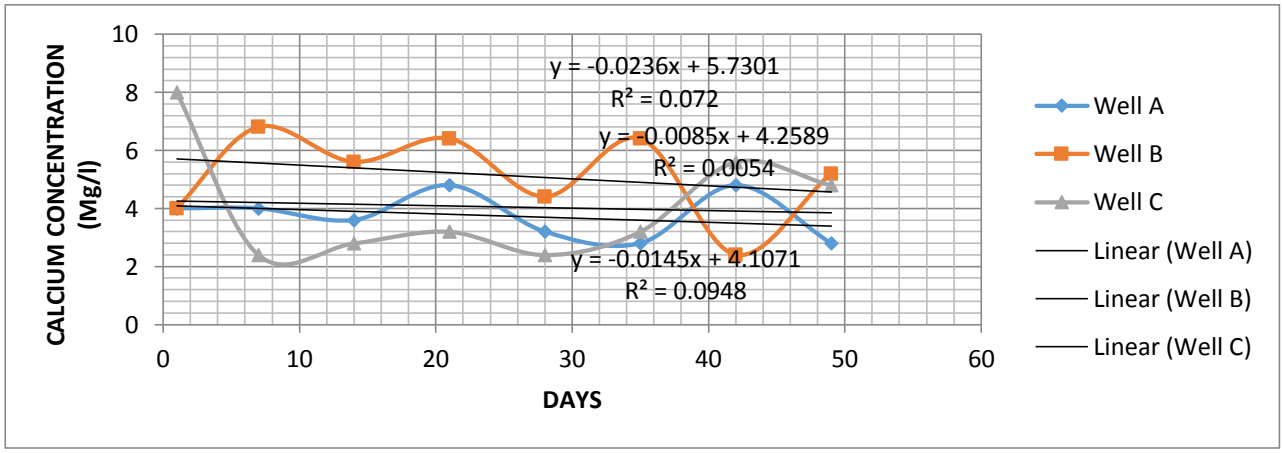

Fig 4.6 Calcium conc. variations versus Days of sample.

ISSN: 2277-9655
Scientific Journal Impact Factor: 3.449
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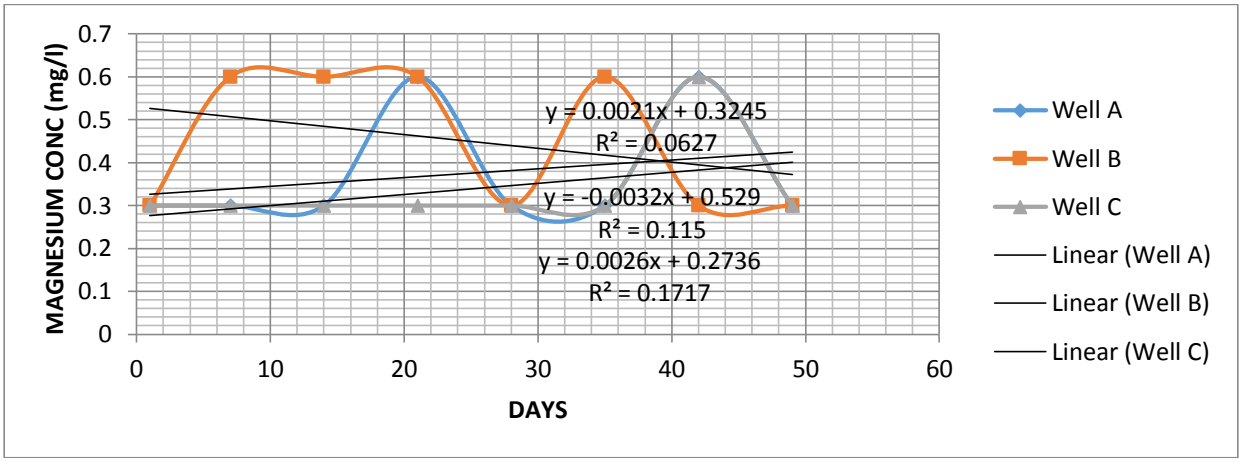

Fig 4.7. Magnesium conc. variations versus Days of sample.

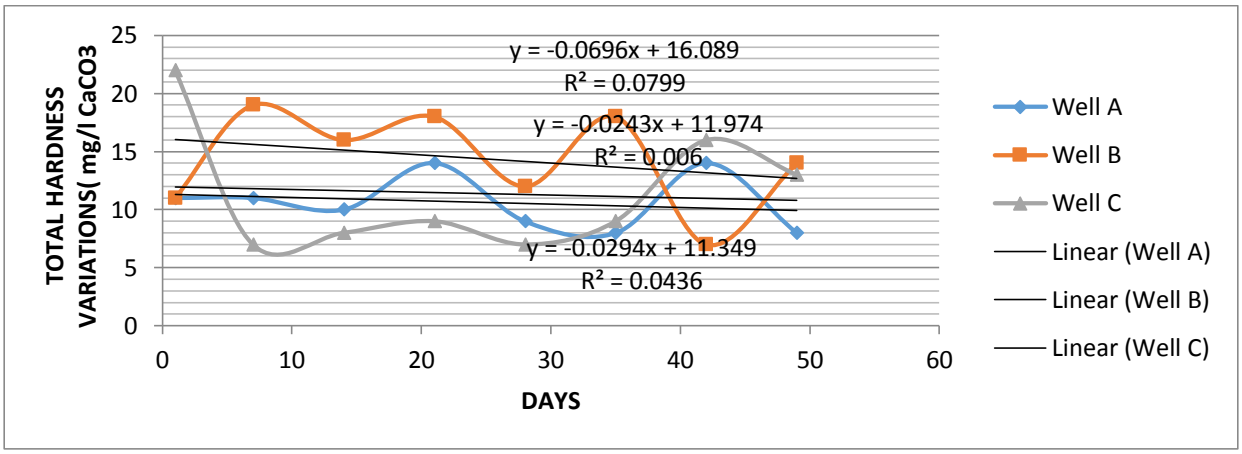

Fig 4.8 Total hardness variations versus Days of sample.

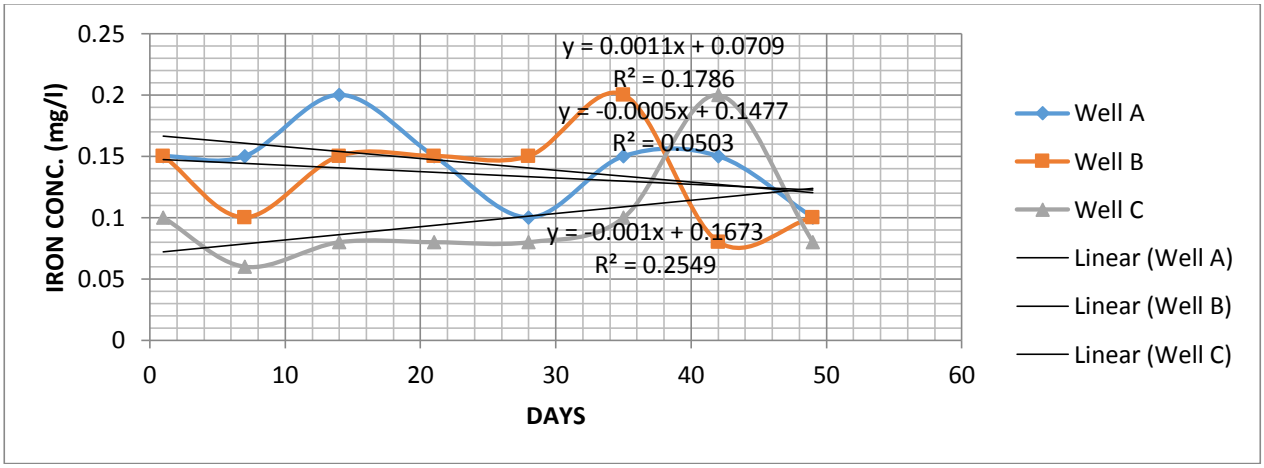

Fig 4.9. Iron conc. variations versus Days of sample.

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Scientific Journal Impact Factor: 3.449
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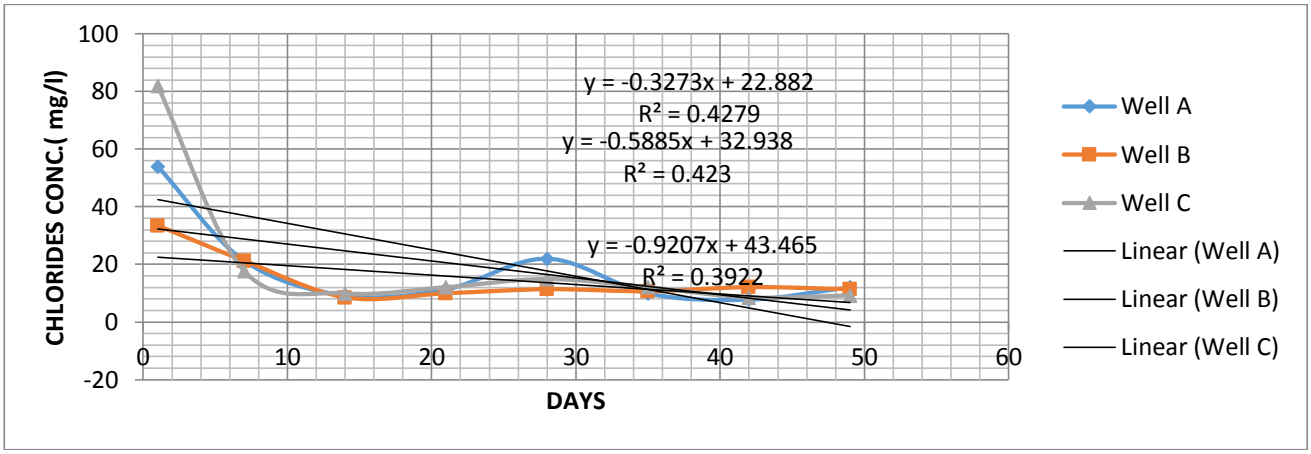

Fig 4.10. Chlorides conc. variations versus Days of sample.

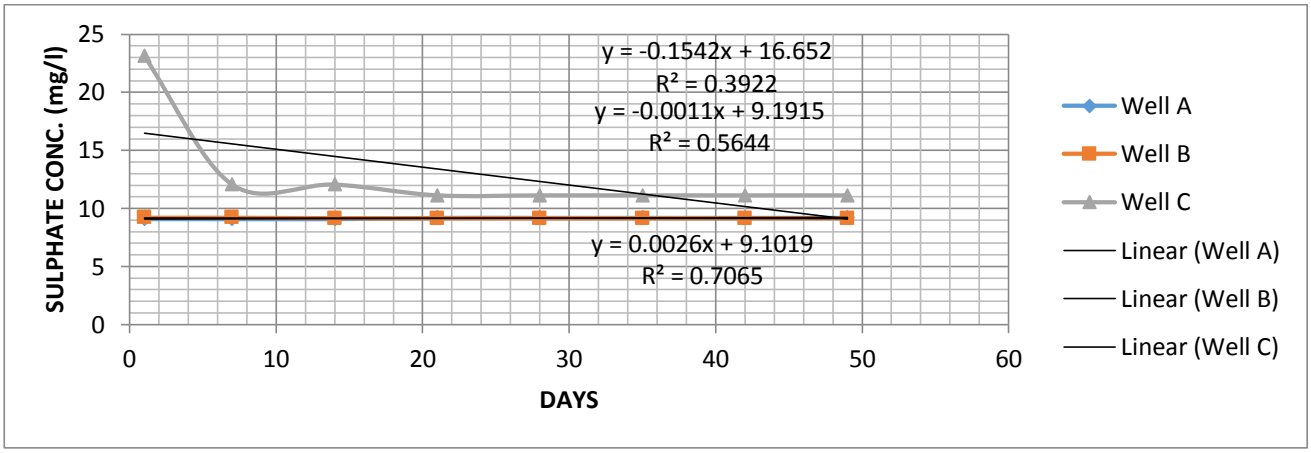

Fig 4.11. Sulphate conc. variations versus Days of sample.

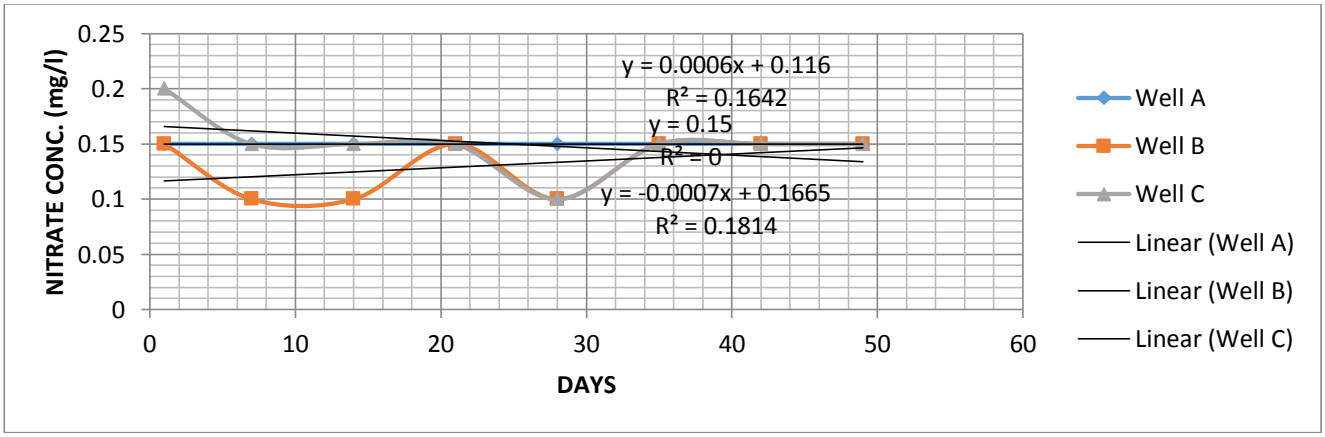

Fig 4.12. Nitrate conc. variations versus Days of sample.

ISSN: 2277-9655
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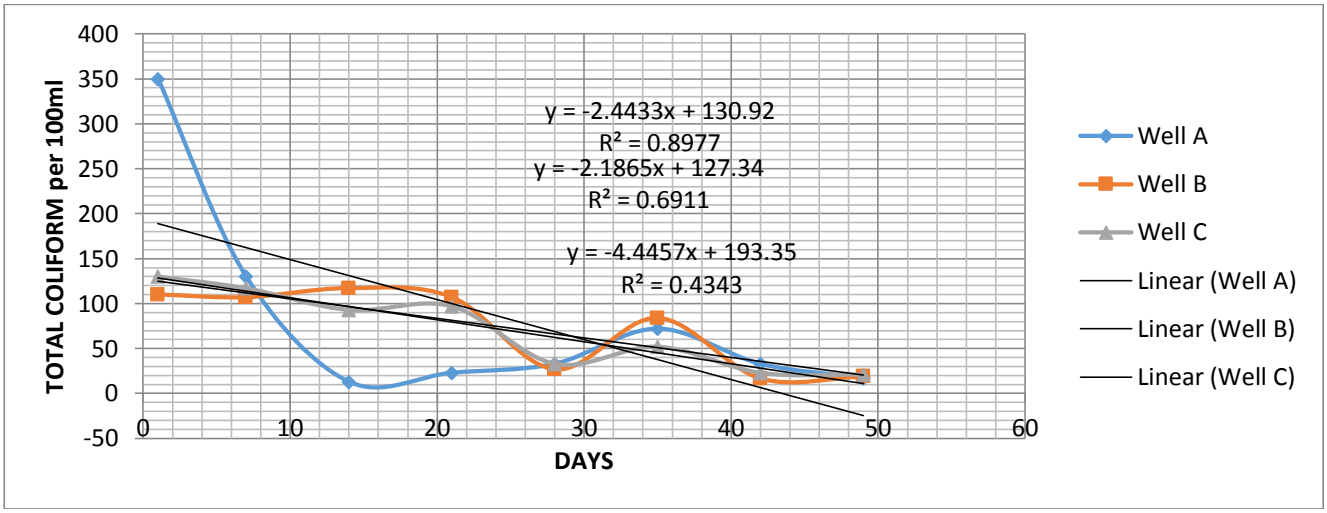

Fig 4.13. Total coliform conc. variations versus Days of sample.

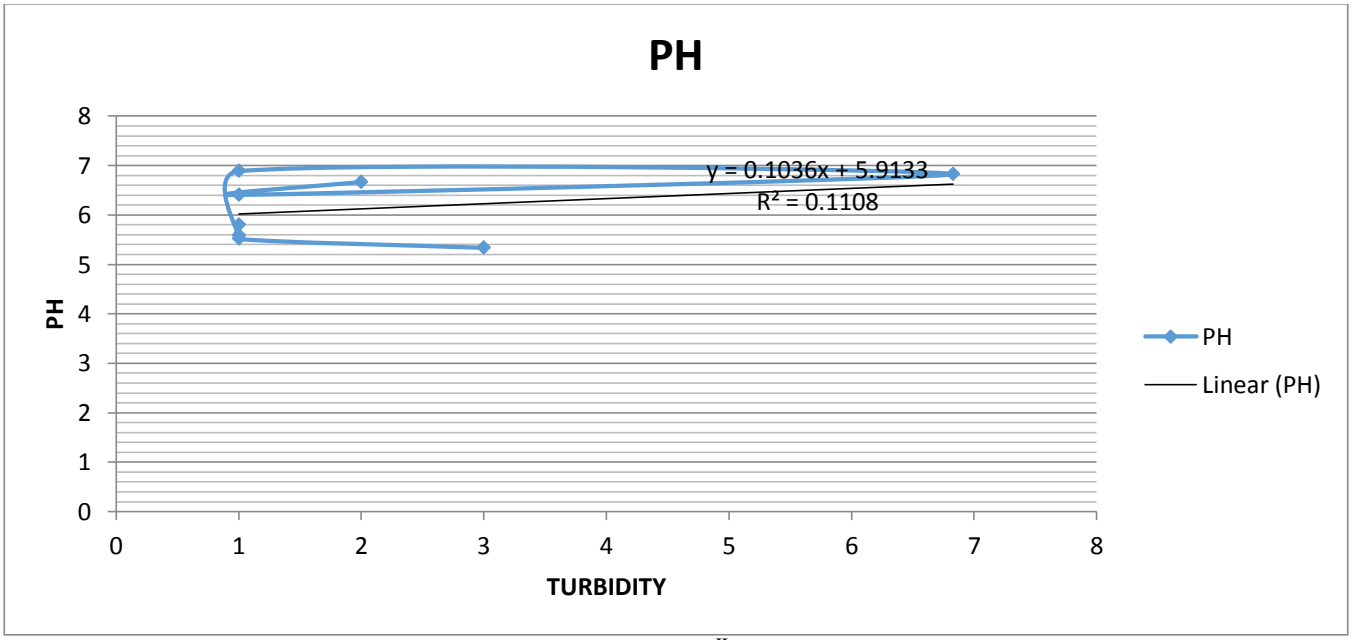

Fig 4.14. Relationship between P^H and turbidity

ISSN: 2277-9655
Scientific Journal Impact Factor: 3.449
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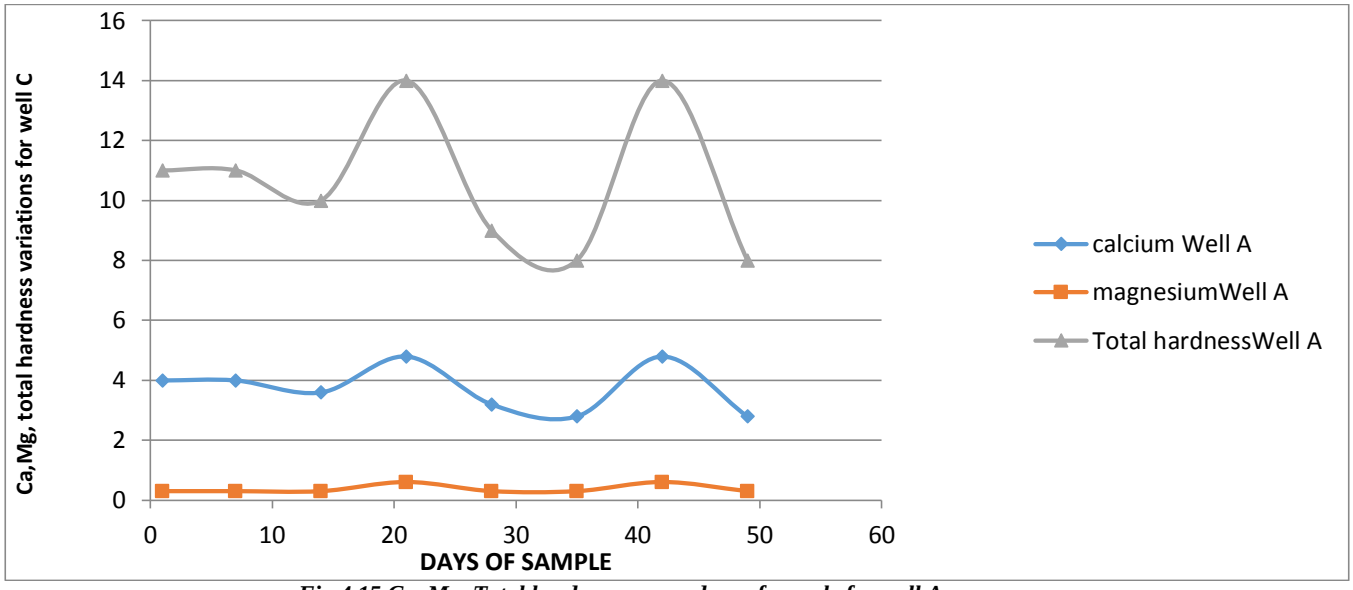

Fig 4.15 Ca, Mg, Total hardness versus days of sample for well A

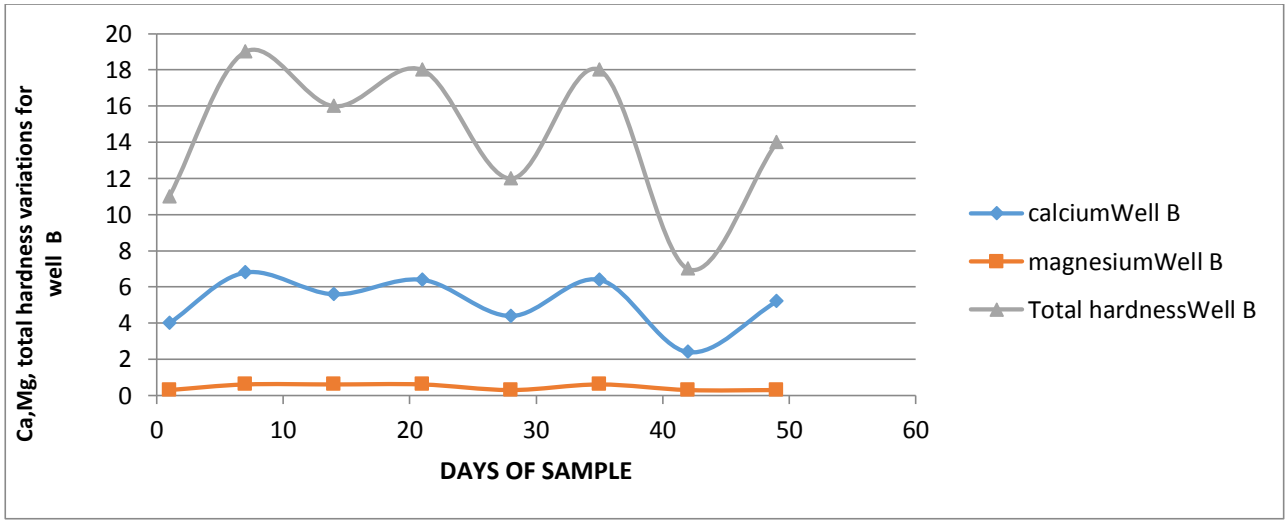

Fig 4.16. Ca, Mg, Total hardness versus days of sample for well B

ISSN: 2277-9655
Scientific Journal Impact Factor: 3.449
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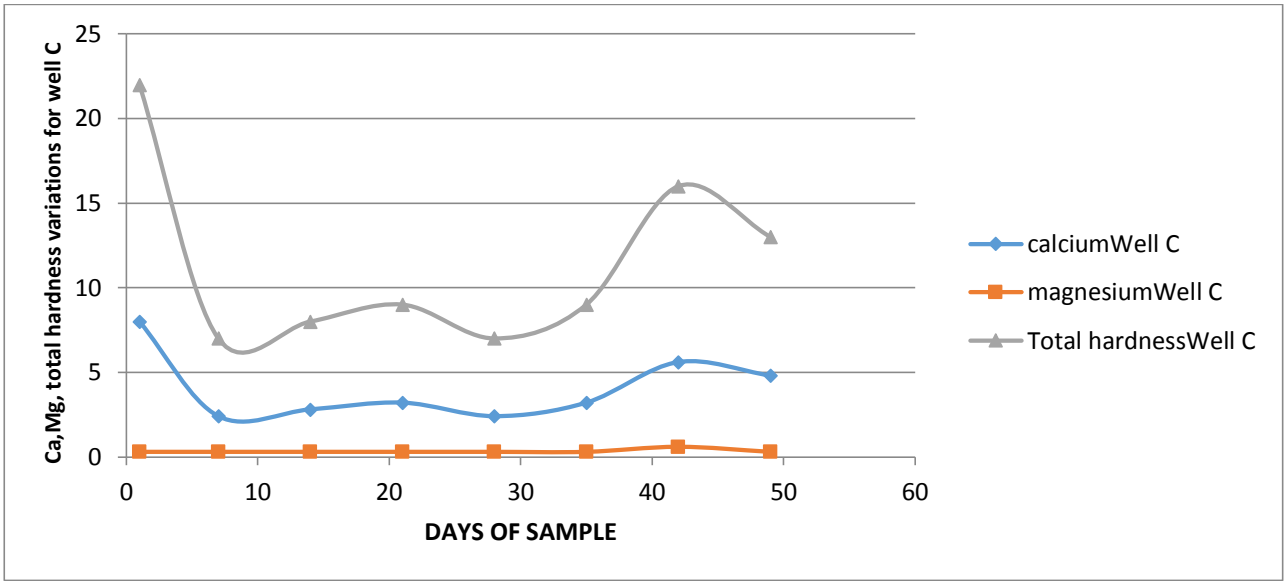

Fig 4.17. Ca, Mg, Total hardness versus days of sample for well C

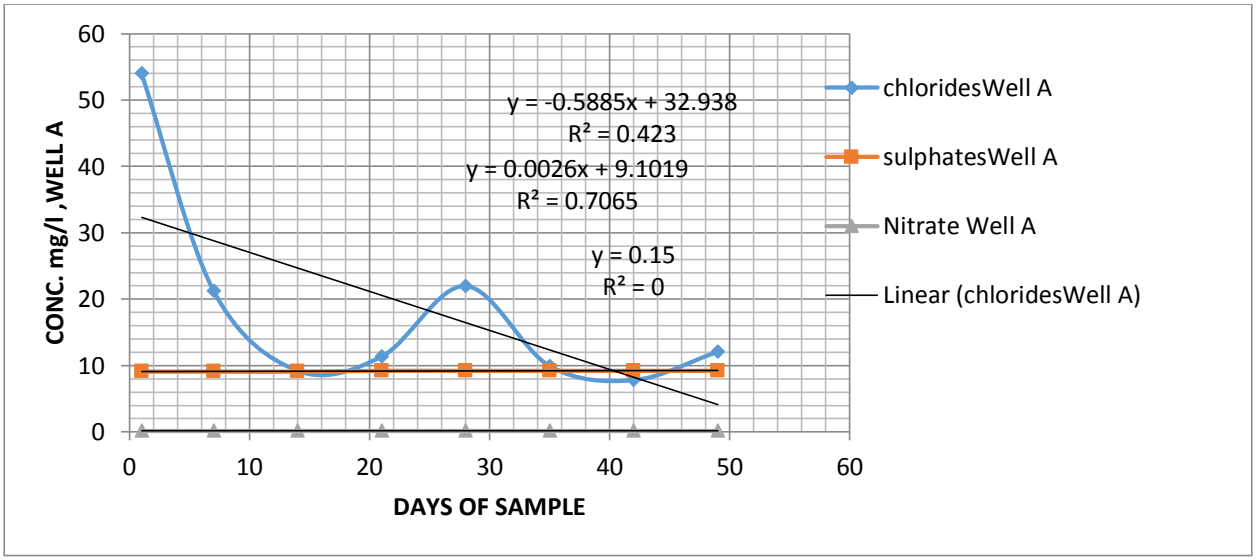

Fig 4.18. relationship between Cl, Sulphate, Nitrate against days of sample

ISSN: 2277-9655
Scientific Journal Impact Factor: 3.449
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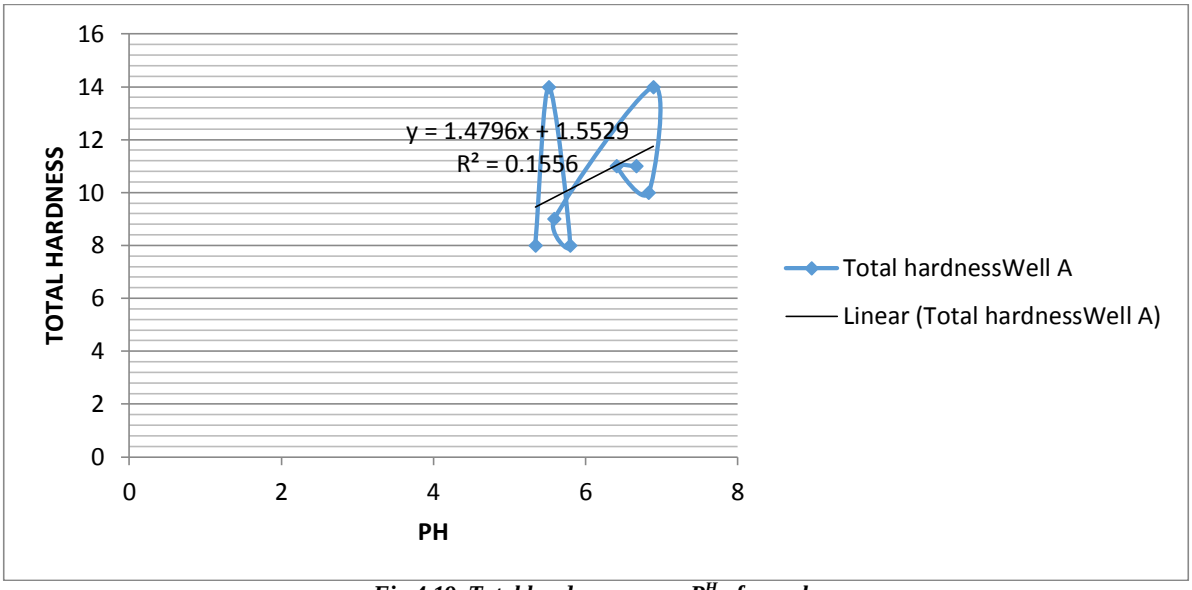

Fig 4.19. Total hardness versus P^H of sample

Conclusions and recommendations

Conclusions

Chemical, physical, and biological examination was carefully done on the water samples gotten from the three wells from the study area . the laboratory work was performed at the water and environmental laboratory of Enugu state ministry of water resources enugu Nigeria. Most of the parameters checked fell within the limits set by world health organization (WHO) and Nigeria standard for drinking water quality(NSDWQ). Well B was more closer to the dump site followed by well C and well A.

The analysis done on chapter four above revealed that poor waste management can pollute our underground water and render them unpalatable.

The results presented above showed that the parameters varied with the temperature of the day with well B which more closer to the dump site always maintaining a good trend along the days of sample. A regressional analysis performed showed that well B in most cases has a better correlation between then parameters and days of sample. Coliform test showed that all the wells where polluted with well A having a maximum value of 300 per 100ml, followed by well C 130 per 100ml and well B 110 per100ml. there was no trace of E-coli on the sample.

Recommendations

Based on the findings of this research, the following recommendation would be found useful.

1. Pollutants move through our porous soils into the ground to pollute our underground waters, therefore well should not be dug close dump sites.
2. Waste management agencies in government parastatals should enforce laws prohibiting wastes been dumped anywhere except in places meant for it like landfills
3. Well water should be checked always to ascertain the level of pollutants in it to avoid the spread of disease that are water borne.
4. It was observed that the trace of feacal coliform seen in well A, B, C was a result of septic tanks close to it. Sani S.A et al (2012) recommended a minimum distance from the tank to avoid contamination from it.

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Scientific Journal Impact Factor: 3.449
(ISRA), Impact Factor: 1.852

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