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Optimization Modeling of Borehole Water Quality in Rumuogwunama in Eneka of Obio-Akpor L.G.A in Rivers State Nigeria

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Abstract. This work aims at studying the effect of the dump sites near and away from borehole water located in march 2011 at Rumuogwunama in Eneka of Obio-Akpor L.G.A in Rivers state Nigeria , using optimization modeling. The problem started from poor sanitations as a result of poor human excreta management and related un-hygiene practices like dump site. Methodology involved carefully collection of borehole water samples from two designated sampling point close to and away from the dump site. Results were cross examined with the World Health Organization (WHO) standard. The work applied optimization modeling with Pearson product moment correlation model mode (r) for assessment of the interaction between the elements for optimal water quality in that area. In conclusion the interaction model proved that the average results of the analysis were below the WHO standard, particularly the (PH) of 5.78 to 5.31 and heavy metals. It was found low for drinking water quality. These waters are unsuitable for drinking and industrial in the raw form. Therefor a design on the treatment operation was done for modification of the (pH) and heavy metals before use.

Keywords: Optimization, Modeling and Water quality.

1. Introduction

Quality assessment of ground water in selected waste dump site area in Warri Nigeria according to Ernest et al shows that present of dump sites are potentials source of pollution to the ground water because of the shallow depth of water table and also the dump source of contraindication of drinking water(1). Ibe and Barare (2002) reported that rapid increase in pollution in large cities without adequate plane jeopardizes limited water resources.(2)

According to Rao "water is not natural for either bacteria or viruses and over a long period of time, they will be inactivated due to exposure to hostile. environmental factor such as sunlight temperature, segmentation and biological action. His work also shows that terminal disinfection is essential to complete removal of pathogens before discharge of effluents into the aquaticsensure environment. In Port-Harcourt, also a river-rine environment where uncontrolled open dumping of waste is the norm, leachates generated during the rain eventually contaminate the borehole water (ground water). At present the effect of dump sites on the quality of ground water in Port-Harcourt is ought to be assessed, which gave rise to this research work. Industrial pollutants, agrochemical applications, erosions, and disposal of solid waste are sources that degrade drinking water quality, standards, thereby degenerating into prohibitive water pollution situation. Consequently, water borne diseases such as Iypha, cholera, diarrhea and dysentery become communicable (4) Drinking water must be within tolerable use limits for human consumption, water taste, colour, odour, SAR , PH and Salinity stain must satisfy the recommended drinking water standard (5)Schewab et al (1992). The biological, chemical and physical or radiological agent (conditions) of the water have the potentials to cause adverse health problems(6) according to Bartrain et al (2009).

1.1. Material and Method

The collected borehole water samples A,B, are near while C,D, are away from the dump site.physicochemical analysis, heavy metal concentration deremination microbiological analysis and Pearson product moment correlation (r) model were used were in the analysis.

1.2. Result and Discussion

The results of the physicochemical analysis of borehole water sample.

Table 1: Average results of analysis for physicochemical borehole water sample collected in the month of March 2011 for sample A, B, C and D

Parameter	**A**	**B**	**C**	**D**	**Average**
Colour	Colourless	Colourless	Colourless	Colourless	Colourless
Odor	Nil	Nil	Nil	Nil	Nil
pH at 29^0c	5.78	5.11	5.38	5.31	5.40
Conductivity at 29^0cms/cm	35.1	68.4	12.9	7.4	30.95
Total dissolved solid; mg/1	16.2	31.5	5.9	3.4	14.25
Calcium, C, mg/1	3.2	4.3	0.80	0.64	2.24
Chloride, CL, mg/1	23.0	34.7	18.7	13.1	22.38
Sulphate, SO_4 mg/1	03.9	17.1	10.2	6.4	9.40
Phosphate, $PO4^3$mg/1	0.62	0.73	0.83	0.77	0.74
Sodium, Na(ppm)	10.0127	19.4690	<0.000	<0.0001	7.37
Potassium k(ppm	<0.0001	<0.0001		<0.0001	<0.0003
Turbidity (NTU)	0.5	1.0	0.25	0.25	0.50

Table 2: Average result of the heavy metal concentration in borehole sample collected in the month of march 2011 for sample A, B, C and D

Heavy Metal	A	B	C	D	Average
Mercury Hg	0.0021	0.0107	<0.0001	<0.0001	<0.0033
Lead (Pb)	5.7157	6.2663	5.5932	5.1947	5.6925
Zinc (Zn)	0.2134	0.3497	0.3168	0.2791	0.2898
Manganese (mn)	1.6623	0.8769	<0.0001	<0.0001	0.6349
Copper (cu)	0.6298	0.4277	<0.5049	0.2271	0.4474
Iron (fe)	8.7159	9.8620	110.5520	4.7593	33.4723
Calcium (cd)	0.1593	0.1665	0.1199	<0.0001	0.1115

Table 3: Average results of microbiological analysis of the borehole water sample collected in the month of March, 2011 for sample A, B, C and D

	Sample A		**Sample B**		**Sample C**		**Sample D**		**Average**
Microbial group	Plate readier	Unit cfu/ml	Plate readier	Unit cfu/ml	Plate reading	Unit cfu/ml	Plate reading	Unit cfu/ml	
Coliform other coliform	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
Ecoli	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
Faecal streptococci	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
Salmonella sp	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
Shigeila sp	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
Vivrio sp	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
Clostridia sp	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
Yeast/Mold	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
Total plate count	4 colonies	$0.4x10^1$	2 colonies	$0.2 x 10^1$	6 colonies	$0.6 x 10^1$	88 colonies	$88 x 10^1$colonies	$25x10^1$

2. Discussion

The average result of the analysis of sample of borehole water collected at Rumuogwunama in Enek in Obio-Akpor L.G.A of River state in the month of march 2011 were shown in the the table above.. The pH of the samples of the borehole were below WHO range (7.08.0)for drinking water indicating their unsuitlity for drinking in the raw form. Before drinking it the PH of these borehole have to be modified to value close to 7.0 or there asset. This indicate that those borehole water are polluted in this area is acidic minerals may be from urban runoff, urban waste r refuse dump site. The sample B is the most acidic. Also waste from market places, houses, abalture can also effect the PH of the water borehole and make them acidic.

Let us consider the case where a number of kilograms of chlorine needed per day and capacity of the contact tank in a water treatment plant/operation supplying to the city of area 100,000 people, with reference to tables 1 to 3 is design for the PH, conductively, total dissolved solids, calcium chloride, suplphate, phosphate sodium potassium, Turbidity, Mercury, lead, zinc. Manganese, copper and iron for WHO standard with the Pearson (r) optimization model.

2.1. Solution Case (i)

We consider that at least 1.2mg of chlorine must be added to every liter to overcome the chlorine demand of 1mg/1 and produce a free available chlorine concentration of 0.2mg/1. Since the treatment operation must be capable of operating at the optimum daily flow rate, we can make the following calculation to determine the amount of chlorine needed for the city.

$$\frac{Kgchlorine}{Day} = \frac{L}{d}(foroptimumday)x\frac{1.2mgchlorine}{L}x\frac{kg}{1x10^6 mg}$$

= 99.0 x 10^6L/day x 1.2mg/L x $\frac{1}{10^6}kg/mg$

= 118.8kg chlorine added daily (at optimum production)

2.2. Solution Case (ii)

If we assume a minimum contact time of 30mins then the required capacity of contact tank = flow rate x contact time

$$\frac{L}{day}x\frac{1day}{1440\min} = 30\min$$

= 99.0 x 10^6

= 2.063 x 10^6L

= 2063m^3

3. Conclusion

The average result of the analysis of samples of borehole water collected at Rumuogwunama in Eneka in Obio-Akpor L.G.A of Rivers State in the month of March 2011 were shown in the table 1-3. the pH of samples of the borehole were below WHO range (7.0-8.0) for drinkable water quality indicating their unsuitability for drinking in the raw form. Before it is taken the pH of water in these boreholes have to be modified to a value close to 7.5 by addition of chlorine in accordance with the design of the treatment operation . 118.8kg of chlorine should be added daily at optimum production capacity, of contact tank of 2063m3 for a population of 100,000 people per the city of Port-Harcourt.

The hypothesis tested at 0.10 level of significance shows that null hypothesis is accepted with Pearson's model. The obtain value of r=0 which is less than the critical value of r=497. No relationship exists between WHO standard (x) and the pollution region of Nigeria. For this reason a hypothetical optimization case model proposed some modifications.

The WHO standard model was related to the United State and Canada standards with the Pearson product moment correlation (r) model, the regression equation calculation gave r as I.

This shows that the correlation, r for these two other countries are as perfect as that the WHO standard.

In conclusion , the interaction model proved that the average result of the analysis of samples of borehole water collected particularly of pH of 5.78 to 5.31, and some heavy metals indicate the presence of pollution with acidic minerals from urban run off and waste from refuse dump site. The sample B is the most acidic. The low pH was due to waste from market places, houses and abalture. Therefore, these had led to ill health and industrial problem in the region. This work includes a design for its modification.

4. Refereces

[1] Schewab, G.O.D.D fangmeier/ W.J Elliot and R.K.Fresvert,1992,seil andwater covservation Engineering 4th edu,John wiley and sons Inc, wew gork,pp.256-265

[2] WHO,1971,International standard for drinking water 3rd edu, health organization, genera

[3] Akudo E.O,ozulu G.U and osegbuele 2010.Quality Assessment of raund water in selected waste dump site Areas in warri Nigeria Environmental research journal (4):28-285

[4] Raw v.c (1984)microbial pollution marine and fresh water .National Environmental Engineering Research instate Nigeria India

[5] Ibe,K,M and Barkare A.S (2002).The Environmental Impact assessment of surface and ground water of lagos Area, south west Nigeria world journal of Biotechnology

[6] Musa,S.M,1996.ground water hydrology and walls.Uppuslished Seminiar Paper presented to the department of Agriculture Engineering university of Maiduguri, Nigeria pp 2-10

[7] WHO Guide line for drinking water Quality: Geneva: World health organization (1984).