Optimization Modeling of Water Quality in Pollution Regions of Nigeria

Sylvia Okonkwo
Department of Chemistry, Anambra State University, Uli-Nigeria,
Email Of The Corresponding Author :sylocs70@yahoo.com

Abstract
This work aims at studying the effect of the dump sites near borehole location and away from the location, adopts optimization modeling of quality of water in the pollution regions of Nigeria. The problem starts from poor sanitations as a result of poor human excreta management and related un-hygiene practices like dump site. Secondly, reduction in quality of water and increase in water treatment cost damage to environmental quality and lost of land value etc. Methodology involves carefully collected water sample from two designed Nigerian and result were cross examine with the World Health Organization (WHO) standard thus result was compared with the standard in other Pearson product moment correlation model mode (r) for assessment of the interaction between the elements for optimization modeling of the result with that are mostly endangers. In conclusion the interaction model proved that the average result of the analysis of sample of borehole water collected at Rumuogwamama in Eneka in Obio Akpo Local Government Are of River State of Nigeria in the month of March 2011 were below the WHO standard. Particularly the (PH) of 5.78 to 5.31 and heavy metals for the sample of the borehole near the dump sites and away from the site when corrected with the uses. Therefore these had led to ill health and industrial problems in the rine religion of Nigeria as the waters are unsuitable for drinking industrial uses done for modification of the (pH) and heavy metals before use.
Keywords: Optimization,Modelling water quality,pollution and heavy metals.

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 (Schewab et al. 1992). (Ibe and Barare 2002) reported that rapid increase in pollution in large cities without adequate plane jeopardizes limited water resources. (WHO 1971 and 1984)

According to(Raw 1984) "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 (Akudo et al 2010) 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 (Ibe and Bakare 2002),(Schewab et al 1992). The biological, chemical and physical or radiological agent (conditions) of the water have the potentials to cause adverse health problems (Musa 1996) according to Bartrain et al (2009).

Conception of the Model

In this work the method of least square, the Pearson product moment correlation (r) model is used. Two variables y (dependent) and x (independent) were correlated by plotting them on x and y axis. If they fall on a straight plot, there is a close linear relationship; on the other hand, if the points depart appreciably (without a definite trend), the graph is called a scatter diagram or plot. If the trend is a straight line, the relationship is linear and has the equation $y=a+bx$

Number of lines can be obtained depending on the values of a and b. The method of least squares is used to select the line that fits the data best.

Result and Discussion

The results of the analyzed borehole water sample for physicochemical analysis in the region are as follows.

Table 1: average results of analysis for physicochemical borehole 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, ca, 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

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

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 10^1colonies	$25x10^1$

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 (708.0)for drinking water indicating their unsuitable for drinking in the raw form. Before drinking it the PH of these borehole have modified to value close to 7.0 or there asset. This indicate that those borehole water are polluted with acidic minerals many be from urban runoff, urban waste for 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 the city of port-Harcourt of 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.

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)

Solution Case (ii)
if we assume a minimum contact time of 30mins then the required capacity of contact tank = flow rate x contact time
= 99.0 x 10^6 $\frac{L}{day}x\frac{1day}{1440\min} = 30\min$
= 2.063 x 10^6L
= $2063m^3$

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 $2063m^3$ 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.

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